Mega 500-V

Shop Manual

023-00033E

Serial Number 1001 and Up

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Electrical System

Attachments

SAFETY

S0103010K

DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

WHEEL LOADER SAFETY

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Mega 200-V	1001 and Up
Mega 250-V	1001 and Up
Mega 300-V	1001 and Up
Mega 400-V	1001 and Up
Mega 500-V	1001 and Up

November 2001

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TO THE OPERATOR OF A DAEWOO WHEEL LOADER

DANGER!
Unsafe use of the wheel loader could lead to serious injury or death. Operating procedures, maintenance and equipment practices or traveling or shipping methods that do not follow the safety guidelines on the following pages could cause serious, potentially fatal injuries or extensive damage to the machine or nearby property.

Please respect the importance of taking responsibility for your own safety, and that other people who may be affected by your actions.

Safety information on the following pages is organized into the following topics.

WARNING!

Improper operation and maintenance of this machine can be hazardous and could result in serious injury or death.

Operator and maintenance personnel should read this manual thoroughly before beginning operation or maintenance.

Keep this manual in the storage compartment to the rear of the operator's seat, and have all personnel involved in working on the machine read the manual periodically.

Some actions involved in operation and maintenance of the machine can cause a serious accident, if they are not done in a manner described in this manual.

The procedures and precautions given in this manual apply only to intended uses of the machine.

If you use your machine for any unintended uses that are not specifically prohibited, you must be sure that it is safe for any others. In no event should you or others engage in prohibited uses or actions as described in this manual.

Daewoo delivers machines that comply with all applicable regulations and standards of the country to which it has been shipped. If this machine has been purchased in another country or purchased from someone in another country, it may lack certain safety devices and specifications that are necessary for use in your country. If there is any question about whether your product complies with the applicable standards and regulations of your country, consult Daewoo or your Daewoo distributor before operating the machine.

SAFETY ALERT SYMBOL

Be Prepared - Get to Know All Operating and Safety Instructions

This is the Safety Alert Symbol. Wherever it appears - in this manual or on safety signs on the machine - you should be alert to potential for personal injury or accidents. Always observe safety precautions and follow recommended procedures.

LEARN SIGNAL WORDS USED WITH SAFETY ALERT SYMBOL

Words "**CAUTION**," "**WARNING**," and "**DANGER**" used throughout this manual and on labels on machine indicate hazards or unsafe practices. All three statements indicate that safety is involved. Observe precautions indicated whenever you see the Safety Alert "Triangle," no matter which signal word appears next to the "Exclamation Point" symbol.

CAUTION!

This word is used on safety messages and safety labels and indicates potential of a hazardous situation that, if not avoided, could result in minor or moderate injury. It may also be used to alert against a generally unsafe practice.

WARNING!

This word is used on safety messages and safety labels and indicates potential of a hazardous situation that, if not avoided, could result in serious injury or death. It may also be used to alert against a highly unsafe practice.

DANGER!

This word is used on safety messages and safety labels and indicates imminent hazard of a situation that, if not avoided, is very likely to cause death or extremely serious injury. It may also be used to alert against equipment that may explode or detonate if handled or treated carelessly.

Safety precautions are described in SAFETY from page 6 on.

Daewoo cannot predict every circumstance that might involve a potential hazard in operation and maintenance. Therefore the safety messages in this manual and on the machine may not include all possible safety precautions. If any procedures or actions not specifically recommended or allowed in this manual are used, you must be sure that you and others can do such procedures and actions safely and without damaging the machine. If your unsure about the safety of some procedures, contact a DAEWOO distributor.

GENERAL SAFETY ESSENTIALS

ACCESSORY APPLICATIONS

This wheel loader has been designed primarily for moving earth with a bucket. For use as a grapple or for other object handling, contact Daewoo. Lifting-work applications are permitted in approved lift configuration, to rated capacity only, with no side-loading (unless prohibited by local regulation). Do not use machine for activities for which it was not intended. Do not use bucket for lifting work, unless lift slings are used in approved configuration.

LOCATION OF SAFETY LABELS

Location of safety labels (decals) can vary from unit to unit. Refer to appropriate Operation and Maintenance Manual, and Parts Manual for your unit.

There are several specific warning signs on this machine. The exact location of hazards and the description of the hazards are reviewed in the appropriate Operation and Maintenance Manual.

Please become familiarized with all warning signs.

Make sure that all of the warning signs are legible. Clean the warning signs or replace the warning signs if you cannot read the words. Replace the illustrations if the illustrations are not visible. When you clean the warning signs, use a cloth, water and soap. Do not use solvent, gasoline, or other harsh chemicals to clean the safety signs. Solvents, gasoline, or other harsh chemicals could loosen the adhesive that secures the warning sign. Loose adhesive will allow the warning sign to fall off.

Replace any safety sign that is damaged, or missing. If a safety sign is attached to a part that is replaced, install a safety sign on the replacement part.

UNAUTHORIZED MODIFICATIONS

Any modification made without authorization or written approval from Daewoo can create a safety hazard, for which the machine owner must be held responsible.

For safety’s sake, replace all OEM parts with the correct authorized or genuine Daewoo part. For example, not taking the time to replace fasteners, bolts or nuts with the correct replacement parts could lead to a condition in which the safety of critical assemblies is dangerously compromised.

GENERAL HAZARD INFORMATION

SAFETY RULES

Only trained and authorized personnel can operate and maintain the machine.

Follow all safety rules, precautions and instructions when operating or performing maintenance on the machine.

Do not operate the machine if you are not feeling well, if you are taking medication that makes you feel sleepy, if you have been drinking, or if you are suffering from emotional problems. These problems will interfere with your sense of judgement in emergencies and may cause accidents.

When working with another operator or with a person on work site traffic duty, be sure that all personnel know the nature of the work and understand all hand signals that are to be used.

Always observe strictly any other rules related to safety.

SAFETY FEATURES

Be sure that all guards and covers are installed in their proper position. Have guards and covers repaired immediately if damaged.

Be sure that you understand the method of use of safety features such as transmission lever neutral lock and the seat belt, and use them properly.

Never remove any safety features. Always keep them in good operating condition.

Failure to use safety features according to the instructions in the Operation and Maintenance Manual could result in serious bodily injury.

INSIDE OPERATOR'S COMPARTMENT

When entering the operator's compartment, always remove all mud and oil from the soles of your shoes. If you operate the accelerator and brake pedals with mud or oil stuck to your shoes, your foot may slip and this may cause a serious accident.

Clean grease and dirt from pedals and controls. This contributes to safe operation. Cleaning also provides an opportunity to inspect equipment. Minor damage can be repaired or corrected before major problems result.

Keep cab floor and consoles free of tools and personal items.

After using the ashtray, make sure that any matches or cigarettes are properly extinguished, and be sure to close the ashtray. If the ashtray is left open, there is danger of fire.

Do not stick suction pads to the window glass. Suction pads act as a lens and may cause fire.

Do not leave lighters laying around the operator's compartment. If the temperature inside the operator's compartment becomes high, there is danger that the lighter may explode.

Do not use cellular telephones inside the operator's compartment when driving or operating the machine. There is danger that this may lead to an unexpected accident.

Never bring any dangerous objects such as flammable or explosive items into the operator's cab.

To ensure safety, do not use the radio or music headphones when operating the machine. There is danger that this may lead to a serious accident.

When operating the machine, do not put your hands or head out of the window.

When standing up from the operator's seat, always place transmission neutral lock lever in the "LOCK" position and set pilot cutoff switch to "O" (OFF) position. If you accidentally touch the work equipment levers when they are not locked, the machine may suddenly move and cause serous injury or damage.

When leaving the machine, lower the work equipment completely to the ground, set transmission neutral lock lever in the "LOCK" position, set pilot cutoff switch to "O" (OFF) position, "APPLY" parking brake, and shut down engine. Use the key to lock all the equipment. Always remove the key and take it with you.

CLOTHING AND PERSONAL PROTECTIVE ITEMS

Contain long hair, and avoid loose clothing and jewelry. They can catch on controls or in protruding parts and cause serious injury or death.

Do not wear oily clothes. They are highly flammable.

Full eye protection, a hard hat, safety shoes and gloves may be required at the work site.

While working on the machine, never use inadequate tools. They could break or slip, causing injury, or they may not adequately perform intended functions.

Figure 1

BREATHING MASKS, EAR PROTECTION MAY BE REQUIRED

Do not forget that some risks to your health may not be immediately apparent. Exhaust gases and noise pollution may not be visible, but these hazards can cause disabling or permanent injuries.

NOTE: *Sound level in closed operator's cab is 75 dB(A). Additional information on machine sound and vibration levels can be found in Shop Manual.*

ASBESTOS DUST HAZARD PREVENTION

Asbestos dust can be HAZARDOUS to your health if it is inhaled.

If you handle materials containing asbestos fibers, follow these guidelines as given below:

- Use an approved respirator.
- Never use compressed air for cleaning.
- Use water for cleaning to keep down the dust.
- Work on the machine or component with the wind at your back whenever possible.
- Always observe any rules and regulations related to the work site and working environment.

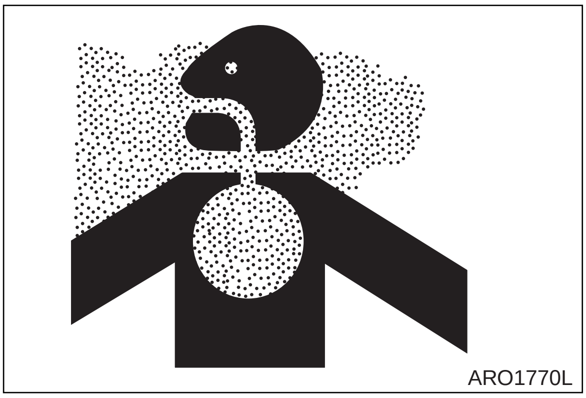

Figure 2

MOUNTING AND DISMOUNTING

Before getting on or off the machine, if there is any oil. grease, or mud on the handrails, steps, or track shoes, wipe it off immediately. Always keep these parts clean. Repair any damage and tighten any loose bolts.

Never get on or off a moving machine. In particular, never get on or off a moving machine. These actions may lead to serious injury.

When getting on or off the machine, always face the machine, and maintain a three-point contact (both feet and one hand or one foot and both hands) with the handholds and steps to ensure that you support yourself securely.

Never hold any control levers when getting on or off the machine.

Never get up from operator's seat or leave operator's station and dismount machine if engine is running.

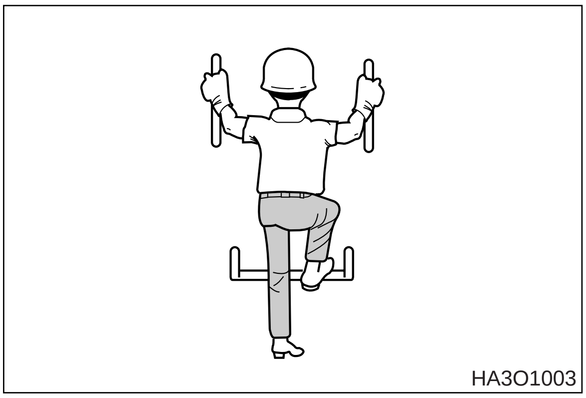

Figure 3

FUEL, OIL AND HYDRAULIC FLUID FIRE HAZARDS

Fuel, oil and antifreeze will catch fire if it is brought close to a flame. Fuel is particularly flammable and can be hazardous.

Always strictly observe the following.

Add fuel, oil, antifreeze and hydraulic fluid to the machine only in a well-ventilated area. The machine must be parked with controls, lights and switches turned "OFF." The engine must be "OFF" and any flames, glowing embers, auxiliary heating units or spark-causing equipment must be doused, turned off and/or kept well clear of the machine.

Static electricity can produce dangerous sparks at the fuel filling nozzle. In very cold, dry weather or other conditions that could produce a static discharge, keep the tip of the fuel nozzle in constant contact with the neck of the fuel filling nozzle, to provide a ground.

Keep fuel and other fluid reservoir caps tight and do not start the engine until caps have been secured.

Figure 4

PRECAUTIONS WHEN HANDLING FLUIDS AT HIGH TEMPERATURE

Immediately after operations are stopped, the coolant, engine oil, and hydraulic oil are at high temperature and the radiator and hydraulic tank are still under pressure. Attempting to remove the cap, drain the oil or coolant, or replace the filters may lead to serious burns. Always wait for the temperature to go down, and follow the specified procedures when carrying out these operations.

Figure 5

To prevent hot coolant from spurting out, stop the engine, wait for the coolant to cool, then loosen the cap slowly to relieve the pressure.

To prevent hot oil from spurting out, stop the engine, wait for the oil to cool, then loosen the cap slowly to relieve the pressure.

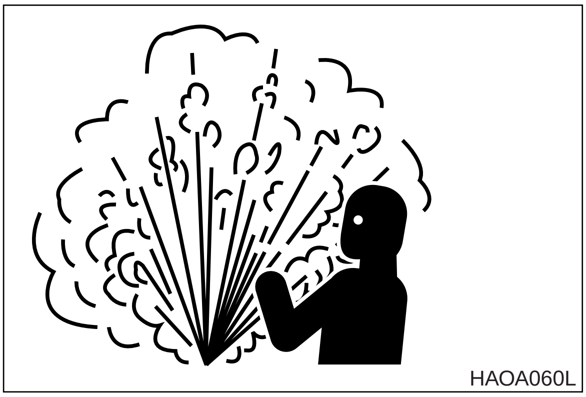

Figure 6

INJURY FROM WORK EQUIPMENT

Do not enter or put your hand, arm or any other part of your body between movable parts, such as between the work equipment and cylinders, or between the machine and work equipment.

If the control levers are operated, the clearance between the machine and the work equipment will change and this may lead to serious damage or personal injury.

If going between movable parts is necessary, always position and secure the work equipment so that it cannot move.

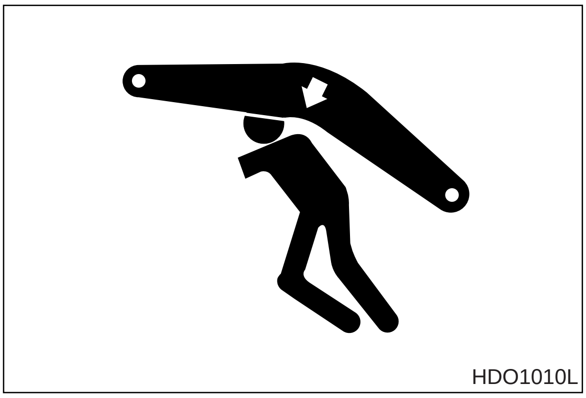

Figure 7

FIRE EXTINGUISHER AND FIRST AID KIT

As a precaution if any injury or fire should occur, always do the following.

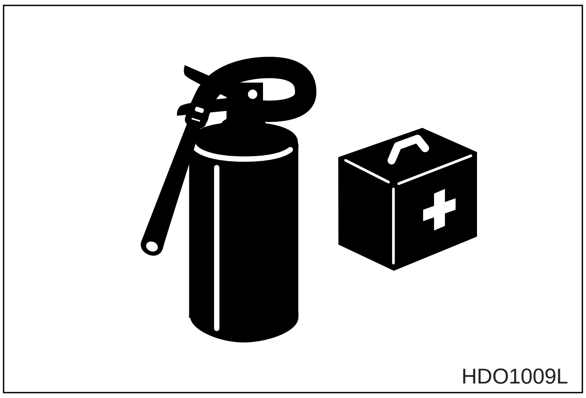

Figure 8

- Be sure that fire extinguishers have been provided and read the labels to ensure that you know now to use them. It is recommended that an appropriately sized (2.27 kg [5 lb] or larger) multipurpose "A/B/C" fire extinguisher be mounted in the cab. Check and service the fire extinguisher at regular intervals and make sure that all work site crew members are adequately trained in its use.
- Provide a first aid kit in the storage compartment and keep another at the work site. Check the kit periodically and make any additions if necessary.
- Know what to do in case of injury from fire.
- Keep emergency numbers for doctor, ambulance service, hospital and fire department near your telephone.

If the machine catches fire, it may lead to serious personal injury or death. If a fire occurs during operation, escape from the machine as follows;

- Turn the starter switch "OFF" and stop the engine.
- If there is time, use the fire extinguisher to extinguish as much of the fire as possible.
- Use the handrails and steps to escape from the machine.

The above is the basic method for escaping from the machine, but changing the method may be necessary according to the conditions, so carry out practice drills at the work site.

PROTECTION FROM FALLING OR FLYING OBJECTS

On work sites where there is danger that falling objects or flying objects may hit the operator's cab select a guard to match the operating conditions to protect the operator.

Work in mines, tunnels, deep pits or on loose or wet surfaces could produce danger of falling rock, roll over or hazardous flying objects. Additional protection for operator’s cab could be required in form of a FOPS/Falling Object Protective Structure and/or ROPS/Roll Over Protective Structure reinforcement system.

Any reinforcement system that is installed on machine must pass safety and certification standards and carry appropriate labeling and rating information. For example, most often added type of reinforcement system, FOPS, must meet or exceed Society of Automotive Engineers standard SAE J1356, "Performance Criteria for Falling Object Guards for Wheel loaders."

Never attempt to alter or modify any type of protective structure reinforcement system, by drilling holes, welding or remounting or relocating fasteners. Any serious impact or damage to system requires a complete integrity reevaluation. Reinstallation, recertification and/ or replacement of system may be necessary.

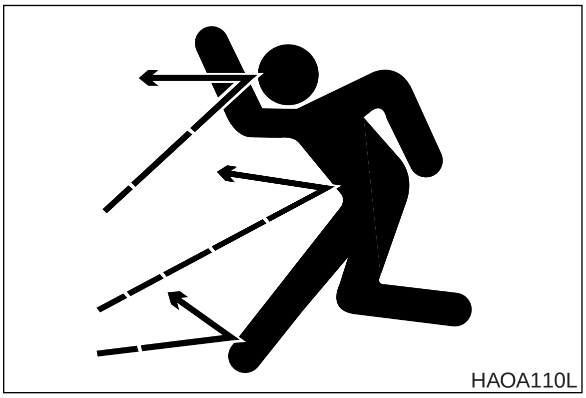

Figure 9

Figure 10

INSTALL ADDITIONAL SAFETY EQUIPMENT IF CONDITIONS REQUIRE

Laminate glass protection for the front, side or rear windows may also be recommended depending upon particular site conditions.

Contact your Daewoo distributor for available safety guards and/or recommendations if there is any danger of getting hit by objects that could strike the operator’s cab. Make sure that all other work site crew members are kept well away from wheel loader and safe from potential hazards.

MAINTAIN STANDARD SAFETY EQUIPMENT IN GOOD CONDITION

Machinery guards and body panel covers must be in place at all times. Keep well clear of rotating parts. Pinch point hazards such as cooling fan and alternator drive belts could catch hair, jewelry or oversize or very loose clothing.

Safety labels must be replaced if they are damaged or become unreadable. Information on labels gives work crew members an important safety reminder. Part numbers for each decal and required mounting locations are shown on pages 1-2 through 1-4 of this section.

ATTACHMENT PRECAUTIONS

Options kits are available through your dealer. Contact Daewoo for information on available one-way (single-acting) and two-way (double-acting) piping / valving / auxiliary control kits. Because Daewoo cannot anticipate, identify or test all attachments that owners may wish to install on their machines, please contact Daewoo for authorization and approval of attachments, and their compatibility with options kits.

ACCUMULATOR

The pilot control system is equipped with an accumulator. For a brief period of time after the engine has been shut down, the accumulator will store a pressure charge that may enable hydraulic controls to be activated. Activation of any controls may enable the selected function to operate under force of gravity.

When performing maintenance on the pilot control system, the hydraulic pressure in the system must be released as describe in Operation and Maintenance Manual.

The accumulator is charged with high-pressure nitrogen gas, so it is extremely dangerous if it is handled in the wrong way. Always observe the following precautions;

- Do not drill or make any holes in the accumulator or expose it any flame, fire or heat source.
- Do not weld on the accumulator, or try attaching anything to it.
- When carrying out disassembly or maintenance of the accumulator, or when disposing of the accumulator, the charged gas must be properly released. Contact your Daewoo distributor.
- Wear safety goggles and protective gloves when working on an accumulator. Hydraulic oil under pressure can penetrate the skin and cause serious injuries.

ENGINE VENTILATION

Engine exhaust gases can cause loss of judgment, loss of alertness, and loss of motor control. These gases can also cause unconsciousness, serious injury and fatal accidents.

Make sure of adequate ventilation before starting engine in any enclosed area.

You should also be aware of open windows, doors or ductwork into which exhaust may be carried, or blown by wind, exposing others to danger.

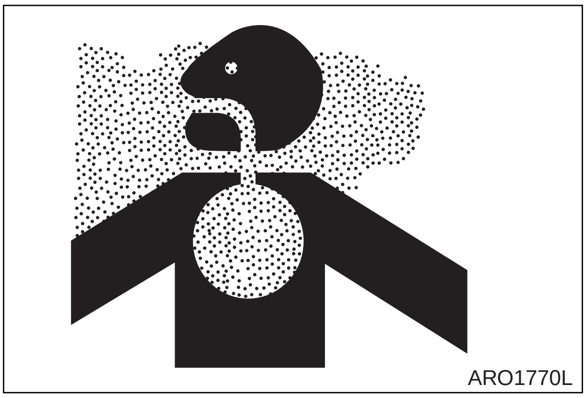

Figure 11

WINDOW GLASS BREAKING TOOL

This loader is equipped with a glass breaking tool. It is on the lower side of the cab beside the operator's seat. This tool can be used in case of an emergency situation which requires the breaking of glass to exit from the operator's cab. Grip the handle firmly and use the sharp point to break the glass.

WARNING!

Protect your eyes when breaking the glass.

Model	Tool Location
Mega 200-V	Lower Right Side
Mega 250-V	Lower Right Side
Mega 300-V	Lower Left Side
Mega 400-V	Lower Left Side
Mega 500-V	Lower Left Side

Figure 12 LEFT SIDE

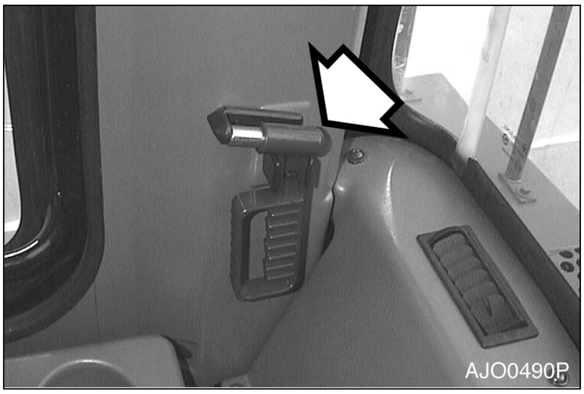

Figure 13 RIGHT SIDE

BEFORE STARTING ENGINE

WORK SITE PRECAUTIONS

Before starting operations, thoroughly check the area for any unusual conditions that could be dangerous.

Check the terrain and condition of the ground at the work site, and determine the best and safest method of operation.

Make the ground surface as hard and horizontal as possible before carrying out operations. If there is a lot of dust and sand on the work site, spray water before starting operations.

If you need to operate on a street, protect pedestrians and cars by designating a person for work site traffic duty or by erecting fences and posting "No Entry" signs around the work site.

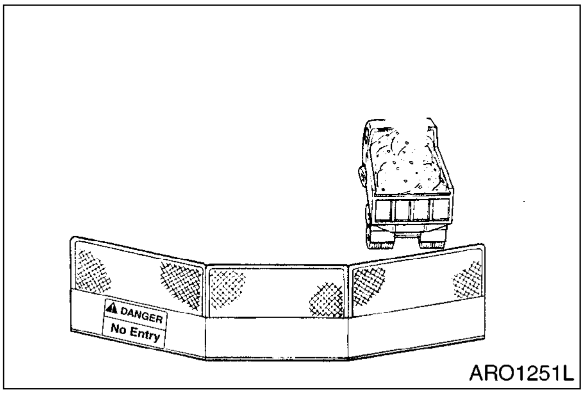

Figure 14

Erect fences, post "No Entry" signs, and take other steps to prevent people from coming close to or entering the work site. If people come close to a moving machine, they may be hit or caught by the machine, and this may lead to serious personal injury or death.

Water lines, gas lines, phone lines and high-voltage electrical lines may be buried under the work site. Contact each utility and identify their locations. Be careful not to damage or cut any of these lines.

NEVER be in water that is in excess of the permissible water depth. Refer to "Operation Manual."

Any type of object in the vicinity of the boom could represent a potential hazard, or cause the operator to react suddenly and cause an accident. Use a spotter or signal person working near bridges, phone lines, work site scaffolds, or other obstructions.

Minimum levels of insurance coverage, work permits or certification, physical barriers around the work site or restricted hours of operation may be mandated by governing authorities. There may also be regulations, guidelines, standards or restrictions on equipment that may have to be followed for local requirements. There may also be regulations related to performing certain kinds of work. If there is any question about whether your machine and work site complies with the applicable standards and regulations contact your local authorities and agencies.

Avoid entering soft ground. It will be difficult for the machine to escape.

Avoid operating your machine to close to the edge of cliffs, overhangs, and deep ditches. The ground may be weak in such areas. If the ground should collapse, the machine could fall or tip over and this could result in serious injury or death.

Remember that the soil after heavy rain, blasting or after earthquakes, is weakened in these areas.

Earth laid on the ground and the soil near ditches is loose. It can collapse under the weight of vibration of your machine and cause your machine to tip over.

Install the head guard (FOPS) if working in areas where there is danger of falling rocks.

CHECKS BEFORE STARTING ENGINE

Every day before starting the engine for the first time, carry out the following checks. If these checks are not carried out properly, there is danger of serious injury.

- Completely remove all wood chips, leaves, grass, paper and other flammable materials accumulated in the engine compartment and around the battery. They could cause a fire. Remove any dirt from the window glass, mirrors, handrails, and steps.
- Do not leave tools or spare parts laying around in the operator's compartment. The vibration of the machine when traveling or during operations may cause them to fall and damage or break the control levers or switches. They may also get caught in the gap of the control levers and cause the work equipment to malfunction or move dangerously. This may lead to unexpected accidents.
- Check the coolant level, fuel level, and hydraulic tank oil level, and check for clogged air cleaner and damage to the electrical wiring.
- Adjust the operator's seat to a position where it is easy to operate the machine, and check the seat belt and mounts for damage and wear.
- Check the operation of the gauges and the angle of the mirrors, and check that the safety lever is in "LOCKED" position.
- If any abnormalities are found in the above checks, carry out repairs immediately.

ENGINE STARTING

- Walk around your machine before getting in operator’s cab. Look for evidence of leaking fluid, loose fasteners, misaligned assemblies or any other indications of possible equipment hazard.
- All equipment covers and machinery safety guards must be in place, to protect against injury while machine is being operated.
- Look around work site area for potential hazards, or people or property that could be at risk while operation is in progress.
- NEVER start engine if there is any indication that maintenance or service work is in progress, or if a warning tag is attached to controls in cab.
- A machine that has not been used recently, or is being operated in extremely cold temperatures, could require a warm-up or maintenance service before start up.
- Check gauges and monitor displays for normal operation before starting engine. Listen for unusual noises and remain alert for other potentially hazardous conditions at start of work cycle.
- Check tire inflation and check tires for damage or uneven wear. Perform maintenance before operation.
- Do not short circuit the starting motor to start the engine. This is not only dangerous, but may also damage the machine.
- When starting the engine, sound the horn as an alert.
- Start and operate the machine only while seated.

BEFORE OPERATING MACHINE

If checks are not carried out properly after starting the engine, it may result in a delay in discovering abnormalities in the machine, and this may lead to personal injury or damage to the machine.

Carry out the checks in an open area where there are no obstructions. Do not let anyone near the machine when carrying out the checks.

- Check the operating condition of the equipment, and the actuation of the bucket, boom, and travel systems.
- Check the machine for any abnormal noise, vibration, heat, smell, or abnormality with the gauges. Check also for leakage of air, oil, and fuel.
- If any abnormality is found, repair the problem immediately. If the machine is used without repairing the problems, it may lead to unexpected injury or failure.
- Clear all personnel from directly around machine and from the area.
- Clear all obstacles from the machine's path. Beware of hazards.
- Be sure that all windows are clean. Secure the doors and the windows in the open position or in the shut position.
- Adjust the rear view mirrors for best visibility close to the machine. Make sure that the horn, the travel alarm (if equipped), and all other warning devices are working properly.
- Fasten the seat belt securely.
- Warm up the engine and hydraulic oil before operating machine.
- Before moving the machine, check the position of undercarriage. The normal travel position is with idler wheels to the front under the cab and the drive sprockets to the rear. When the undercarriage is in the reversed position, the travel controls must be operated in opposite directions.

MACHINE OPERATION

IMPORTANT
If you need more information or have any questions or concerns about safe operating procedures or working the wheel loader correctly in a particular application or in the specific conditions of your individual operating environment, please consult your local Daewoo representative.

OPERATE WHILE SEATED AT OPERATOR'S STATION ONLY

Never reach in through a window to work a control. Do not try to operate wheel loader unless you're in command position - seated at controls. You should stay alert and focused on your work at all times. Do not twist out of seat if job activity behind you (or to the side) requires your attention.

Use a spotter or signal person if you cannot see clearly and something is happening behind you.

Replace damaged safety labels and lost or damaged operator's manuals.

Do not let anyone operate machine unless they've been fully and completely trained, in safety and in operation of the machine.

Figure 15

SEAT BELTS SHOULD BE USED AT ALL TIMES

Whenever engine is running, operator should be seated at the control station with seat belt properly engaged.

Figure 16

MOVEMENT ALARMS

If wheel loader is equipped with an audible travel movement alarm, test alarm on a daily basis. Audible alarm should sound as soon as travel system is engaged.

TRAVEL PRECAUTIONS

When traveling, wheel loader always keeps lights on; make sure that you are in compliance with all state and local regulations concerning warning flags and signs.

Never turn the starter switch to the "O" (OFF) position when traveling. It is dangerous if the engine stops when the machine is traveling. It will be impossible to operate the steering unless the unit is equipped with an emergency steering system.

Pilot control valve lever (joystick) should not be operated while traveling.

Lower work equipment so that it is 400 mm (16 in) above ground.

Never travel over obstacles or slopes that will cause machine to tilt severely. Travel around any slope or obstacle that causes 10 degrees tilt, or more.

Do not operate the steering suddenly. The work equipment may hit the ground and cause the machine to lose its balance, and this may damage the machine or structures in the area.

When traveling on rough ground, travel at low speed, and avoid sudden changes in direction.

Always keep to the permissible water depth.

When traveling over bridges or structures on private land, check first that the bridge or structure can withstand the weight of the machine. When traveling on public roads, check with the local authorities and follow their instructions.

SLOPING TERRAIN REQUIRES CAUTION

Dig evenly around work site whenever possible, trying to gradually level any existing slope. If it’s not possible to level area or avoid working on a slope, reducing size and cycling rate workload is recommended.

On sloping surfaces, use caution when positioning wheel loader before starting a work cycle. Stay alert for instability situations to avoid getting into them. For example, you should always avoid working bucket over downhill side of machine when parked perpendicular to slope. Avoid full extensions of bucket in a downhill direction. Lifting bucket too high, too close to machine, while wheel loader is turned uphill can also be hazardous.

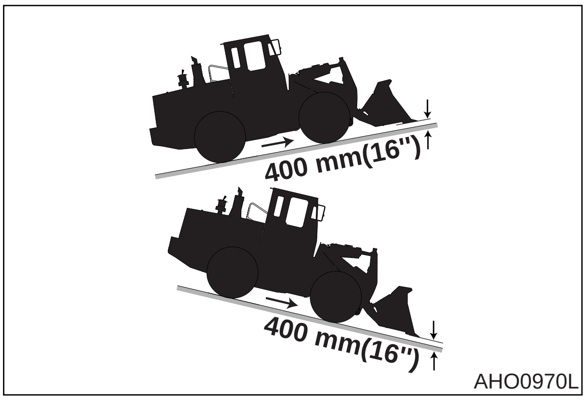

Figure 17

AVOID HIGH-VOLTAGE CABLES

Serious injury or death can result from contact or proximity to high-voltage electric lines. The bucket does not have to make physical contact with power lines for current to be transmitted.

Use a spotter and hand signals to stay away from power lines not clearly visible to operator.

VOLTAGE	MINIMUM SAFE DISTANCE
6.6 kV	3 m (9’ 10")
33.0 kV	4 m (13’ 1")
66.0 kV	5 m (16’ 5")
154.0 kV	8 m (26’ 3")
275.0 kV	10 m (32’ 10")

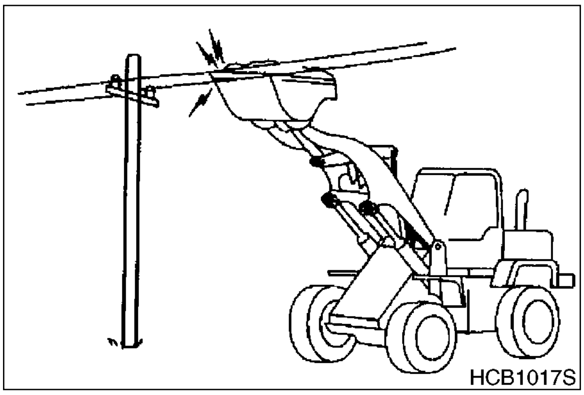

Figure 18

Use these minimum distances as a guideline only. Depending upon voltage in line and atmospheric conditions, strong current shocks can occur with boom or bucket as far away as 4 - 6 m (13 - 20 ft) from power line. Very high voltage and rainy weather could further decrease that safety margin.

NOTE: *Before starting any type of operation near power lines (either above ground or buried cable-type) you should always contact power utility directly and work out a safety plan with them.*

BEFORE STARTING TO DIG, CONTACT AUTHORITIES

Below ground hazards also include natural gas lines, water mains, tunnels and buried foundations. Know what’s underneath work site before starting to dig.

BE AWARE OF HEIGHT OBSTACLES

Any type of object in vicinity of boom could represent a potential hazard, or cause operator to react suddenly and cause an accident. Use a spotter or signal person working near bridges, phone lines, work site scaffolds, or other obstructions.

USE CARE ON LOOSE SUPPORT

Working heavy loads over loose, soft ground or uneven, broken terrain can cause dangerous side load conditions and possible tipover and injury. Travel without a load or balanced load may also be hazardous.

If temperatures are changing, be cautious of dark and wet patches when working or traveling over frozen ground. Stay away from ditches, overhangs and all other weak support surfaces. Halt work and install support mats or blocking if work is required in an area of poor support.

USE SOLID SUPPORT BLOCKING

Never rely on lift jacks or other inadequate supports when work is being done. Block wheels fore and aft to prevent any movement.

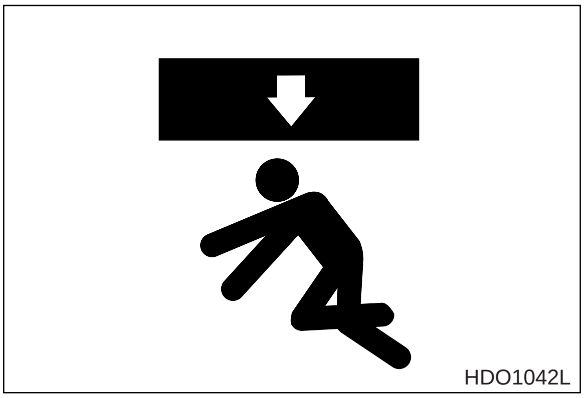

Figure 19

DIGGING BENEATH OVERHANGS

Digging beneath an overhang is dangerous. Overhand could collapse on top of operator and cause serious injury or death. Go on to another digging area before steep overhangs are formed. Know height and reach limits of wheel loader and plan ahead while working. Park wheel loader away from overhangs before work shutdown.

DIGGING BENEATH WHEEL LOADER

Digging beneath wheel loader is dangerous. Earth beneath could collapse. This could cause wheel loader to tip, which could cause serious injury or death to operator. Working around deep pits, trenching or along high walls may require support blocks, especially after heavy rainfalls or during spring thaws.

STAY ALERT FOR PEOPLE MOVING THROUGH WORK AREA

When loading a truck you should always know where the driver is.

Avoid loading over the cab of a truck even if the driver is in a safe spot. Someone else could have gone inside, for any number of reasons. Avoid working where unseen passersby might be.

Slow down work cycle and use slower travel speeds in congested or populated areas. Use a commonly understood signal so that other members of work crew can warn operator to slow or halt work in an impending hazardous situation.

Figure 20

BE AWARE OF AND CONFORM TO LOCAL REGULATIONS

Minimum levels of insurance coverage, work permits or certification, physical barriers around work-site or restricted hours of operation may be mandated by governing authorities. There may also be guidelines, standards or restrictions on equipment that may be used to perform certain kinds of work. Check and follow all local requirements, which may also be related to below ground hazards and power lines.

NEVER USE ETHER STARTING AIDS

An electric-grid type manifold heater is used for cold starting. Glowing heater element can cause ether or other starting fluid to detonate, causing injury.

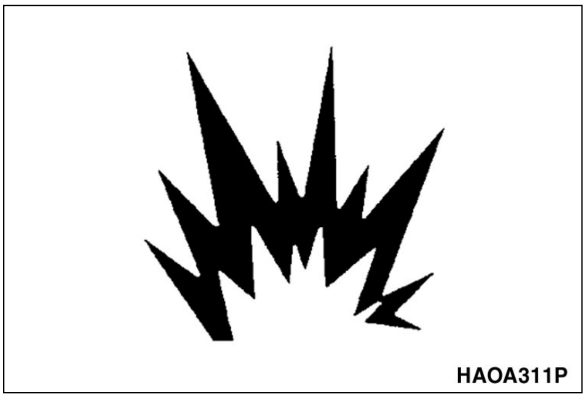

Figure 21

OBSERVE GENERAL SAFETY RULES

Only trained and authorized personnel, with a good knowledge and awareness of safe procedures, may be allowed to operate or perform maintenance or service on wheel loader.

All personnel at work site should be aware of assigned individual responsibilities and tasks. Communication and hand signals used should be understood by everyone.

Terrain and soil conditions at job site, approaching traffic, weather-related hazards and any above or below ground obstacles or hazards should be observed and monitored by all work crew members.

TAKE TIME TO PROVIDE GOOD VISIBILITY

Be careful not to go close to the edge of a cliff by mistake.

Use the machine only for its main purpose. Using it for other purposes will cause failures.

To ensure an ample view, do as follows:

- When working in dark areas, attach working lights and front lights to the machine. If necessary, set up lighting at the work site.
- Stop operations when the visibility is poor, such as in fog, mist, snow, and rain. Wait for the visibility to improve to a level which causes no problems for the operation.
- Keep dirt and dust off of windows and off lens surfaces of work lights. Stop working if lights, windows or mirrors need cleaning or adjustment.

To avoid hitting the work equipment, always do the following;

- When working in tunnels, on bridges, under electric wires, or when parking the machine or carrying out other operations in places with limited height, be extremely careful not to hit the bucket or other parts.
- To prevent collisions, operate the machine at a safe speed when working in confined spaces, indoors, or in crowded areas.
- Do not pass the bucket over the heads of workers or over the operator's compartment of dump truck.

KEEP "PINCH POINT" AREAS CLEAR - USE CAUTION IN REVERSE

Use a signal person in high traffic areas and whenever operator’s view is not clear, such as when traveling in reverse.

Anyone standing near wheels, or working assemblies of the attachment, is at risk of being caught between moving parts of machine.

Never allow anyone to ride on any part of machine or attachment, including any part of operator’s cab.

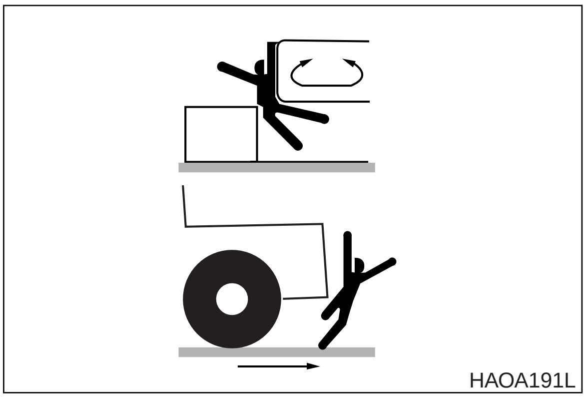

Figure 22

OPERATE CAREFULLY ON SNOW AND ICE AND IN VERY COLD TEMPERATURES

In icy cold weather avoid sudden travel movements and stay away from even very slight slopes. Machine could skid off to one side very easily.

Snow accumulation could hide or obscure potential hazards. Use care while operating or while using machine to clear snow.

Warming up engine for a short period may be necessary, to avoid operating with sluggish or reduced working capacity. Jolting shocks and impact loads caused by bumping or bottoming boom or attachment are more likely to cause severe stress in very cold temperatures. Reducing work cycle rate and work load may be necessary.

When the temperature rises, frozen road surfaces become soft, so the machine travel becomes unstable.

In cold weather, do not touch metal surfaces with your bare hands. If you touch a metal surface in extremely cold weather, your skin may freeze to the metal surface.

PARKING MACHINE

Avoid making sudden stops, or parking machine wherever it happens to be at the end of the work day. Plan ahead so that the wheel loader will be on a firm, level surface away from traffic and away from high walls, cliff edges and any area of potential water accumulation or runoff. If parking on inclines is unavoidable, block wheels to prevent movement. Lower bucket or other working attachment completely to ground, or to an overnight support saddle. There should be no possibility of unintended or accidental movement.

When parking on public roads, provide fences, signs, flags, or lights, and put up any other necessary signs to ensure that passing traffic can see the machine clearly, and park the machine so that the machine, flags, and fences do not obstruct traffic.

SHUTDOWN CONTROL FUNCTIONS

After bucket has been lowered to overnight storage position, move all switches and controls to "OFF" position. Pull parking brake knob to "APPLIED" position. This will apply parking brake. Move pilot cutoff switch to "LOCK" position. This will disable pilot control valve lever (joystick). Move key in starter switch to "OFF" position, and remove key from switch.

Engage all lock-down security equipment that may have been installed on machine.

IMPORTANT
When hydraulic system maintenance or service work must be performed, be aware that accumulators in system store fluid under pressure after system has been shutdown. To release hydraulic pressure in accumulators, operate control with engine "OFF" until accumulator pressure is completely dissipated.

NEVER LET ANYONE RIDE ON ATTACHMENT

Never let anyone ride on any work attachment, such as the bucket, crusher, grapple, or clamshell (grab bucket). There is a danger of the person falling and suffering serious injury.

Figure 23

MAINTENANCE

USE WARNING TAG DURING SERVICE

Alert others that service or maintenance is being performed and tag operator's cab controls - and other machine areas if required - with a warning notice.

Warning tags for controls are available from Daewoo distributors; see Figure 24.

Figure 24

CLEAN BEFORE INSPECTION OR MAINTENANCE

Clean the machine before carrying out inspection and maintenance. This prevents dirt from getting into the machine and also ensures safety during maintenance.

If inspection and maintenance are carried out when the machine is dirty, it will become more difficult to locate the problems, and also there is danger that you may get dirt or mud in your eyes or that you may slip and injure yourself.

When washing the machine, do the following;

- Wear shoes with non-slip soles to prevent yourself from slipping and falling on wet places.
- Wear safety glasses and protective clothing when washing the machine with high-pressure steam.
- Take action to prevent touching high-pressure water and cutting your skin or having mud fly into your eyes.
- Do not spray water directly on electrical components (sensors, connector) (1, Figure 25). If water gets into the electrical system, there is danger that it will cause defective operation and malfunction.

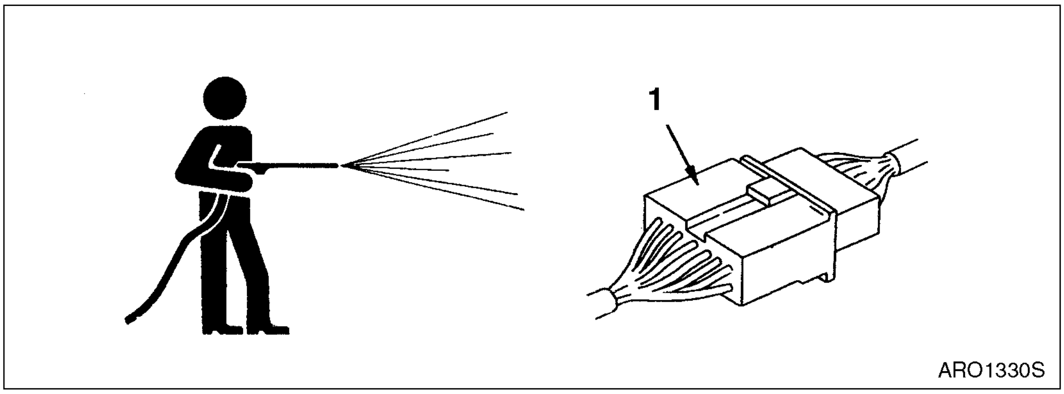

Figure 25

Pick up any tools or hammers that are laying in the work place, wipe up any grease or oil or any other slippery substances, and clean the area to make it possible to carry out the operation in safety. If the work place is left untidy, you may trip or slip and suffer injury.

PROPER TOOLS

Use only tools suited to the task. Using damaged, low qualify, faulty, or makeshift tools could cause personal injury. There is danger that pieces from, chisels with crushed heads, or hammers, may get into your eyes and cause blindness.

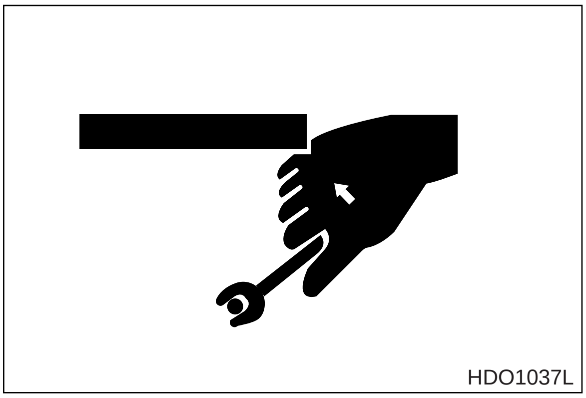

Figure 26

USE OF LIGHTING

When checking fuel, oil, battery electrolyte, or window washing fluid, always use lighting with anti-explosion specifications. If such lighting equipment is not used, there is danger of explosion.

If work is carried out in dark places without using lighting, it may lead to injury, so always use proper lighting.

Even if the place is dark, never use a lighter or flame instead of lighting. There is danger of fire. There is also danger that the battery gas may catch fire and cause and explosion.

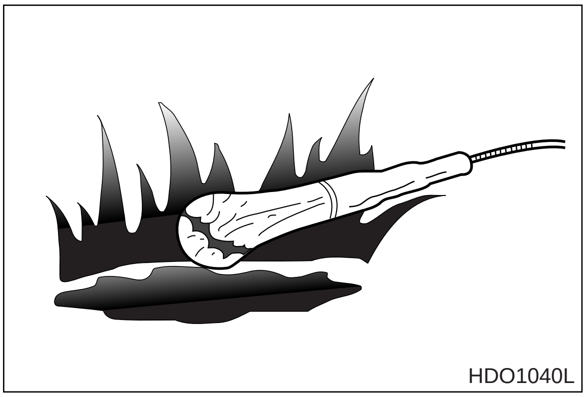

Figure 27

FIRE PREVENTION AND EXPLOSION PREVENTION

All fuels, most lubricants and some coolant mixtures are flammable. Leaking fuel or fuel that is spilled onto hot surfaces or onto electrical components can cause a fire.

Store all fuels and all lubricants in properly marked containers and away from all unauthorized persons.

Store oily rags and other flammable material in a protective container.

Do not smoke while you refuel the machine or while you are in a refueling area.

Do not smoke in battery charging areas or in areas the contain flammable material.

Clean all electrical connections and tighten all electrical connections. Check the electrical wires daily for wires that are loose of frayed. Tighten all lose electrical wires before you operate the machine. Repair all frayed electrical wires before you operate the machine.

Remove all flammable materials before the flammable materials accumulate on the machine.

Do not weld on pipes or on tubes that contain flammable fluids. Do not flame cut on pipes or on tubes that contain flammable fluids. Before you weld on pipes or on tubes or before you flame cut on pipes or on tubes, clean the pipes or tubes thoroughly with a nonflammable solvent.

BURN PREVENTION

When checking the radiator coolant level, stop the engine, let the engine and radiator cool down, then check the coolant recovery tank. If the coolant level in the coolant recovery tank is near the upper limit, there is enough coolant in the radiator.

Loosen the radiator cap gradually to release the internal pressure before removing the radiator cap.

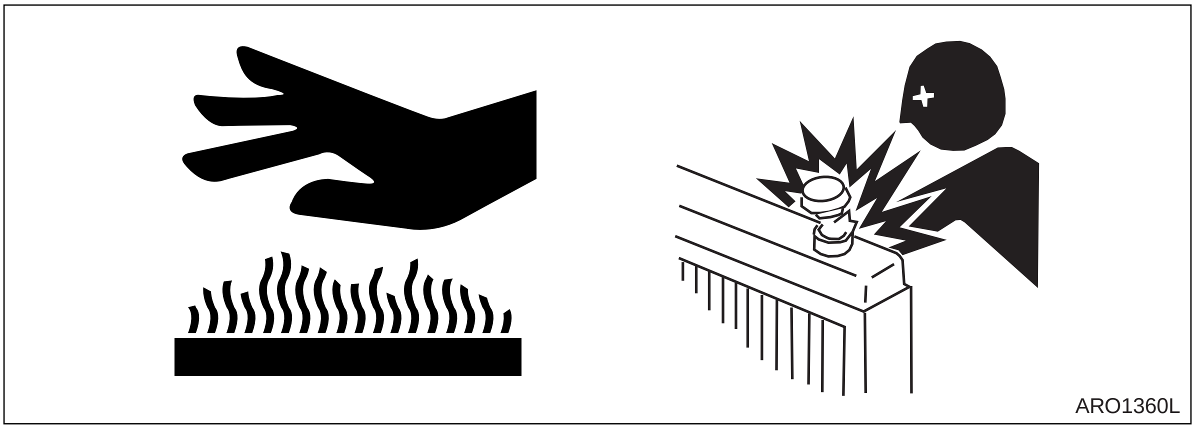

Figure 28

If the coolant level in the coolant recovery tank is below the lower limit, add coolant.

Cooling system conditioner contains alkali. Alkali can cause personal injury. Do not allow alkali to contact the skin, the eyes, or the mouth.

Allow cooling system components to cool before you drain the cooling system.

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.

Remove the hydraulic tank filter plug only after the engine has been stopped. Make sure that the hydraulic tank filter plug is cool before you remove it with your bare hand. Remove the hydraulic tank filter plug slowly to relieve pressure.

Relieve all pressure in the hydraulic oil system, in the fuel system, or in the cooling system before you disconnect any lines, fittings, or related items.

Batteries give off flammable fumes that can explode.

Do not smoke while you are checking the battery electrolyte levels.

Electrolyte is an acid. Electrolyte can cause personal injury. Do not allow electrolyte to contact the skin or the eyes.

Always wear protective glasses when you work on batteries.

WELDING REPAIRS

When carrying out welding repairs, carry out the welding in a properly equipped place. The welding should be performed by a qualified worker. During welding operations, there is the danger of, generation of gas, fire, or electric shock, so never let an unqualified worker do welding.

The qualified welder must do the following;

- To prevent explosion of the battery, disconnect the battery terminals and remove batteries.
- To prevent generation of gas, remove the paint from the location of the weld.
- If hydraulic equipment, piping or places close to them are heated, a flammable gas or mist will be generated and there is danger of it catching fire. To avoid this, never subject these places to heat.
- Do not weld on pipes or on tubes that contain flammable fluids. Do not flame cut on pipes or on tubes that contain flammable fluids. Before you weld on pipes or on tubes or before you flame cut on pipes or on tubes, clean the pipes or tubes thoroughly with a nonflammable solvent.
- If heat is applied directly to rubber hoses or piping under pressure, they may suddenly break so cover them with a fireproof covering.
- Wear protective clothing.
- Make sure there is good ventilation.
- Remove all flammable objects and provide a fire extinguisher.

PRECAUTIONS FOR REMOVAL, INSTALLATION, AND STORAGE OF ATTACHMENTS

Before starting removal and installation of attachments, decide the team leader.

Do not allow anyone except the authorized workers close to the machine or attachment.

Place attachments that have been removed from the machine in a safe place so that they do not fall. Put up a fence around the attachments and take other measures to prevent unauthorized persons from entering.

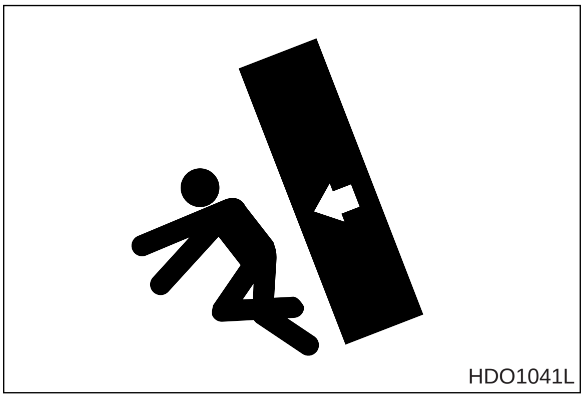

Figure 29

PRECAUTIONS WHEN WORKING ON MACHINE

When carrying out maintenance operations on the machine, keep the area around your feet clean and tidy to prevent you from falling. Always do the following;

- Do not spill oil or grease.
- Do not leave tools laying about.
- Watch your step when walking.

Never jump down from the machine. When getting on or off the machine, use the steps and handrails, and maintain a three-point contact (both feet and one hand or both hands and one foot) to support yourself securely.

If the job requires it, wear protective clothing.

To prevent injury from slipping or falling, when working on the hood or covers, never use any part except the inspection passage fitted with non-slip pads.

Figure 30

LOCK INSPECTION COVERS

When carrying out maintenance with the inspection cover open, lock the cover securely in position with the lock bar.

If maintenance work is carried out with the inspection cover open but not locked, there is danger that it may suddenly close and cause injury if there is a gust of wind.

CRUSHING PREVENTION AND CUTTING PREVENTION

You should always have at least two people working together if the engine must be run during service. One person needs to remain in the operator’s seat, ready to work the controls or stop the machine and shut off the engine.

Unless you are instructed otherwise, never attempt adjustments while the machine is moving or while the engine is running.

Stay clear of all rotating parts and moving parts.

Keep objects away from moving fan blades. The fan blades will throw objects and the fan blades can cut objects.

Do not use a wire rope cable that is kinked or flayed. Wear gloves when you handle a wire rope cable.

When you strike a retainer pin, the retainer pin might fly out. The loose retainer pin can injure personnel. Make sure that the area is clear of people when you strike a retainer pin. To avoid injury to your eyes, wear protective glasses when you strike a retainer pin.

DO NOT RUN ENGINE IF REPAIRS OR WORK ARE BEING PERFORMED ALONE

You should always have at least two people working together if engine must be run during service. One person needs to remain in operator’s seat, ready to work controls or stop machine and shut "OFF" engine.

ALWAYS USE ADEQUATE EQUIPMENT SUPPORTS AND BLOCKING

Do not allow weight or equipment loads to remain suspended. Lower everything to ground before leaving operator’s seat. Do not use hollow, cracked or unsteady, wobbling weight supports. Do not work under any equipment supported solely by a lift jack.

DO NOT WORK ON HOT ENGINES OR HOT COOLING OR HYDRAULIC SYSTEMS

Wait for engine to cool off after normal operation. Park wheel loader on a firm, level surface and lower all equipment before shutting down and switching "OFF" controls. When engine lube oil, gearbox lubricant or other fluids require change, wait for fluid temperatures to decrease to a moderate level before removing drain plugs.

NOTE: *Oil will drain more quickly and completely if it is warm. Do not drain fluids at temperatures exceeding 95°C (203°F), however do not allow full cool-down.*

HYDRAULIC CYLINDER SEALS REQUIRE PERIODIC REPLACEMENT

Check cylinder drift rate at regular intervals. Overhaul seal kits are available through Daewoo.

HIGH PRESSURE HYDRAULIC LINES CAN STORE A GREAT DEAL OF ENERGY

Exposed hydraulic hoses on arm or boom could react with explosive force if struck by a falling rock, overhead obstacle or other job site hazard. Extra safety guards may be required. NEVER allow hoses to be hit, bent or interfered with during operation.

PRECAUTIONS WITH HIGH PRESSURE LINE, TUBES AND HOSES

When inspecting or replacing high-pressure piping or hoses, check that the pressure has been released form the circuit. Failure to release the pressure may lead to serious injury. Always do the following;

- Wear protective glasses and leather gloves.
- Fluid leaks from hydraulic hoses or pressurized components can be difficult to see but pressurized oil has enough force to pierce the skin and cause serious injury. Always use a piece of wood or cardboard to check for suspected hydraulic leaks. Never use your hands or expose your fingers.
- Do not bend high pressure lines. Do not strike high pressure lines. Do not install lines, tubes or hoses that are bent or damaged.
- Make sure that all clamps, guards and heat shields are installed correctly to prevent vibration, rubbing against other parts, and excessive heat during operation.
  - If any of the following conditions are found, replace the part.
  - Damage or leakage from hose end.
  - Wear, damage, cutting of covering, or exposure of strengthening wire layer.
  - Cover portion is swollen in places.
  - There is twisting or crushing at movable parts of hose.
  - Foreign material is embedded in the covering.
  - Hose end is deformed.

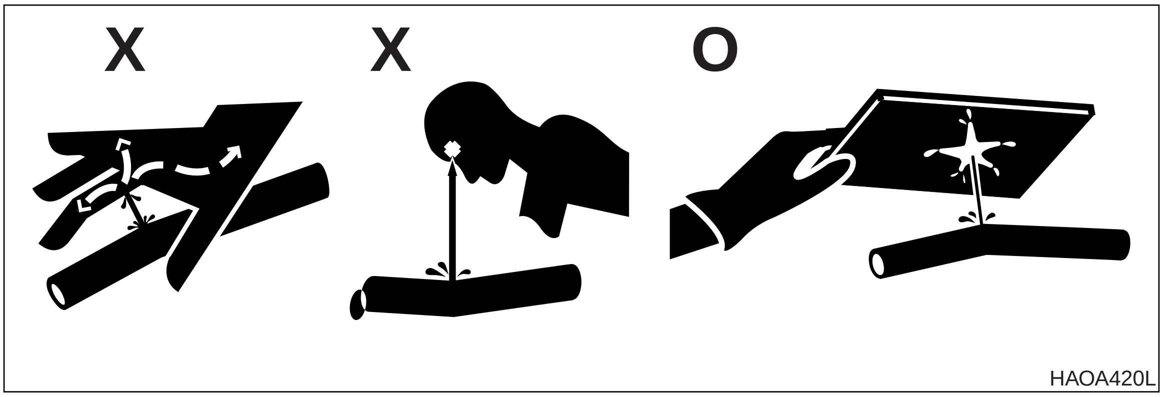

Figure 31

OBTAIN IMMEDIATE MEDICAL ATTENTION IF PRESSURIZED OIL PIERCES SKIN.

WARNING!
Failure to obtain prompt medical assistance could result in gangrene or other serious damage to tissue.

USE CORRECT REPLACEMENT FASTENERS TIGHTENED TO PROPER TORQUE

Refer to "General Maintenance" section of Shop Manual for information on tightening torques and recommended assembly compounds and always use correct part.

Poor or incorrect fastener connections can dangerously weaken assemblies.

SAFETY-CRITICAL PARTS MUST BE REPLACED PERIODICALLY

Replace following fire-related components as soon as they begin to show any sign of wear, or at regular periodic intervals, whether or not deterioration is visible:

- Fuel system flexible hoses, the tank overflow drain hose and the fuel filler cap.
- Hydraulic system hoses, especially the pump outlet lines and front and rear pump branch hoses.
- Keep mounting brackets and hose and cable routing straps tight. Hose routing should have gradual bends.

DISPOSE OF ALL PETROLEUM-BASED OILS AND FLUIDS PROPERLY

Physical contact with used motor oil may pose a health risk. Wipe oil from your hands promptly and wash off any remaining residue.

Used motor oil is an environmental contaminant and may only be disposed of at approved collection facilities. To prevent pollution of the environment, always do the following;

- Never dump waste oil in a sewer system, rivers, etc.
- Always put oil drained from your machine in containers. Never drain oil directly onto the ground.
- Obey appropriate laws and regulations when disposing of harmful materials such as oil, fuel, solvent, filters, and batteries.

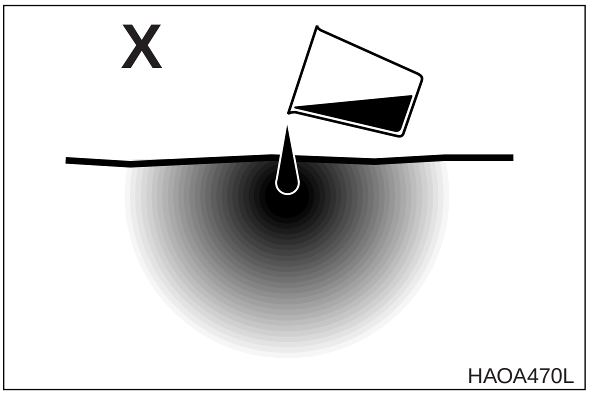

Figure 32

CHECK TIRE PRESSURE AND CONDITION

Maintain tire pressure but do not over inflate. Inspect tires and wheels daily. When inflating tires, follow procedures in Maintenance Section, which include using an extension to allow you to avoid standing in front of or over a tire. Do not change a tire unless you have both experience and proper equipment.

BATTERY

BATTERY HAZARD PREVENTION

Battery electrolyte contains diluted sulfuric acid and batteries generate hydrogen gas. Hydrogen gas is highly explosive, and mistakes in handling them can cause serious injury or fire. To prevent problems, always do the following;

- Do not smoke or bring any flame near the battery.
- When working with batteries, ALWAYS wear safety glasses and rubber gloves.
- If you spill battery electrolyte on yourself or your clothes, immediately flush the area with water.
- If battery electrolyte gets into your eyes, flush them immediately with large quantities of water and see a doctor at once.
- If you accidentally drink battery electrolyte, drink a large quantity of water or milk, raw egg or vegetable oil. Call a doctor or poison prevention center immediately.
- When cleaning the top surface of the battery, wipe it with a clean, damp cloth. Never use gasoline, thinner, or any other organic solvent or detergent.
- Tighten the battery caps securely.
- Explosive battery gas can be set off by sparks from incidental contact or static discharge. Turn "OFF" all switches and engine when working on batteries. Keep battery terminals tight. Contact between a loose terminal and post can create an explosive spark.
- If the battery electrolyte is frozen, do not charge the battery or start the engine with power from another source. There is danger that the battery may catch fire.
- When charging the battery or starting with power from another source, let the battery electrolyte melt and check that there is no leakage of battery electrolyte before starting the operation.
- Always remove the battery from the machine before charging.

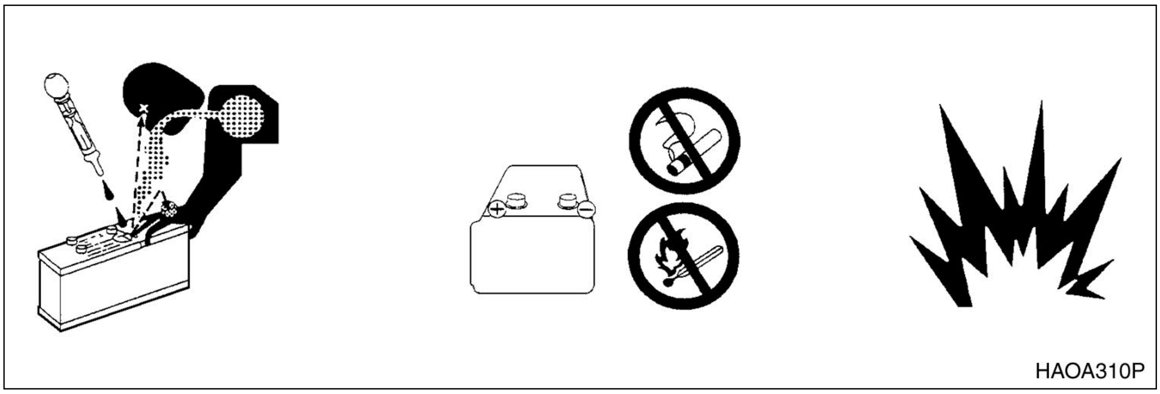

Figure 33

DISCONNECT BATTERIES BEFORE ELECTRICAL SERVICE OR ELECTRICAL WELDING

Remove cable to negative terminal first when disconnecting cable. Connect positive terminal cables first when installing a battery.

USE LOW HEAT PORTABLE LIGHTING

Hot surfaces on trouble lights or portable work lights can set off fuel or battery explosive gases.

BOOST STARTING OR CHARGING ENGINE BATTERIES

If any mistake is made in the method of connecting the booster cables, it may cause an explosion or fire. Always do the following;

- Turn off all electrical equipment before connecting leads to the battery. This includes electrical switches on the battery charger or boost starting equipment.
- When boost-starting from another machine or vehicle do not allow the two machines to touch. Wear safety glasses or goggles while required battery connections are made.

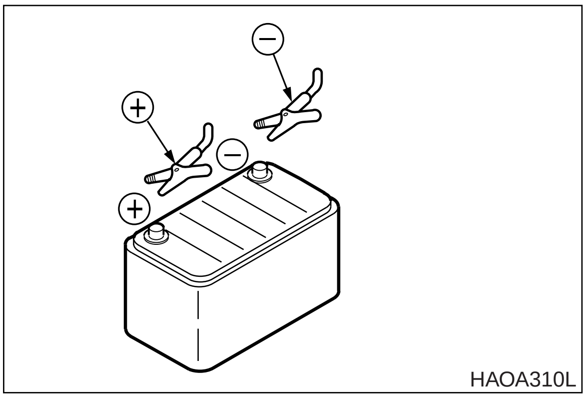

Figure 34

- 24 volt battery units consisting of two series-connected twelve volt batteries have a cable connecting one positive terminal on one of the 12 volt batteries to a negative terminal on the other battery. Booster or charger cable connections must be made between the non-series-connected positive terminals and between the negative terminal of the booster battery and the metal frame of the machine being boosted or charged. Refer to the procedure and illustration in Operation and Maintenance Manual.
- Connect positive cable first when installing cables and disconnect the negative cable first when removing them. The final cable connection, at the metal frame of the machine being charged or boost-started, should be as far away from the batteries as possible.

TOWING

PRECAUTIONS WHEN TOWING

If any mistake is made in the method of selecting or inspecting the towing wire or in the method of towing, it may lead to serious personal injury. Always do the following;

- Always use the method of towing given in this Operation and Maintenance Manual. Do not use any other method.
- Use leather gloves when handling the wire rope.
- When carrying out the preparation work for towing with two or more workers, determine the signals to use and follow these signals correctly.
- If the engine on the problem machine will not start or there is a failure in the brake system. always contact your Daewoo distributor.
- Never go between the towing machine and the towed machine during the towing operation.
- It is dangerous to carry out towing on slopes, so select a place where the slope is gradual. If there is no place where the slope is gradual, carry out operations to reduce the angle of the slope before starting the towing operation.
- When towing a problem machine, always use a wire rope with a sufficient towing capacity.
- Do not use a frayed, kinked rope or a rope with any loss of diameter.

SHIPPING AND TRANSPORTATION

OBEY STATE AND LOCAL OVER-THE-ROAD REGULATIONS

Check state and local restrictions regarding weight, width and length of a load before making any other preparation for transport.

Hauling vehicle, trailer and load must all be in compliance with local regulations governing intended shipping route.

Partial disassembly or tear-down of wheel loader may be necessary to meet travel restrictions or particular conditions at work site.

Refer to the section "Transportation" section of operation manual.

SUMMARY OF SAFETY PRECAUTIONS FOR LIFTING

WARNING!
Improper lifting can allow load to shift and cause personal injury or damage to the machine

To make safe lifts, the following items must be evaluated by operator and work site crew.

- Condition of ground support.
- Wheel loader configuration and attachments.
- Weight, lifting height and lifting radius.
- Safe rigging of load.
- Proper handling of suspended load.

Taglines on opposite sides of load can be very helpful in keeping a suspended load secure, if they are anchored safely to control points on ground.

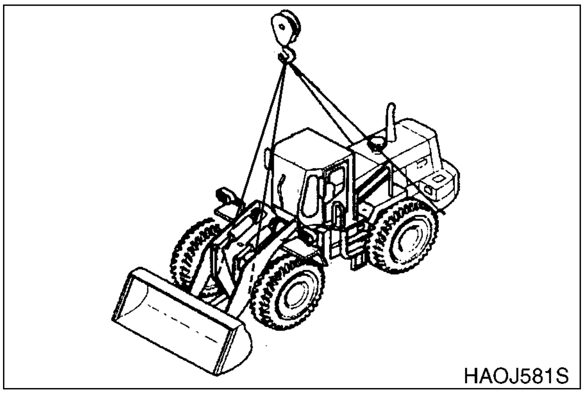

Figure 35

SPECIFICATIONS

DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

SPECIFICATIONS FOR MEGA 500-V

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Mega 500-V	1001 and Up

May 2001

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GENERAL DESCRIPTION

Figure 1 identifies the location of major machine components.

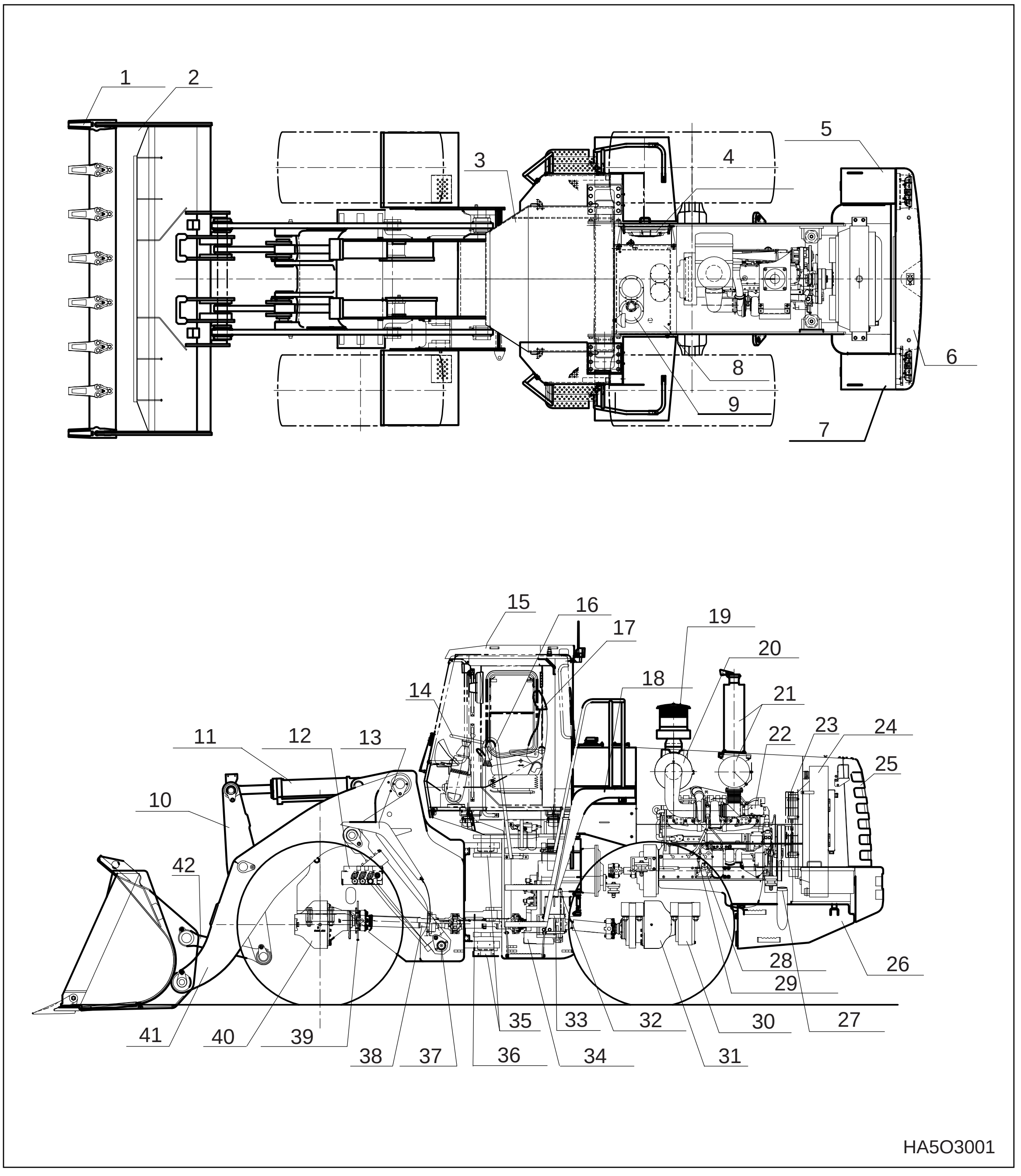

Figure 1

Reference Number	Description
1	Bucket Tooth
2	Bucket
3	Operator's Cab
4	Air Conditioner Condenser
5	Battery Box (R.h)
6	Counterweight
7	Battery Box (L.h)
8	Oil Tank
9	Full Flow Filter
10	Tilt Lever
11	Bucket Cylinder
12	Control Valve
13	Front Wheel Cover
14	Steering Wheel
15	Tops
16	Work Lever
17	Seat
18	Rear Wheel Cover
19	Pre-cleaner
20	Air Cleaner
21	Muffler

Reference Number	Description
22	Engine
23	Fan
24	Radiator
25	Grill
26	Fuel Tank
27	Fuel Filler Pipe
28	Engine Oil Filler Pipe
29	Engine Oil Level Gauge
30	Rear Axle Pivot
31	Rear Axle
32	Transmission Oil Filter
33	Wheel Chock
34	Transmission
35	Center Pin
36	Steering Wheel Cylinder
37	Boom Cylinder
38	Drive Shaft
39	Parking Brake
40	Front Axle
41	Loader Arm
42	Link

GENERAL SPECIFICATIONS

MEGA 500-V		
Item		**Specification**
Standard Bucket Capacity		4.8 m^3 (6.3 yd^3)
Vehicle Weight (W/ROPS CANOPY)		28,800 (29,600) kg (63.493 (65.257) lb)
Engine		
	Type	Cummins N14-C
	Horsepower	320 ps (316 hp) / 2,100 rpm
	Max. Torque	156 kg•m (1,128 ft lb) / 1,400 rpm
Transmission		
	Full Automatic Power -Shift	Full Automatic Power Shift
	Speeds	4 Forward, 3 Reverse
Brake Systems		
	Travel Brakes	4 Wheel, Wet Disk
	Parking Brake	SHAR, Dry Disc Type
Performance		
	Travel Speed	7 – 35 km/h (4.35 - 21.75 MPH)
	Steering Angle	± 40°
	Min. Tire Turning Radius	6,140 mm (242")
	Safe Operating Load	8,640 kg (19,047 lb)
	Max. Breakout Force	27,000 kg (59,525 lb)
	Bucket Rise Time	6.5 Sec
	Bucket Dump Time	1.3 Sec
	Bucket Descent Time	3.4 Sec
	Maximum Gradeability	30° (58%)

ENGINE PERFORMANCE CURVES

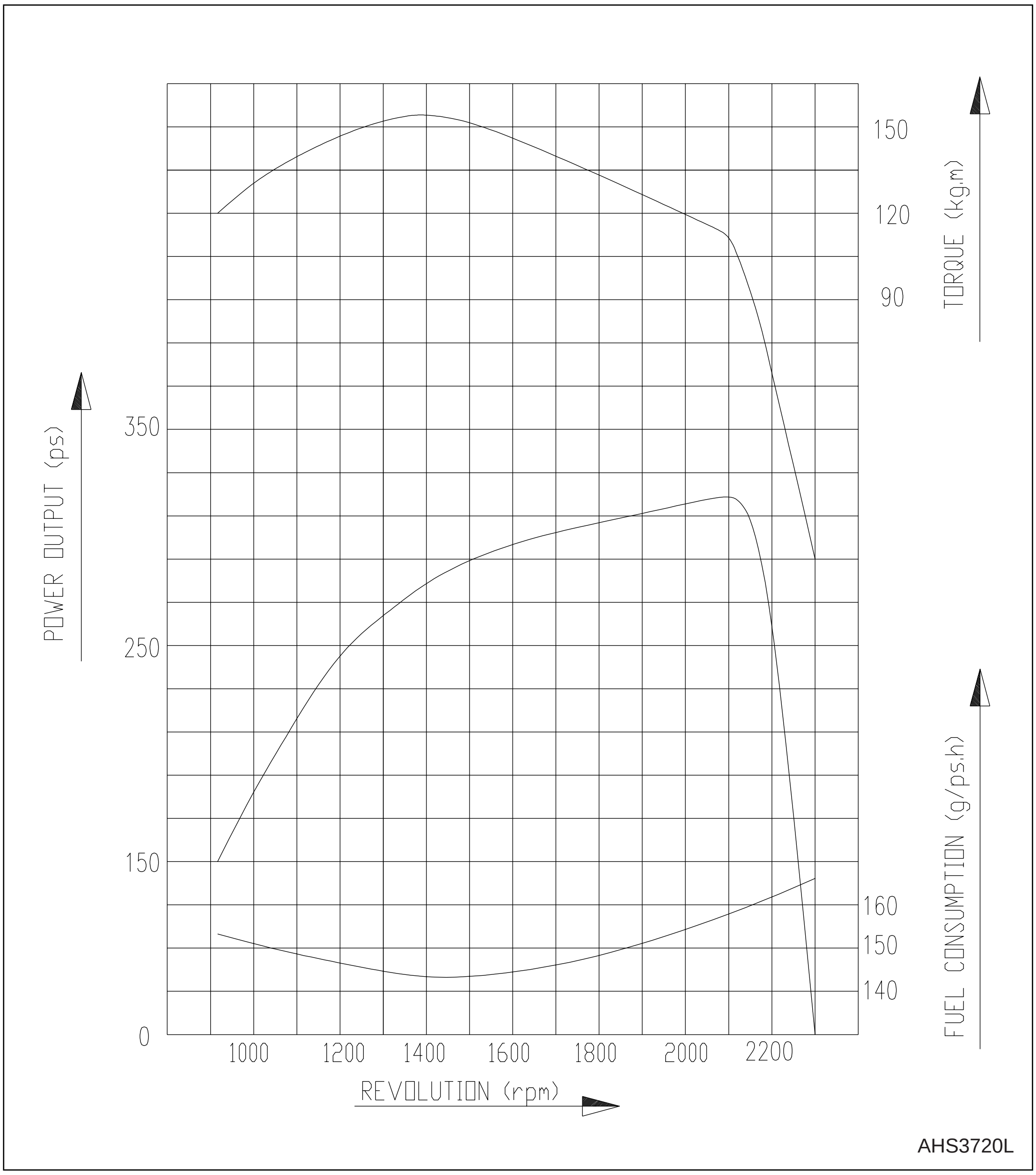

Figure 2

Performance standard	KS-R1004
Power (Maximum / rpm	320 ps @ 2,100 rpm (316 hp @ 2,100 rpm)
Maximum Torque	156 kg•m / 1,400 rpm (1,128 ft lb @ 1,400 rpm)
Fuel Consumption	158 g/ps•h

NOTE: *Barometric Pressure: 760 mm (30") Mercury*

Temperature: 20°C (68°F)

W/ Cooling Fan

Alternator: 24 V, 70 amp

Exhaust System: Complete, attached

Air Cleaner; Installed

WORKING RANGE AND DIMENSIONS

Figure 3, illustrates exterior machine dimensions and working range of machine when it is equipped with a standard bucket.

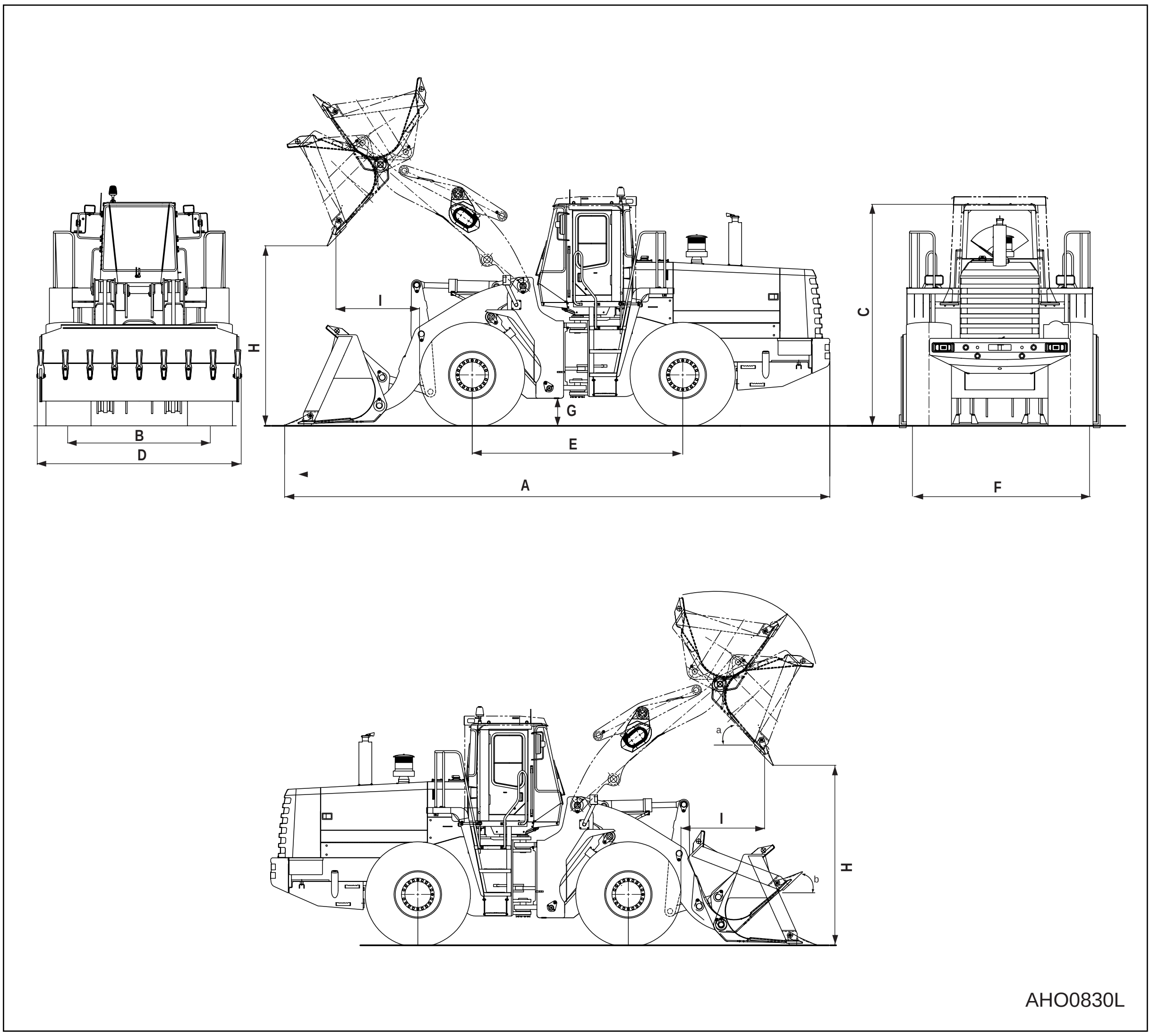

Figure 3

Category	Dimension
Overall Length (A)	9,320 mm (30’ 7")
Overall Width, without bucket (B)	3,190 mm (10’ 6")
Overall Height (C)	3,780 mm (12’ 5")
Bucket Width (D)	3,480 mm (11’ 5")
Wheel Base (E)	3,600 mm (11’ 10")
Tread (F)	2,420 mm (7’ 11")
Ground Clearance (G)	490 mm (1’ 7")
Dump Height, to tooth (H)	3,080 mm (10’ 1")
Dump Distance, to Bucket Edge (I)	1,380 mm (4’ 6")
Dump Height to Bucket Pivot	4,470 mm (14’ 8")
Bucket Angle, Raised (a)	47°
Bucket Angle (b), Lowered (at carry)	48°
Tire Size	29.5-25-22 PR(L3)

Figure 4 and Figure 5, illustrate working range when machine is equipped with optional Pallet or Log Fork.

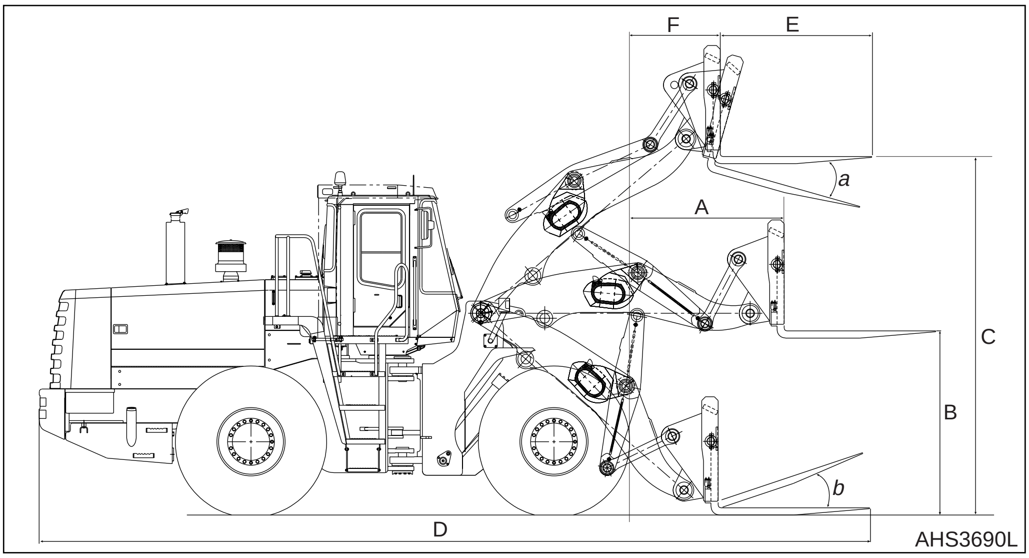

Figure 4

Reference Number	Dimension
A	1,785 mm (5’ 10")
B	2,185 mm (7’ 2")
C	4,260 mm (13’ 12")
D	9,870 mm (32’ 5")

Reference Number	Dimension
E	1,800 (5’ 11")
F	1,025 (3’ 4")
a	16°
b	22°

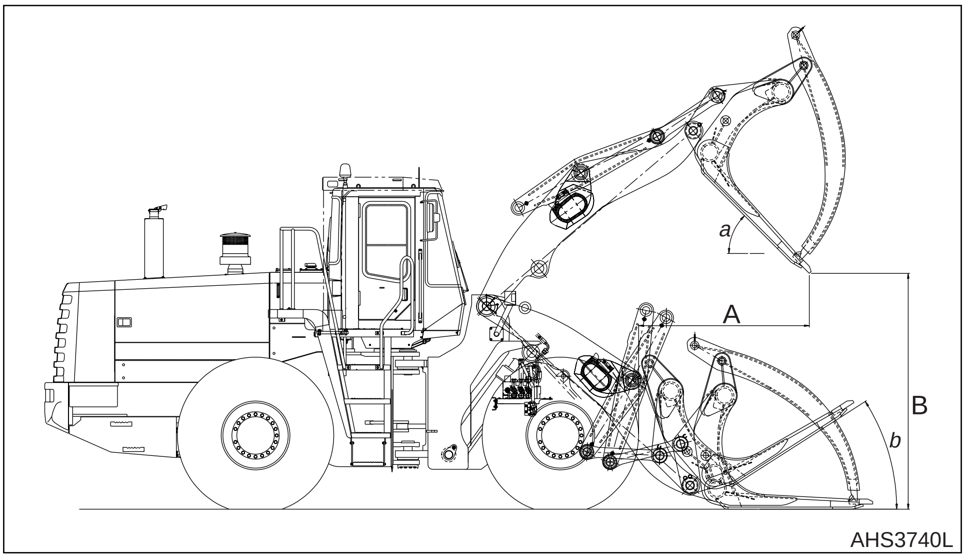

Figure 5

Reference Number	Dimension
A	2,016 mm (6’ 7")
B	2,785 mm (9’ 2")

Reference Number	Dimension
a	45°
b	33°

WORKING CAPACITIES

BUCKET CAPACITY

Standard toothed bucket has a capacity of 4.8 m^3 (6.3 yd^3). An optional bucket equipped with a cutting edge and no teeth has a capacity of 4.8 m^3 (6.3 yd^3).

TIPPING LOAD

Static Tipping Load with bucket in Over Front position is 22,000 kg (48,500 lb). With bucket in Fully Turned position, Static Tipping Load is 19,000 kg (41,890 lb).

MATERIAL WEIGHT

The data below describes weight of a cubic meter (cubic yard) of many types of workload materials.

APPROXIMATE WEIGHT OF WORKLOAD MATERIALS

MATERIAL	LOW WEIGHT OR DENSITY 1,100 KG/M^3 (1,850 LB/YD^3), OR LESS	MEDIUM WEIGHT OR DENSITY 1,600 KG/M^3 (2,700 LB/YD^3), OR LESS	HIGH WEIGHT OR DENSITY 2,000 KG/M^3 (3,370 LB/YD^3), OR LESS
Charcoal	401 kg/m^3 (695 lb/yd^3)	---------------------	---------------------
Coke, blast furnace size	433 kg/m^3 (729 lb/yd^3)	---------------------	---------------------
Coke, foundry size	449 kg/m^3 (756 lb/yd^3)	---------------------	---------------------
Coal, bituminous slack, piled	801 kg/m^3 (1,350 lb/yd^3)	---------------------	---------------------
Coal, bituminous r. of m., piled	881 kg/m^3 (1,485 lb/yd^3)	---------------------	---------------------
Coal, anthracite	897 kg/m^3 (1,512 lb/yd^3)	---------------------	---------------------
Clay, DRY, in broken lumps	1,009 kg/m^3 (1,701 lb/yd^3)	---------------------	---------------------
Clay, DAMP, natural bed	---------------------	1,746 kg/m^3 (2,943 lb/yd^3)	---------------------

MATERIAL	LOW WEIGHT OR DENSITY 1,100 KG/M^3 (1,850 LB/YD^3), OR LESS	MEDIUM WEIGHT OR DENSITY 1,600 KG/M^3 (2,700 LB/YD^3), OR LESS	HIGH WEIGHT OR DENSITY 2,000 KG/M^3 (3,370 LB/YD^3), OR LESS
Cement, Portland, DRY granular	---------------------	1,506 kg/m^3 (2,583 lb/yd^3)	---------------------
Cement, Portland, DRY clinkers	---------------------	1,362 kg/m^3 (2,295 lb/yd^3)	---------------------
Dolomite, crushed	---------------------	1,522 kg/m^3 (2,565 lb/yd^3)	---------------------
Earth, loamy, DRY, loose	---------------------	1,202 kg/m^3 (2,025 lb/yd^3)	---------------------
Earth, DRY, packed	---------------------	1,522 kg/m^3 (2,565 lb/yd^3)	---------------------
Earth, WET, muddy	---------------------	---------------------	1,762 kg/m^3 (2,970 lb/yd^3)
Gypsum, calcined, (heated, powder)	961 kg/m^3 (1,620 lb/yd^3)	---------------------	---------------------
Gypsum, crushed to 3 inch size	---------------------	1,522 kg/m^3 (2,565 lb/yd^3)	---------------------
Gravel, DRY, packed fragments	---------------------	---------------------	1,810 kg/m^3 (3,051 lb/yd^3)
Gravel, WET, packed fragments	---------------------	---------------------	1,922 kg/m^3 (3,240 lb/yd^3)
Limestone, graded above 2	---------------------	1,282 kg/m^3 (2,160 lb/yd^3)	---------------------
Limestone, graded 1-1/2 or 2	---------------------	1,362 kg/m^3 (2,295 lb/yd^3)	---------------------
Limestone, crushed	---------------------	1,522 kg/m^3 (2,565 lb/yd^3)	---------------------
Limestone, fine	---------------------	---------------------	1,602 kg/m^3 (2,705 lb/yd^3)
Phosphate, rock	---------------------	1,282 kg/m^3 (2,160 lb/yd^3)	---------------------

MATERIAL	LOW WEIGHT OR DENSITY 1,100 KG/M^3 (1,850 LB/YD^3), OR LESS	MEDIUM WEIGHT OR DENSITY 1,600 KG/M^3 (2,700 LB/YD^3), OR LESS	HIGH WEIGHT OR DENSITY 2,000 KG/M^3 (3,370 LB/YD^3), OR LESS
Salt	929 kg/m^3 (1,566 lb/yd^3)	---------------------	---------------------
Snow, light density	529 kg/m^3 (891 lb/yd^3)	---------------------	---------------------
Sand, DRY, loose	---------------------	1,522 kg/m^3 (2,565 lb/yd^3)	---------------------
Sand, WET, packed	---------------------	---------------------	1,922 kg/m^3 (3,240 lb/yd^3)
Shale, broken	---------------------	1,362 kg/m^3 (2,295 lb/yd^3)	---------------------
Sulphur, broken	529 kg/m^3 (1,620 lb/yd^3)	---------------------	---------------------

IMPORTANT

Weights are approximations of estimated average volume and mass. Exposure to rain, snow or ground water; settling or compaction due to overhead weight and chemical or industrial processing or changes due to thermal or chemical transformations could all increase value of weights listed in table.

GENERAL MAINTENANCE

DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

GENERAL MAINTENANCE PROCEDURES

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
ALL MODELS	ALL RANGES

December 2000

TABLE OF CONTENTS

WELDING PRECAUTIONS AND GUIDELINES

IMPORTANT
To avoid accidents, personal injury and the possibility of causing damage to the machine or to components, welding must only be performed by properly trained and qualified personnel, who possess the correct certification (when required) for the specific welding fabrication or specialized repair being performed.

WARNING!
Structural elements of the machine may be built from a variety of steels. These could contain unique alloys or may have been heat treated to obtain particular strength characteristics. It is extremely important that welding repairs on these types of steel are performed with the proper procedures and equipment. If repairs are performed incorrectly, structural weakening or other damage to the machine (that is not always readily visible) could be caused. Always consult Daewoo After Sales Service before welding on integral components (loader arm, frames, car body, track frames, turntable, attachment, etc.) of the machine. It is possible that some types of structurally critical repairs may require Magnetic Particle or Liquid Penetrant testing, to make sure there are no hidden cracks or damage, before the machine can be returned to service.

CAUTION!
Always perform welding procedures with the proper safety equipment on hand. Adequate ventilation and a dry work area are absolutely essential. Keep a fire extinguisher nearby and always wear protective clothing and the recommended type of eye protection.

CAUTION!

Observe the following safety precautions:

1. **Use extra caution and adequate safety shielding when welding near fuel and oil tanks, batteries, hydraulic piping lines or other fire hazards.**
2. **Never weld when the engine is running. Battery cables must be disconnected before the welding procedure is started.**
3. **Never weld on a wet or damp surface. The presence of moisture causes hydrogen embrittlement and structural weakening of the weld.**
4. **If welding procedures are being performed near cylinder rods, operator's cab window areas or any other assemblies that could be damaged by weld spatters, use adequate shielding protection in front of the assembly.**
5. **During equipment setup, always attach ground cables directly to the area or component being welded to prevent arcing through bearings, bushings, or spacers.**
6. **Always use correct welding rods for the type of weld being performed and observe recommended precautions and time constraints. AWS Class E7018 welding rods for low alloy to medium carbon steel must be used within two hours after removal from a freshly opened container. Class E11018G welding rods for T-1 and other higher strength steel must be used within 1/2 hour.**

HYDRAULIC SYSTEM - GENERAL PRECAUTIONS

Always maintain oil level in the system at recommended levels. Assemblies that operate under heavy loads, at high speed, with extremely precise dimensional tolerances between moving parts - pistons and cylinders, or shoes and swash plates, for example - can be severely damaged if oil supply runs dry.

Assemblies can be run dry and damaged severely in a very short time when piping or hoses are disconnected to repair leaks and/or replace damaged components. Hoses that are inadvertently switched during disassembly (inlet for outlet and vice versa), air introduced into the system or assemblies that are low on oil due to neglect or careless maintenance, could all produce sufficient fluid loss to cause damage.

When starting the engine (particularly after long layoff or storage intervals), make sure that all hydraulic controls and operating circuits are in neutral, or "OFF." That will prevent pumps or other components that may be temporarily oil-starved from being run under a load.

Replacement of any hydraulic system component could require thorough cleaning, flushing, and some amount of pre-filling with fresh, clean oil if the protective seal on replacement parts has obviously been broken or if seal integrity may have been compromised. When protective seals are removed before installation and reassembly, inspect all replacement parts carefully, before they are installed. If the replacement part is bone dry (with no trace of factory pre-lube) or has been contaminated by dirt or by questionable oils, flushing and pre-filling with clean hydraulic fluid is recommended.

Vibration, irregular or difficult movement or unusual noise from any part of the hydraulic system could be an indication of air in the system (and many other types of problems). As a general precaution (and to help minimize the risk of potential long-term damage), allow the engine to run at no-load idle speed immediately after initial start-up. Hydraulic fluid will circulate, releasing any air that may have been trapped in the system before load demands are imposed.

A daily walk-around pre-start equipment safety inspection, including a quick visual scan for any exterior evidence of leaking hydraulic fluid, can help extend the service life of system components.

IMPORTANT

Hydraulic system operating conditions (repetitive cycling, heavy work loads, fluid circulating under high pressure) make it extremely critical that dust, grit or any other type of contamination be kept out of the system. Observe fluid and filter change maintenance interval recommendations and always pre-clean any exterior surface of the system before it is exposed to air. For example, the reservoir filler cap and neck area, hoses that have to be disassembled, and the covers and external surfaces of filter canisters should all be cleaned before disassembly.

MAINTENANCE SERVICE AND REPAIR PROCEDURE

GENERAL PRECAUTIONS

Fluid level and condition should always be checked whenever any other type of maintenance service or repair is being performed.

NOTE: *If the unit is being used in an extreme temperature environment (in sub-freezing climates or in high temperature, high humidity tropical conditions), frequent purging of moisture condensation from the hydraulic reservoir drain tap should be a regular and frequent part of the operating routine. In more moderate, temperate climates, draining reservoir sediment and moisture may not be required more than once or twice every few months.*

Inspect drained oil and used filters for signs of abnormal coloring or visible fluid contamination at every oil change. Abrasive grit or dust particles will cause discoloration and darkening of the fluid. Visible accumulations of dirt or grit could be an indication that filter elements are overloaded (and will require more frequent replacement) or that disintegrating bearings or other component failures in the hydraulic circuit may be imminent or have already occurred. Open the drain plugs on the main pump casings and check and compare drain oil in the pumps. Look for evidence of grit or metallic particles.

Vibration or unusual noise during operation could be an indication of air leaking into the circuit (Refer to the appropriate Troubleshooting section for component or unit for procedures.), or it may be evidence of a defective pump. The gear-type pilot pump could be defective, causing low pilot pressure, or a main pump broken shoe or piston could be responsible.

NOTE: *If equipped, indicated operating pressure, as shown on the multidisplay digital gauge on the Instrument Panel ("F-Pump" and "R-Pump") will be reduced as a result of a mechanical problem inside the pump. However, pressure loss could also be due to cavitation or air leakage, or other faults in the hydraulic system.*

Check the exterior case drain oil in the main pumps. If no metallic particles are found, make sure there is no air in the system. Unbolt and remove the tank return drain line from the top part of the swing motor, both travel motors and each main pump. If there is air in any one of the drain lines, carefully pre-fill the assembly before bolting together the drain line piping connections. Run the system at low rpm.

HYDRAULIC SYSTEM CLEANLINESS AND OIL LEAKS

MAINTENANCE PRECAUTIONS FOR HYDRAULIC SYSTEM SERVICE

Whenever maintenance, repairs or any other type of troubleshooting or service is being performed, it's important to remember that the hydraulic system - including both the interior and exterior surfaces of assemblies, and every drop of operating fluid - must be protected from contamination.

Dust and other foreign contaminants are major contributors to premature wear in hydraulic circuits. The narrow tolerances, rapidly moving parts and high operating pressures of the system require that fluid be kept as clean as possible. The performance and dependability of the machine (and the service lift of individual components) can be noticeably reduced if proper precautions are not observed:

- Use a safe, non-combustible, evaporative-type, low-residue solvent and thoroughly clean exterior surfaces of assemblies before any part of the circuit is opened up or disassembled.

NOTE: *It's just as important to clean the cap and reservoir top before routine fluid changes or quick checks as it is before major repairs. (Accumulated dirt attracts moisture, oil and other fluids - and more dirt.)*

- Keep dismantled parts covered during disassembly. Use clean caps, plugs or tape to protect the disconnected openings of flanges, manifolds and piping.
- Do not allow cleaning solvents or other fluids to mix with the oil in the system. Use clean oil to flush any traces of solvent or other residue before reassembly.
- If metal or rubber fragments are found in the system, flush and replace all fluid in the system and troubleshoot the circuit to identify the source of contamination.

IMPORTANT
Make sure that cleaning solvents will be compatible with rubber materials used in the hydraulic system. Many petroleum based compounds can cause swelling, softening, or other deterioration of system sealing elements, such as O-rings, caps and other seals.

OIL LEAKAGE PRECAUTIONS

Oil that is visibly seeping from joints or seals should always serve as a "red flag" alarm.

Leaks must alert the machine operator and maintenance crew that air, water and dirt have an open, free passageway through which to enter the circuit. Harsh, corrosive salt air, freezing and thawing condensation cycles and working environments that are full of fine dust are especially hazardous. Clogging of valve spools or external piping (especially pilot circuit piping) can gradually diminish or very suddenly put a complete stop to normal hydraulic function. You can prevent having to make these types of repairs by following recommended assembly procedures:

1. Use new O-rings and oil seals whenever hydraulic assemblies are rebuilt.
2. Prepare joint surfaces before assembly by checking alignment and flatness. Clean and repair corrosion or any other damage.
3. Follow bolt torque recommendations and all other assembly requirements.

NOTE: *Grease lip seals before assembly.*

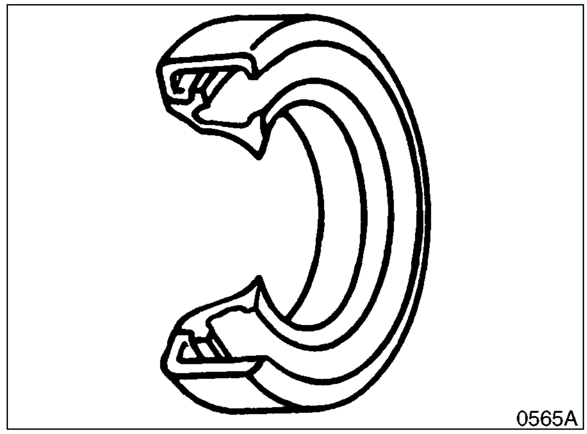

Figure 1

CLEANING AND INSPECTION

GENERAL GUIDELINES

All parts must be clean to permit an effective inspection. During assembly, it is very important that no dirt or foreign material enters unit being assembled. Even minute particles can cause malfunction of close fitting parts such as thrust bearing, matched parts, etc.

WARNING!

Care should be exercised to avoid inhalation of vapors, exposure to skin and creating fire hazards when using solvent type cleaners.

1. Clean all metal parts thoroughly using a suitable cleaning fluid. It is recommended that parts be immersed in cleaning fluid and moved up and down slowly until all oils, lubricants, and/or foreign materials are dissolved and parts are thoroughly clean.

2. For bearings that can be removed, soak them in a suitable cleaning fluid for a minute or two, then remove bearings from cleaning fluid and strike flat against a block of wood to dislodge solidified particles of lubricant. Immerse again in cleaning fluid to flush out particles. Repeat above operation until bearings are thoroughly clean. To dry bearings, use moisture-free compressed air. Be careful to direct air stream across bearing to avoid spinning bearings that are not lubricated. DO NOT SPIN BEARINGS WHEN DRYING; bearings may be rotated slowly by hand to facilitate drying process.

3. Carefully inspect all bearing rollers, cages and cups for wear, chipping or nicks to determine condition. Do not replace a bearing cone or cup individually without replacing mating cup or cone at the same time. After inspection, dip bearings in light weight oil and wrap in clean lintless cloth or paper to protect them until installation.

   For those bearings that are to be inspected in place; inspect bearings for roughness of rotation, scoring, pitting, cracked or chipped races. If any of these defects are found, replace bearings. Also inspect defective bearing housing and/or shaft for grooved, galled or burred conditions that indicate bearing has been turning in its housing or on its shaft.

4. It is more economical to replace oil seals, O-rings, sealing rings, gaskets and snap rings when unit is disassembled than waiting for premature failures; refer to latest Micro Fiche and/or Parts Book for replacement items. Be extremely careful when installing sealing members, to avoid cutting or

scratching. Curling under of any seal lip will seriously impair its efficiency. Apply a thin coat of Loctite #120 to outer diameter, of metal casing, on oil seals to assure an oil tight fit into retainer. Use extreme care not to get Loctite on lips of oil seals. If this happens, that portion of the seal will become brittle and allow leakage.

When replacing lip type seals, make sure spring loaded side is towards oil to be sealed.

5. If available, use magna-flux or similar process for checking for cracks that are not visible to the eye. Examine teeth on all gears carefully for wear, pitting, chipping, nicks, cracks or scores. Replace all gears showing cracks or spots where case hardening has worn through. Small nicks may be removed with suitable hone. Inspect shafts and quills to make certain they have not been sprung, bent, or splines twisted, and that shafts are true.

   NOTE: *Spline wear is not considered detrimental except where it affects tightness of splined parts.*

   Inspect thrust washers for distortion, scores, burs, and wear. Replace thrust washer if defective or worn.

6. Inspect bores and bearing surfaces of cast parts and machined surfaces for scratches, wear, grooves and dirt. Remove any scratches and burrs with crocus cloth. Remove foreign matter. Replace any parts that are deeply grooved or scratched which would affect their operation.

BEARING INSPECTION

The conditions of the bearing are vital to the smooth and efficient operation of the machinery. When any component containing bearings is disassembled, always carefully examine the condition of the bearings and all of its components for wear and damage.

Once the bearing is removed, clean all parts thoroughly using a suitable cleaning solution. If the bearing is excessively dirty soak the bearing assembly in a light solution and move the bearing around until all lubricants and or foreign materials are dissolved and the parts are thoroughly clean.

When drying bearings, moisture free compressed air can be used. Be careful not to direct the air in a direction which will force the bearing to dry spin while not being properly lubricated.

After the bearings have been cleaned and dried, carefully inspect all bearing rollers, cages and cups for wear, chipping or nicks. If the bearing cannot be removed and is to be inspected in place, check foe roughness of rotation, scoring, pitting, cracked or chipped races. If any of these defects are found replace the whole bearing assembly. NEVER replace the bearing alone without replacing the mating cup or the cone at the same time.

After inspection lightly coat the bearing and related parts with oil and wrap in a clean lintless cloth or paper and protect them from moisture and other foreign materials until installation.

It is also important to inspect the bearing housing and/or shaft for grooved, galled or burred conditions that indicate that the bearing has been turning in its housing or on its shaft.

If available, use magna-flux or similar process for checking for cracks that are not visible to the naked eye.

The following illustrations will aid in identifying and diagnosing some of the bearing related problems.

NOTE: *The illustrations will only show tapered roller bearings, but the principles of identifying, diagnosing and remedying the defects are common to all styles and types of bearings.*

Normal Bearing

Smooth even surfaces with no discoloration or marks.

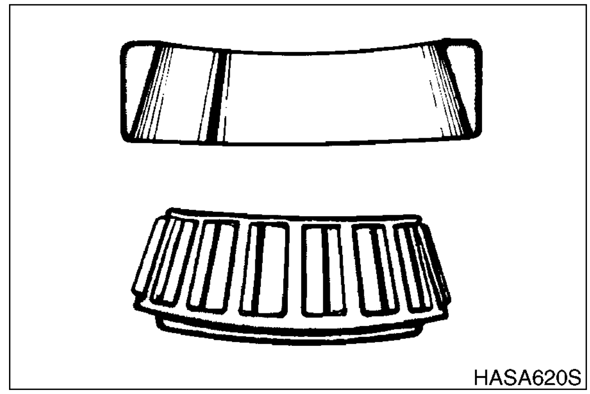

Figure 2

Bent Cage

Cage damage due to improper handling or tool usage.

Replace bearing.

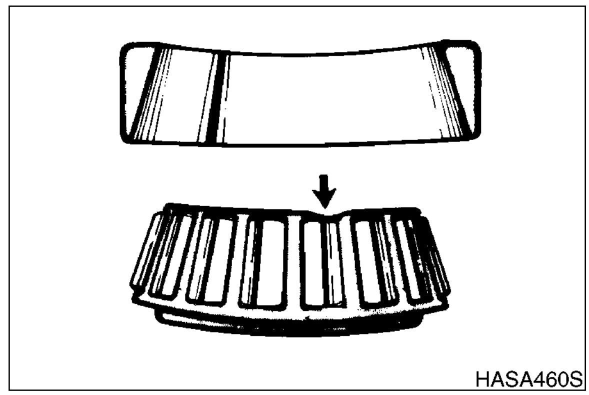

Figure 3

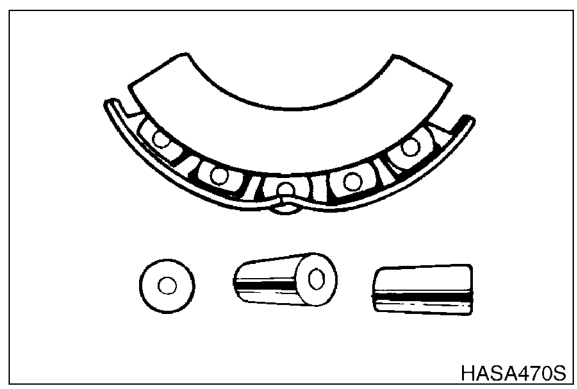

Figure 4

Galling

Metal smears on roller ends due to overheat, lubricant failure or overload.

Replace bearing - check seals and check for proper lubrication.

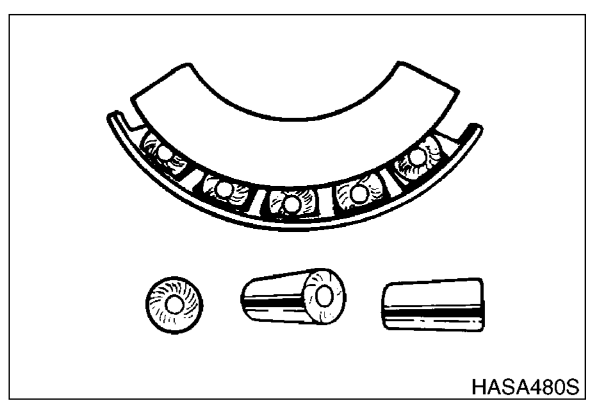

Figure 5

Abrasive Step Wear

Pattern on roller ends caused by fine abrasives.

Clean all parts and housings, check all parts and housings, check seals and bearings and replace if leaking, rough or noisy.

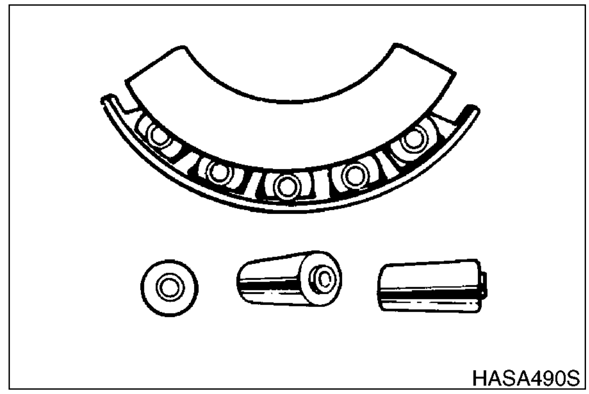

Figure 6

Etching

Bearing surfaces appear gray or grayish black in color with related etching away of material usually at roller spacing.

Replace bearings - check seals and check for proper lubrication.

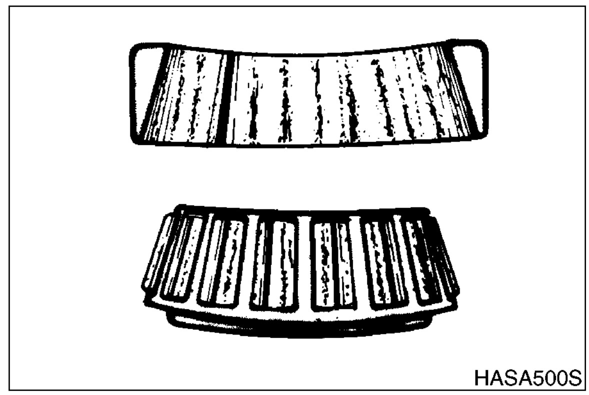

Figure 7

Misalignment

Outer race misalignment due to foreign object.

Clean related parts and replace bearing. Make sure races are properly seated.

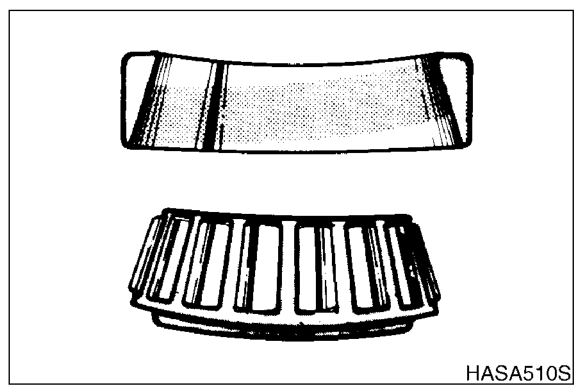

Figure 8

Indentations

Surface depressions on race and rollers caused by hard particles of foreign materials.

Clean all parts and housings, check seals and replace bearings if rough or noisy.

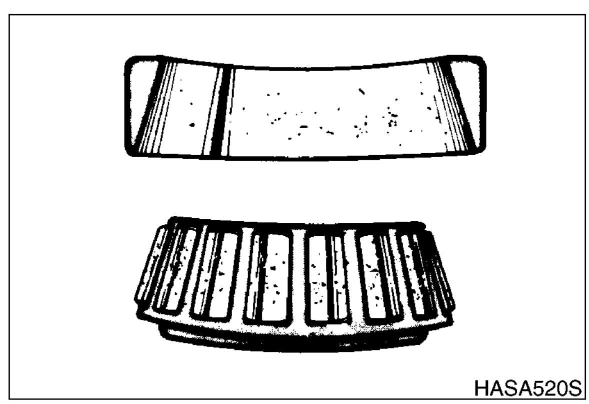

Figure 9

Fatigue Spalling

Flaking of surface metal resulting from fatigue.

Replace bearing - clean all related parts.

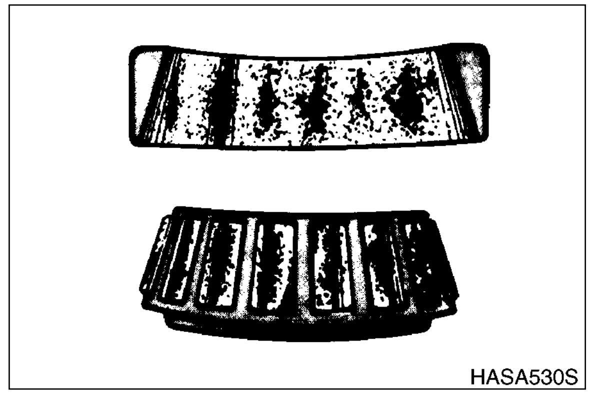

Figure 10

Brinelling

Surface indentations in raceway caused by rollers either under impact loading or vibration while the bearing is not rotating.

Replace bearing if rough or noisy.

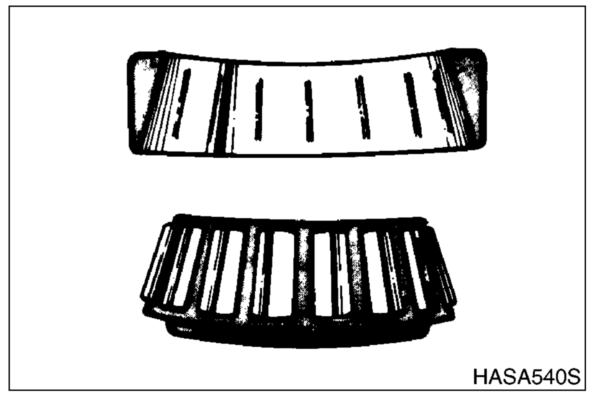

Figure 11

Cage Wear

Wear around outside diameter of cage and roller pockets caused by abrasive material and inefficient lubrication.

Replace bearings - check seals.

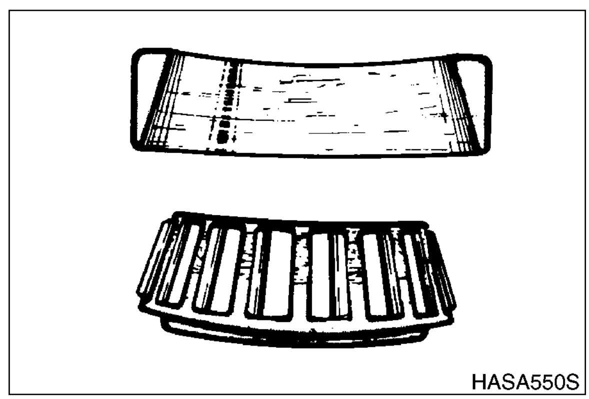

Figure 12

Abrasive Roller Wear

Pattern on races and rollers caused by fine abrasives.

Clean all parts and housings, check seals and bearings and replace if leaking, rough or noisy.

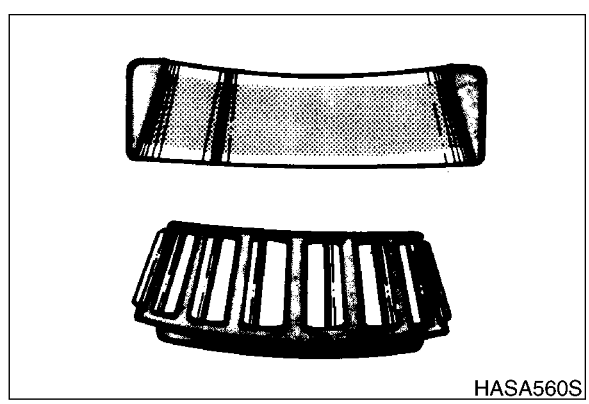

Figure 13

Cracked Inner Race

Race cracked due to improper fit, cocking or poor bearing seat.

Replace all parts and housings, check seals and bearings and replace if leaking.

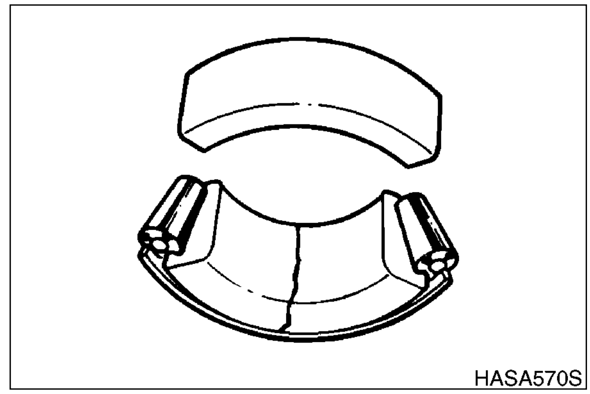

Figure 14

Smears

Smearing of metal due to slippage caused by poor fitting, lubrication, overheating, overloads or handling damage.

Replace bearings, clean related parts and check for proper fit and lubrication.

Replace shaft if damaged.

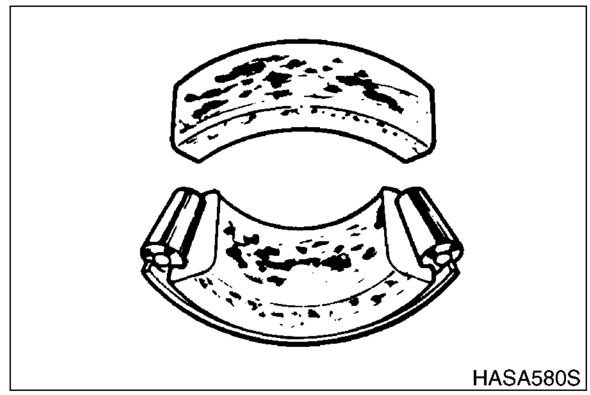

Figure 15

Frettage

Corrosion set up by small relative movement of parts with no lubrication.

Replace bearing. Clean all related parts. Check seals and check for proper lubrication.

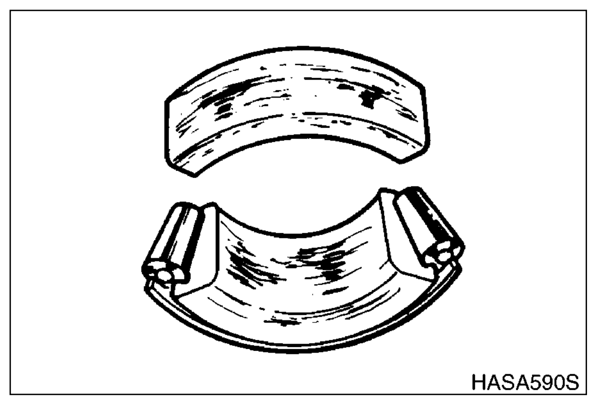

Figure 16

Heat Discoloration

Heat discoloration can range from faint yellow to dark blue resulting from overload or incorrect lubrication.

Excessive heat can cause softening of races or rollers.

To check for loss of temper on races or rollers, a simple file test may be made. A file drawn over a tempered part will grab and cut metal, whereas a file drawn over a hard part will glide readily with no metal cutting.

Replace bearing if over heating damage is indicated. Check seals and other related parts for damage.

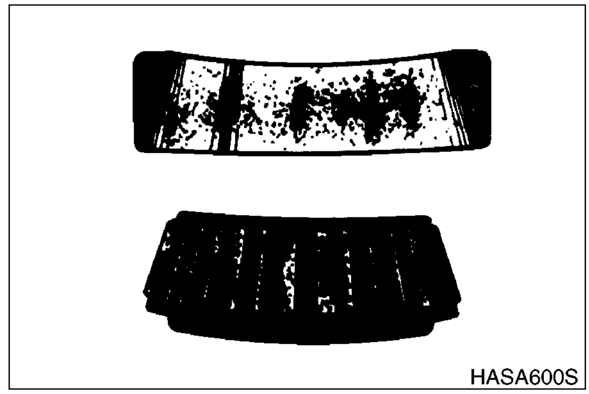

Figure 17

Stain Discoloration

Discoloration can range from light brown to black caused by incorrect lubrication or moisture.

if the stain can be removed by light polishing or if no evidence of overheating is visible, the bearing can be reused.

Check seals and other related parts for damage.

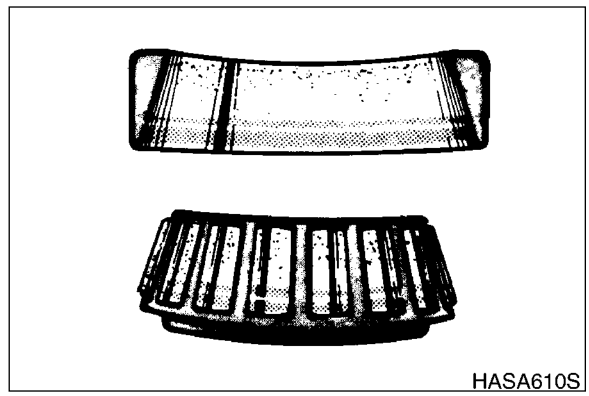

Figure 18

DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

STANDARD TORQUES

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
ALL MODELS	ALL RANGES

December 2000

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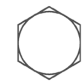
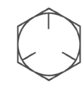
TORQUE VALUES FOR STANDARD METRIC FASTENERS

NOTE: *The units for the torque values are kg•m (ft lb).*

Dia. x Pitch (mm)	Grade										
	3.6 (4A)	**4.6 (4D)**	**4.8 (4S)**	**5.6 (5D)**	**5.8 (5S)**	**6.6 (6D)**	**6.8 (6S)**	**6.9 (6G)**	**8.8 (8G)**	**10.9 (10K)**	**12.9 (12K)**
M5 x Std.	0.15 (1.08)	0.16 (1.15)	0.25 (1.80)	0.22 (1.59)	0.31 (2.24)	0.28 (2.02)	0.43 (3.11)	0.48 (3.47)	0.50 (3.61)	0.75 (5.42)	0.90 (6.50)
M6 x Std.	0.28 (2.02)	0.30 (2.16)	0.45 (3.25)	0.40 (2.89)	0.55 (3.97)	0.47 (3.39)	0.77 (5.56)	0.85 (6.14)	0.90 (6.50)	1.25 (9.04)	1.50 (10.84)
M7 x Std.	0.43 (3.11)	0.46 (3.32)	0.70 (5.06)	0.63 (4.55)	0.83 (6.00)	0.78 (5.64)	1.20 (8.67)	1.30 (9.40)	1.40 (10.12)	1.95 (14.10)	2.35 (16.99)
M8 x Std.	0.70 (5.06)	0.75 (5.42)	1.10 (7.95)	1.00 (7.23)	1.40 (10.12)	1.25 (9.04)	1.90 (13.74)	2.10 (15.18)	2.20 (15.91)	3.10 (22.42)	3.80 (27.48)
M8 x 1	0.73 (5.28)	0.80 (5.78)	1.20 (8.67)	1.00 (7.23)	1.50 (10.84)	1.35 (9.76)	2.10 (15.18)	2.30 (16.63)	2.40 (17.35)	3.35 (24.23)	4.10 (29.65)
M10 x Std.	1.35 (9.76)	1.40 (10.12)	2.20 (15.91)	1.90 (13.74)	2.70 (19.52)	2.35 (19.99)	3.70 (26.76)	4.20 (30.37)	4.40 (31.18)	6.20 (44.84)	7.20 (52.07)
M10 x 1	1.50 (10.84)	1.60 (11.57)	2.50 (18.08)	2.10 (15.18)	3.10 (22.42)	2.80 (20.25)	4.30 (31.10)	4.90 (35.44)	5.00 (36.16)	7.00 (50.63)	8.40 (60.75)
M12 x Std.	2.40 (17.35)	2.50 (18.08)	3.70 (26.76)	3.30 (23.86)	4.70 (33.99)	4.20 (30.37)	6.30 (45.56)	7.20 (52.07)	7.50 (54.24)	10.50 (75.94)	12.50 (90.41)
M12 x 1.5	2.55 (18.44)	2.70 (19.52)	4.00 (28.93)	3.50 (25.31)	5.00 (36.16)	4.50 (32.54)	6.80 (49.18)	7.70 (55.69)	8.00 (57.86)	11.20 (81.00)	13.40 (96.92)
M14 x Std.	3.70 (26.76)	3.90 (28.20)	6.00 (13.23)	5.20 (37.61)	7.50 (54.24)	7.00 (50.63)	10.00 (72.33)	11.50 (83.17)	12.00 (86.79)	17.00 (122.96)	20.00 (144.66)
M14 x 1.5	4.10 (29.65)	4.30 (31.10)	6.60 (47.73)	5.70 (41.22)	8.30 (60.03)	7.50 (54.24)	11.10 (80.28)	12.50 (90.41)	13.00 (94.02)	18.50 (11.26)	22.00 (158.12)
M16 x Std.	5.60 (40.50)	6.00 (43.39)	9.00 (65.09)	8.00 (57.86)	11.50 (83.17)	10.50 (75.94)	15.50 (112.11)	17.90 (129.47)	18.50 (133.81)	26.00 (188.05)	31.00 (224.22)
M16 x 1.5	6.20 (44.84)	6.50 (47.01)	9.70 (70.16)	8.60 (62.20)	12.50 (90.41)	11.30 (81.73)	17.00 (122.96)	19.50 (141.04)	20.00 (144.66)	28.00 (202.52)	35.50 (256.77)
M18 x Std.	7.80 (56.41)	8.30 (60.03)	12.50 (90.41)	11.00 (79.56)	16.00 (115.72)	14.50 (104.87)	21.00 (151.89)	27.50 (198.90)	28.50 (206.14)	41.00 (296.55)	43.00 (311.01)
M18 x 1.5	9.10 (65.82)	9.50 (68.71)	14.40 (104.15)	12.50 (90.41)	18.50 (133.81)	16.70 (120.79)	24.50 (177.20)	27.50 (198.90)	28.50 (206.14)	41.00 (296.55)	49.00 (354.41)
M20 x Std.	11.50 (83.17)	12.00 (86.79)	18.00 (130.19)	16.00 (115.72)	22.00 (159.12)	19.00 (137.42)	31.50 (227.83)	35.00 (253.15)	36.00 (260.38)	51.00 (368.88)	60.00 (433.98)
M20 x 1.5	12.80 (92.58)	13.50 (97.64)	20.50 (148.27)	18.00 (130.19)	25.00 (180.82)	22.50 (162.74)	35.00 (253.15)	39.50 (285.70)	41.00 (296.55)	58.00 (419.51)	68.00 (491.84)
M22 x Std.	15.50 (112.11)	16.00 (115.72)	24.50 (177.20)	21.00 (151.89)	30.00 (216.99)	26.00 (188.05)	42.00 (303.78)	46.00 (332.71)	49.00 (354.41)	67.00 (484.61)	75.00 (542.47)
M22 x 1.5	17.00 (122.96)	18.50 (133.81)	28.00 (202.52)	24.00 (173.59)	34.00 (245.92)	29.00 (209.75)	47.00 (339.95)	52.00 (44.76)	56.00 (405.04)	75.00 (542.47)	85.00 (614.80)
M24 x Std.	20.50 (148.27)	21.50 (155.50)	33.00 (238.68)	27.00 (195.29)	40.00 (289.32)	34.00 (245.92)	55.00 (397.81)	58.00 (419.51)	63.00 (455.67)	82.00 (593.10)	92.00 (655.43)
M24 x 1.5	23.00 (166.35)	35.00 (253.15)	37.00 (267.62)	31.00 (224.22)	45.00 (325.48)	38.00 (202.52)	61.00 (441.21)	67.00 (484.61)	74.00 (535.24)	93.00 (672.66)	103.00 (744.99)

TORQUE VALUES FOR STANDARD U.S. FASTENERS

TYPE	S.A.E. GRADE	DESCRIPTION	BOLT HEAD MARKING
1	1 OR 2	WILL HAVE NO MARKINGS IN THE CENTER OF THE HEAD. Low or Medium Carbon Steel Not Heat Treated.	
5	5	WILL HAVE THREE RADIAL LINES. Quenched and Tempered Medium Carbon Steel.	
8	8	WILL HAVE 6 RADIAL LINES. Quenched and Tempered Special Carbon or Alloy Steel.	

Recommended torque, in foot pounds, for all Standard Application Nuts and Bolts, provided:

1. All thread surfaces are clean and lubricated with SAE-30 engine oil. (See Note.)
2. Joints are rigid, that is, no gaskets or compressible materials are used.
3. When reusing nuts or bolts, use minimum torque values.

NOTE: *Multiply the standard torque by:*

0.65 *when finished jam nuts are used.*

0.70 *when Molykote, white lead or similar mixtures are used as lubricants.*

0.75 *when parkerized bolts or nuts are used.*

0.85 *when cadmium plated bolts or nuts and zinc bolts w/waxed zinc nuts are used.*

0.90 *when hardened surfaces are used under the nut or bolt head.*

NOTE: *When reusing bolts and nuts in service, use minimum torque values.*

The following General Torque Values must be used in all cases where **SPECIAL TORQUE VALUES** are not given

NOTE: *TORQUE VALUES LISTED THROUGHOUT THIS MANUAL ARE LUBRICATED (WET) THREADS; VALUES SHOULD BE INCREASED 1/3 FOR NON-LUBRICATED (DRY) THREADS.*

THREAD SIZE	HEAT TREATED MATERIAL GRADE 5 AND GRADE 8			
	GRADE 5 (3 RADIAL DASHES ON HEAD)		GRADE 8 (6 RADIAL DASHES ON HEAD)	
	FOOT POUNDS (ft lb)	NEWTON METER (Nm)	FOOT POUNDS (ft lb)	NEWTON METER (Nm)
1/4" - 20	6	8	9	12
1/4" - 28	7	9	11	15
5/16" - 18	13	18	18	24
5/16" - 24	15	20	21	28
3/8" - 16	24	33	34	46
3/8" - 24	27	37	38	52
7/16" - 14	38	52	54	73
7/16" - 20	42	57	60	81
1/2" - 13	58	79	82	111
1/2" - 20	65	88	90	122
9/16" - 12	84	114	120	163
9/16" - 18	93	126	132	179
5/8" - 11	115	156	165	224
5/8" - 18	130	176	185	251
3/4" - 10	205	278	290	393
3/4" - 16	240	312	320	434
7/8" - 9	305	414	455	617
7/8" - 14	334	454	515	698
1" - 8	455	617	695	942
1" - 14	510	691	785	1064
1 1/8" - 7	610	827	990	1342
1 1/8" - 12	685	929	1110	1505
1 1/4" - 7	860	1166	1400	1898
1 1/4" - 12	955	1295	1550	2102
1 3/8" - 6	1130	1532	1830	2481
1 3/8" - 12	1290	1749	2085	2827
1 1/2" - 6	1400	2034	2430	3295
1 1/2" - 12	1690	2291	2730	3701
1 3/4" - 5	2370	3213	3810	5166
2" - 4 1/2	3550	4813	5760	7810

NOTE: *If any bolts and nuts are found loose or at values less than what the chart states, it is recommended that the loose bolt and/or nut be replaced with a new one.*

TYPE 8 PHOSPHATE COATED HARDWARE

This chart provides tightening torque for general purpose applications using original equipment standard hardware as listed in the Parts Manual for the machine involved. **DO NOT SUBSTITUTE**. In most cases, original equipment standard hardware is defined as Type 8, coarse thread bolts and nuts and thru hardened flat washers (Rockwell "C" 38 - 45), all phosphate coated and assembled without supplemental lubrication (as received) condition.

The torques shown below also apply to the following:

1. Phosphate coated bolts used in tapped holes in steel or gray iron.
2. Phosphate coated bolts used with phosphate coated prevailing torque nuts (nuts with distorted threads or plastic inserts).
3. Phosphate coated bolts used with copper plated weld nuts.

Markings on bolt heads or nuts indicate material grade ONLY and are NOT to be used to determine required torque.

NOMINAL THREAD DIAMETER	STANDARD TORQUE ±10%	
	KILOGRAM METER (kg•m)	FOOT POUNDS (ft lb)
1/4"	1.1	8
5/16"	2.2	16
3/8"	3.9	28
7/16"	6.2	45
1/2"	9.7	70
9/16"	13.8	100
5/8"	19.4	140
3/4"	33.2	240
7/8"	53.9	390
1"	80.2	580
1 - 1/8"	113.4	820
1 - 1/4"	160.4	1160
1 - 3/8"	210.2	1520
1 - 1/2"	279.4	2020
1 - 3/4"	347.1	2510
2	522.8	3780

TORQUE VALUES FOR HOSE CLAMPS

The following chart provides the tightening torques for hose clamps used in all rubber applications (radiator, air cleaner, operating lever boots, hydraulic system, etc.).

CLAMP TYPE AND SIZE	TORQUE ±5 in lb (0.1 kg•m)			
	RADIATOR, AIR CLEANER, BOOTS, ETC.		HYDRAULIC SYSTEM	
	KILOGRAM METER (kg•m)	INCH POUNDS (in lb)	KILOGRAM METER (kg•m)	INCH POUNDS (in lb)
"T" Bolt (Any Diameter)	0.6 - 0.7	55 - 65	-------	------
Worm Drive - 1-3/4 in Open Diameter and Under	0.2 - 0.3	20 - 30	0.5 - 0.6	40 - 50
Worm Drive - Over 1-3/4 in Open Diameter	0.5 - 0.6	40 - 50	-------	------
Worm Drive - All "Ultra-Tite"	1.1 - 1.2	95 - 105	0.5 - 0.6	40 - 50

TORQUE VALUES FOR SPLIT FLANGES

The following chart provides the tightening torques for split flange connections used in hydraulic systems. Split flanges and fitting shoulders should fit squarely. Install all bolts, finger tight and then torque evenly.

NOTE: *Over torquing bolts will damage the flanges and/or bolts, which may cause leakage.*

FLANGE SIZE (*)	BOLT SIZE	BOLT TORQUE	
		KILOGRAM METER (kg•m)	FOOT POUNDS (ft lb)
1/2"	5/16"	2.1 - 2.5	15 - 18
3/4"	3/8"	3.0 - 3.7	22 - 27
1"	3/8"	3.7 - 4.8	27 - 35
1 - 1/4"	7/16"	4.8 - 6.2	35 - 45
1 - 1/2"	1/2"	6.4 - 8.0	46 - 58
2"	1/2"	7.6 - 9.0	55 - 65
2 - 1/2"	1/2"	10.9 - 12.6	79 - 91
3"	5/8"	19.1 - 20.7	138 - 150
3 - 1/2"	5/8"	16.2 - 18.4	117 - 133

(*) - Inside diameter of flange on end of hydraulic tube or hose fitting.

NOTE: *Values stated in chart are for Standard Pressure Series (Code 61) Split Flanges.*

TORQUE WRENCH EXTENSION TOOLS

Very large diameter, high grade fasteners (nuts, bolts, cap screws, etc.) require a great deal of turning force to achieve recommended tightening torque values.

Common problems that could occur as a result are:

- Recommended torque exceeds the measuring capacity of the torque wrench.
- Specialized sockets do not fit the adapter on the front end (nose) of the torque wrench.
- Generating adequate force on the back end (handle) of the wrench is difficult or impossible.
- Restricted access or an obstruction may make use of the torque wrench impossible.
- A unique application requires fabrication of an adapter or other special extension.

Most standard torque wrenches can be adapted to suit any one of the proceeding needs or situations, if the right extension tool is used or fabricated.

TORQUE MULTIPLICATION

A wrench extension tool can be used to increase the tightening force on a high capacity nut or bolt.

For example, doubling the distance between the bolt and the back (handle) end of the torque wrench doubles the tightening force on the bolt. It also halves the indicated reading on the scale or dial of the torque wrench. To accurately adjust or convert indicated scale or dial readings, use the following formula:

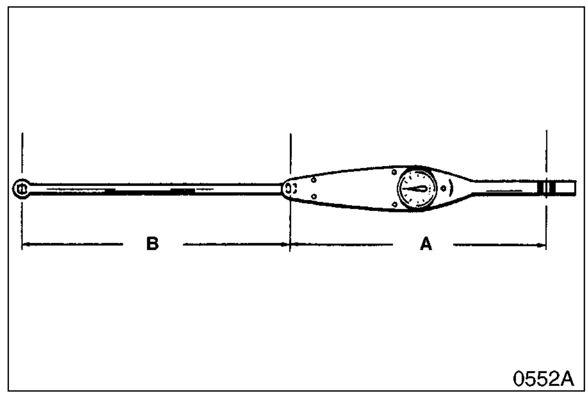


Figure 1

I = A x T / A + B where:

I = Indicated force shown on the torque wrench scale or dial.

T = Tightening force applied to the nut or bolt (actual Torque).

A = Length of the torque wrench (between the center of the nut or bolt and the center of the handle).

B = Length of the extension.

As an example, if a 12" extension is added to a 12" torque wrench, and the indicated torque on the dial reads "150 ft lb," the real force applied to the bolt is 300 ft lb:

$$I = \frac{A \times T}{A + B} = \frac{12 \times 300}{12 + 12} = \frac{3600}{24} = 150$$

NOTE: *The formula assumes that there is no added deflection or "give" in the joint between the extension and torque wrench. Readings may also be inaccurate:*

- If the extension itself absorbs some of the tightening force and starts to bend or bow out.
- If an extension has to be fabricated that is not perfectly straight (for example, an extension made to go around an obstruction, to allow access to a difficult to tighten fastener), the materials and methods used must be solid enough to transmit full tightening torque.

OTHER USES FOR TORQUE WRENCH EXTENSION TOOLS

Torque wrench extensions are sometimes made up for reasons other than increasing leverage on a fastener.

For example, a torque wrench and extension can be used to measure adjustment "tightness" of a linkage or assembly. Specially fabricated extensions can be used to make very precise checks of the force required to engage or disengage a clutch mechanism, release a spring-applied brake assembly, or "take up" free play in most any movable linkage.

Once the value of the adjustment force is established, repeated checks at regular intervals can help to monitor and maintain peak operating efficiency. These types of adjustment checks are especially useful if physical measurements of linkage travel are difficult to make or will not provide the needed degree of precision and accuracy.

To allow the assembly or mechanism to accept a torque wrench, welding a nut or other adapter on the end of a linkage shaft or other leverage point will allow turning the shaft or assembly manually.

TIGHTENING TORQUE SPECIFICATIONS (METRIC)

(For coated threads, prelubricated assemblies.)

CAUTION!

Disassembly, overhaul and replacement of components on the machine, installation of new or replacement parts and/or other service-related maintenance may require the use of thread or flange sealing assembly compound.

Use the information on this page as a general guide in selecting specific formulas that will meet the particular requirements of individual assembly installations. Daewoo does not specifically endorse a specific manufacturer or brand name but the following table of "Loctite" applications is included for which cross-references to other makers' products should also be widely available.

IMPORTANT

Use primer "T" or "N" for all cold weather assembly of fastener adhesives, with Thread locker sealers 222, 242/243, 262, 271, 272, or 277.

I. "Loctite" Fastener Adhesives

Product	Application	Color	Removal	Break-away Cure Strength (in lb) Of Sealer Alone
222	Low strength for 6 mm (1/4") or smaller fasteners.	Purple	Hand tools	45
242 or 243	Medium strength for 6 mm (1/4") and larger fasteners.	Blue	Hand tools	80
262	High strength for high grade fasteners subject to shock, stress and vibration.	Red	Heat/260°C (500°F) Remove HOT (NO solvent)	160
271	Extra high strength for fine thread fasteners up to 25 mm (1") diameter.	Red	Heat/260°C (500°F) Remove HOT	160
272	High temperature/high strength for hostile environments to 232°C (450°F).	Red	Heat/316°C (600°F) Remove HOT	180
277	Extra high strength for coarse thread fasteners 25 mm (1") diameter and larger.	Red	Heat/260°C (500°F) Remove HOT	210

II. "Loctite" Pipe Thread Sealant

Product	Application	Color	Removal	Required Setup
545	"No-filler/non-clog" formula for high-pressure hydraulic systems. Over-application will not restrict or foul system components.	Purple	Hand tools	4 Hours (or 1/2 hour with Locquic "T" Primer)
656	Solvent-resistant, higher viscosity tapered thread sealer.	White	Hand tools	4 Hours (or 1/2 hour with Locquic "T" Primer)

III. "Loctite" gasket/flange sealer

Product	Application	Color	Notes
518	Gasket eliminator specifically made for aluminum flanges/surfaces. For hydraulic systems to 34,475 kPa (5,000 psi).	Red	Use Locquic "N" primer for fast (1/2 - 4 hours) setup. Unprimed setup 4 - 24 hours.
504	Low pressure/wide-gap gasket eliminator compound. Fills gaps to 0.0012 mm (0.030"), cures to rigid seal.	Orange	Use Locquic "N" primer for faster (1/2 - 4 hours) setup. Unprimed setup 4 - 24 hours.
515	General purpose, fast setup, flexible-cure gasket eliminator. For non-rigid assemblies subject to shock, vibration or deflection.	Purple	Use Locquic "N" primer for faster (1/4 - 2 hours) setup. Unprimed setup 1 - 12 hours.

IV. "Loctite" retaining compounds

Product	Application	Color	Notes
609	For bushings, sleeves, press-fit bearings, splines and collars. For gaps to 0.0002 mm (0.005"), temperatures to 121°C (250°F).	Green	Use Locquic "N" primer for increased bond strength and all cold temperature applications.
620	For high temperatures to 232°C (450°F).	Green	Same as 609, above.
680	For high strength bonds and tight clearance gaps, to 0.00008 mm (0.002").	Green	Same as 609, above.

V. "Loctite" Adhesives

Product	Application	Color	Notes
380	Black Max instant adhesive for shock and vibration-resistant bonds.	Black	May take 120 hours to reach full cure strength.
454	Adhesive for porous surfaces.	Clear	Full strength in 24 hours.
480	Increased strength (+50%), shock and vibration-resistant.	Black	Full strength in 24 hours.

UPPER STRUCTURE

S0403040K

DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

COUNTERWEIGHT

CAUTION!

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Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Mega 500-V	1001 and Up

May 2001

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SPECIFICATIONS

NOTE: *Weight*

Mega 500-V	*1,920 kg (4,233 lb)*

COUNTERWEIGHT

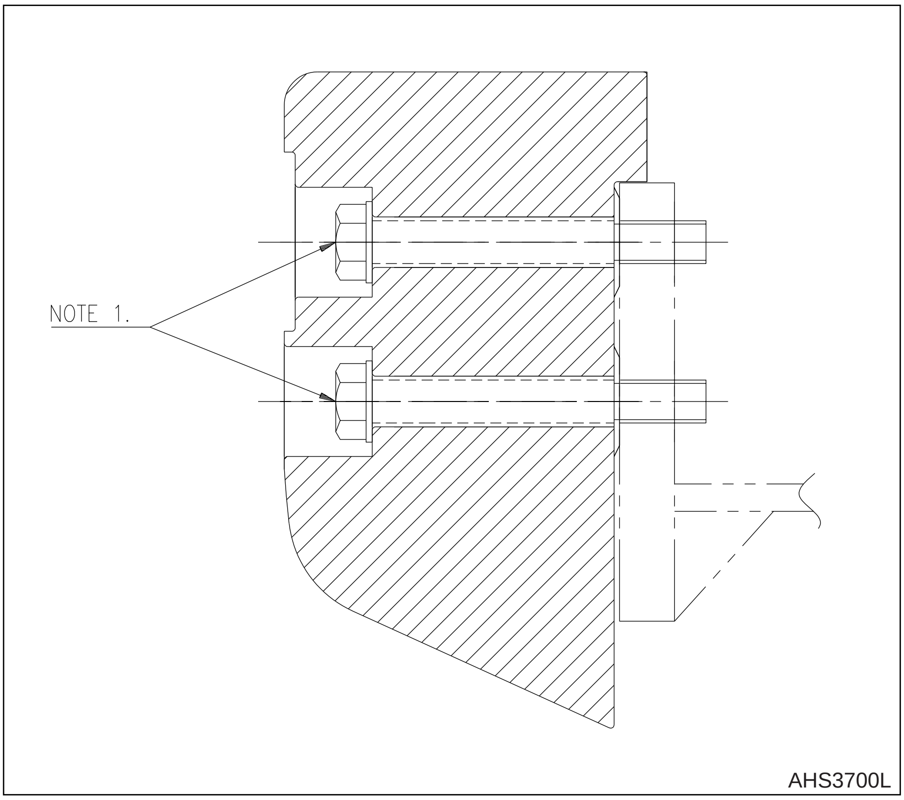

Figure 1

NOTE: *1) 110 kg•m (796 ft lb)*

DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

FUEL TRANSFER PUMP

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Mega 130	0001 and Up
Mega 160	0001 and Up
Mega 200-III	1001 and Up
Mega 200-V	1001 and Up
Mega 250-III	1001 and Up
Mega 250-V	1001 and Up
Mega 300-V	1001 and Up
Mega 400-III PLUS	1001 and Up
Mega 400-V	1001 and Up
Mega 500-V	1001 and Up
Solar 130LC-V	0001 and Up
Solar 130W-V	0001 and Up
Solar 170LC-V	1001 and Up
Solar 170W-V	1001 and Up
Solar 200W-V	0001 and Up
Solar 220LC-V	0001 and Up
Solar 220LL	1001 and Up
Solar 220N-V	1001 and Up
Solar 250LC-V	1001 and Up

Models continued on back of cover.

November 2001

MODEL	SERIAL NUMBER RANGE
Solar 290LC-V	0001 and Up
Solar 290LL	1001 and Up
Solar 330LC-V	1001 and Up
Solar 400LC-V	1001 and Up
Solar 450LC-V	1001 and Up

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GENERAL DESCRIPTION

THEORY OF OPERATION

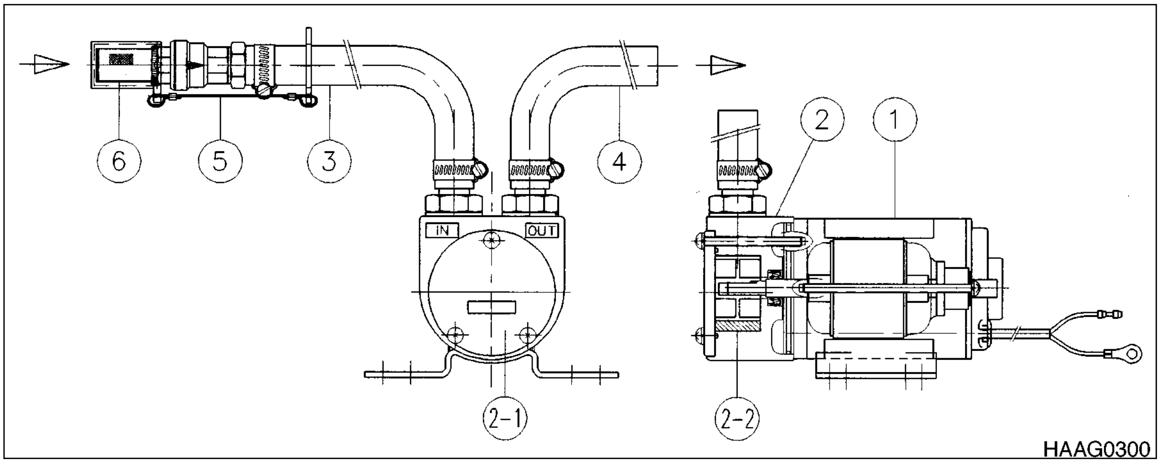

Figure 1

Reference Number	Description
1	Motor
2	Pump
2-1	Pump Cover
2-2	Rotor and Vane

Reference Number	Description
3	Inlet Hose
4	Outlet Hose
5	Check Valve
6	Strainer Cap

Fuel pump consists of motor, pump, switch and hose assembly.

Figure 2

TROUBLESHOOTING

On some pumps the ON-OFF switch is installed separately at a remote location.

A thermal limiter, built into the motor, will automatically shut off power if motor is overheating to protect it from damage.

NOTE: *OPEN TEMP: 150 ±5°C (302 ±41°F). After circuit is automatically shut off due to overheating the pump will stop running. When temperature drops below 143˚C (289˚F) the circuit will reactivate allowing the pump to restart.*

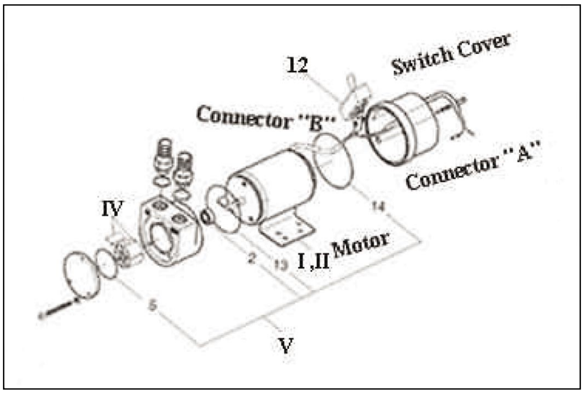

Figure 3 WITH TOGGLE SWITCH

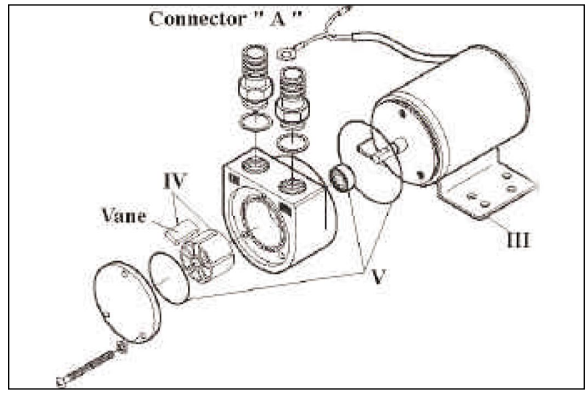

Figure 4 WITHOUT TOGGLE SWITCH

Check resistance at connectors "A." If reading is zero, or very close to zero, the motor is bad and must be replaced.

On units equipped with a toggle switch, check the resistance through the toggle switch, while the switch is in the "ON" position. If continuity is not present, the switch is bad. Be sure to check resistance through the motor.

REPLACEMENT OF ROTOR AND VANE

If dirt or other foreign materials enter pump during operation, it can become lodged between the rotor and/or vanes and generate heat which can cause pump damage.

Remove the pump cover and check the rotor and vane. If any pump parts or components become lost, damaged or inoperable, immediately replace them with a new ones.

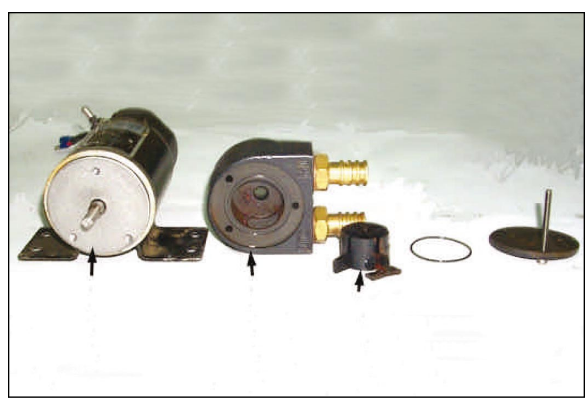

Figure 5 WITHOUT TOGGLE SWITCH

Insert vane, with the circled edge of vane facing in the counterclockwise direction. (Detail A)

Insert O-ring again at reassembly of pump cover.

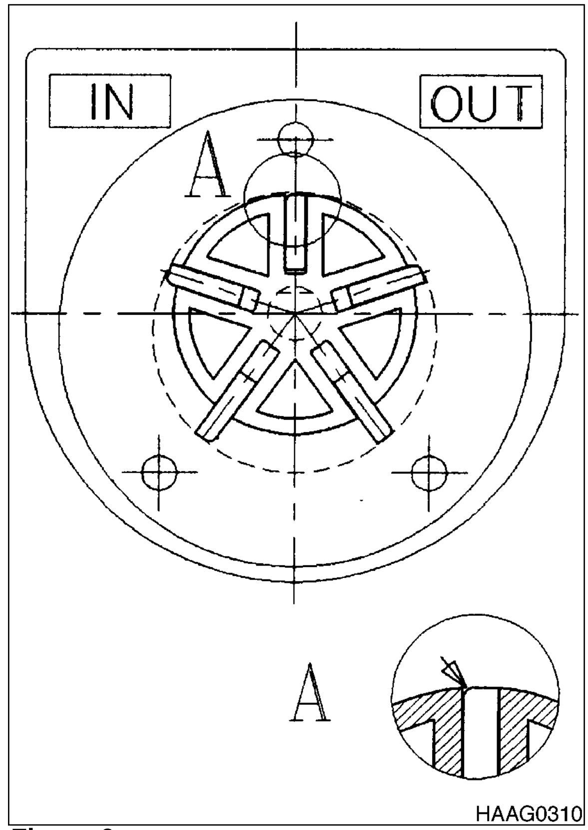

Figure 6

REPLACEMENT OF REAR COVER

Brush assembly and a thermal limiter are installed in the rear cover. If you find any damage, replace them with new ones.

Loosen the switch cover and screw (M5 x L95) from the rear cover.

Remove cover.

At reassembly of rear cover, widen the space of brush and insert it to the armature. Then fit the hole of screw in the housing.

Be careful when installing screw. The cover screw may be attracted by the motor magnet.

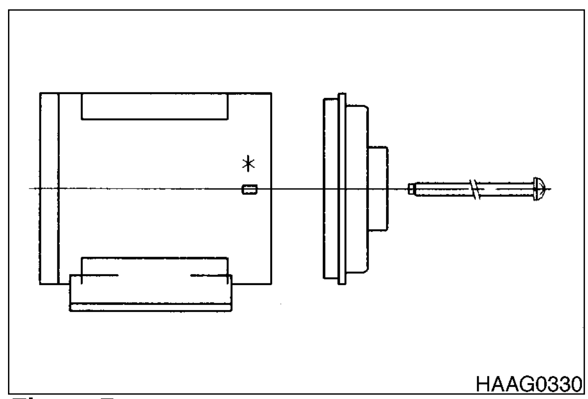

Figure 7

REPLACEMENT OF ARMATURE

You can replace only the armature in case motor was damaged by a short circuit.

Remove the switch cover and rear cover, than remove the armature from the housing.

Loosen the pump cover and remove the rotor and vane.

Insert a new armature into the housing.

Refer to “Replacement of Rear Cover” on page 5, for installation of rear cover.

Fit the rotor in the shaft flute of armature. Insert vane to the rotor being careful for the direction. Refer to “Replacement of Rotor and Vane” on page 4.

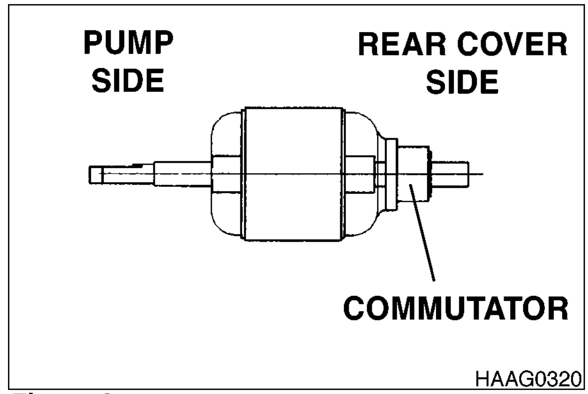

Figure 8

DAEWOO
DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

HYDRAULIC OIL TANK

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that is in good working order.

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MODEL	SERIAL NUMBER RANGE
Mega 500-V	1001 and Up

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GENERAL DESCRIPTION

PARTS LIST

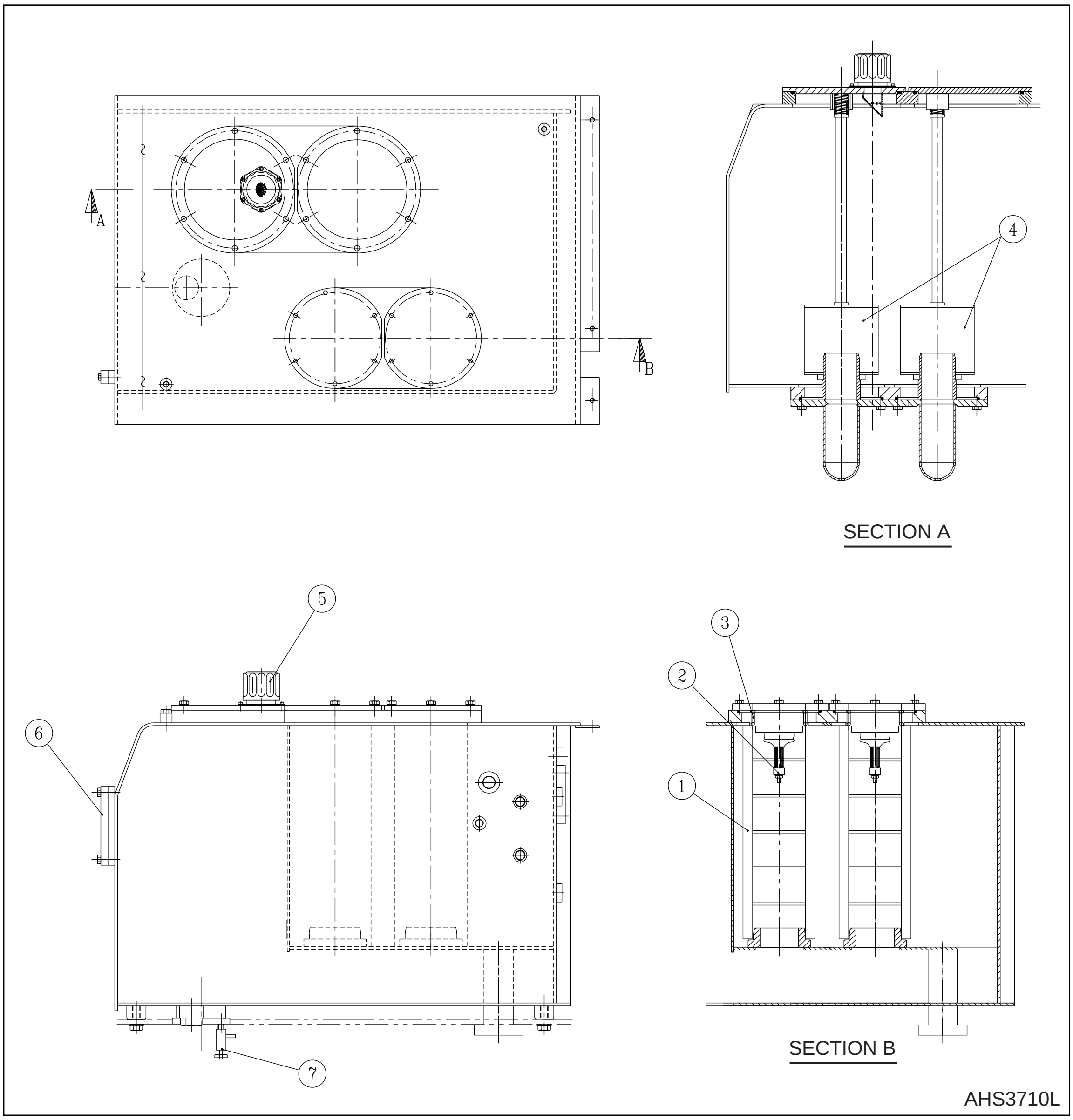

Figure 1

Reference Number	Description
1	Return Filter
2	By-pass Valve
3	Spring
4	Suction Filter

Reference Number	Description
5	Air Breather
6	Level Gauge
7	Drain Plug

SPECIFICATIONS

	Mega 500-V
Type	Pressurized Sealing
Capacity (System)	300 liters (79 U.S. gal.)
Air breather	
Open Pressure	0.40 kg/cm^2 (5.7 psi)
Vacuum pressure	0.035 kg/cm^2 @ 900 ℓ/min. (0.5 psi @ 238 gpm)
Return Filter	
Filtration rating	10 μ
Pressure drop	0.2 kg/cm^2 @ 600 ℓ/min. (3 psi @ 159 gpm)
Suction Filter	177 μ

LOWER STRUCTURE AND CHASSIS

DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

CENTER JOINT (ARTICULATION JOINT)

CAUTION!

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MODEL	SERIAL NUMBER RANGE
Mega 500-V	1001 and Up

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TABLE OF CONTENTS

GENERAL DESCRIPTION

The loader frame is an articulated type: the front frame is joined to the rear frame with two hinge pins around which the loader pivots for steering.

> **CAUTION!**
>
> **When the loader is steered, the area near the center hinge pins becomes so narrow that you might get caught between the front and rear frames. Before trying to service the loader, make sure to set the frame lock plate.**
>
> **Prior to moving (traveling) the loader, make sure the frame lock plate is set to the original position.**

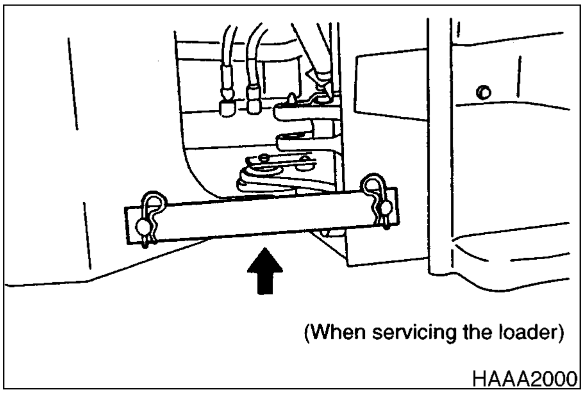

Figure 1

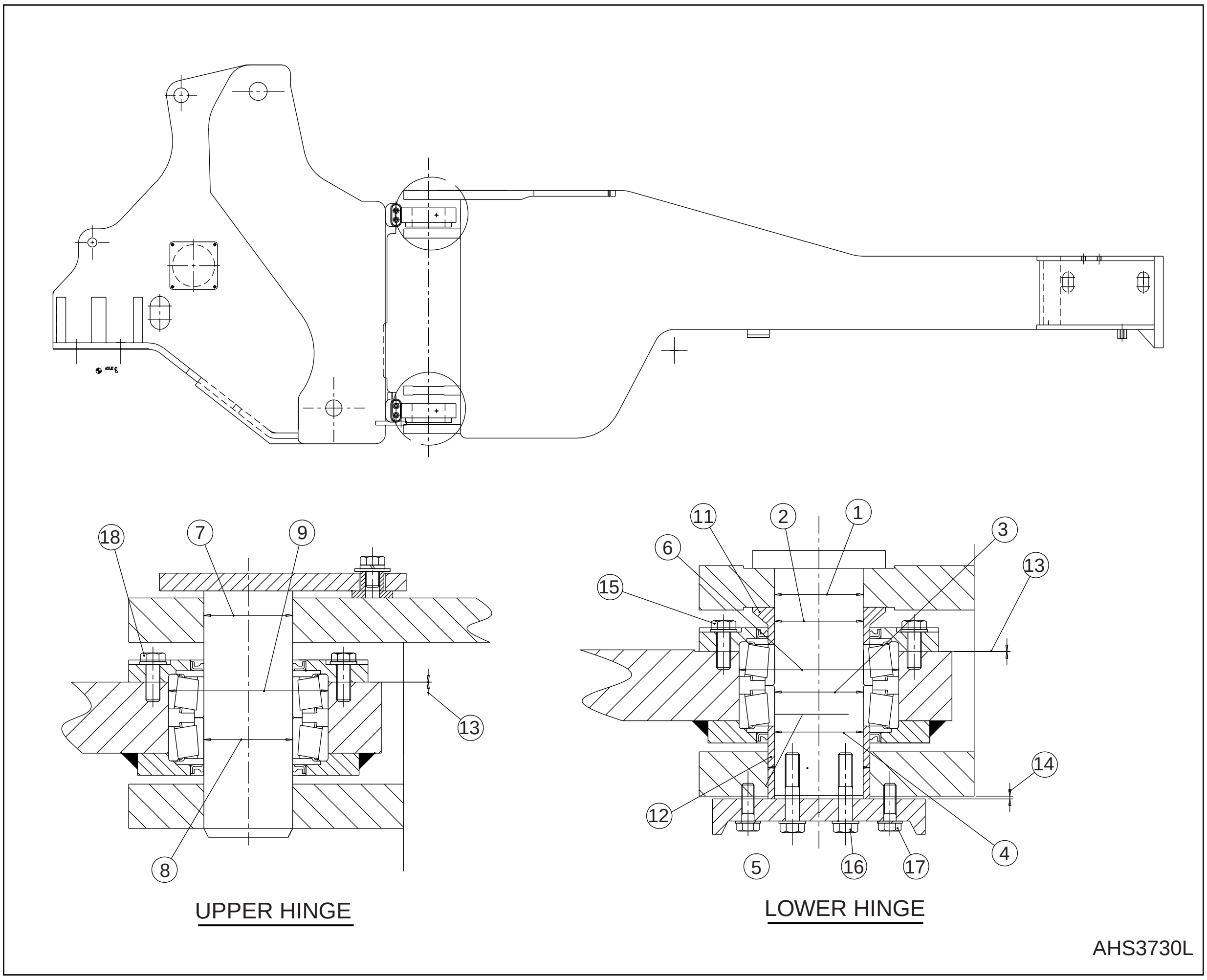
18
7
9
13
8
UPPER HINGE
11
2
1
6
15
3
13
14
12
4
5
16
17
LOWER HINGE
AHS3730L

Figure 2

Unit: mm

No.	Check item	Criteria						Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit		
1	Clearance between lower hinge pin and rear frame.	100	-0.030 -0.076	+0.071 +0.036	0.030 - 0.130	-		Replace
2	Clearance between lower hinge pin and spacer (small).	100	-0.030 -0.076	+0.060 +0.030	0.060 - 0.136	-		Replace
3	Clearance between lower hinge pin and bearing.	100	-0.030 -0.076	0 -0.015	0.015 - 0.076	-		Replace
4	Clearance between lower hinge pin and spacer (large).	100	-0.030 -0.076	+0.060 +0.030	0.060 - 0.136	-		Replace
5	Clearance between rear frame and spacer (large).	115	-0.036 -0.090	+0.071 +0.036	0.072 - 0.161	-		Replace
6	Clearance between front frame and upper hinge bearing.	180	0 -0.025	-0.048 -0.088	-0.023 - -0.088	-		Replace
7	Clearance between upper hinge pin and rear frame.	100	-0.030 -0.076	+0.054 0	0.030 - 0.130	-		Replace
8	Clearance between upper hinge pin and bearing.	100	-0.030 -0.076	0 -0.015	0.015 - 0.076	-		Replace
9	Clearance between front frame and upper hinge bearing.	180	0 -0.025	-0.048 -0.088	-0.023 - -0.088	-		Replace
11	Height of lower hinge spacer (small).	42	-	-	0	0		Replace
12	Height of lower hinge spacer (large).	81.5	-	-	0	0		Replace
13	Shim thickness for lower hinge and retainer (front frame).	0.8 - 1.14	-	-	-	-		
14	Shim thickness for lower hinge and retainer (rear frame).	2.99 - 3.5	-	-	-	-		
15	Tightening torque of upper hinge retainer mounting bolt.	When adjusting with shim: 8±0.2 kg•m Final value: 30±1.0 kg•m						Retighten
16	Tightening torque of upper hinge retainer mounting bolt.	When adjusting with shim: 8±0.2 kg•m Final value: 30±1.0 kg•m						Retighten
17	Tightening torque of upper hinge pin mounting bolt.	13±1.0 kg•m						Retighten
18	Tightening torque of lower hinge pin mounting bolt.	30±1.0 kg•m						Retighten

ENGINE AND DRIVE TRAIN

DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

S0602170K

AXLE
(ZF AP 420R)

⚠ CAUTION!

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Use lifting and hoisting equipment capable of safely handling load.

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MODEL	SERIAL NUMBER RANGE
Mega 500-V	1001 and Up

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GENERAL DESCRIPTION

AP 407 - 420

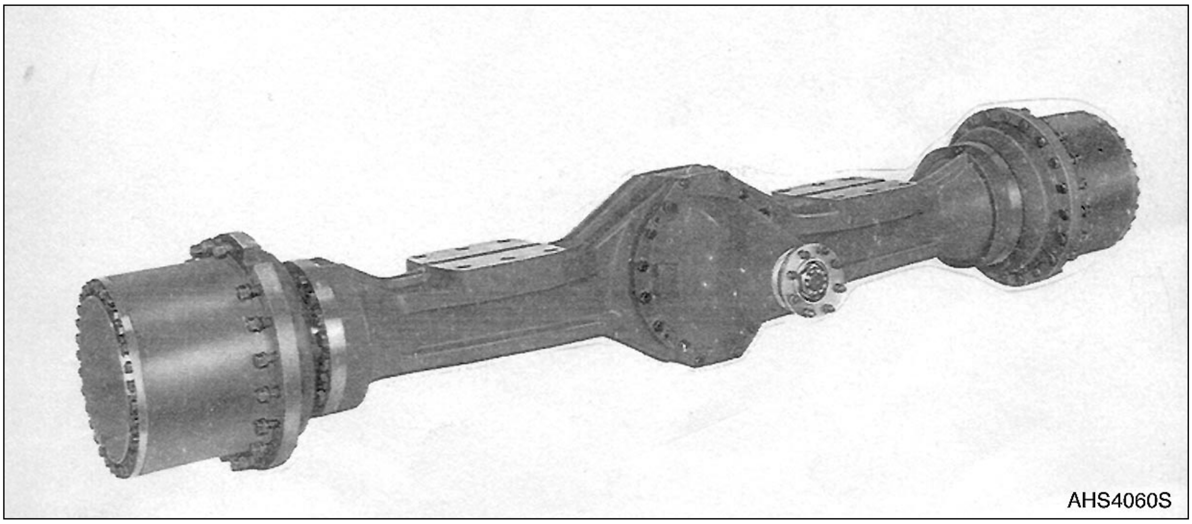


Figure 1

SPECIFICATIONS

Specifications	M500-V Front Axle	M500-V Rear Axle
Maker	ZF	ZF
Model	AP420R	AP420R
Type	Fully floating planetary drive	Fully floating planetary drive
Drive Unit	Limited Slip Differential	Limited slip differential
Final Drive	Planetary gear train	Planetary gear train
Overall Reduction Ratio	27:1	27:1
Axle Load (Travel Condition)	14,900 kg (32,850 lb)	14,000 kg (30,860 lb)
Axle Load (Working Condition)	27,000 kg (59,520 lb)	10,500 kg (23,150 lb)
Brake Type	- Wet disc - Multidisk brake with hydraulic control	- Wet disc - Multidisk brake with hydraulic control
Brake Torque	3,960 kg @ 50 kg/cm^2 (8,730 lb @ 711 psi)	3,960 kg @ 50 kg/cm^2 (8,730 lb @ 711 psi)
Steering Angle	40°	40°
Differential Carrier Version	Screwed Bearing Caps - Differential Carrier Type "RK"	

TORQUE LIMITS FOR SCREWS

Torque Limits for Screws (In Nm) According to ZF-Standards 148

Coefficient of friction: m total 0.12 for screws and nuts without after treatment and for phosphated nuts.

NOTE: *Tighten by hand.*

Torque limits, if not especially indicated, can be taken from the following list:

Metric ISO-Standard Thread DIN 13, (See page 60)				**Metric ISO-Fine Thread DIN 13, (See page 60)**			
Size	8.8	10.9	12.9	Size	8.8	10.9	12.9
M 4 M 5 M 6	2.8 5.5 9.5	4.1 8.1 14.0	4.8 9.5 16.5	M 8 x 1 M 9 x 1 M 10 x 1	24.5 36 52	36 53 76	43 62 89
M 7 M 8 M 10	15.5 23 46	23.0 34 68	27.0 4. 79	M 10 x 1, 25 M 12 x 1, 25 M 12 x 1, 5	49 87 83	72 125 122	84 150 145
M 12 M 14 M 16	79 125 195	117 185 280	135 215 330	M 14 x 1, 5 M 16 x 1, 5 M 18 x 1, 5	135 205 310	200 300 440	235 360 520
M 18 M 20 M 22	280 390 530	390 560 750	460 650 880	M 18 x 2 M 20 x 1, 5 M 22 x 1, 5	290 430 580	420 620 820	490 720 960
M 24 M 27 M 30	670 1,000 1,350	960 1,400 1,900	1,120 1,650 2,250	M 24 x 1, 5 M 24 x 2 M 27 x 1, 5	760 730 1,110	1,090 1,040 1,580	1,270 1,220 1,850
M 33 M 36 M 39	1,850 2,350 3,000	2,600 3,300 4,300	3,000 3,900 5,100	M 27 x 2 M 30 x1, 5 M 30 x 2	1,070 1,540 1,490	1,500 2,190 2,120	1,800 2,560 2,480
				M 33 x 1, 5 M 33 x 2 M 36 x 1, 5	2,050 2,000 2,680	2,920 2,800 3,820	3,420 3,300 4,470
				M 36 x 3 M 39 x 1, 5 M 39 x 3	2,500 3,430 3,200	3,500 4,890 4,600	4,100 5,720 5,300

Torque Limits for Locking Screws (In Nm).

Metric ISO-Standard Thread DIN 13, (See page 60)			Metric ISO-Fine Thread DIN 13, (See page 60)		
Size	10.8	12.9	Size	10.8	12.9
M 5	7.8	10.8	M 8 x 1	34	47
M 6	13.2	18.2	M 10 x 1	68	94
M 7	22.0	30.0	M 10 x 1, 25	65	89
M 8	32	44	M 12 x 1, 25	118	163
M 10	61	84	M 12 x 1, 5	113	155
M 12	108	148	M 14 x 1, 5	185	254
M 14	169	233	M 16 x 1, 5	280	385
M 16	263	362	M 18 x 1, 5	405	556
M 18	358	493	M 20 x 2	536	737
M 20	508	698			

Torque Limits for Locking Screws with Locked Toothing (In Nm).

Metric ISO-Standard Thread DIN 13, (See page 60)		Metric ISO-Fine Thread DIN 13, (See page 60)	
Size	12.9	Size	12.9
M 5	10.5	M 8 x 1	46
M 6	17.5	M 10 x 1, 25	86
M 8	42.0	M 10 x 1	91
M 10	81	M 12 x 1, 5	150
M 12	140	M 12 x 1, 25	155
M 14	225	M 14 x 1, 5	245
M 16	350	M 16 x 1, 5	375
M 18	470	M 18 x 2	500
M 20	680	M 18 x 1, 5	530
		M 20 x 2	710
		M 20 x 1, 5	750

LUBRICATION INSTRUCTIONS

Valid for ZF Axles with and without ZF-Locking differential.

The basis for a correct lubrication of all axles and their parts is a horizontal plane of installation in every direction. (An inclined position of the differential carrier up to 5° is tolerable). In case of variations, ZF must be asked for advice.

Place the vehicle in a horizontal position. All lubricating points must b cleaned carefully before refilling.

Drain oil only immediately after a longer run.

Type of Lubrication

See “List of Lubricants TE-ML 05” on page 9.

Oil Level

Wheel end: Turn wheel hubs until the word "Oil level" can be read in a horizontal position. Fill up oil to the overflow on the level plug.

Axle housing: Fill up oil, to the overflow on the level plug or the oil filler opening resp., installed in the center.

Differential carrier, not installed in a ZF - Axle: Fill up oil 20 mm (0.7874 in) below the middle of the crown wheel.

Oil Level Check

After a few minutes, if oil level has dropped fill up to the correct level until level remains constant. Oil level check monthly. Especially before you start a vehicle with new or repaired axles or their components resp.

Oil Change Intervals (Generally)

1st oil change after 500 operating hours. Further oil changes must be made every 1,000 operating hours, or at least once a year.

Brake

For the pneumatic - hydraulic or memory controlled brake actuation are admitted.

Motor oils SAE 10W according to specifications MIL-L-2104 C, MIL-L-46152, API-CC, CD, SC, SD, SE, SF.

ATF-Oils (Type A / Suffix A, Dexron IID).

NOTE: *Other brake fluids may be not used.*

Point of Grease Lubrication

At greasing points, use a multipurpose grease with following properties: Lithium soap, drop point 170 C, NLGI Class 2.

The grease must be anti-corrosive, water-resistant and walk stable.

Re-grease all pressure grease fittings monthly.

LIST OF LUBRICANTS TE-ML 05

NOTE: *Axles for cars, commercial vehicles and off-road vehicles.*

Axles	Approved Lubricants
Axles and axle-center reduction gears. Wheel hubs and half-shafts. Axle differentials.	Gear oils with or without limited-slip additives. API GL-5 MIL-L 2105 D SAE 80 W-90 SAE 85 W--90 SAE 85 W-140 SAE 90 For commercial products see A12 and A13
Axles and axle-center reduction gears with multidisc limited-slip differentials.	Gear oils with or without limited-slip additives. API GL-5 MIL-L 2105 D SAE 80 W-90 SAE 85 W-90 SAE 85 W-140 SAE 90 For commercial products see A12 and A13
Axles and axle-center reduction gears with wet multidisc brakes.	Gear oils with limited-slip additives. API GL-5 MIL-L 2105 D SAE 80 W-90 SAE 85 W-90 SAE 85 W-140 SAE 90

When using multigrade gear oils, the base oil must not contain more than 2% by weight of dissolved additives (VI improver, pour point depressant etc.) in addition to EP additives.

At greasing points, use a multipurpose grease with the following properties:

Lithium soap, drop point above 170°C (338°F), NLGI Class 2.

The grease must be anti-corrosive, water-resistant and walk stable.

Note to lubricant suppliers: Please inform ZF immediately of any changes to the composition of trade names of approved products, and of differences between Germany and other countries.

IMPORTANT
Check correct torque limit of all screwed joints within regular intervals. (First check after 50 operating hours). Axle with ZF-multidisk self-locking differentials: a slight noise could be noted, when oil without limited slip additives have been filled in. This noise can be regarded as harmless. In case of heavy noise or when the tire is jerking, use EP-gear lubricants with Limited-Slip additives. You will find the corresponding products on the list of lubricants TE-ML-05 for the above mentioned units.

EXAMPLES OF GEAR-TOOTH-CONTACT PATTERNS FOR THE GLEASON GEAR-TOOTH SYSTEM

Ideals Tooth-contact Pattern I.E. Pinion Distance Is Correct

Coast side (concave).

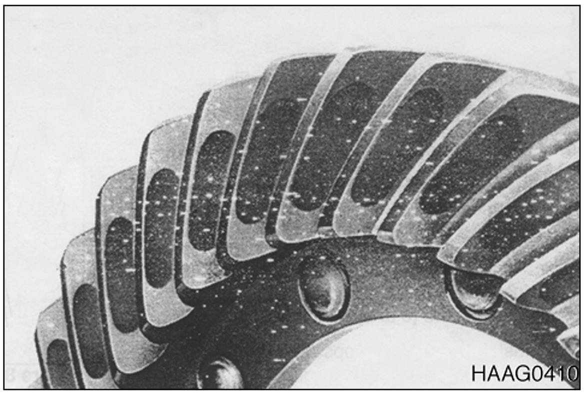


Figure 2

Drive side (convex).

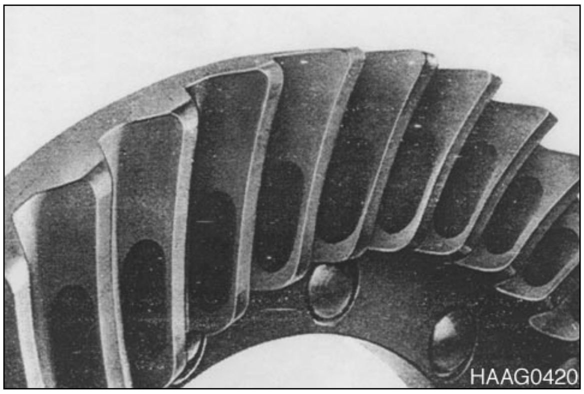


Figure 3

Pinion Distance must be increased.

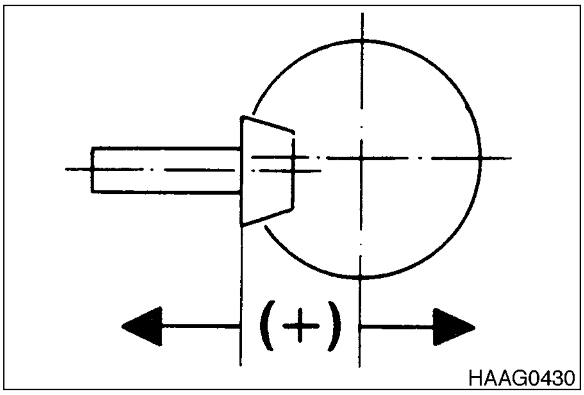


Figure 4

Pinion distance must be decreased.

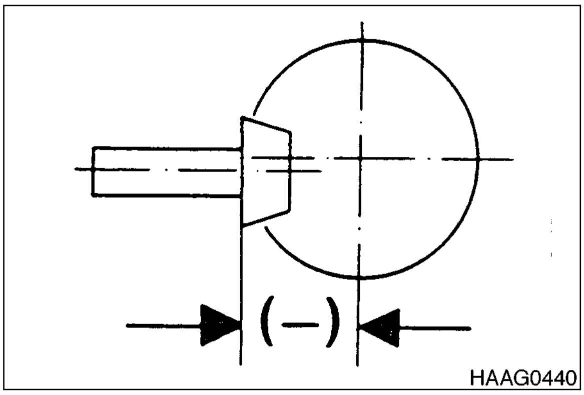


Figure 5

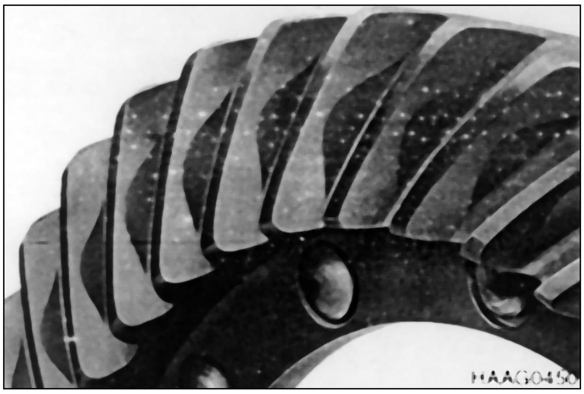


Figure 6

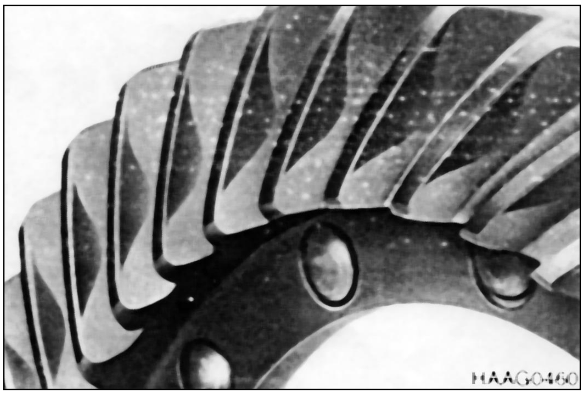


Figure 7

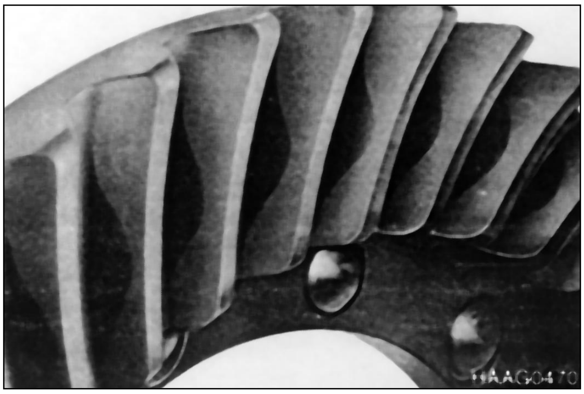


Figure 8

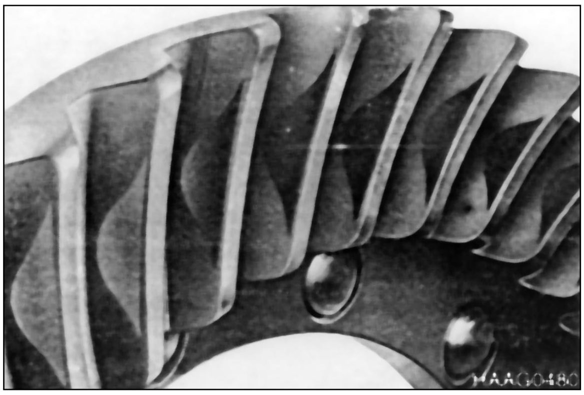


Figure 9

SPECIAL TOOLS

The following illustrations show special tools required to service the axle assembly.

Many of these tools are common tools used by most service personnel.

It is advised that the service person review these illustrations and make their determination of what is required in their particular case.

All tools are listed throughout the text of the manual with an; (S), Name of the tool, and a ZF part number.

All tools are available through ZF.

FINAL DRIVE

AP - 407 / 409

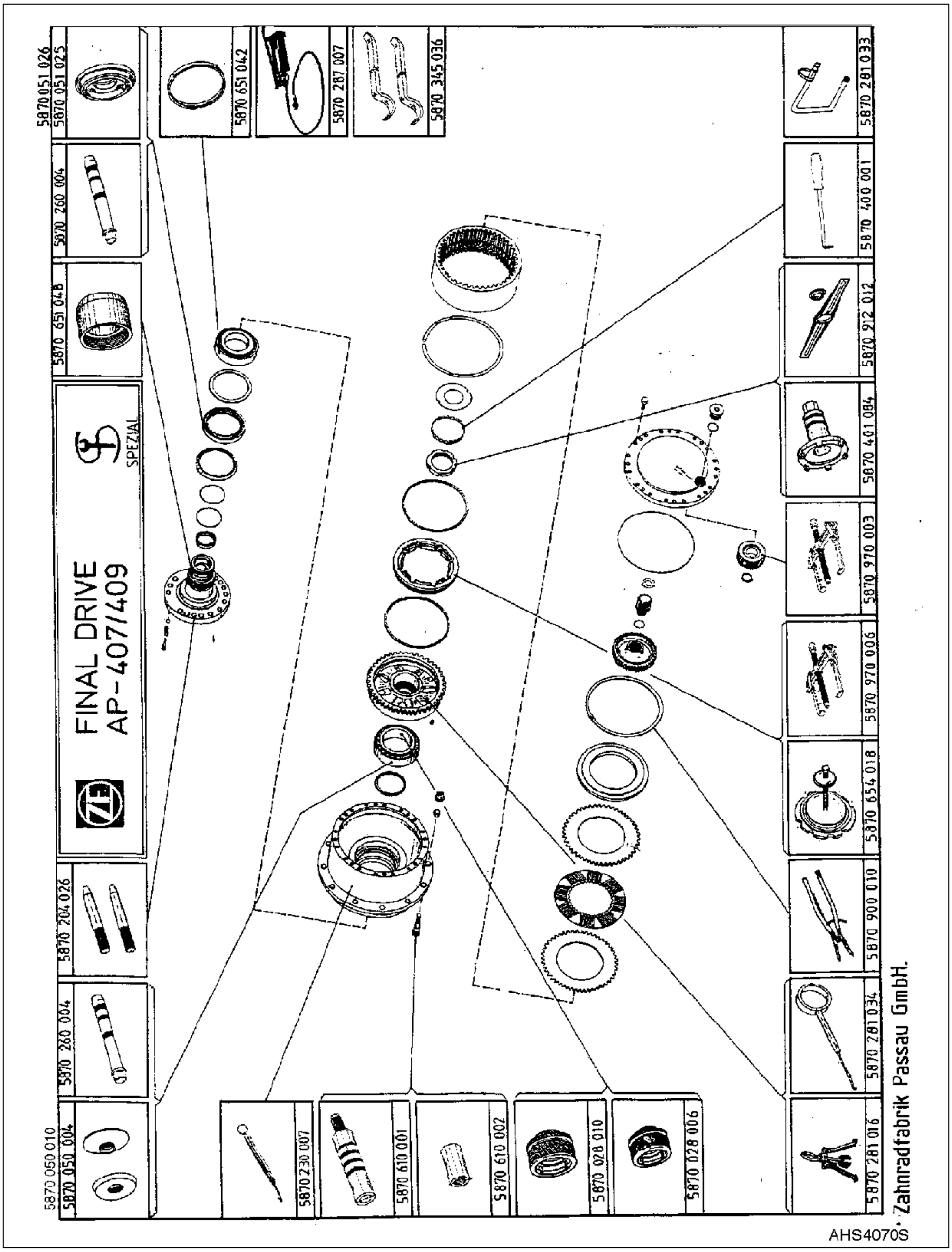


Figure 10

Disassembly	Reassembly	Subject-No.	Denomination /Application Special Tool (S)
Figure 18		5370 350 000	Assembly car compl. with tilting device
		5870 350 055	Support
Figure 21		5870 970 003	Two-leg puller
Figure 24	Figure 134, Figure 142	5870 900 010	Clamping pliers
Figure 27, Figure 33		5870 400 001	Adjustment device
Figure 28	Figure 111, Figure 125	5870 401 084	Hook spanner
Figure 28	Figure 111	5870 912 012	Centering bracket
Figure 30, Figure 35	Figure 123	5870 375 036	Pry bar (set of 2)
Figure 30	Figure 110	5870 281 033	Lifting bracket
Figure 31		5870 281 016	Expanding claw
Figure 32	Figure 123	5870 281 034	Spring hook
Figure 34		5870 028 006	Grab sleeve "super"
Figure 34		5870 028 010	Grab sleeve "super"
	Figure 103	5870 204 026	Adjusting screw Ml8 (set of 2)
	Figure 104	5870 610 001	Wheel stud puller - Basic set
		5870 610 002	Insert M22 x 1.5
	Figure 105	5870 050 004	Driver
	Figure 105	5870 050 010	Driver
		5870 260 004	Driver
	Figure 110, Figure 115, Figure 125	5870 651 048	Installer M90 x 1.5
	Figure 112	5870 230 007	Spring scale O - 200 N
	Figure 114	5870 051 025	Driver
		5870 260 004	Driver
	Figure 114	5870 051 026	Driver (AP-9)
	Figure 119	5870 651 042	Installer inner ∅ 260 mm (10.2362 in)
	Figure 121	5870 654 018	Clamping plate
		5870 970 006	Two-leg puller
	Figure 150	5870 287 007	HP-Pump

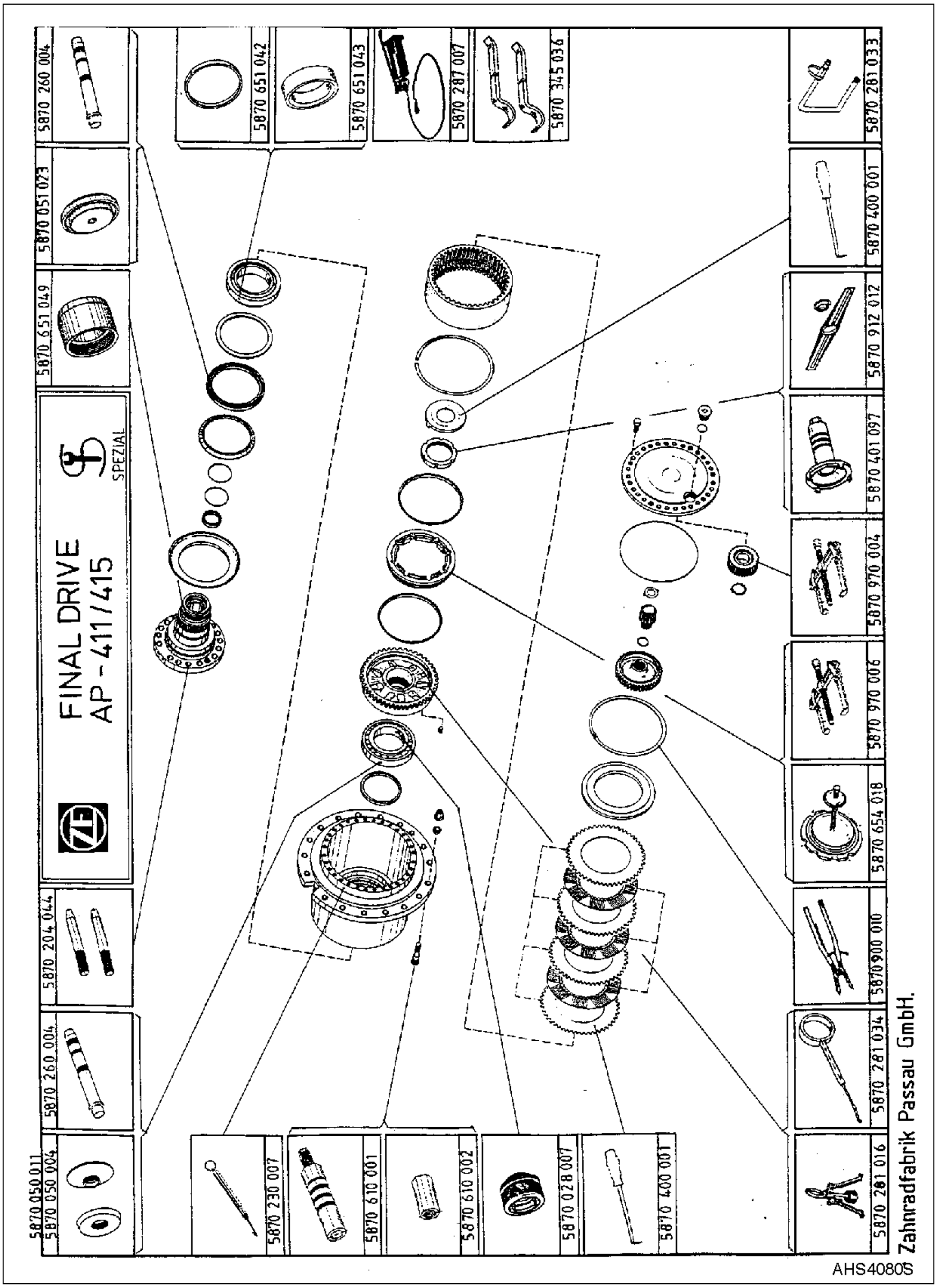

FINAL DRIVE
AP - 411/415
SPEZIAL
5870 260 004
5870 651 042
5870 651 043
5870 287 007
5870 345 036
5870 281 033
5870 051 023
5870 651 049
5870 400 001
5870 912 012
5870 401 097
5870 970 004
5870 970 006
5870 654 018
5870 900 010
5870 281 034
5870 204 044
5870 260 004
5870 050 011
5870 050 004
5870 230 007
5870 610 001
5870 610 002
5870 028 007
5870 400 001
5870 281 016
Zahnradfabrik Passau GmbH.
AHS4080S

Figure 11

Disassembly	Reassembly	Subject-No.	Denomination /Application Special Tool (S)
Figure 18		5870 350 000	Assembly car compl. with tilting device
		5870 350 008	Support
Figure 21		5870 970 004	Two-leg puller
Figure 24	Figure 134, Figure 142	5870 900 010	Clamping pliers
Figure 27, Figure 33		5870 400 001	Adjustment device
Figure 28	Figure 111, Figure 125	5870 401 097	Hook spanner
		5870 912 Ol2	Centering bracket
Figure 30, Figure 35		5870 345 036	Pry bar (set of 2)
Figure 30	Figure 110	5870 281 033	Lifting bracket
Figure 31		5870 281 016	Expanding claw
Figure 32	Figure 123	5870 281 034	Spring hook
Figure 34		5870 028 007	Grab sleeve "super"
	Figure 103	5870 204 044	Adjusting screw M20 x 1.5 (set of 2)
	Figure 104	5870 610 001	Wheel stud puller - Basic set
		5870 610 002	Insert M22 x 1.5
	Figure 105	5870 050 004	Driver
		5870 260 004	Driver
	Figure 105	5870 050 011	Driver
		5870 260 004	Driver
	Figure 110, Figure 115, Figure 125	5870 651 049	Installer M110 x 1.5
	Figure 112	5870 230 007	Spring scale O - 200 N
	Figure 114	5870 051 023	Driver
		5870 260 004	Driver
	Figure 119	5870 651 042	Installer ∅ 260 mm (10.2362 in)
		5870 651 043	Installer ∅ 315 mm (12.4016 in)
	Figure 121	5870 654 Ol8	Clamping plate
		5870 970 006	Two-leg puller
	Figure 150	5870 287 007	HP-Pump

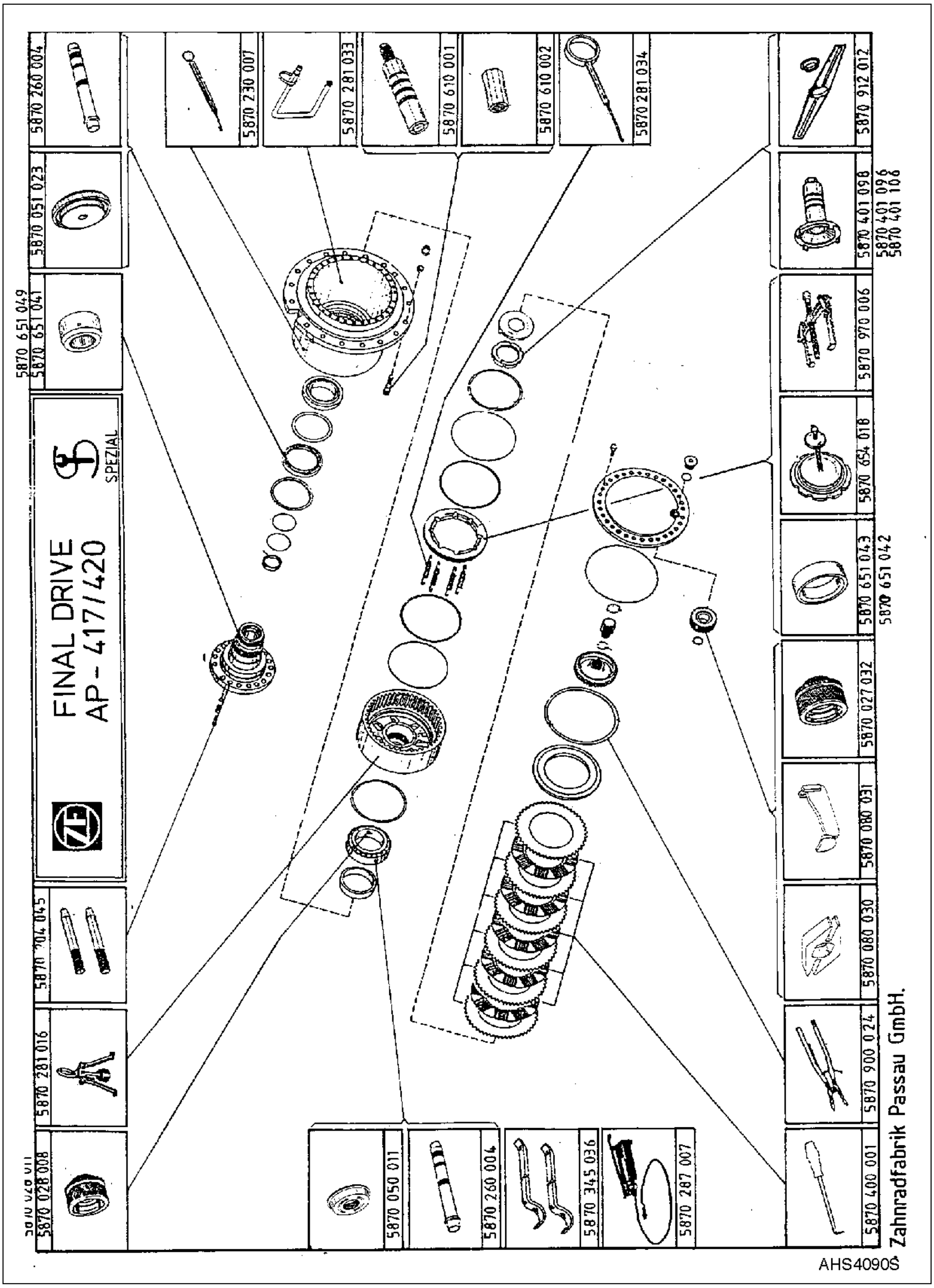

5870 260 004
5870 051 023
5870 651 049
5870 651 041
FINAL DRIVE
AP - 417/420
SPEZIAL
5870 704 045
5870 281 016
5870 028 008
5870 230 007
5870 281 033
5870 610 001
5870 610 002
5870 281 034
5870 912 012
5870 401 098
5870 401 096
5870 401 106
5870 970 006
5870 654 018
5870 651 043
5870 651 042
5870 027 032
5870 080 031
5870 080 030
5870 900 024
5870 400 001
Zahnradfabrik Passau GmbH.
5870 050 011
5870 260 004
5870 345 036
5870 287 007
AHS4090S

Figure 12

Disassembly	Reassembly	Subject-No.	Denomination /Application Special Tool (S)
Figure 18		5870 350 000	Assembly car compl. with tilting device
		5870 350 053	Support
Figure 21		5870 080 030	Cross bracket
		5870 027 032	Cover and spindle
		5870 080 031	Puller hook # 2 pieces needed
Figure 24	Figure 134, Figure 142	5870 900 024	Clamping pliers
Figure 27		5870 400 001	Adjustment device 2 Pieces needed
Figure 28	Figure 111, Figure 125	5870 401 098	Hook spanner
		5870 912 012	Centering bracket
Figure 28	Figure 111	5870 401 106	Hook spanner
		5870 912 012	Centering bracket
Figure 28	Figure 111	5870 401 097	Hook spanner AP 417
Figure 30, Figure 35		5870 345 036	Pry bar (set of 2)
Figure 30	Figure 110	5870 281 033	Lifting bracket
Figure 31		5870 281 016	Expanding claw
Figure 32	Figure 123	5870 281 034	Spring hook
Figure 34		5870 028 008	Grab sleeve "super"
Figure 34		5870 028 011	Grab sleeve "super"
	Figure 103	5870 204 045	Adjusting screw M24 (set of 2)
	Figure 104	5870 610 001	Wheel stud puller - Basic set
		5870 610 002	Basic set M22 x 1.5
	Figure 105	5870 050 011	Driver
		5870 260 004	Driver
	Figure 110, Figure 115, Figure 125	5870 651 041	Installer M130 x 1.5
	Figure 110, Figure 115, Figure 125	5870 651 049	Installer M110 x 1.5
	Figure 112	5870 230 007	Spring scale O - 200 N
	Figure 114	5870 051 023	Driver
		5870 260 004	Driver
	Figure 119	5870 651 042	Installer ∅ 260 mm (10.2362 in)
		5870 651 043	Installer ∅ 315 mm (12.4016 in)
	Figure 121	5870 654 018	Clamping plate
		5870 970 006	Two-leg puller
	Figure 150	5870 287 007	HP-Pump

DIFFERENTIAL (VERSION - SCREWED BEARING CAPS)

Differential Carrier "CK"

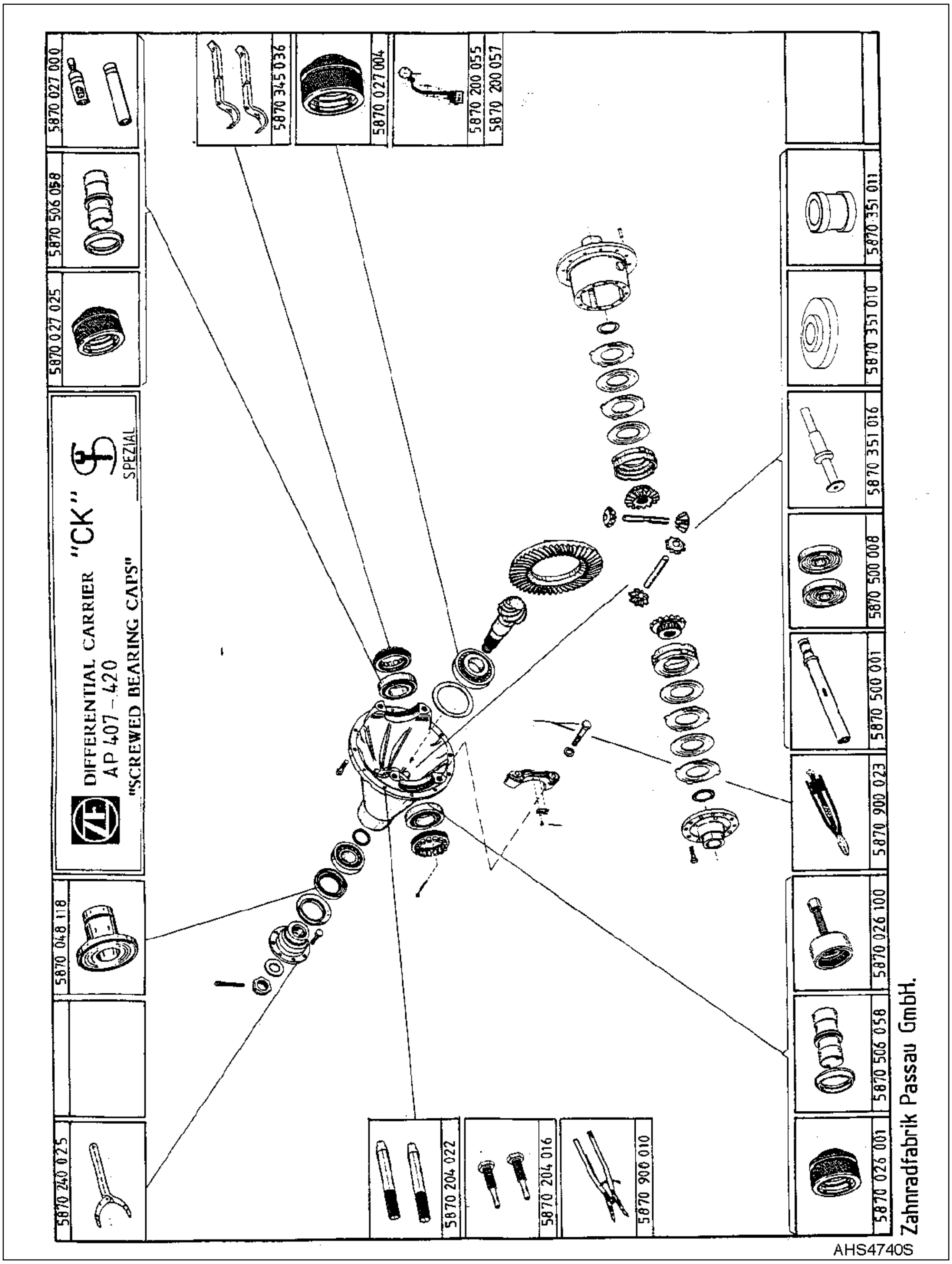


Figure 13

Disassembly	Reassembly	Subject-No.	Denomination /Application Special Tool (S)
Figure 39		5870 240 016	Back-off screws M18 (set of 2)
Figure 41		5870 900 010	Clamping pliers
Figure 42	Figure 194	5870 204 022	Adjusting screws M14 (set of 2)
Figure 43		5870 350 000	Assembly car compl. with tilting device
		5870 350 004	Support
		5870 350 005	Insert "BK/CK"
Figure 44		5870 345 036	Pry bar (set of 2)
Figure 47		5870 026 001	Grab sleeve "Super"
		5870 506 058	Pressure piece
		5870 026 100	Back-off insert
Figure 47		5870 027 025	Grab sleeve "Super"
		5870 506 058	Pressure piece
		5870 027 000	Basic set
Figure 53	Figure 164, Figure 166, Figure 169	5870 240 025	Clamping yoke
Figure 58		5870 027 004	Grab sleeve "Super"
	Figure 154	5870 500 001	Measuring shaft
		5870 500 028	Adjusting piece
		5870 351 016	Measuring pin
		5870 351 010	Stop washer
		5870 351 011	Spacer
	Figure 168	5870 048 118	Driver
	Figure 187	5870 200 055	Magnetic base
	Figure 189	5870 200 057	Dial indicator
	Figure 192	5870 900 023	Wire pincers

Differential Carrier "RK"

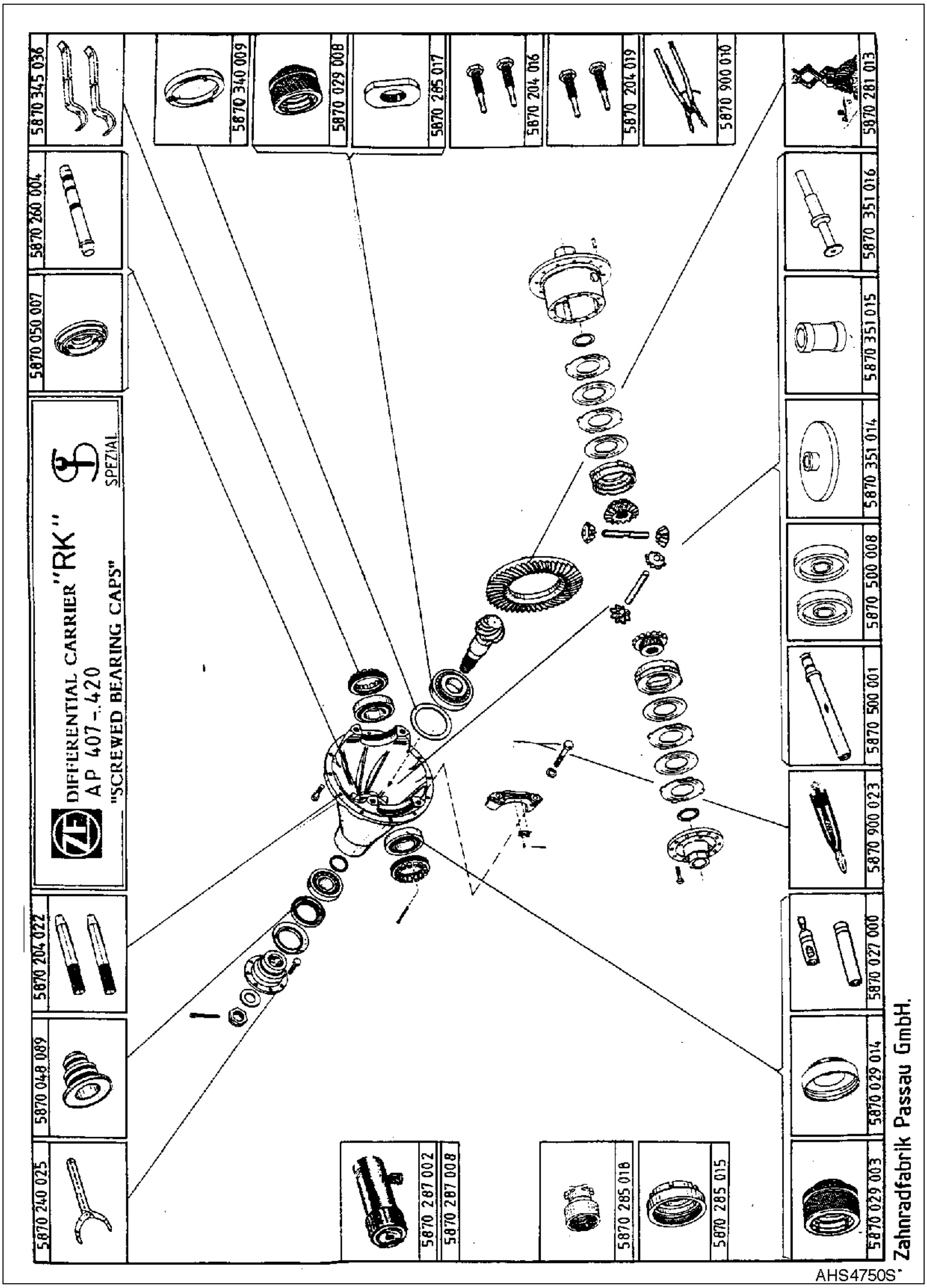
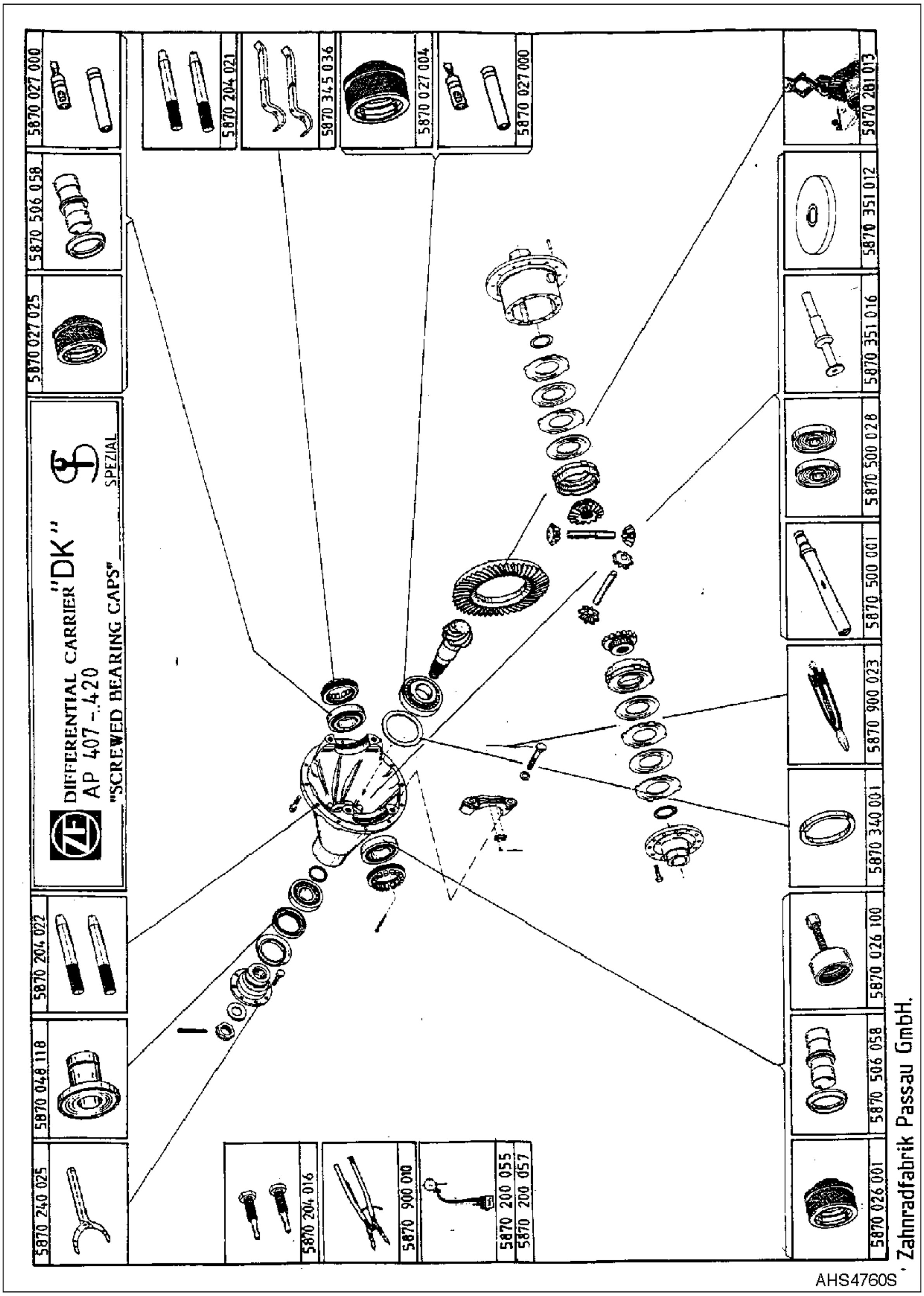


Figure 14

Disassembly	Reassembly	Subject-No.	Denomination /Application Special Tool (S)
Figure 39		5870 204 016	Back-off screws M18 (set of 2)
Figure 39		5870 204 019	Back-off screws M20 (set of 2)
Figure 41		5870 900 010	Clamping pliers
Figure 42	Figure 194	5870 204 022	Adjusting screws M14 (set of 2)
Figure 43		5870 350 000	Assembly car compl. with tilting device
		5870 350 004	Support
Figure 44		5870 345 036	Pry bar (set of 2)
Figure 46		5870 281 013	Grip tongs
Figure 47		5870 029 003	Grab sleeve "Super"
		5870 029 014	Reduction
		5870 027 000	Basic set
Figure 47		5870 287 002	HP-Pump
		5870 287 008	Hydro-cylinder LZM 25/200
		5870 285 018	Sleeve M110 x 3 / M68 x 2
		5870 285 015	Bayonet catch M125 x 3
Figure 53	Figure 164, Figure 166, Figure 169	5870 240 025	Clamping yoke
Figure 58		5870 029 008	Grab sleeve "Super"
		5870 285 017	Pressing ring M125 x 3
	Figure 154	5870 500 001	Measuring shaft
		5870 500 008	Adjusting piece (set of 2)
		5870 351 016	Measuring pin
		5870 351 014	Stop washer
		5870 351 015	Spacer
	Figure 158	5870 050 007	Driver
		5870 260 004	Driver
	Figure 160	5870 340 009	Measuring ring
	Figure 168	5870 048 089	Driver
	Figure 185	5870 281 013	Grip tongs
	Figure 187	5870 200 055	Magnetic base
	Figure 189	5870 200 057	Dial indicator
	Figure 192	5870 900 023	Wire pincers

Differential Carrier "DK"



Disassembly	Reassembly	Subject-No.	Denomination /Application Special Tool (S)
Figure 39		5870 204 016	Back-off screws M18 (set of 2)
Figure 42		5870 204 022	Adjusting screws M14 (set of 2)
Figure 41		5870 900 010	Clamping pliers
Figure 43		5870 350 000	Assembly car compl. with tilting device
		5870 350 004	Support
		5870 350 006	Insert D-DK-DST
Figure 44		5870 345 036	Pry bar (set of 2)
Figure 46		5870 281 013	Grip tongs
Figure 47		5870 026 001	Grab sleeve "Super"
		5870 506 058	Pressure piece
		5870 026 100	Back-off insert
Figure 47		5870 027 025	Grab sleeve "Super"
		5870 506 058	Pressure piece
		5870 027 000	Basic set
Figure 53	Figure 164, Figure 166, Figure 169	5870 240 025	Clamping yoke
Figure 58		5870 027 004	Grab sleeve "Super"
		5870 027 000	Basic set
	Figure 154	5870 500 001	Measuring shaft
		5870 500 028	Adjusting piece (set of 2)
		5870 351 016	Measuring pin
		5870 351 012	Stop washer
	Figure 160	5870 340 001	Measuring ring
	Figure 168	5870 048 118	Driver
	Figure 185	5870 281 013	Grip tongs
	Figure 187	5870 200 055	Magnetic base
	Figure 189	5870 200 057	Dial indicator
	Figure 192	5870 900 023	Wire pincers
	Figure 194	5870 204 021	Adjusting screws M12 (set of 2)

DIFFERENTIAL (VERSION - CAST-ON BEARING CAPS)

Differential Carrier "DK"

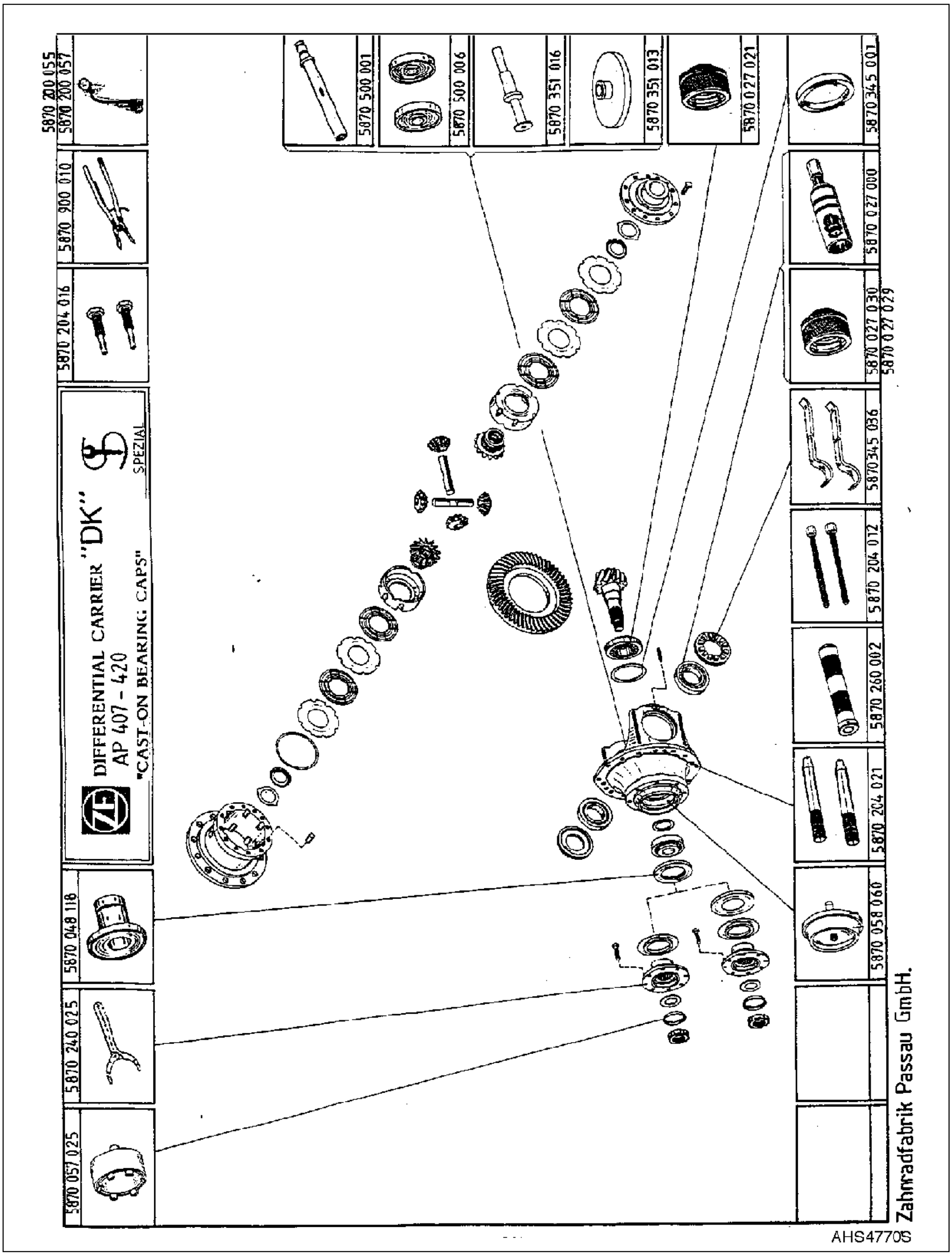


Figure 15

Disassembly	Reassembly	Subject-No.	Denomination /Application Special Tool (S)
Figure 60		5870 204 016	Back-off screws M18 (set of 2)
Figure 63		5870 900 010	Clamping pliers
Figure 64		5870 204 012	Back-off screws M12 (set of 2)
Figure 64		5870 350 000	Assembly car compl. with tilting device
		5870 350 006	Support
Figure 69		5870 027 029	Grab sleeve "Super" 33 281
Figure 69		5870 027 030	Grab sleeve "Super" JM 714 249
		5870 027 000	Basic set
Figure 70		5870 345 036	Pry bar (set of 2)
Figure 76	Figure 208, Figure 212	5870 240 025	Clamping yoke
Figure 81		5870 027 021	Grab sleeve "Super" 31 313
	Figure 198	5870 500 001	Measuring shaft
		5870 500 006	Adjusting piece (set of 2)
		5870 351 016	Measuring pin
		5870 351 013	Stop washer
	Figure 202	5870 058 060	Drive
	Figure 204	5870 340 001	Measuring ring
	Figure 211	5870 048 118	Driver
	Figure 234	5870 200 055	Magnetic base
	Figure 235	5870 200 057	Dial indicator
	Figure 239	5870 057 025	Driver
	Figure 240	5870 204 021	Adjusting screws M14 (set of 2)
		5870 260 002	Handle

Differential Carrier "HK"

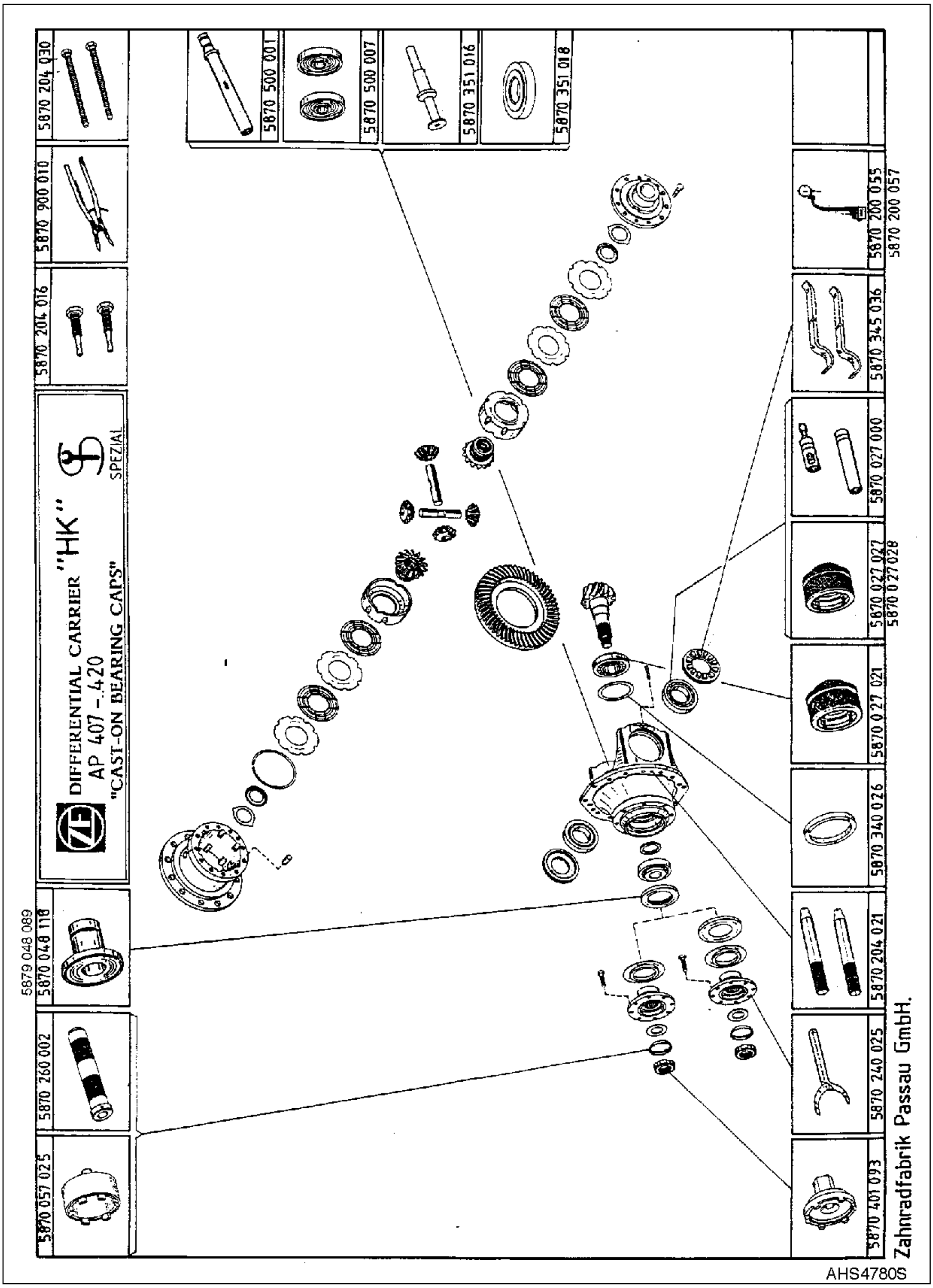


Figure 16

Disassembly	Reassembly	Subject-No.	Denomination /Application Special Tool (S)
Figure 60		5870 204 016	Back-off screws M18 (set of 2)
Figure 63		5870 900 010	Clamping pliers
Figure 64		5870 204 030	Back-off screws M14 (set of 3)
Figure 64		5870 350 000	Assembly car compl. with tilting device
		5870 350 007	Support
Figure 69		5870 027 027	Grab sleeve "Super" 27 695
Figure 69		5870 027 028	Grab sleeve "Super" 47 686
		5870 027 000	Basic set
Figure 70		5870 345 036	Pry bar (set of 2)
Figure 76	Figure 208, Figure 212	5870 240 025	Clamping yoke
	Figure 198	5870 500 001	Measuring shaft
		5870 500 007	Adjusting piece (set of 2)
		5870 351 016	Measuring pin
		5870 351 018	Stop washer
Figure 76	Figure 208, Figure 212	5870 401 093	Hook spanner
Figure 81		5870 027 021	Grab sleeve "Super" JW 7049
	Figure 204	5870 340 026	Measuring ring
	Figure 211	5870 048 089	Driver
	Figure 211	5870 048 118	Driver
	Figure 232, Figure 235	5870 200 055	Magnetic base
		5870 200 057	Dial indicator
	Figure 239	5870 057 025	Driver
	Figure 240	5870 204 021	Adjusting screws M14 (set of 2)
	Figure 240	5870 204 022	Adjusting screws M16 (set of 2)
		5870 260 002	Handle

DIFFERENTIAL (VERSION - CAST-ON AND SCREWED BEARING CAPS)

Differential Carrier "LK"

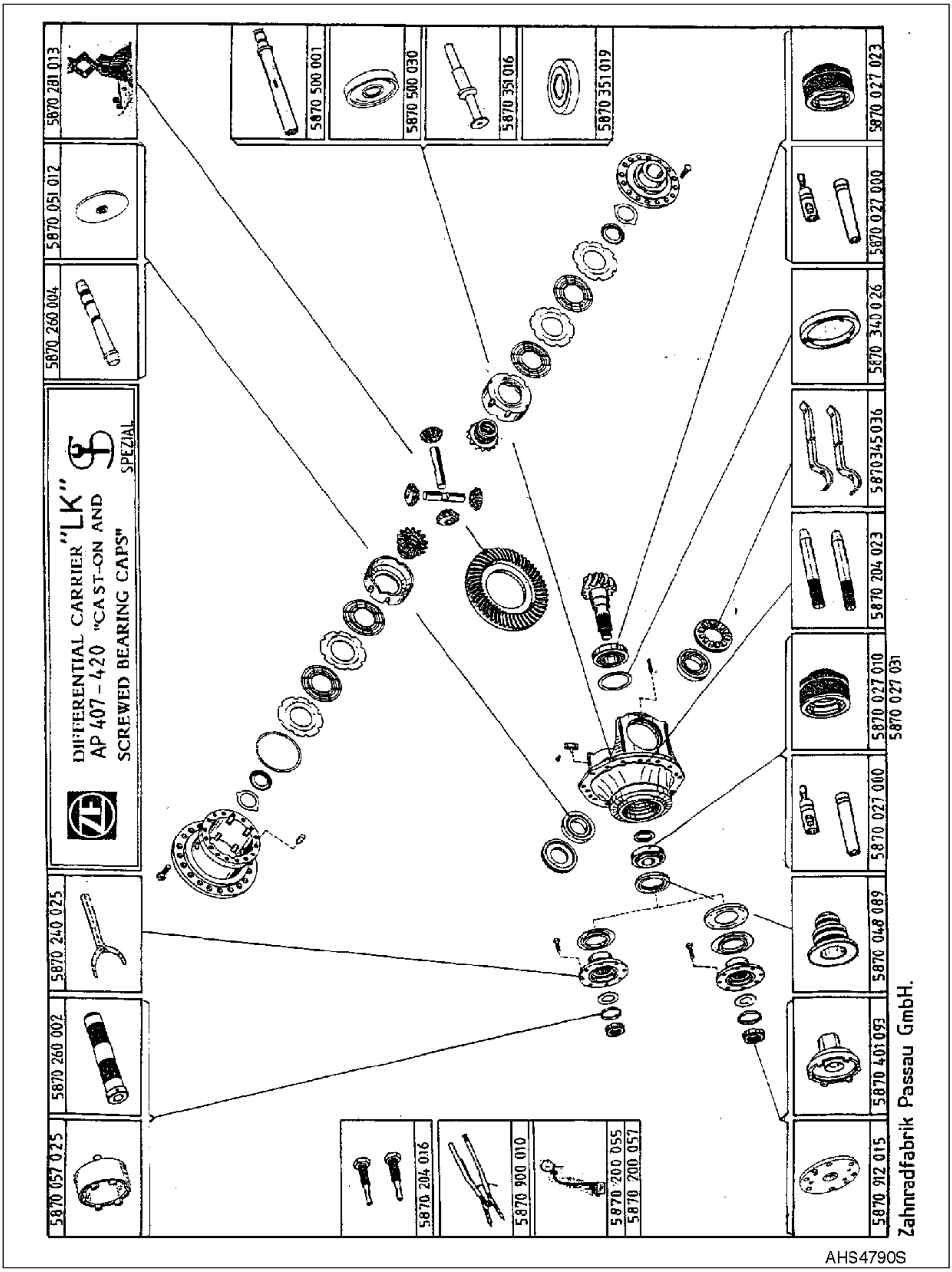


Figure 17

Disassembly	Reassembly	Subject-No.	Denomination /Application Special Tool (S)
Figure 82		5870 204 016	Back-off screws M18 (set of 2)
Figure 84		5870 900 010	Clamping pliers
Figure 85		5870 204 023	Adjusting screws M16 (set of 2)
Figure 86		5870 350 000	Assembly car compl. with tilting device
		5870 350 004	Support
Figure 88		5870 345 036	Pry bar (set of 2)
Figure 90		5870 281 013	Grip tongs
Figure 91		5870 027 010	Grab sleeve "Super"
		5870 027 000	Basic set
Figure 91		5870 027 031	Grab sleeve "Super"
		5870 027 000	Basic set
Figure 96	Figure 254, Figure 256, Figure 259	5870 240 025	Clamping yoke
Figure 96	Figure 254, Figure 256, Figure 259	5870 401 093	Hook spanner
		5870 912 015	Centering disk
Figure 101		5870 027 023	Grab sleeve "Super"
		5870 027 000	Basic set
	Figure 244	5870 500 001	Measuring shaft
		5870 500 030	Adjusting piece (set of 2)
		5870 500 022	Adjusting piece (set of 2)
		5870 351 016	Measuring pin
		5870 351 019	Stop washer
	Figure 248	5870 051 012	Driver
		5870 260 004	Handle
	Figure 250	5870 340 026	Measuring ring
	Figure 258	5870 048 089	Driver
	Figure 278	5870 281 013	Grip tongs
	Figure 281, Figure 283	5870 200 055	Magnetic base
		5870 200 057	Dial indicator
	Figure 287	5870 057 025	Driver
		5870 260 002	Handle

PLANETARY RIGID AXLE AP 407 - 420 DISASSEMBLY

Figure 18, shows the total view of the axle.

NOTE: *See "Special Tools" on page 15.*

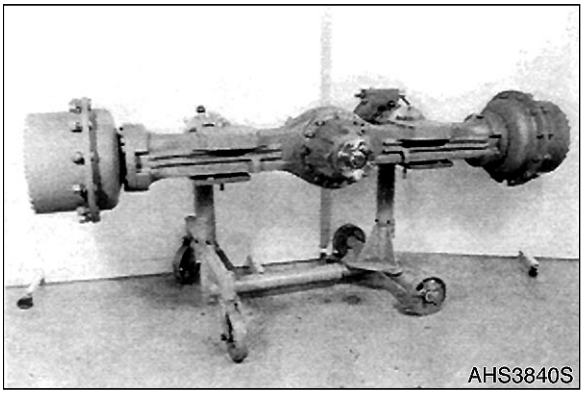


Figure 18

FINAL DRIVE

1. Remove oil drain plug and drain oil.

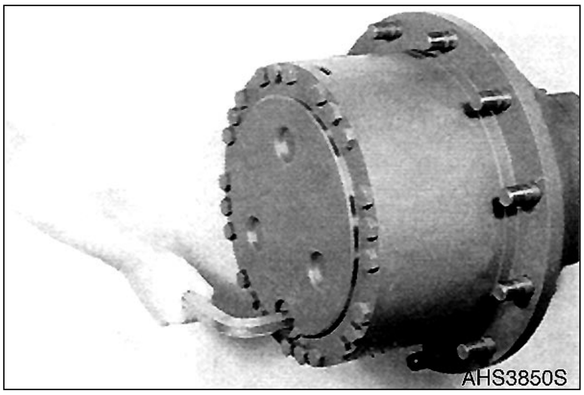


Figure 19

2. Remove hex. head screws and lift off the planetary carrier.

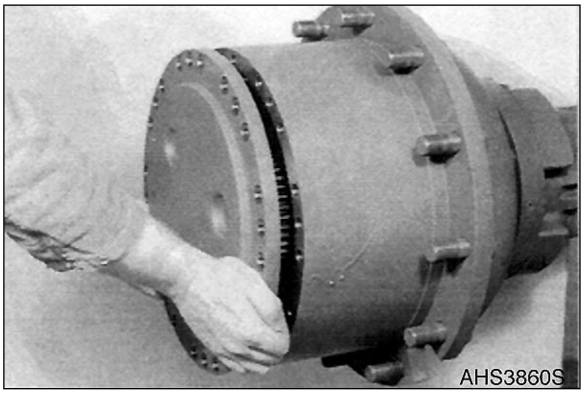


Figure 20

3. Squeeze out circlip and pull off the planetary gears.
4. Remove thrust washer.

   NOTE: *See “Special Tools” on page 15.*

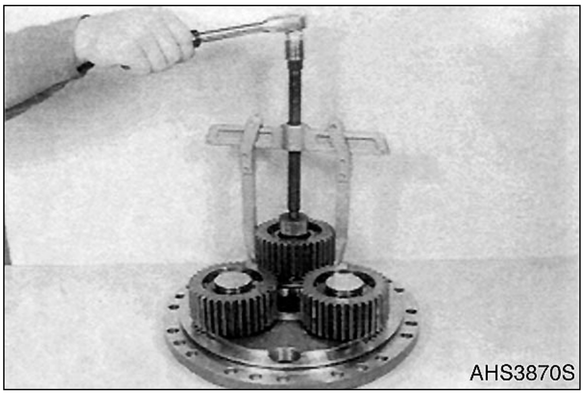


Figure 21

5. Pull sun gear along with inner plate carrier from the stab shaft, resp. out of the plate pack.

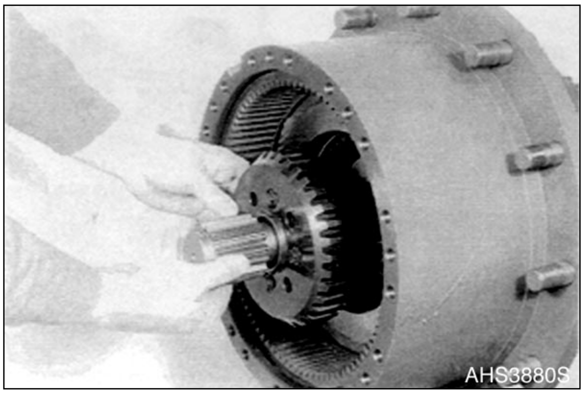


Figure 22

6. Remove locking screws and remove ring from the inner plate carrier.

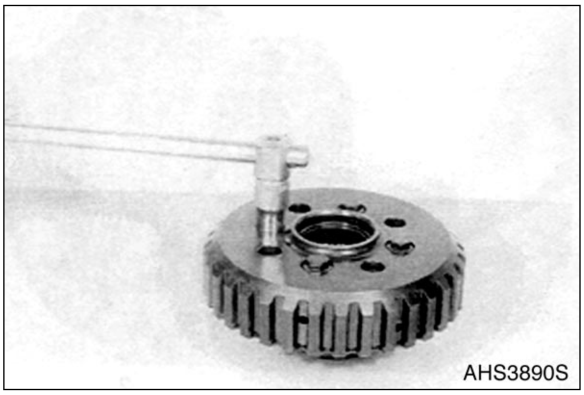


Figure 23

7. Squeeze out circlip.

   NOTE: *See “Special Tools” on page 15.*

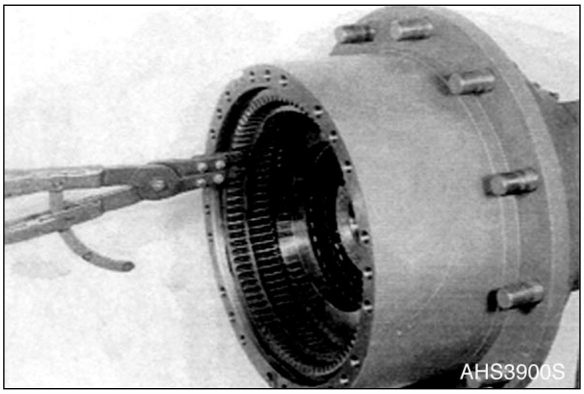


Figure 24

8. Remove backing plate and plate pack.

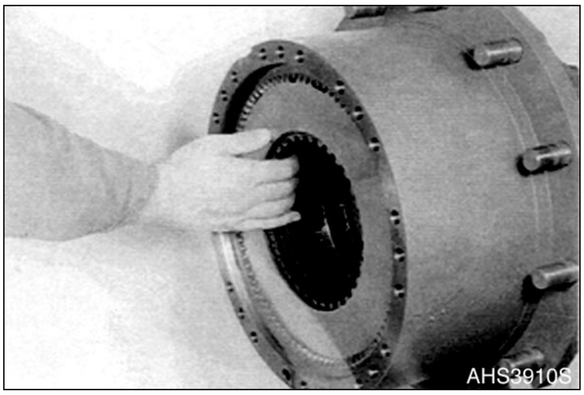


Figure 25

9. Remove thrust washer.

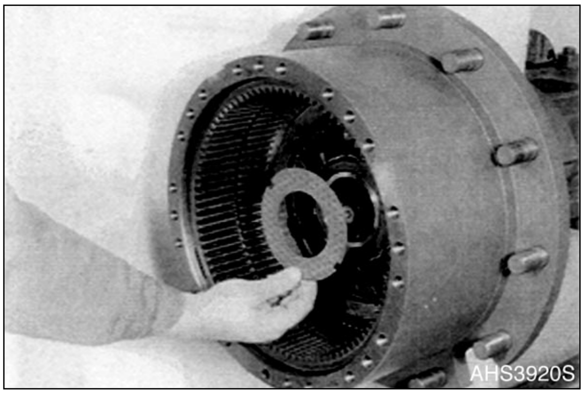


Figure 26

10. Remove lock plate.

    NOTE: *See “Special Tools” on page 15.*

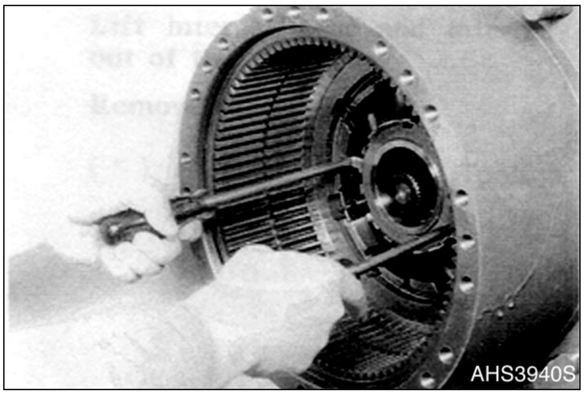


Figure 27

11. Loosen and remove slotted nut.

    NOTE: *See “Special Tools” on page 15.*

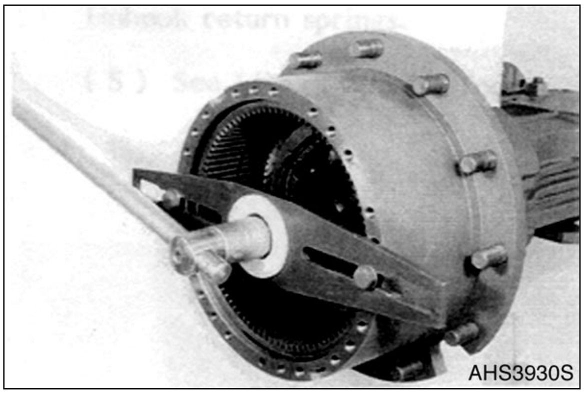


Figure 28

12. Pull stub shaft out of the axle housing.

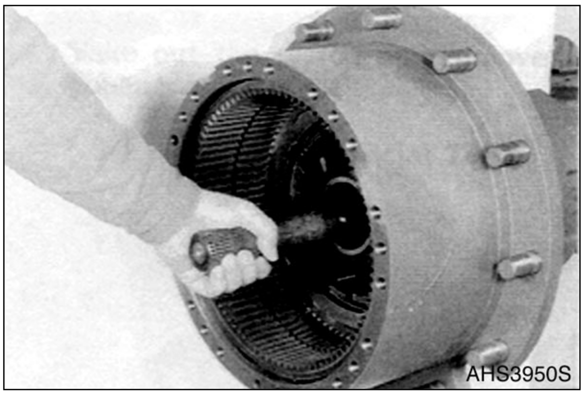


Figure 29

13. Separate complete hub from hub carrier.

NOTE: *See "Special Tools" on page 15.*

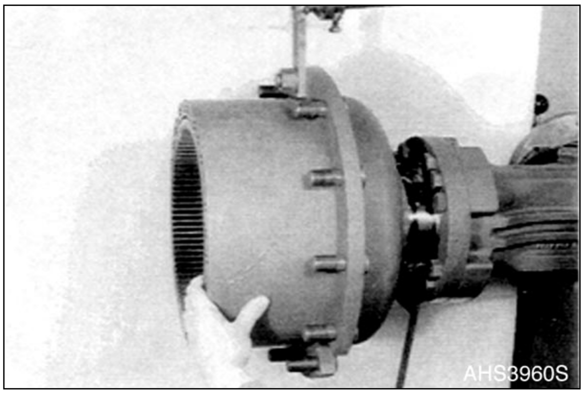


Figure 30

14. Lift internal gear and internal gear carrier out of the hub.
15. Remove released spacer.

NOTE: *See "Special Tools" on page 15.*

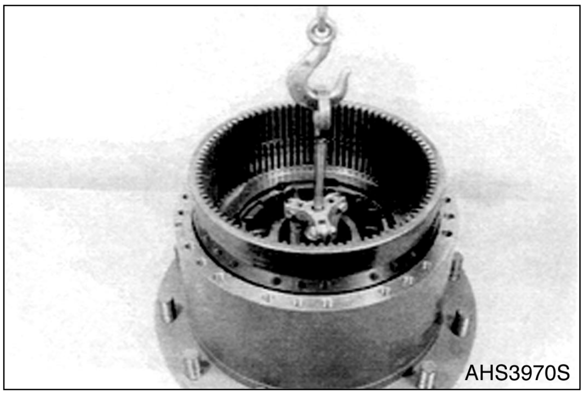


Figure 31

16. Unhook return springs.

NOTE: *See "Special Tools" on page 15.*

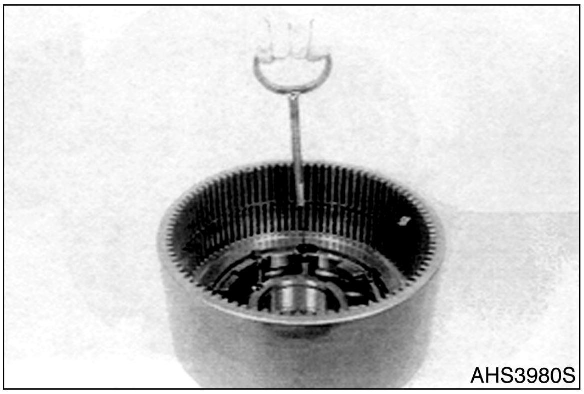


Figure 32

17. Take out the piston and remove sealing components.

    NOTE: *See “Special Tools” on page 15.*

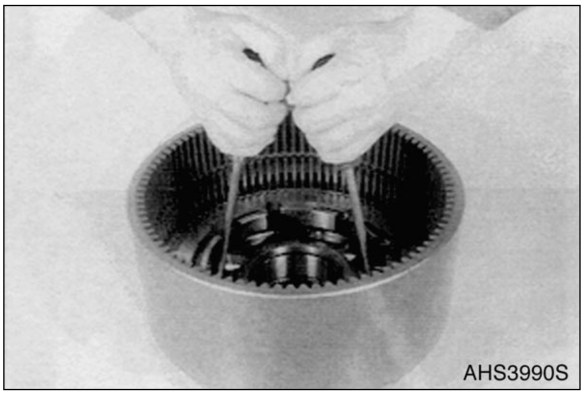


Figure 33

18. Pull off tapered roller bearing from the internal gear carrier.

    NOTE: *See “Special Tools” on page 15.*

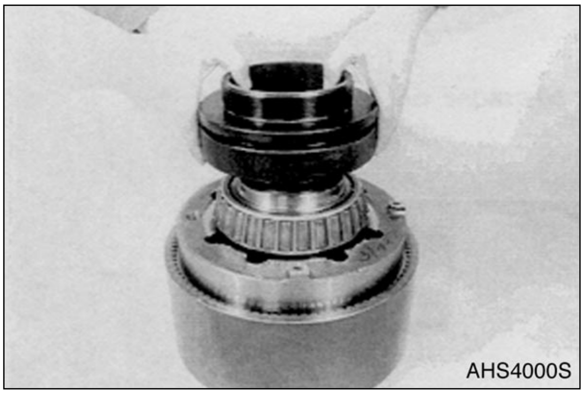


Figure 34

19. Pry shaft seal out of the hub and remove the inner bearing race.

    NOTE: *See “Special Tools” on page 15.*

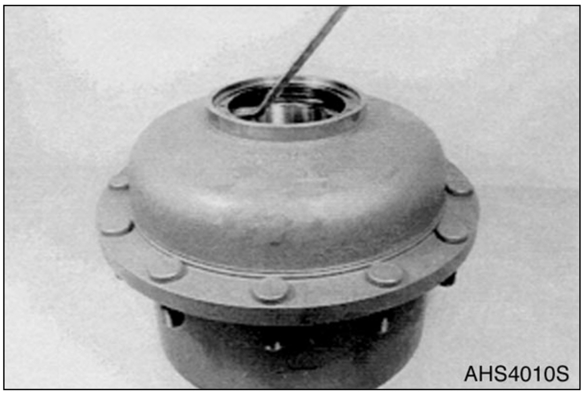


Figure 35

20. If required drive out and remove the two outer bearing races.

Figure 36

21. Remove bleeder valve.

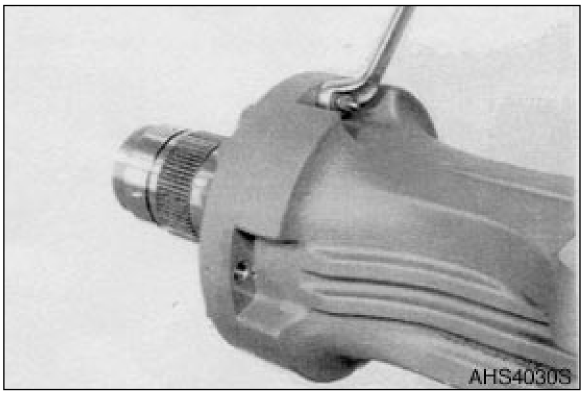


Figure 37

22. Remove hex. head screws and separate the hub carrier from the axle housing.

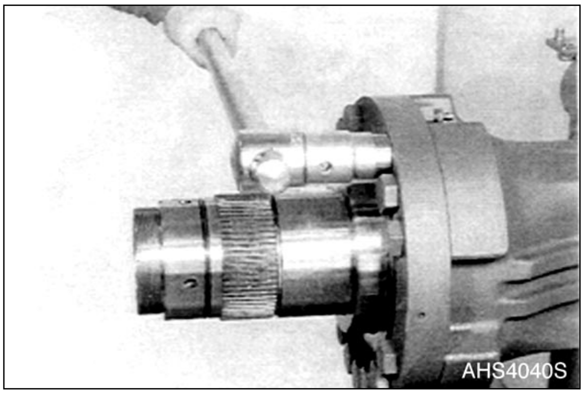


Figure 38

DIFFERENTIAL DISASSEMBLY (VERSION - SCREWED BEARING CAPS)

NOTE: *Remove the two stub shafts before separate the differential carrier from the axle housings. See Figure 39 - Figure 41.*

1. Drain oil from the final drive and the axle housing.
2. Remove hex. head screws and separate planetary carrier from the hubs using eye hook.

   NOTE: *See “Special Tools” on page 15.*

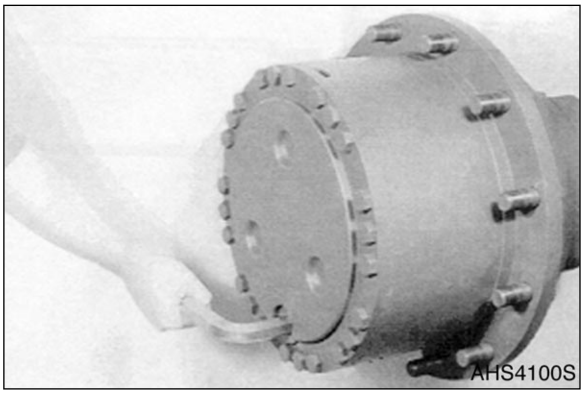


Figure 39

3. Pull inner plate carrier (along with sun gear) from the stub shaft.

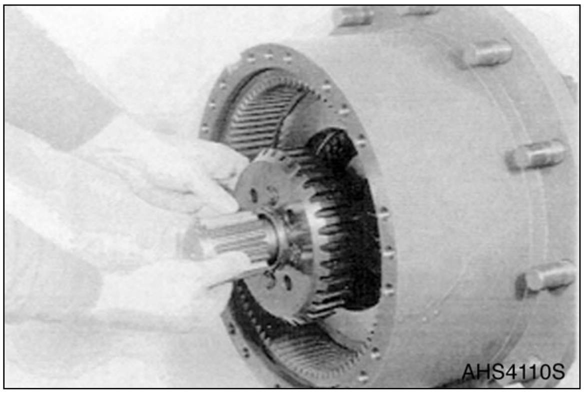


Figure 40

4. Pull stub shaft out of the axle housing. Squeeze out circlip and remove the plate pack.

   NOTE: *This step is necessary to make the later installation of the inner plate carrier possible.*

   NOTE: *See “Special Tools” on page 15.*

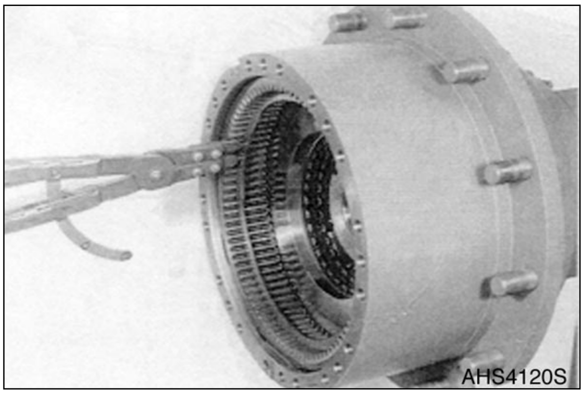


Figure 41

5. Remove hex. head screws and separate the differential carrier from the axle housing.

   NOTE: *See "Special Tools" on page 15.*

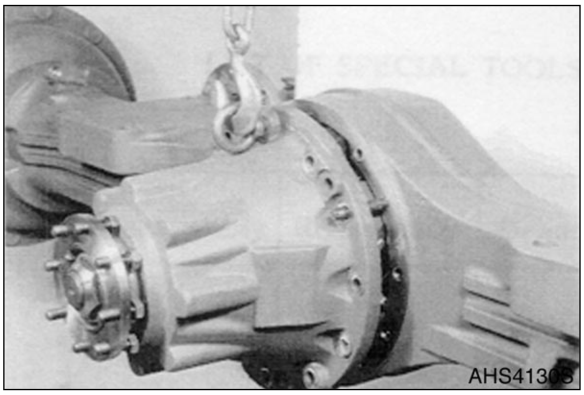


Figure 42

6. Fasten the differential carrier in the assembly jig.
7. Remove lock wire and drive roll pins out.

   NOTE: *See "Special Tools" on page 15.*

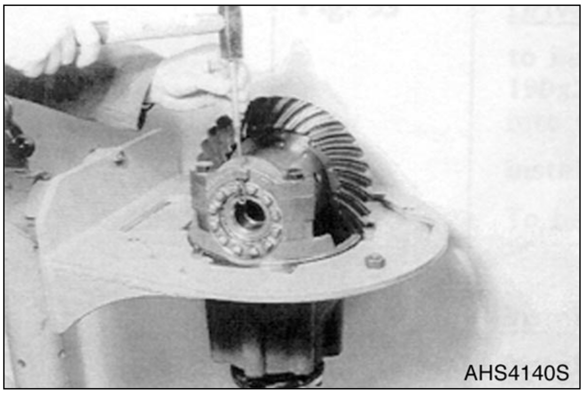


Figure 43

8. Loosen adjusting nuts.

   NOTE: *See "Special Tools" on page 15.*

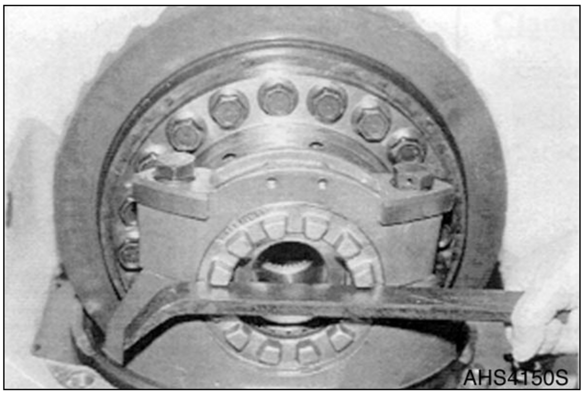


Figure 44

9. Remove hex. head screws and remove the two bearing caps.

   NOTE: *Match mark bearing caps with housings, see Arrow.*

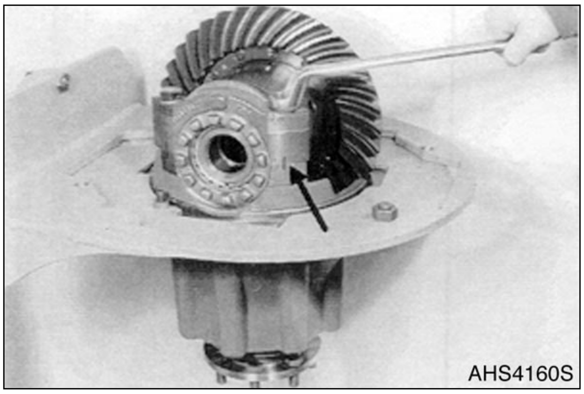


Figure 45

10. Remove adjusting nuts.
11. Remove differential assembly from the axle carrier.

    NOTE: *See “Special Tools” on page 15.*

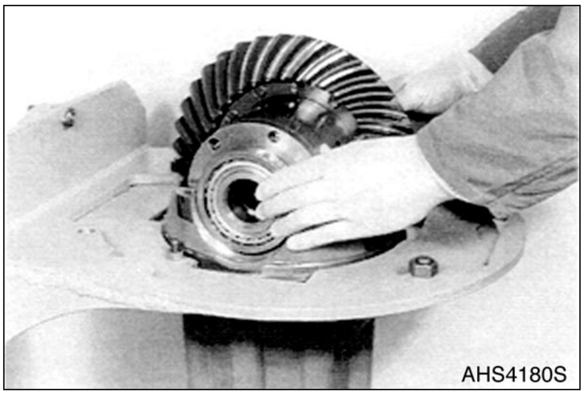


Figure 46

DIFFERENTIAL

1. Pull the two inner bearing races of the tapered roller bearing from the differential case halves.

   NOTE: *See “Special Tools” on page 15.*

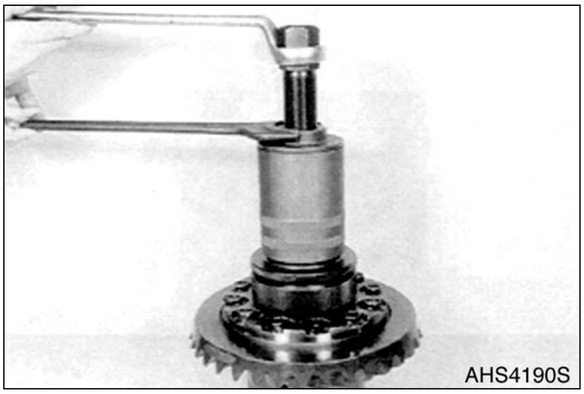


Figure 47

2. Match mark housing cover with differential.
3. Clamp the differential case halves, remove the locking screws.

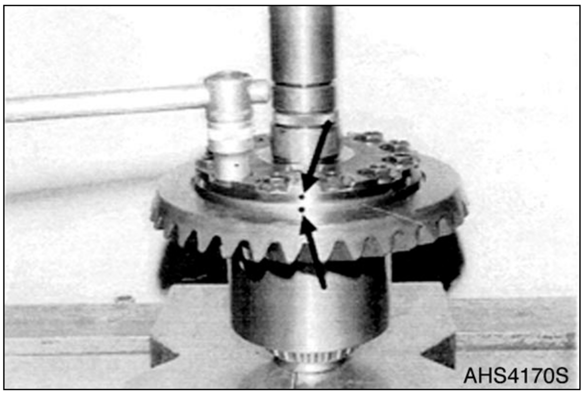


Figure 48

4. Back off the cover.

   NOTE: *Pay attention to the released thrust washer.*

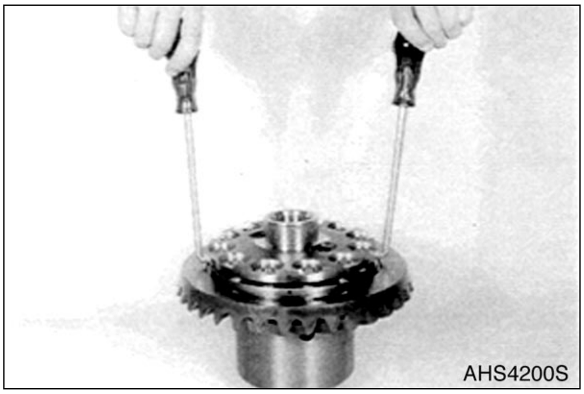


Figure 49

5. Take all components of the multidisk self locking differential out of the differential case.

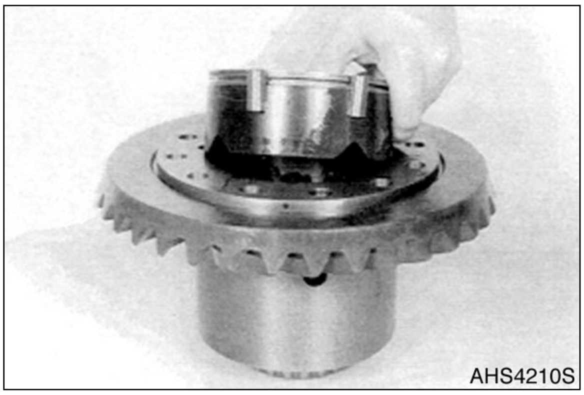


Figure 50

6. Press crown wheel from the differential case.

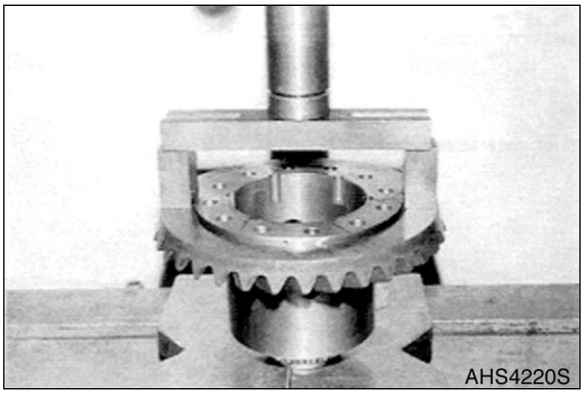


Figure 51

DRIVE UNIT

1. Unlock slotted nut or hex. head screw (according to the Version) and remove lock plate.

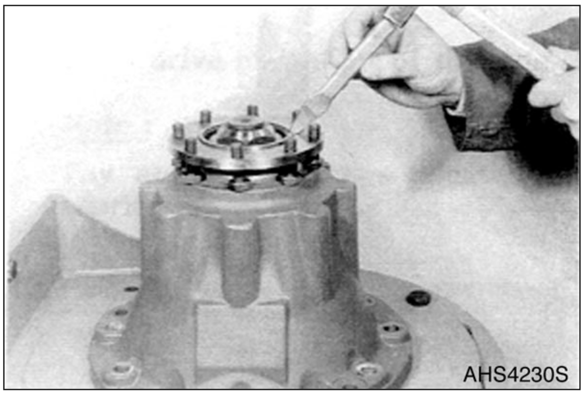


Figure 52

2. Loosen slotted nut or hex. nut (according to the Version) and remove it along with washer.

   NOTE: *See “Special Tools” on page 15.*

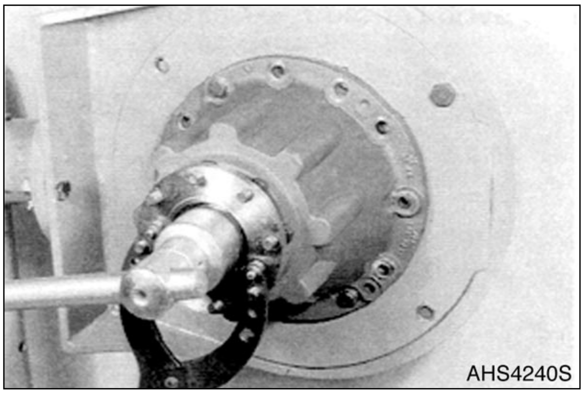


Figure 53

3. Pull off the drive flange.

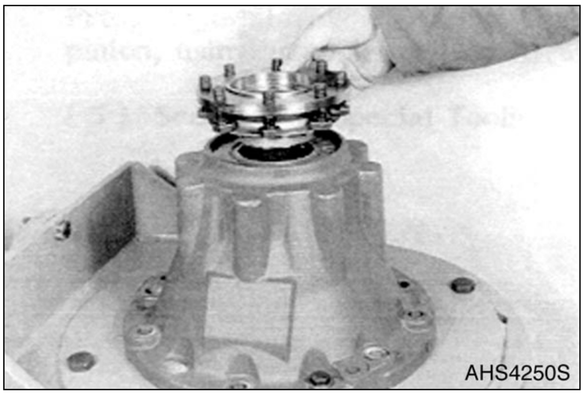


Figure 54

4. Pry out the shaft seal.

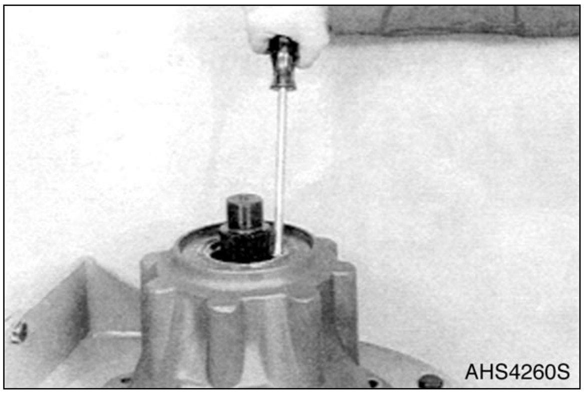


Figure 55

5. Press drive pinion out of the axle carrier.

   NOTE: *Pay attention to the released tapered roller bearing.*

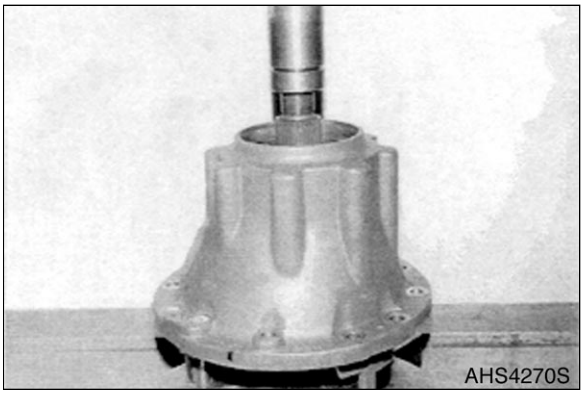


Figure 56

6. Remove spacer from the drive pinion end.

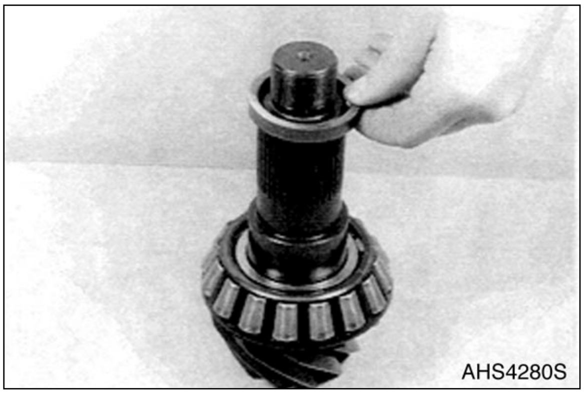


Figure 57

7. Press tapered roller bearing from the drive pinion, using grab sleeve (see Arrow).

   NOTE: *See "Special Tools" on page 15.*

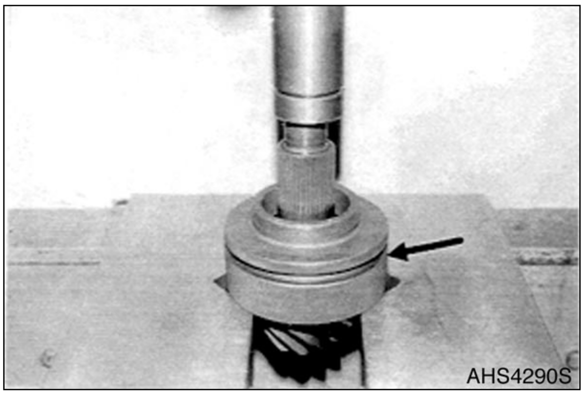


Figure 58

8. If necessary, drive the two outer bearing races out of the axle carrier bores.

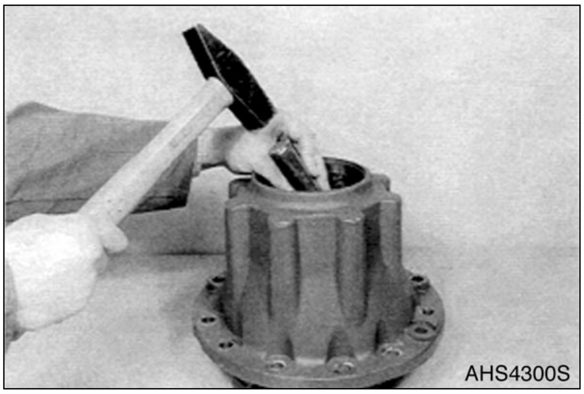


Figure 59

DIFFERENTIAL DISASSEMBLY (VERSION - CAST-ON BEARING CAPS)

NOTE: *Remove the two stub shafts before separate the differential carrier from the axle housing, see Figure 60 - Figure 63.*

1. Drain oil from the final drive and the axle housing.
2. Remove hex. head screws and separate planetary carrier from the hubs, using eye bolt.

   NOTE: *See “Special Tools” on page 15.*

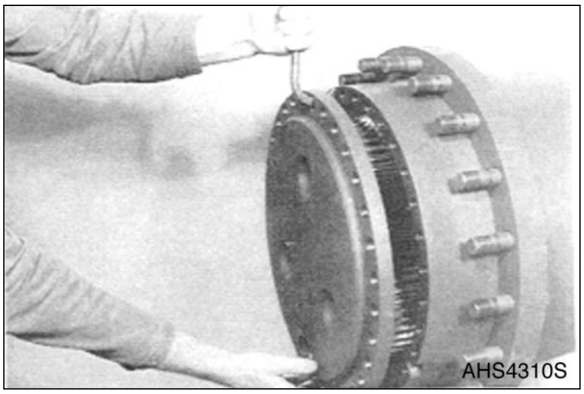


Figure 60

3. Pull inner plate carrier (along with sun gear) from the stub shaft.

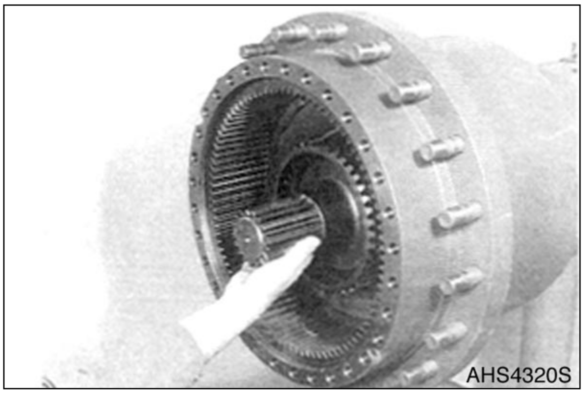


Figure 61

4. Pull stub shaft out of the axle housing.

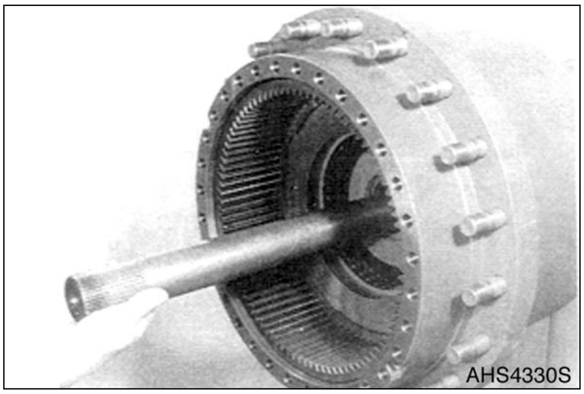


Figure 62

5. Squeeze out circlip and remove plate pack.

   NOTE: *This step is necessary to allow the later installation of the inner plate carrier.*

   NOTE: *See “Special Tools” on page 15.*

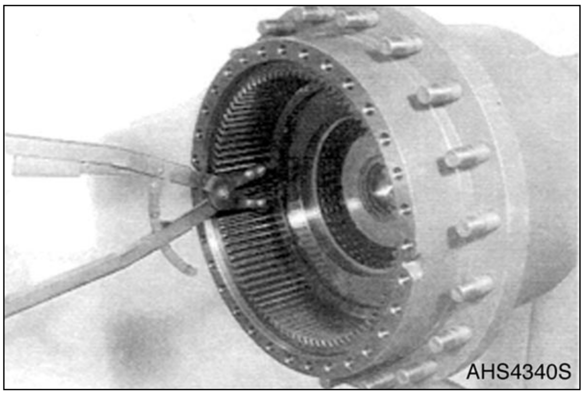


Figure 63

6. Remove hex. head screws and separate differential carrier from the axle housing, using back-off screws.

   NOTE: *See “Special Tools” on page 15.*

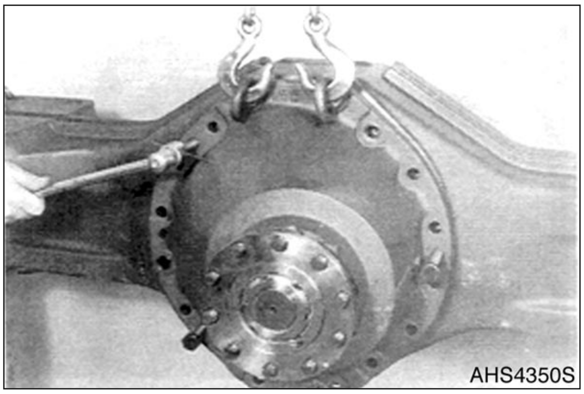


Figure 64

DIFFERENTIAL

1. Fasten the differential carrier in the assembly jig.
2. Drive out the roll pin on the crown wheel side.

   NOTE: *See “Special Tools” on page 15.*

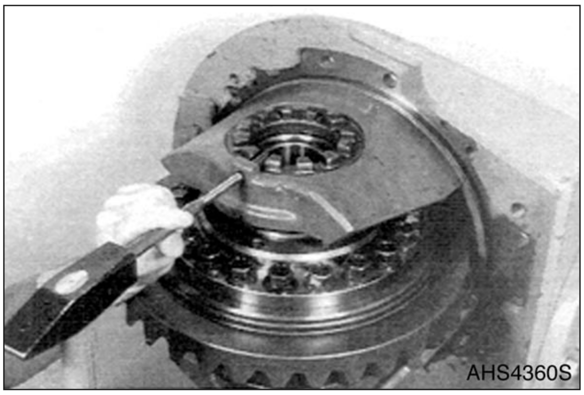


Figure 65

3. Loosen and remove adjusting nut.

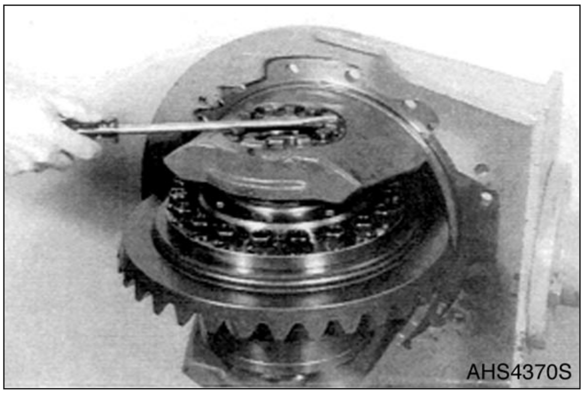


Figure 66

4. Lift differential and remove outer bearing race.

Figure 67

5. Tilt axle carrier 180°.
6. Drive out roll pin (opposite the crown wheel side), remove adjusting nut and outer bearing race (See Figure 68).

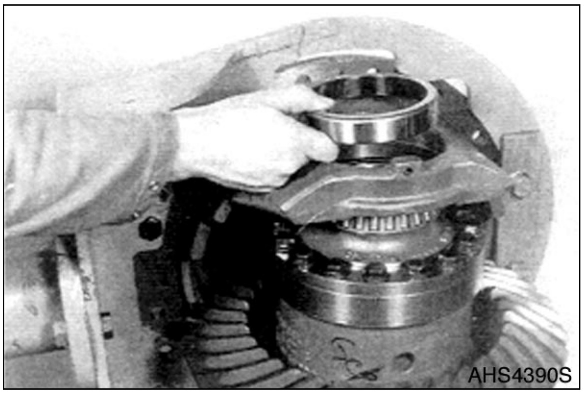


Figure 68

7. Pull off inner bearing race from the housing cover, resp. differential case.

   NOTE: *See "Special Tools" on page 15.*

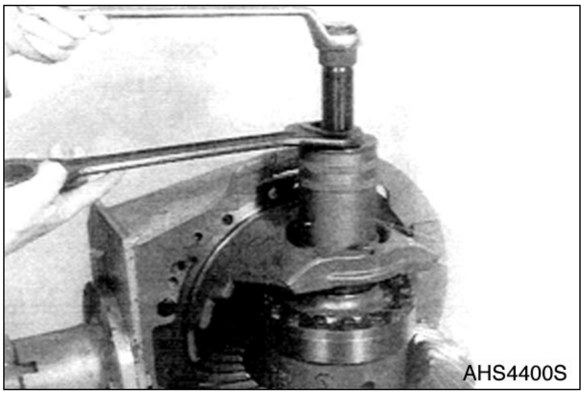


Figure 69

8. Match mark housing cover with differential case.
9. Remove locking screws.

   NOTE: *See "Special Tools" on page 15.*

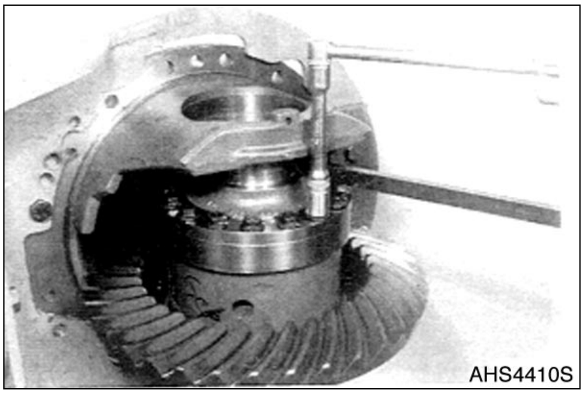


Figure 70

10. Separate housing cover from differential case and pull it out of the axle carrier.

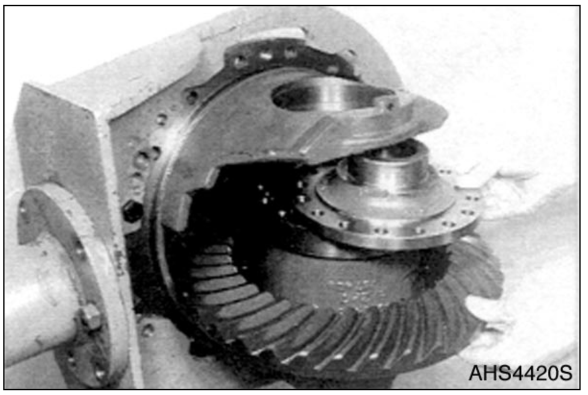


Figure 71

11. Lift differential carrier out of the axle carrier.

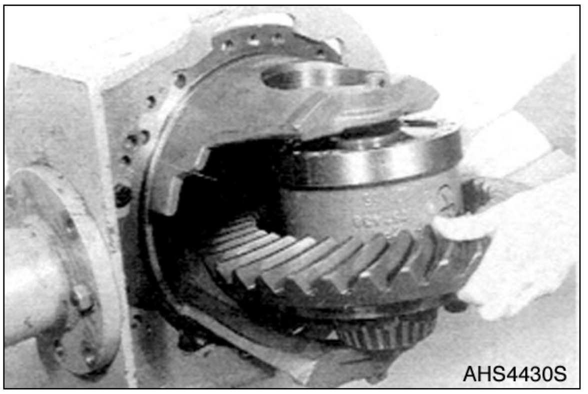


Figure 72

12. Take all components of the multidisk self-locking differential out of the differential case.

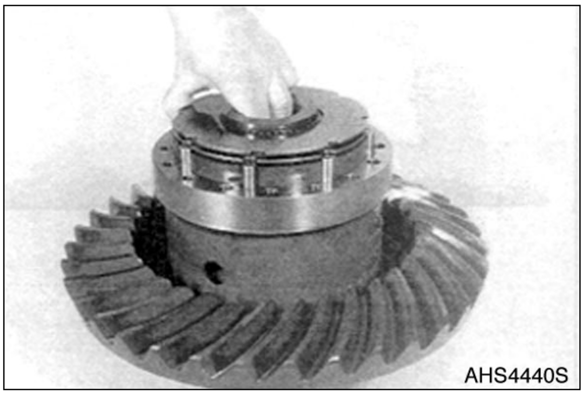


Figure 73

13. Clamp the differential housing.
14. Remove locking screws and separate the crown wheel from the differential case.

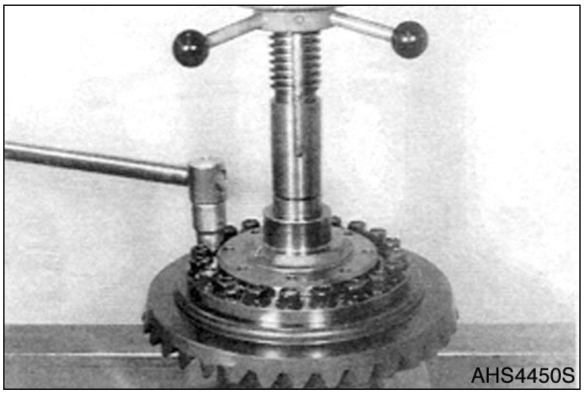


Figure 74

DRIVE UNIT

1. Unlock slotted nut or hex. nut (according to the Version) and remove lock plate.

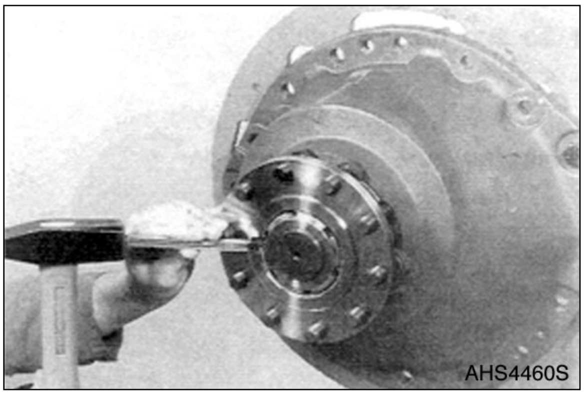


Figure 75

2. Loosen slotted nut or hex. nut (according to the Version) and remove it along with washer.

   NOTE: *See “Special Tools” on page 15.*

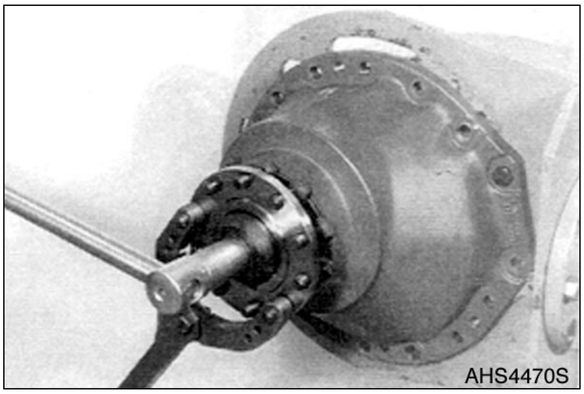


Figure 76

3. Pull off drive flange.

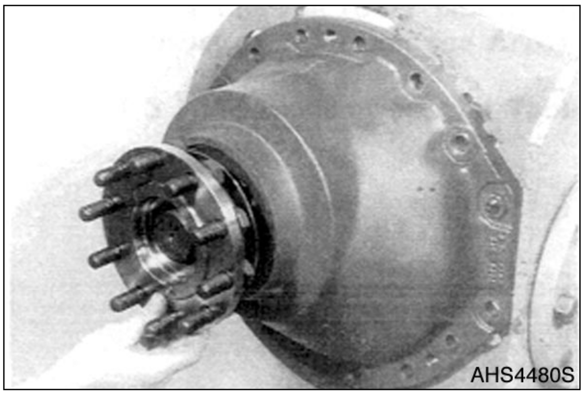


Figure 77

4. Pry out shaft seal.

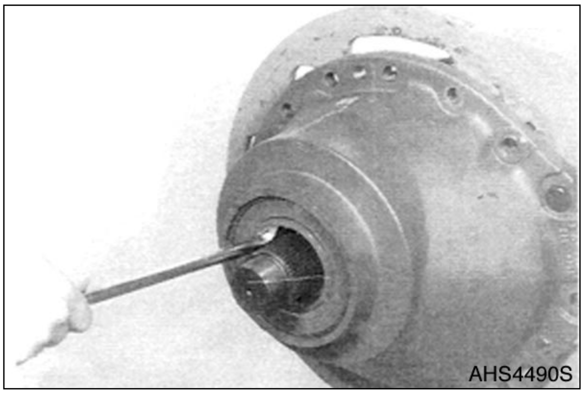


Figure 78

5. Drive the drive pinion out of the axle carrier.

   NOTE: *Pay attention to the released tapered roller bearing. If necessary drive the two outer bearing races out of the axle carrier bores.*

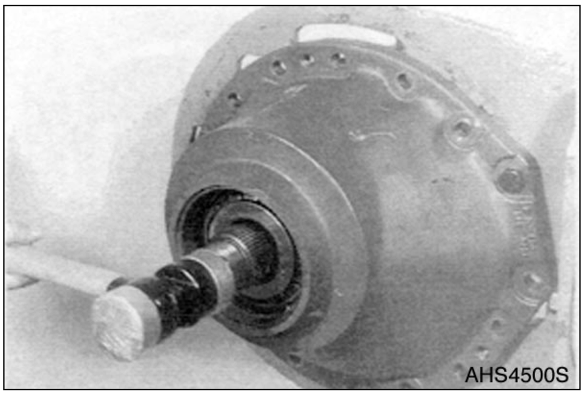


Figure 79

6. Pull spacer from the drive pinion end.

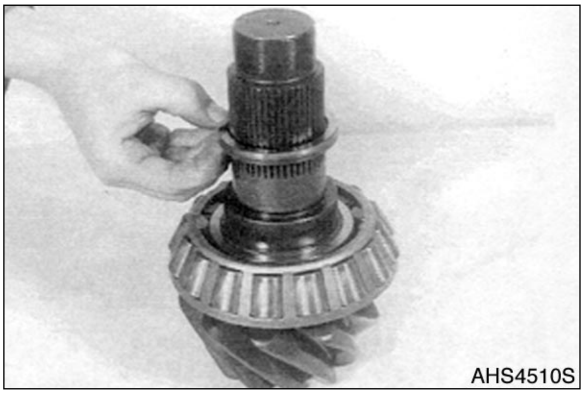


Figure 80

7. Press tapered roller bearing from drive pinion using grab sleeved (See Arrow).

   NOTE: *See "Special Tools" on page 15.*

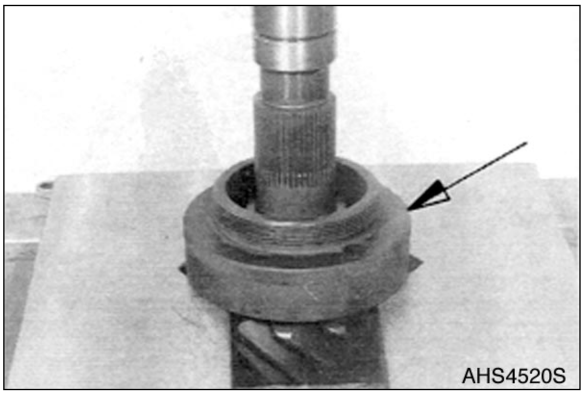


Figure 81

DIFFERENTIAL DISASSEMBLY (VERSION - SCREWED AND CAST-ON BEARING CAPS)

NOTE: *Remove the two stub shafts before separate the differential carrier from the axle housing, see Figure 82 - Figure 84.*

1. Drain oil from the final drive and the axle housing.
2. Remove hex. head screws and separate planetary carrier from the hub, using eye bolt.

   NOTE: *See "Special Tools" on page 15.*

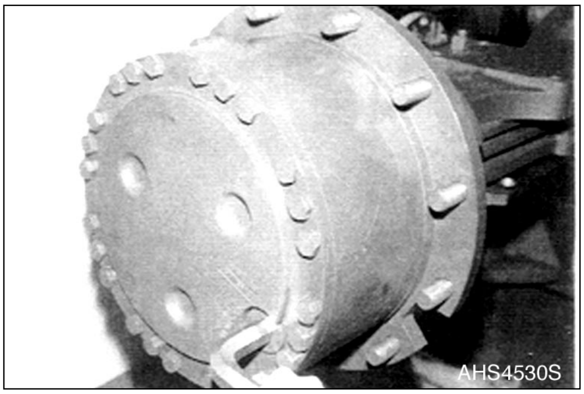


Figure 82

3. Pull inner plate carrier along with the sun gear from the stub shaft.

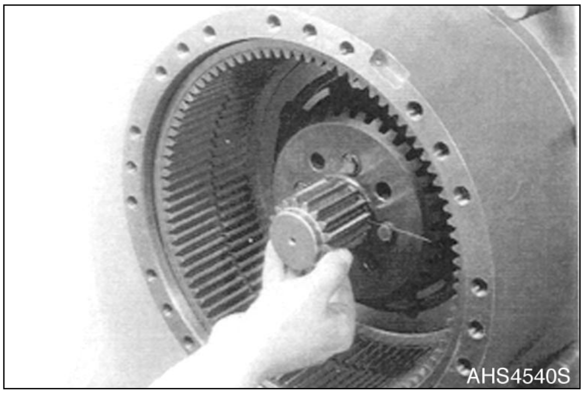


Figure 83

4. Pull stub shaft out of the axle housings squeeze out circlip and remove the plate pack.

   NOTE: *This step is necessary to allow the later installation of the inner plate carrier.*

   NOTE: *See "Special Tools" on page 15.*

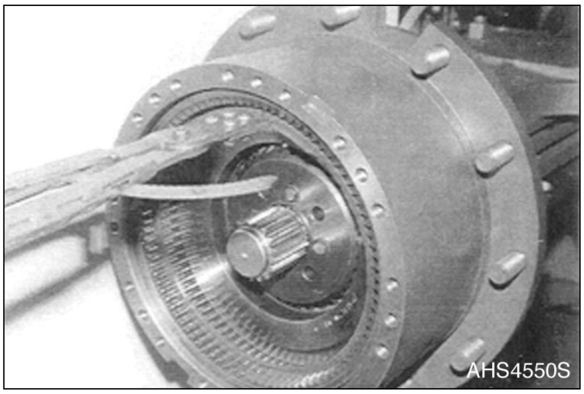


Figure 84

5. Remove hex. head screws and separate the differential carrier from the axle housing.

   NOTE: *See "Special Tools" on page 15.*

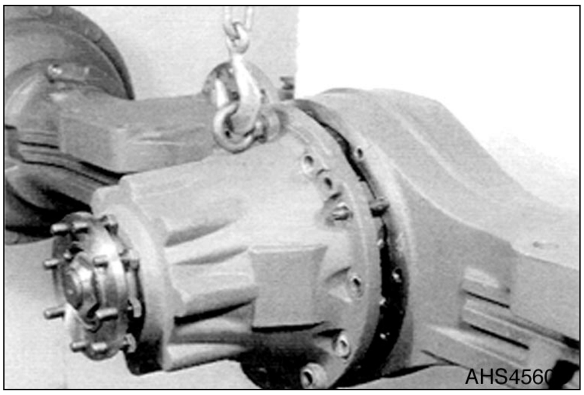


Figure 85

6. Fasten differential carrier in the assembly jig.

7. Drive out the roll pin.

   NOTE: *See "Special Tools" on page 15.*

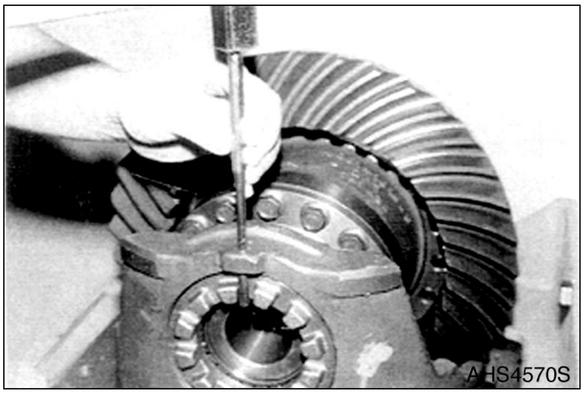


Figure 86

8. Remove lock wire and lock plate.

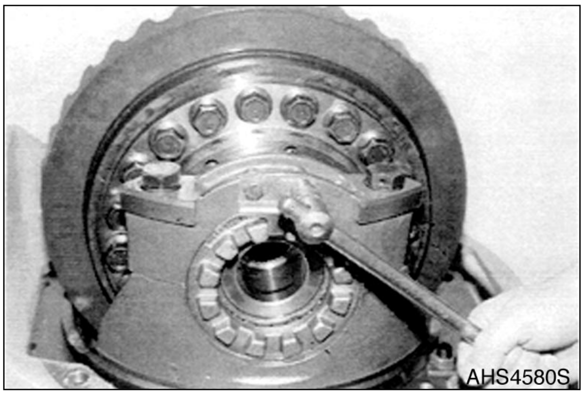


Figure 87

9. Loosen and remove the two adjusting nuts.

   NOTE: *See "Special Tools" on page 15.*

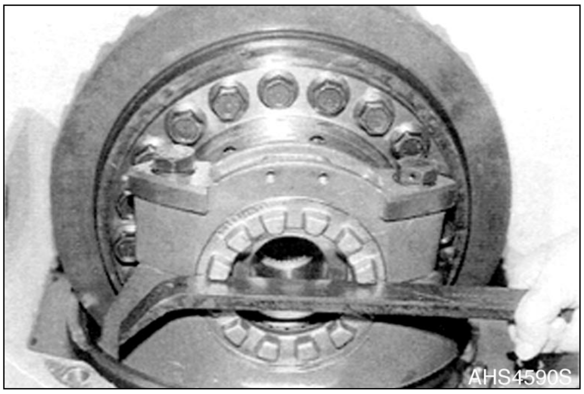


Figure 88

10. Remove hex. head screws and remove bearing caps.

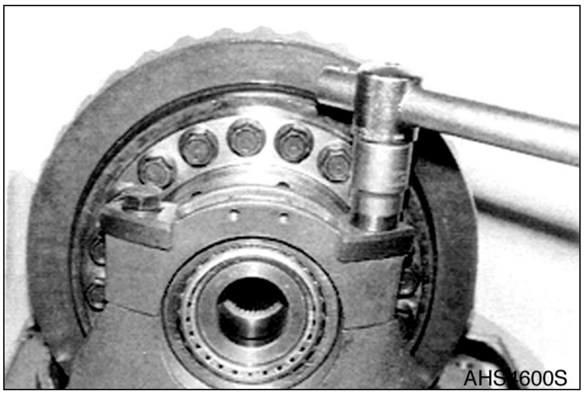


Figure 89

11. Lift the differential assembly out of the axle carrier.

    NOTE: *Pay attention to the released outer bearing races.*

    NOTE: *See “Special Tools” on page 15.*

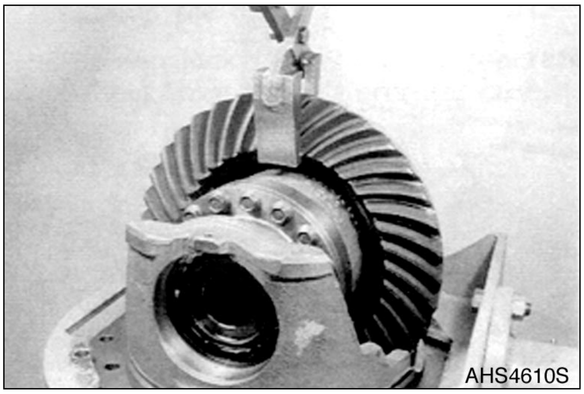


Figure 90

DIFFERENTIAL

1. Pull off the two inner bearing races from the housing cover, resp. differential case.

   NOTE: *See “Special Tools” on page 15.*

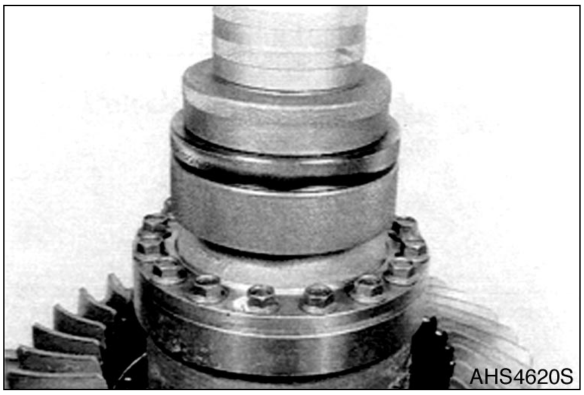


Figure 91

2. Match mark housing cover with differential case.
3. Remove locking screws.

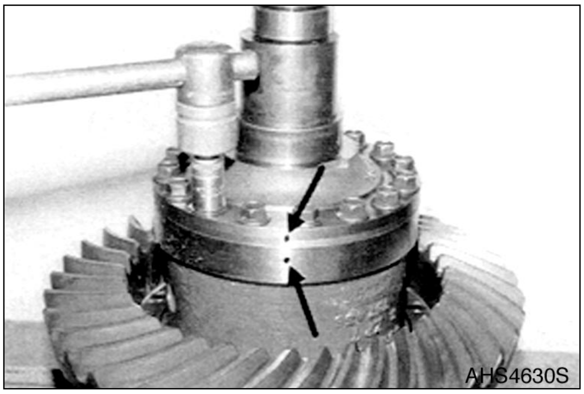


Figure 92

4. Take all components of the multidisk self-locking differential out of the differential case.

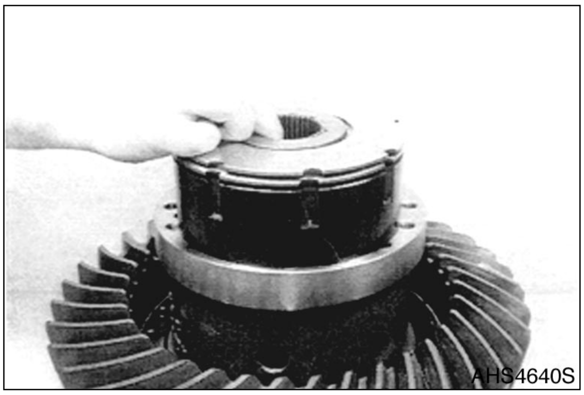


Figure 93

5. Clamp the differential case half.
6. Remove locking screws and separate the crown wheel from the differential case.

Figure 94

DRIVE UNIT

1. Unlock slotted nut and remove lock plate.

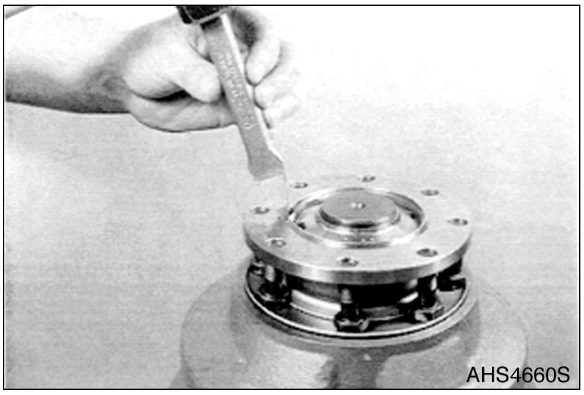


Figure 95

2. Loosen slotted nut or hex. nut (according to the Version) and remove it along with washer.

   NOTE: *See "Special Tools" on page 15.*

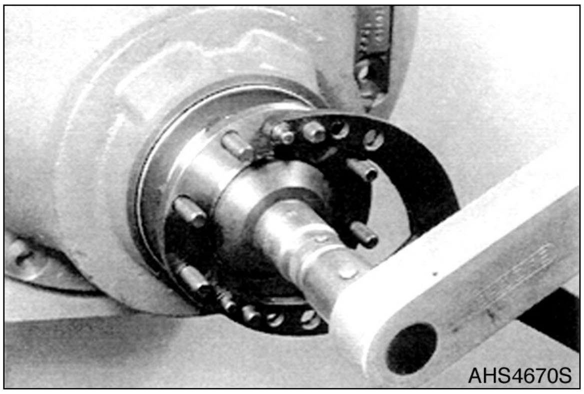


Figure 96

3. Pull off drive flange.

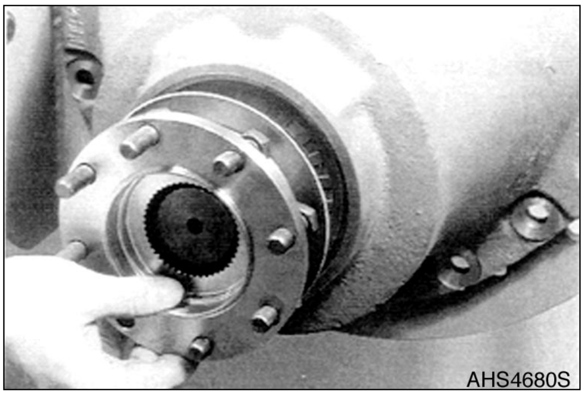


Figure 97

4. Pry out shaft seal.

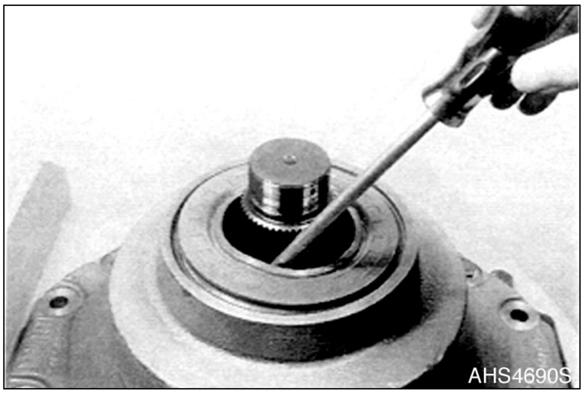


Figure 98

5. Press drive flange out of the axle carrier.

NOTE: *Pay attention to the released tapered roller bearing.*

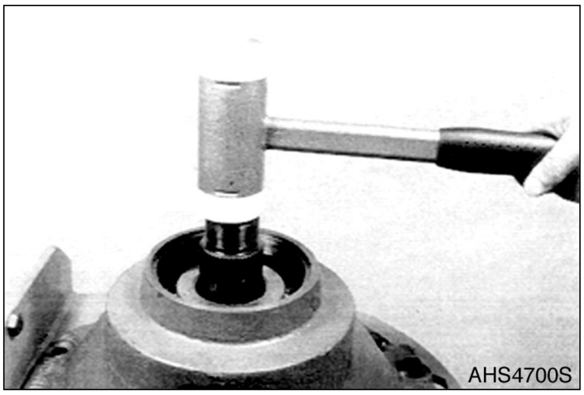


Figure 99

6. Pull spacer from the drive pinion end.

Figure 100

7. Separate the tapered roller bearing from the drive pinion.

   NOTE: *See “Special Tools” on page 15.*

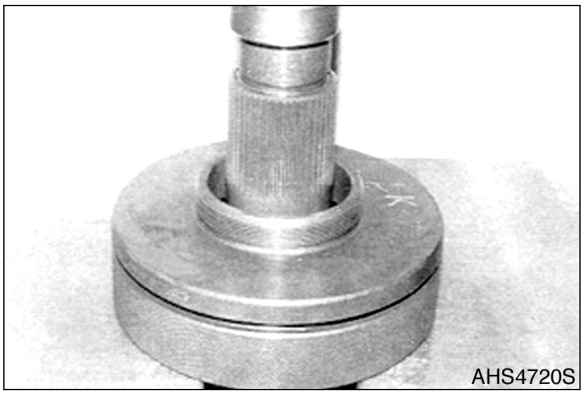


Figure 101

8. If necessary, drive the two outer bearing races out of the axle carrier.

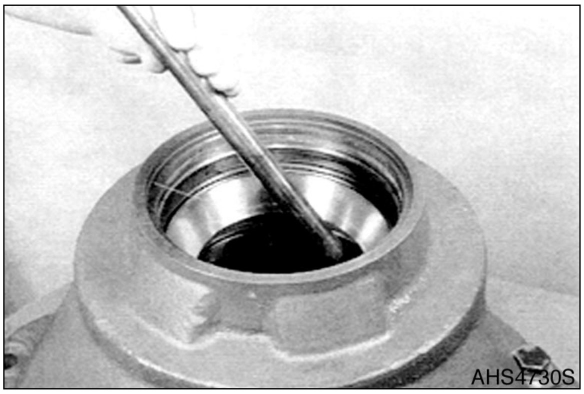


Figure 102

FINAL DRIVE REASSEMBLY

HUB CARRIER

1. Fasten hub carrier on the axle housing using hex. head screws.

   NOTE: *See "Torque Limits for Screws" on page 6.*

   NOTE: *See "Special Tools" on page 15.*

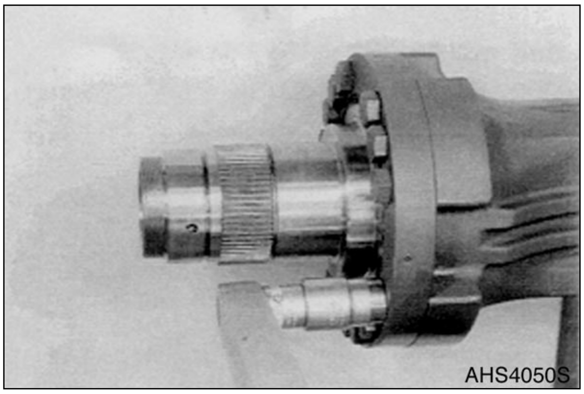


Figure 103

CAUTION!

Pay attention to the installation position.

Cover flange-mounted surface with sealing compound.

2. Pull the wheel studs into the hub bores, using a special device.

   NOTE: *See "Special Tools" on page 15.*

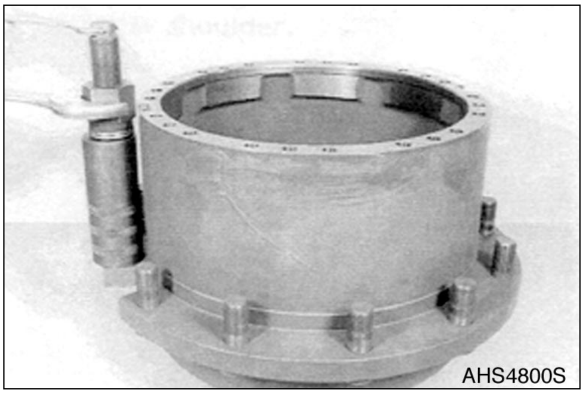


Figure 104

3. Drive both outer bearing races firmly against shoulder.

   NOTE: *See "Special Tools" on page 15.*

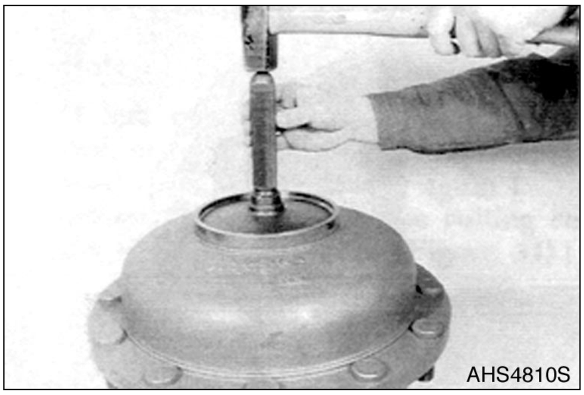


Figure 105

4. Guide the inner bearing race over the end of the hub carrier until contact is obtained.

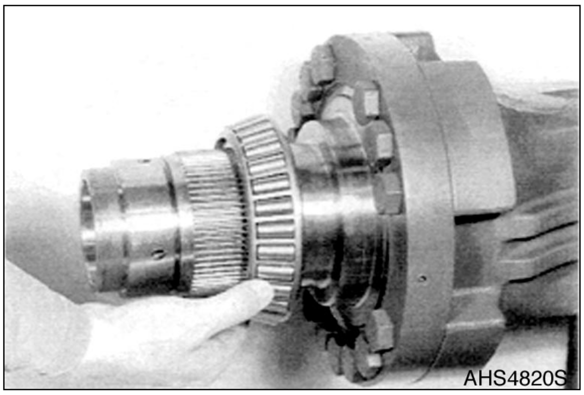


Figure 106

5. Guide hub over the end of the hub carrier.

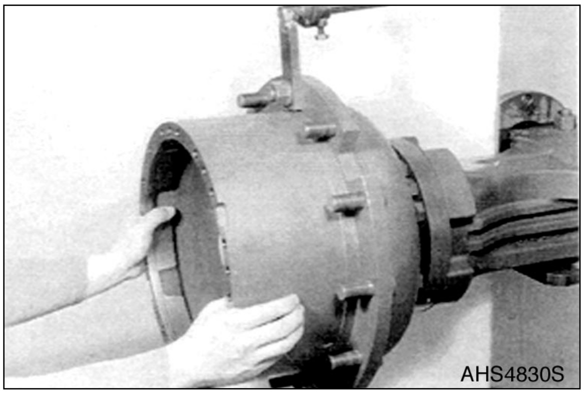


Figure 107

6. Heat inner bearing race and place it firmly against shoulder.

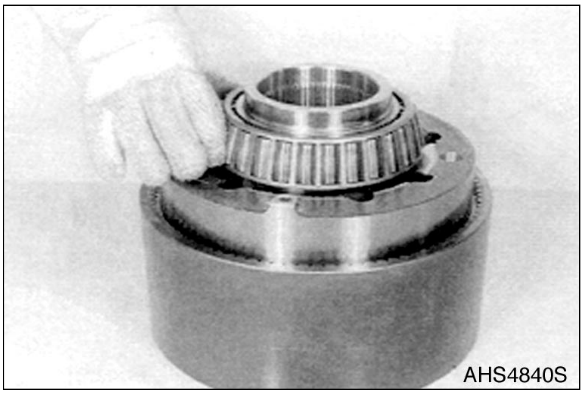


Figure 108

7. Assemble spacer s = 5.4 mm (0.2126 in) (empirical value).

NOTE: *If hub carriers hub and internal gear carrier are not replaced we recommend to install the existing spacer again. Decisive, however, is the rolling resistance of the wheel bearing, See Figure 112.*

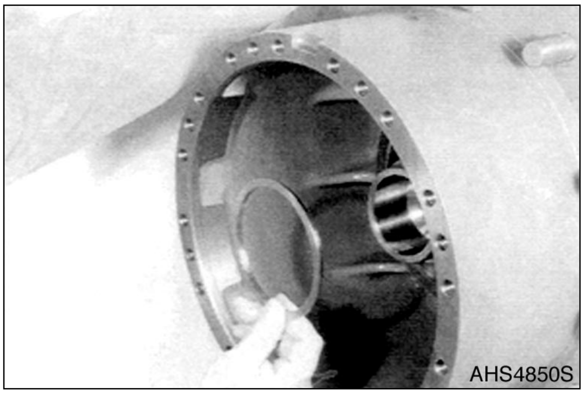


Figure 109

8. Screw installer (S) over the threads of the hub carrier.
9. Guide complete internal gear over the hub carrier splines and fix the hub.

NOTE: *See “Special Tools” on page 15.*

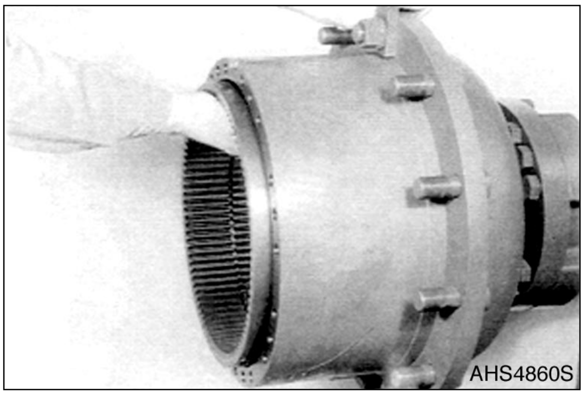


Figure 110

10. Tighten slotted nut while continuously turning of the hub.

NOTE: *Torque limit:*
AP-407/409 = 800 - 1000 Nm (590 - 740 ft lb)
AP-411/415 = 1370 - 7570 Nm (1,010 - 5,585 ft lb)
AP-417/420 = 2000 - 2200 Nm (1,475 - 1,620 ft lb)

NOTE: *See “Special Tools” on page 15.*

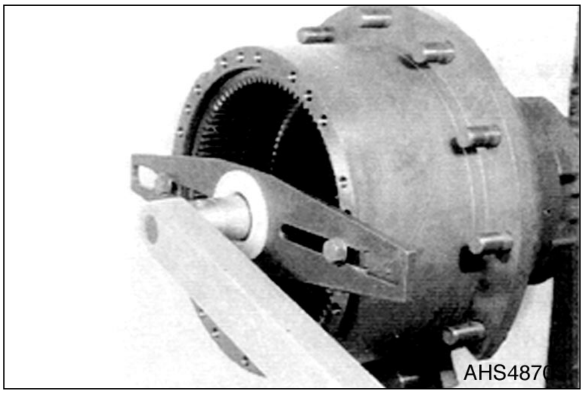


Figure 111

Check Rolling Resistance of Wheel Bearing

T = F x R, from that result: Tractive Force

$$F = \frac{T}{R}$$

T = Rolling resistance in Nm (Newton meter)
F = Tractive Force in N (Newton)
R = Radius in m (meter)

NOTE: *See “Special Tools” on page 15.*

1. Nominal value / Bearing rolling moment.

NOTE: *AP - 407/409/411/415 = 11 - 18 Nm (8.1 - 13.3 ft lb)*
AP - 417/420 = 14 - 20 Nm (10.3 - 14.7 ft lb)

NOTE: *For already run-in bearings try to find the lower value.*

NOTE: *If the required rolling resistance is not obtained, correct using a corresponding spacer, see Figure 109.*

NOTE: *After adjustment of the wheel bearing remove hub again.*

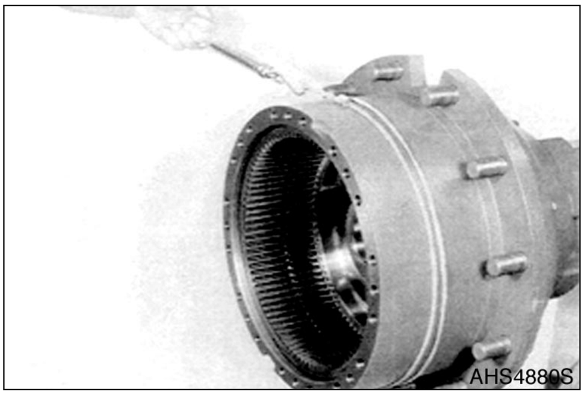


Figure 112

HUB

1. Insert inner bearing race into the hub.

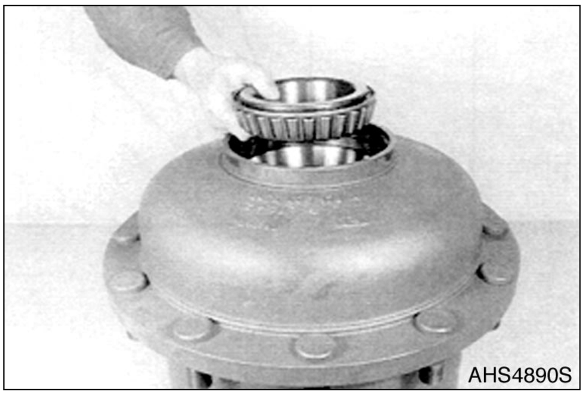


Figure 113

2. Cover outside of shaft seal with Loctite #578 and drive it in.

   NOTE: *Installation depth 7.0 - 7.8 mm (0.2756 - 0.3071 in) is determined by the special tool. If necessary, (according to the Version) heat cover plate before assemble the hub and install it.*

   NOTE: *See “Special Tools” on page 15.*

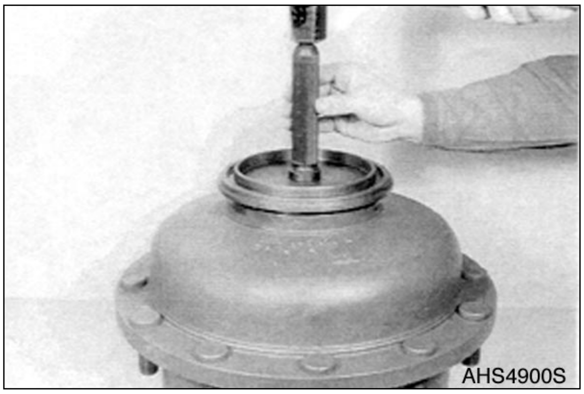


Figure 114

3. Carefully guide hub over the hub carrier end against shoulder.

   NOTE: *See “Special Tools” on page 15.*

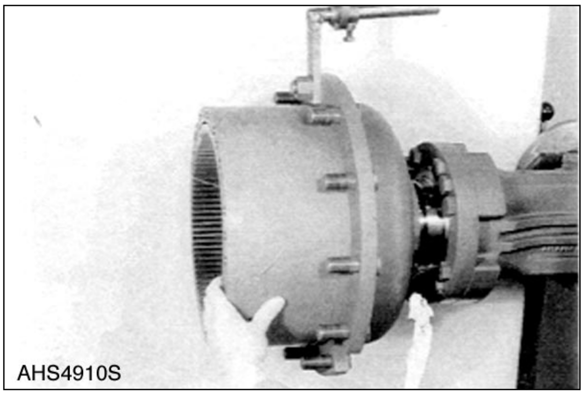


Figure 115

Complete Internal Gear Carrier

1. Figure 116, shows the installation position of the backup sealing elements.

Reference Number	Description
1	Backup Ring
2	Packing Ring
3	U-section Ring

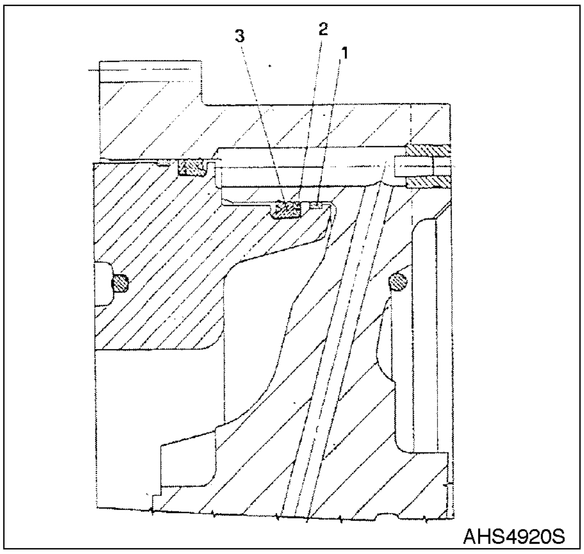


Figure 116

2. Clean the piston with mineral spirits. Stick on support ribbons at two points using Loctite #496.
3. The support ribbons must adhere exactly around the whole circumference. Remove any sticking residues.

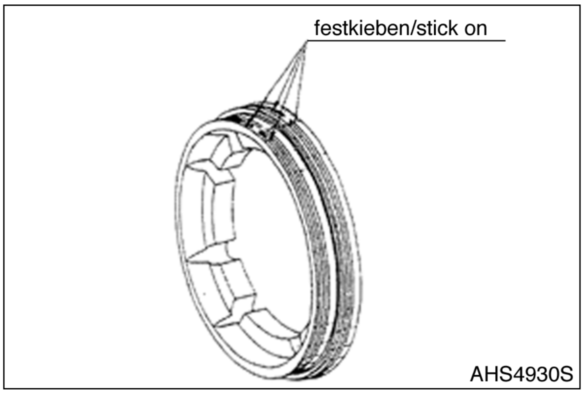


Figure 117

4. Install packing rings (2) and U-section lings (3).

   NOTE: *Pay attention to the installation position, see Figure 116.*

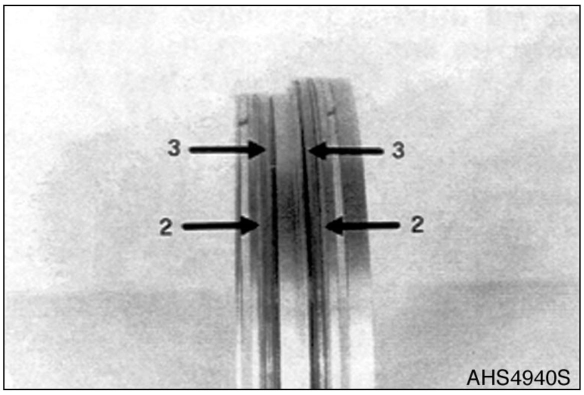


Figure 118

5. Insert piston into the installer (S).

   NOTE: *Lubricate sealing and backup elements, (Use W-10 oil).*

   NOTE: *See “Special Tools” on page 15.*

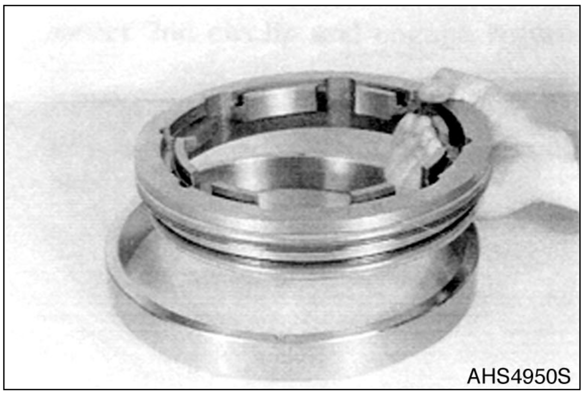


Figure 119

6. Insert piston with installer into the internal gear carrier.

   NOTE: *Pay attention to the radial installation position, (openings for return springs).*

   With installed condition, the support ribbon openings must face upwards.

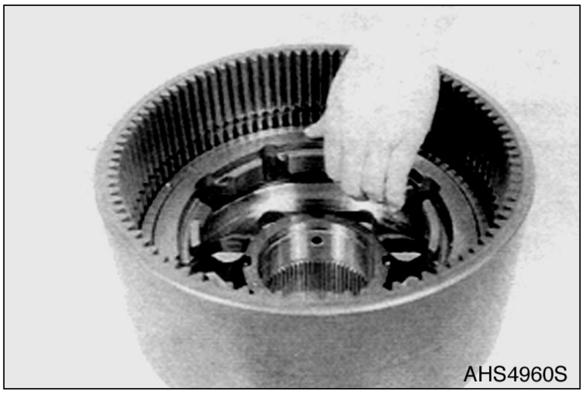


Figure 120

7. Press piston carefully against shoulder, using clamping plate (S) and two-leg puller (S).

   NOTE: *See “Special Tools” on page 15.*

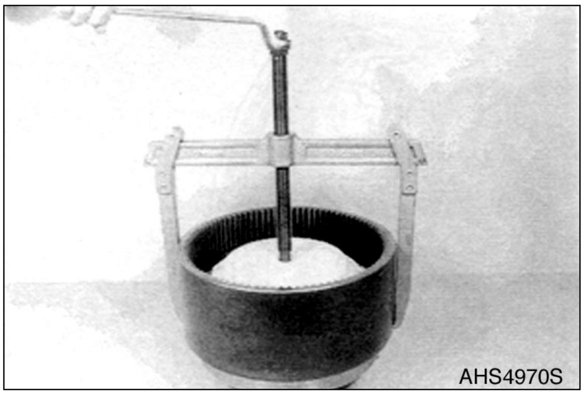


Figure 121

8. Engage return springs (with lug facing outwards) on the circlip and assemble it in the internal gear carrier.

   NOTE: *Pay attention to the radial installation position of the circlip (see Arrow).*

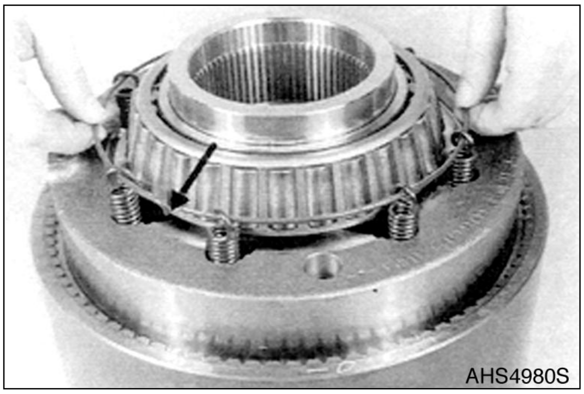


Figure 122

9. Insert 2nd circlip and engage return springs.

   NOTE: *Pay attention to the radial installation position of the circlip.*

   NOTE: *See "Special Tools" on page 15.*

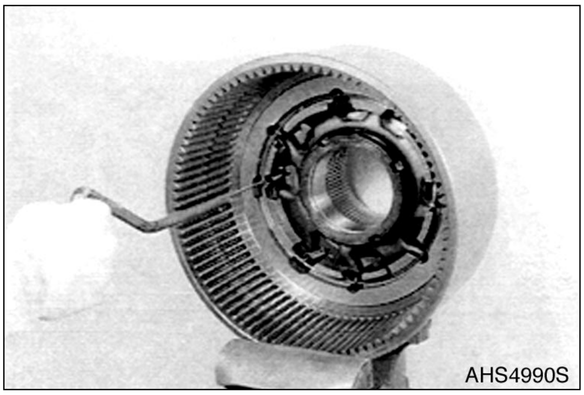


Figure 123

10. Insert O-ring into the groove of the internal gear carrier and grease it slightly.

11. Mark the location of the oil supply holes on the face, (see Arrow).

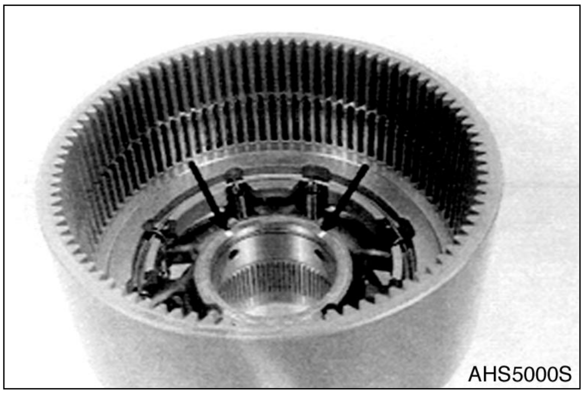


Figure 124

INTERNAL GEAR CARRIER

1. Screw installer (S) over the threads of the hub carrier.

2. Assemble the spacer determined in Figure 109.

   NOTE: *See "Special Tools" on page 15.*

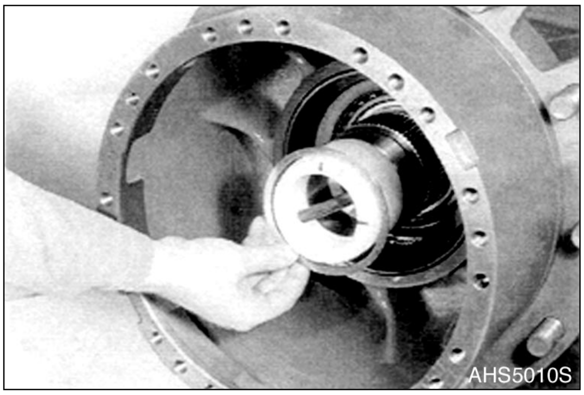


Figure 125

3. Guide O-ring over the hub carrier and insert it into the groove.

4. Mark the radial location of the oil supply bores on the face (see Arrows).

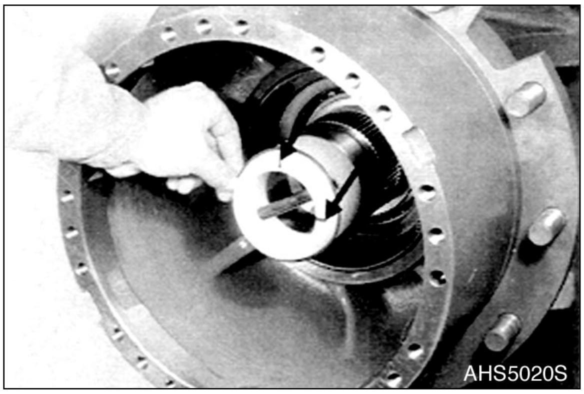


Figure 126

5. Guide the complete internal gear over the splines of the hub carrier. At the same time pay attention to the overlapping of the oil holes (hub carrier, internal gear carrier), (see Arrows).

   NOTE: *During these steps it is absolutely necessary to respect the centric location of the hub to make a correct reassembly of the internal gear - internal gear carrier possible, and to avoid a damage of the two O-rings.*

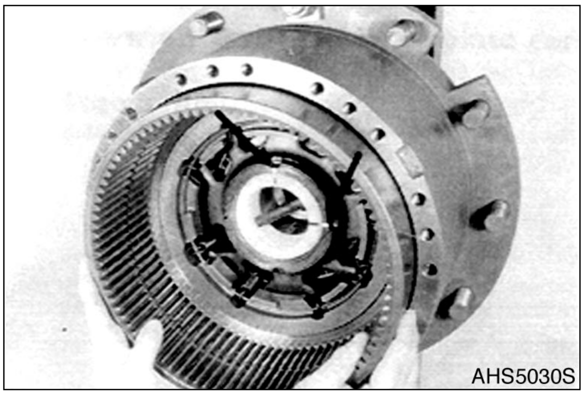


Figure 127

6. Tighten slotted nut while continuously turning of the hub.

   NOTE: *Torque limit:*
   AP-407/409 = 800 - 1,000 Nm (590 - 740 ft lb)
   AP-411/415 = 1,300 - 1,500 Nm (960 - 1,105 ft lb)
   AP-417/420 = 2,000 - 2,200 Nm (1,475 - 1,620 ft lb)

   NOTE: *See "Special Tools" on page 15.*

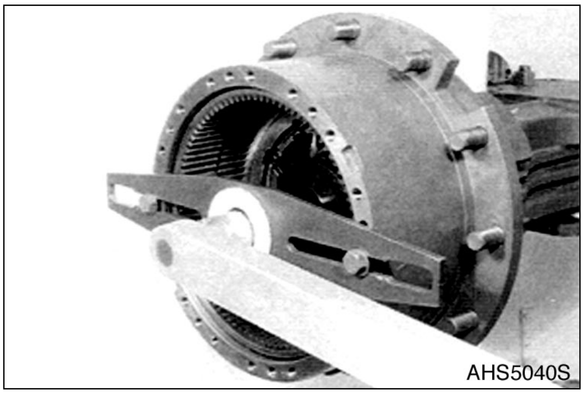


Figure 128

7. Install lock plate and secure slotted nut.

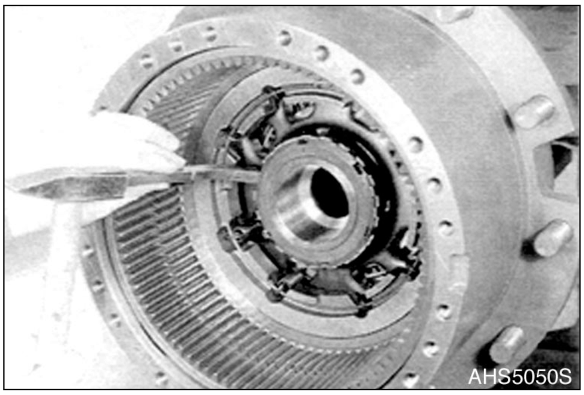


Figure 129

8. Assemble stub shaft until contact is obtained.

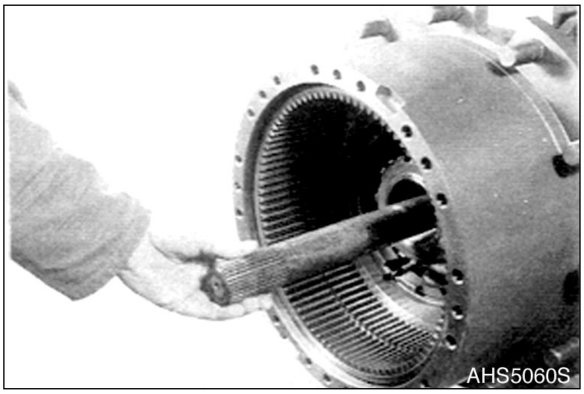


Figure 130

9. Attach oil seal to inner plate carrier.

   NOTE: *Torque limit:*
   AP 407 - 420 = 50 Nm (37 ft lb)

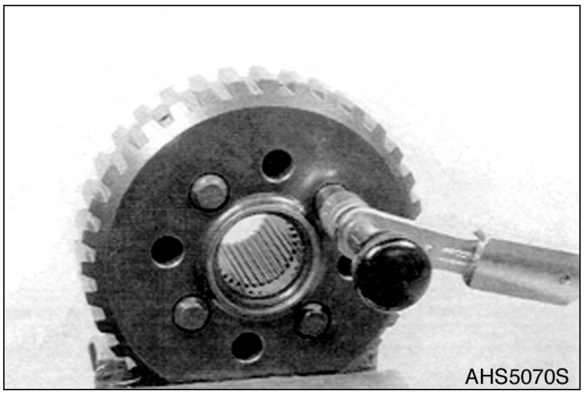


Figure 131

10. Install thrust washer.

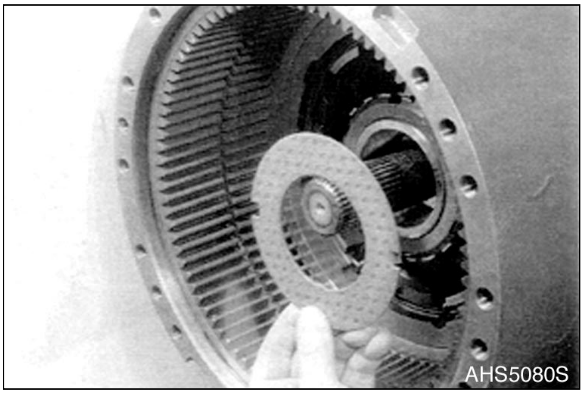


Figure 132

11. Guide the inner plate carriers (along with the sun gear) on the stub shaft splines.

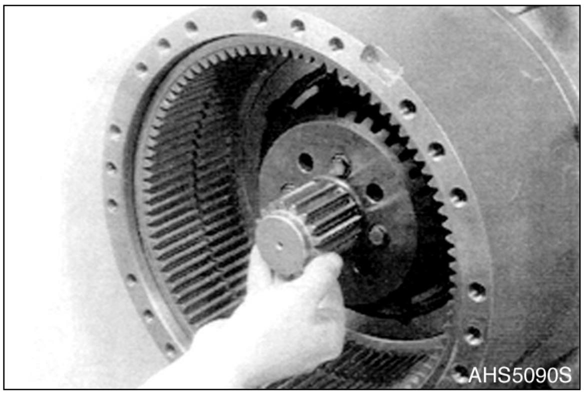


Figure 133

Adjusting Plate Clearance According To Table

Number of inner plate	Number of friction faces	Plate clearance - piston stroke in	
		mm	in.
2	4	1.6 - 2.0	0.0630 -0.0787
3	6	2.4 - 2.8	0.0945 - 0.1102
4	8	3.2 - 3.6	0.1260 - 0.1417
5	10	4.0 - 4.4	0.1575 - 0.1732

1. Determine piston stroke (Nominal value 2.4 - 2.8 mm) (0.0945 - 0.1102 in).
2. Squeeze in circlip and place it against shoulder towards the outside.
3. Determine dimension A from the flange-mounted surface / hub to the plane surface / piston.
   - Dimension A e.g. 121.50 mm (4.7835 in).

   NOTE: *Pay attention to the correct location of the piston against the internal gear carrier.*

   NOTE: *See “Special Tools” on page 15.*

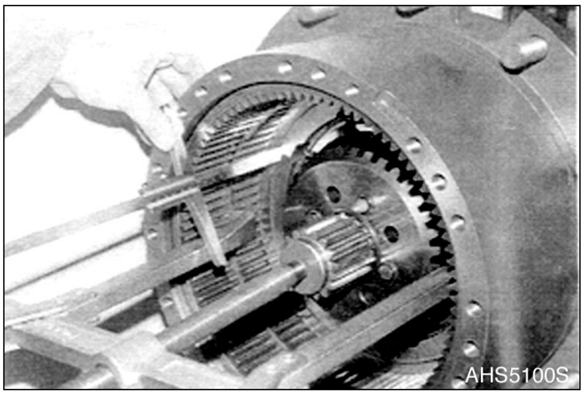


Figure 134

4. Measure dimension B from the flange-mounted surface/hub to the inner plane surface of the circlip.
   - Dimension B e.g. 75.20 mm (2.9606 in).

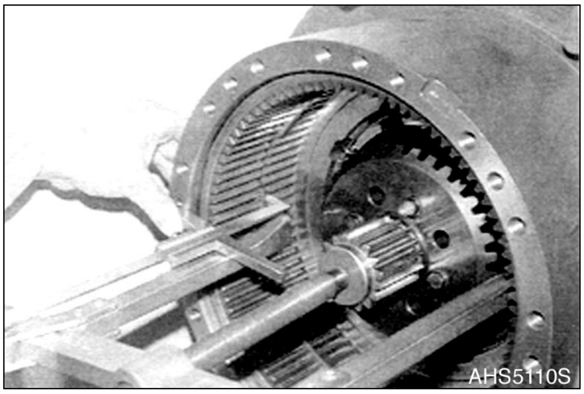


Figure 135

5. Outer plate: 4 x 4.5 mm (0.1575 x 0.1772 in).
   - Dimension C e.g. 18.00 mm (0.7087 in).

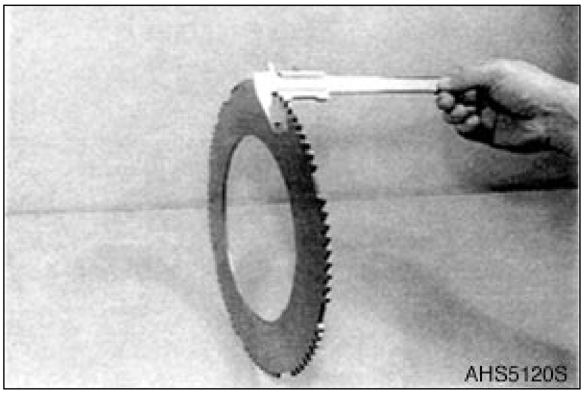


Figure 136

6. Inner plate: 3 x 4.5 mm (0.1181 x 0.1772 in).

   - Dimension D e.g. 13.50 mm (0.5315 in).

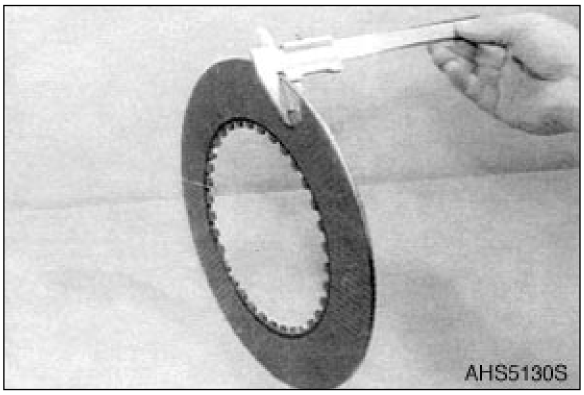


Figure 137

7. Dimension E = Backing plate.

   - Dimension E e.g. 12.00 mm (0.4724 in).

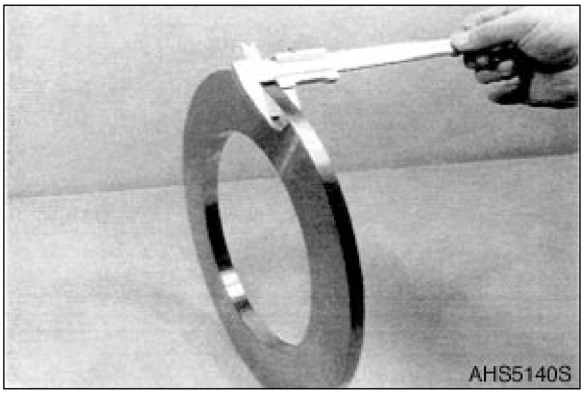


Figure 138

EXAMPLE

Dimension A		121.50 mm (4.7835 in)
Dimension B	-	75.20 mm (2.9606 in)
Dimension C	-	18.00 mm (0.7080 in)
Dimension D	-	13.50 mm (0.5315 in)
Dimension E	-	12.00 mm (0.4724 in)
Difference = Plate clearance	=	2.80 mm (0.1102 in)

NOTE: *If the required plate clearance according the table, (See page 67) is not obtained, correct with corresponding outer plates. If necessary, mount thinner outer plates on the piston side, resp. backing plate side.*

8. Install alternating outer and Inner plates (starting with one outer plate).

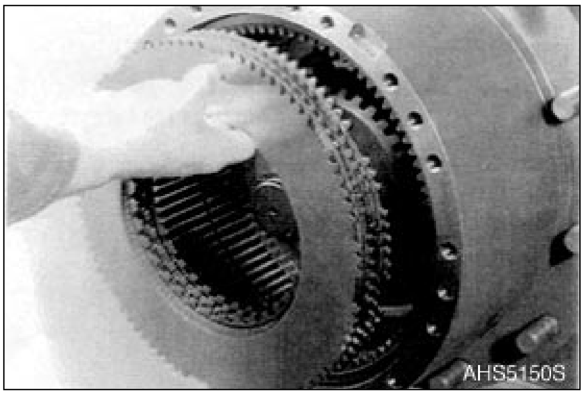


Figure 139

9. Figure 140, shows the required arrangement of the outer plates.

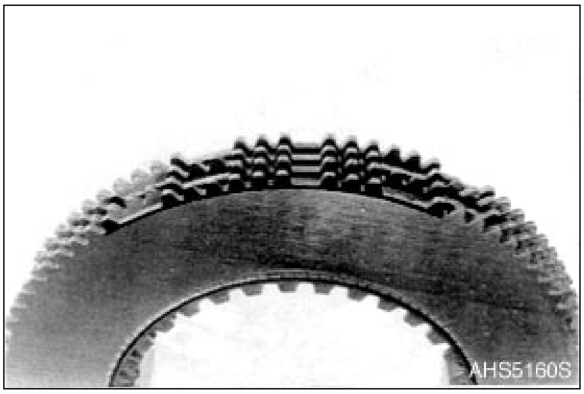


Figure 140

10. Insert backing plate - stepped plane surface is facing outwards.

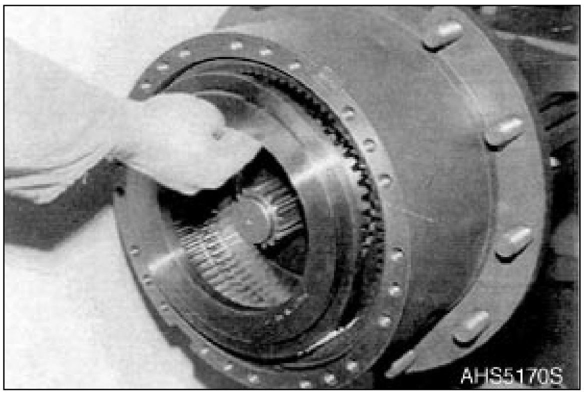


Figure 141

11. Hold plate pack into position using circlip.

NOTE: *See "Special Tools" on page 15.*

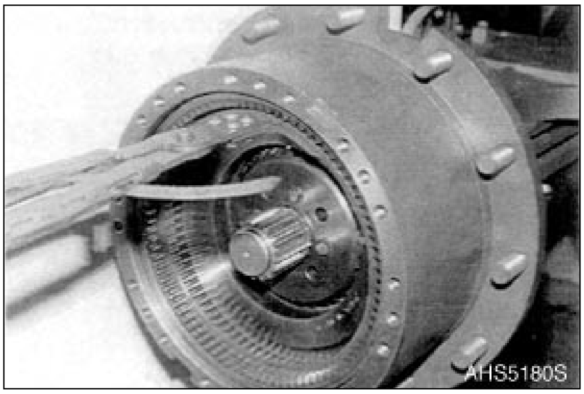


Figure 142

12. Heat planetary gear and place it on the planetary carrier.

    NOTE: *Pay attention to the installation position, large radius of the inner bearing race must be facing the planetary carrier (downwards).*

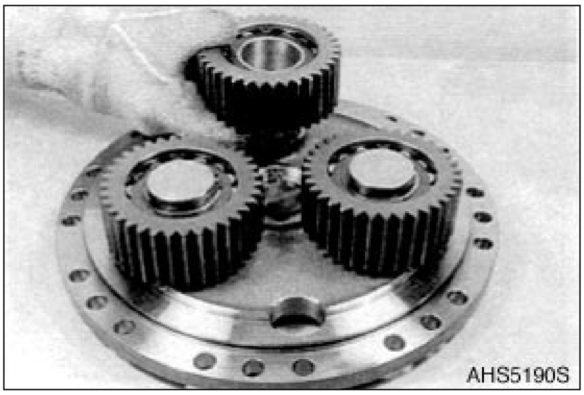


Figure 143

13. Squeeze in circlip.

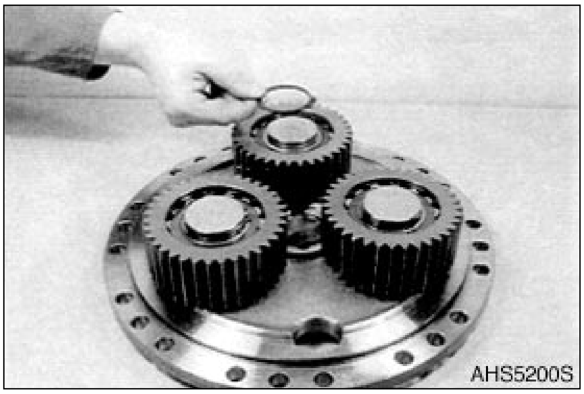


Figure 144

Determine Sun-gear Shaft Play

Normal value 0. 3 - 0.6 mm (0.0118 - 0.0236 in), try to fine the higher value.

1. Place sun gear and plate carrier against shoulder.
    - Dimension A e.g. 6.00 mm (0.2362 in).

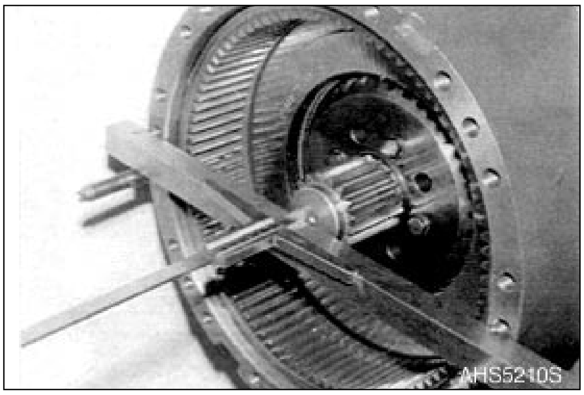


Figure 145

2. Determine dimension B from the flange-mounted surface to the thrust washer.
    - Dimension B e.g. 5.50 mm (0.2165 in).

    NOTE: *For the measurement, lay thrust washer into the planetary carrier.*

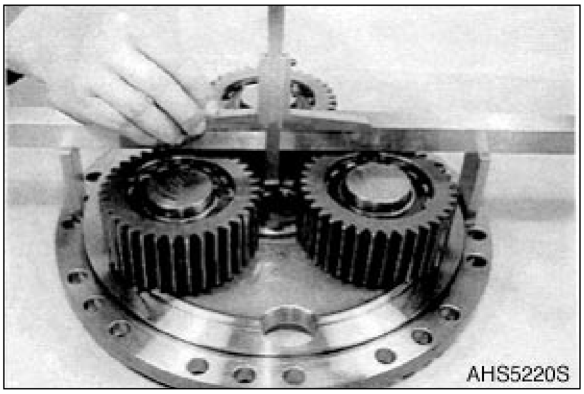


Figure 146

EXAMPLE

Dimension A	6.00 mm (0.2362 in)
Dimension B	- 5.50 mm (0.2165 in)
Required end play of the sun-gear shaft	= 0.50 mm (0.0197 in)

NOTE: *Remove thrust washer again and make it adhere with Loctite #270.*

3. Insert new O-ring into the ring groove of the planetary carrier (Arrow).

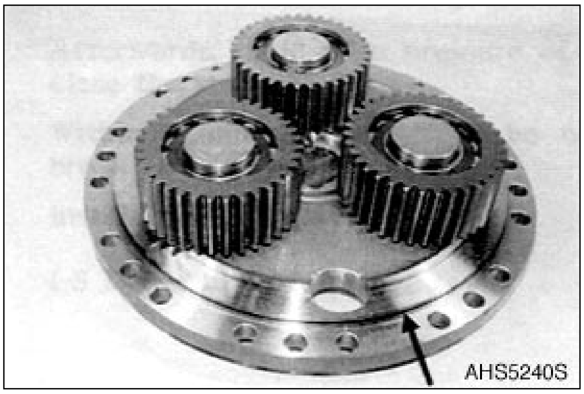


Figure 147

4. Assemble planetary carrier until contact is obtained.

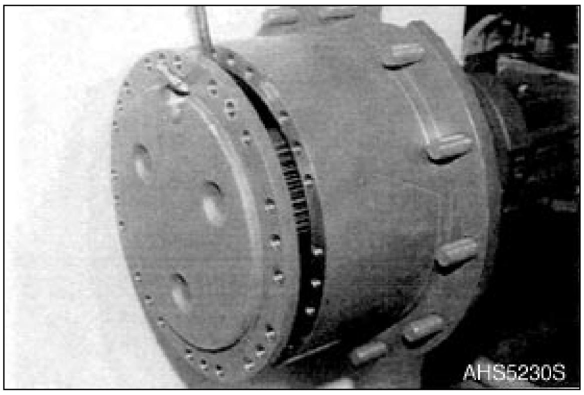


Figure 148

5. Tighten hex. head screws.

   NOTE: *See "Torque Limits for Screws" on page 6.*

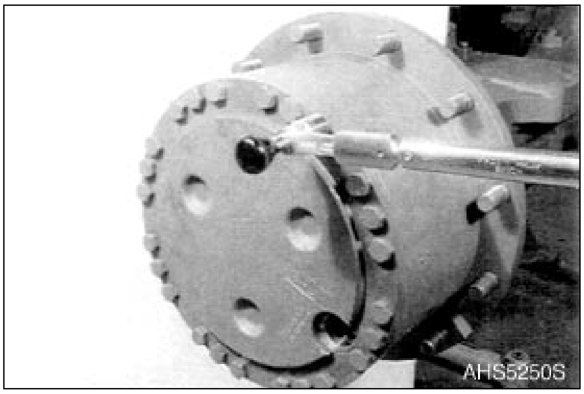


Figure 149

6. Check tightness of the brake hydraulic system

CAUTION!

Bleed the brake.

After having applied the brake for about 10 times carry out the following pressure test.

Using a suitable pressure apparatus (Lukas or similar) with stopcock build up an actuating pressure of 120 bar.

Close the stopcock and pressurize the brake for 5 minutes with this pressure. After this timer the pressure may have dropped to 117 bar (1,700 psi) only.

A. Afterwards, build up a pressure of 5 bar (70 psi) and close the stopcock.

B. Within 5 minutes there may be no pressure break.

C. Install bleeder valve.

NOTE: *See "Special Tools" on page 15.*

D. Tighten oil drain plug.

NOTE: *Torque limit 50 Nm (37 ft lb).*

NOTE: *Before the Axle is put into service, follow the "Lubrication Instructions" on page 8*

Figure 150

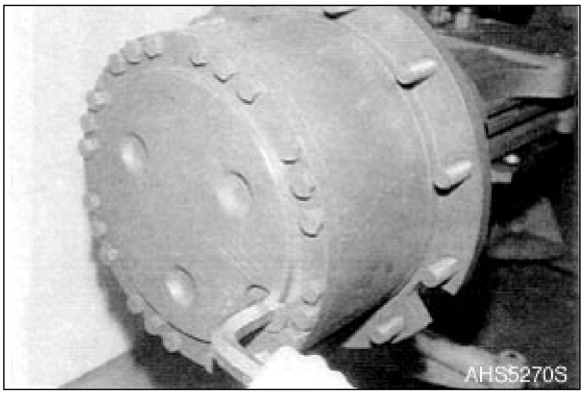


Figure 151

ILLUSTRATED TABLE

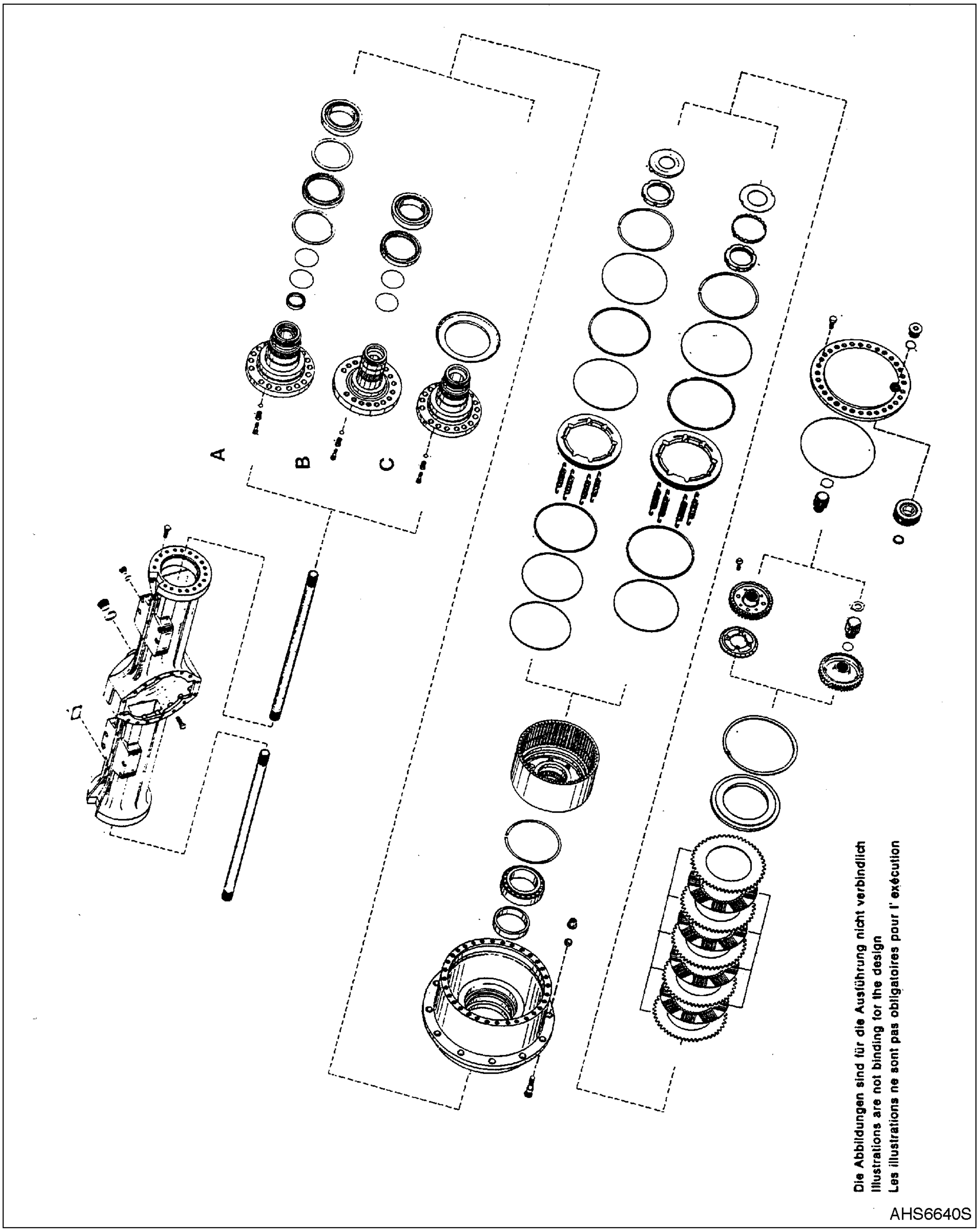


Figure 152

DIFFERENTIAL REASSEMBLY (VERSION - SCREWED BEARING CAPS)

NOTE: *If crown wheel or drive pinion are damaged, the two parts must be replaced as a set. If a new complete crown wheel set is installed, pay attention that crown wheel and drive pinion have the same mating numbers.*

NOTE: *When replacing a complete crown wheel set or axle carrier, pay attention to the Figure 153.*

DETERMINE THICKNESS OF SHIM

NOTE: *The following measuring operations must be carried out with utmost care. Inexact measurements would cause an incorrect contact pattern and require replacement of the drive pinion and the differential (partial) after the contact pattern has been taken. See "Examples of Gear-tooth-contact Patterns for the Gleason Gear-tooth System" on page 11.*

1. Install adjusting pieces (3) and temporarily fasten the two bearing caps Install stop washer (2) and measuring pin (1) and introduce measuring shaft (4). (See Figure 153.)

   CK-Drive

Reference Number	Description
1	Measuring Pin
2	Stop Washer
3	Adjusting Piece
4	Measuring Shaft

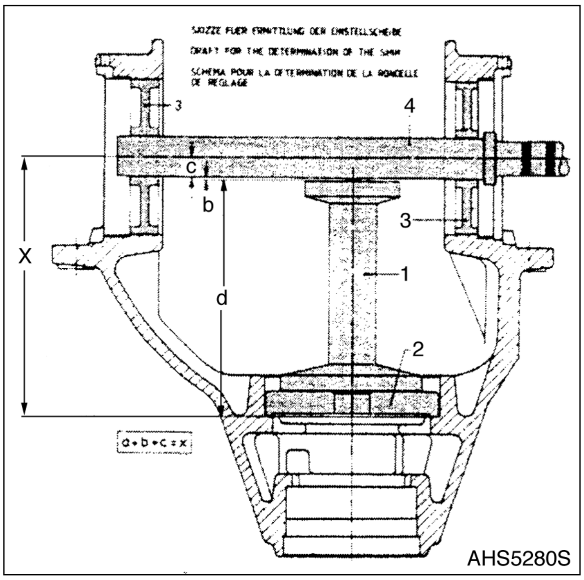


Figure 153

2. Determine gap (Dimension b) between measuring pin and measuring shaft with feeler gauge.

   • Dimension b e.g. 0.70 mm (0.0276 in).

NOTE: *See “Special Tools” on page 15.*

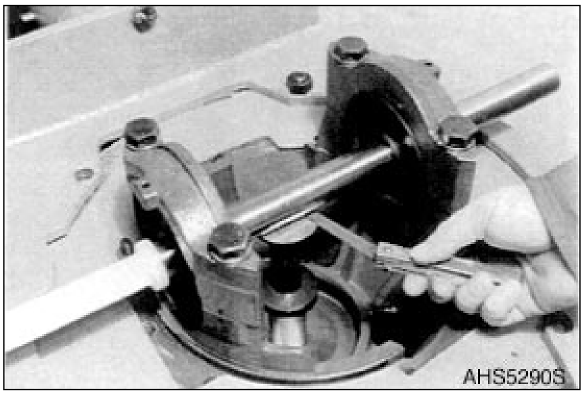


Figure 154

EXAMPLE I

Dimension a (measuring piston)		166.80 mm (6.5669 in)
Dimension b	+	0.70 mm (0.0276 in)
Dimension C (1/2 ∅ measuring shaft)	+	15.00 mm (0.5906 in)
Gives Dimension "X"	=	182.50 mm (7.1850 in)

3. Measure bearing width.

   • Bearing width e.g. 33.50 mm (1.3189 in).

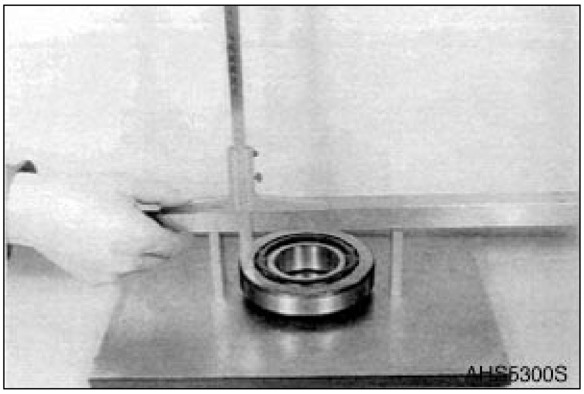


Figure 155

4. Read pinion dimension.
   - Pinion dimension e.g. 147.80 mm (5.8189 in).
5. Now, remove bearing caps, shims, measuring shaft and measuring pin again.

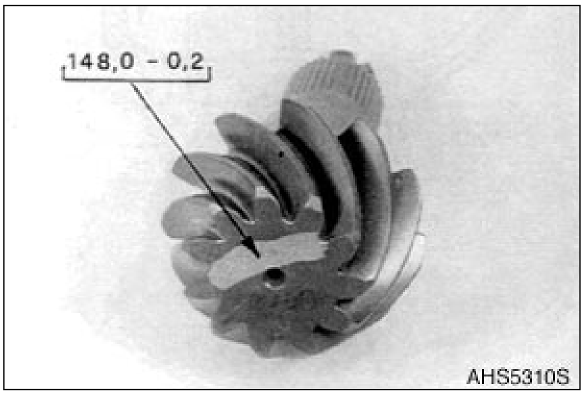


Figure 156

EXAMPLE II

Bearing width	33.50 mm (1.3189 in)
Pinion dimension	+ 147.80 mm (5.8189 in)
Gives Dimension "X" 1	= 181.30 mm (7.1378 in)

EXAMPLE III

Dimension "X"	182.50 mm (7.1457 in)
Dimension "X" 1	- 182.30 mm (7.1772 in)
Difference = Shim thickness	s = 1.20 mm (0.0472 in)

6. Lay shim (s = 1.20 mm (0.0472 in)) into the housing bore.

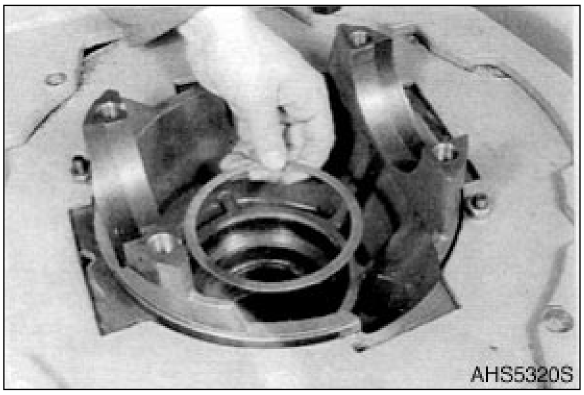


Figure 157

7. Freeze outer bearing race and press it firmly against shoulder.
8. Install the drive flange side outer bearing race correspondingly.

   NOTE: *See “Special Tools” on page 15.*

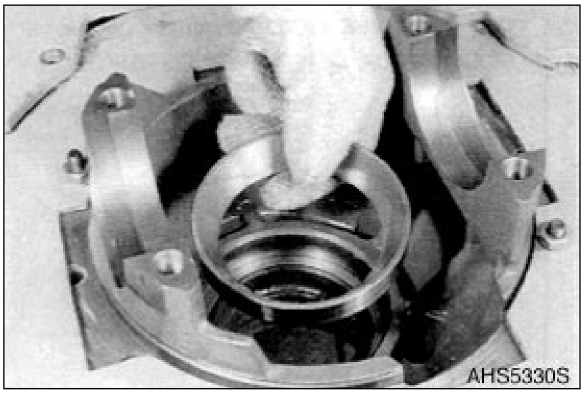


Figure 158

9. Heat inner bearing race, guide it over the drive pinion end until contact is obtained.

   NOTE: *Pay attention to a correct contact, reset after the cooling.*

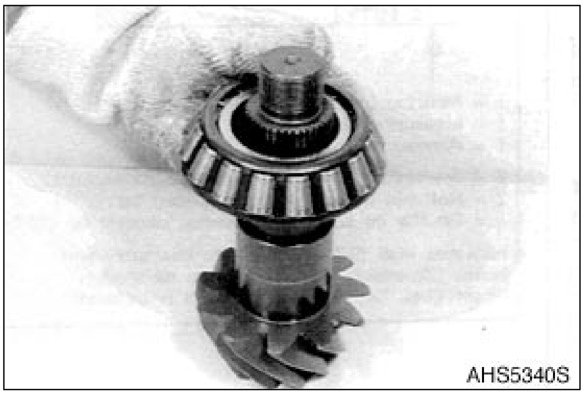


Figure 159

ADJUST ROLLING RESISTANCE OF DRIVE PINION BEARING

Nominal Value

DK / CK	1.1 - 2.3 Nm (9.7 - 20.3 in lb)
HK	1.5 - 3.0 Nm (13.2 - 17.7 in lb)
LK / RK	3.0 - 4.5 Nm (17.7 - 39.8 in lb)

1. Lay measuring ring over the drive pinion collar.

   NOTE: *Configuration and description of the measuring ring, See Figure 161.*

   NOTE: *See “Special Tools” on page 15.*

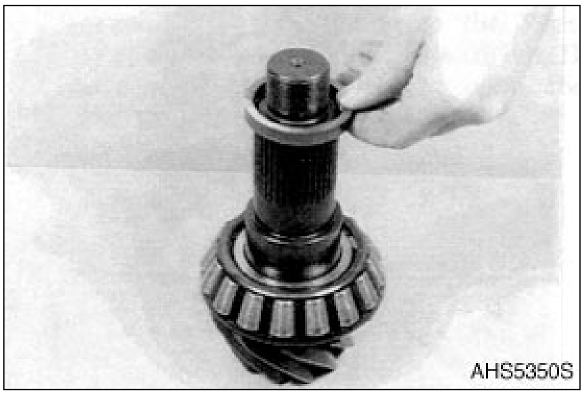


Figure 160

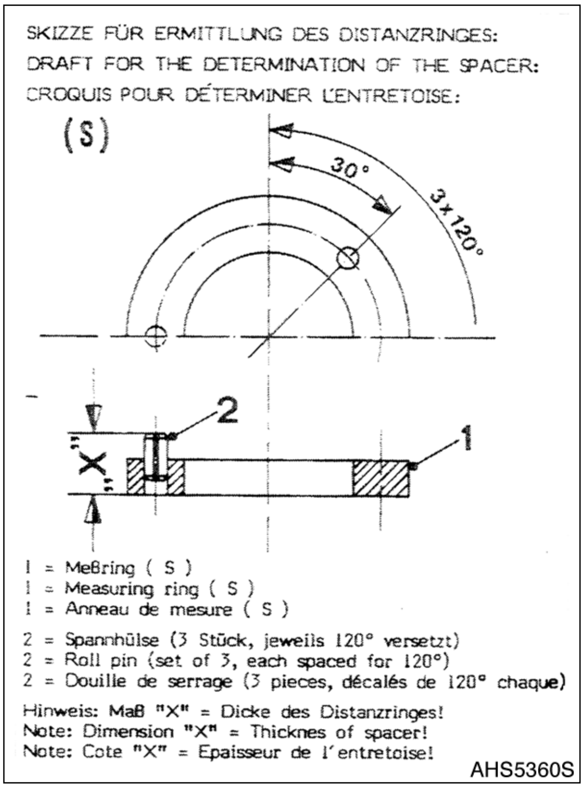


Figure 161

2. If necessary (according to the version), install hex. head screws into the drive flange bores and press the dust shield on the collar of the drive flange.

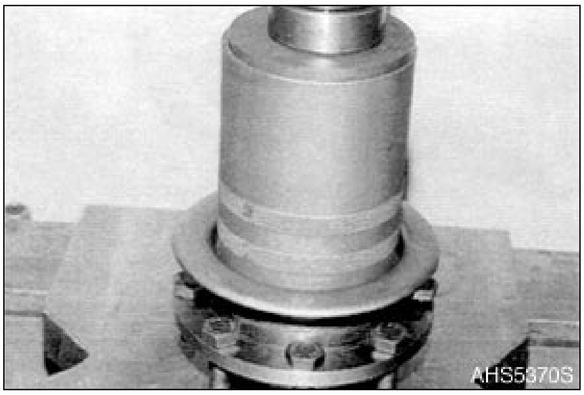


Figure 162

3. Insert the drive pinion into the axle carrier and assemble the heated inner bearing race until contact is obtained.

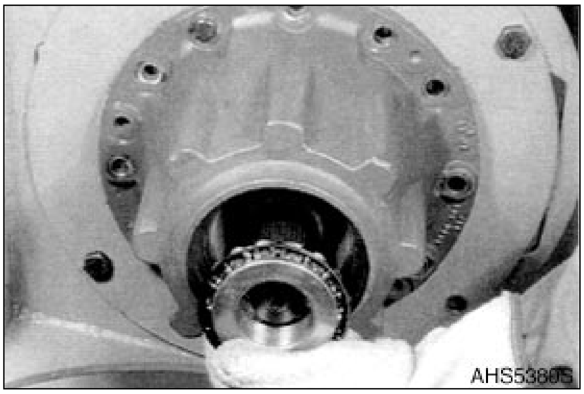


Figure 163

4. Guide drive flange over the drive pinion splines.
5. Install washer and tighten slotted nut until the required rolling resistance is obtained.

   NOTE: *When tightening, make several full revolutions of the drive pinion in both directions, and check the rolling resistance continuously.*

   NOTE: *See "Special Tools" on page 15.*
6. Remove slotted nut, pull off drive flange and remove the pinion again.

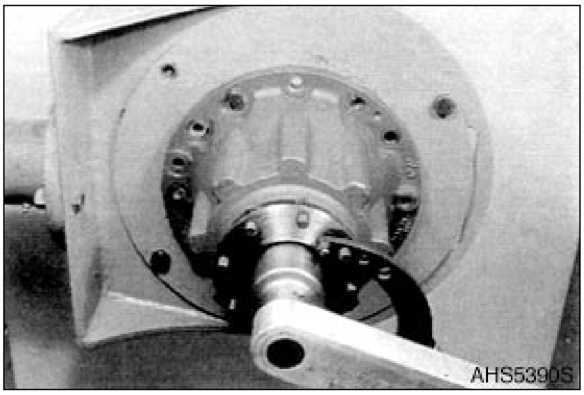


Figure 164

7. Take off measuring ring and determine dimension "X" see Figure 161.

   - Dimension "X" e.g. s = 8.55 mm (0.3366 in).

   NOTE: *Dimension "X" corresponds to the thickness of the spacer to be installed.*

   NOTE: *Lay spacer (e.g. s = 8.55 mm (0.3366 in)) instead of the measuring ring over the drive pinion end. Install drive pinion again.*

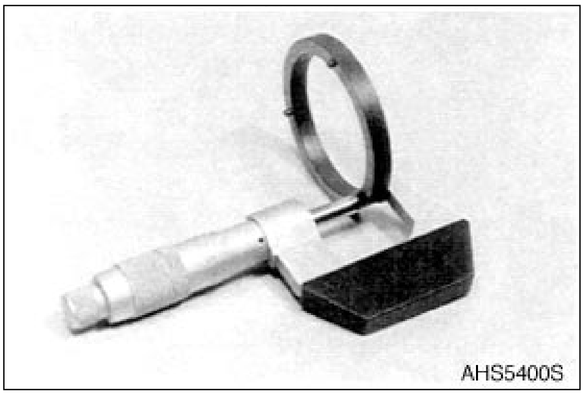


Figure 165

8. Replace drive flange, install washer and tighten slotted nut

   NOTE: *Torque limit:*
   RK 1,100 Nm (810 ft lb)
   LK 1,200 Nm (885 ft lb)
   CK 700 Nm (515 ft lb)

   NOTE: *When tightening, mate several full revolutions of the drive pinion in both directions.*

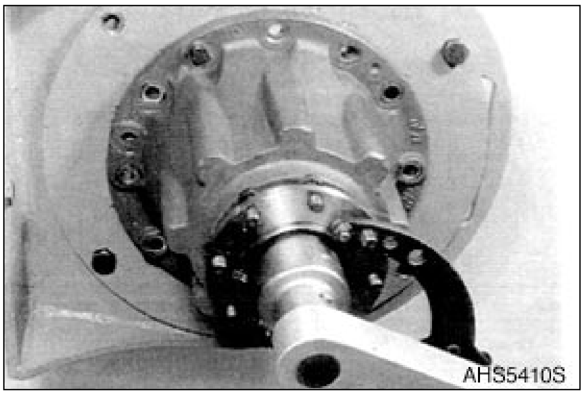


Figure 166

9. Check rolling resistance

   NOTE: *If the required rolling resistance is not obtained correct again with one corresponding spacer.*

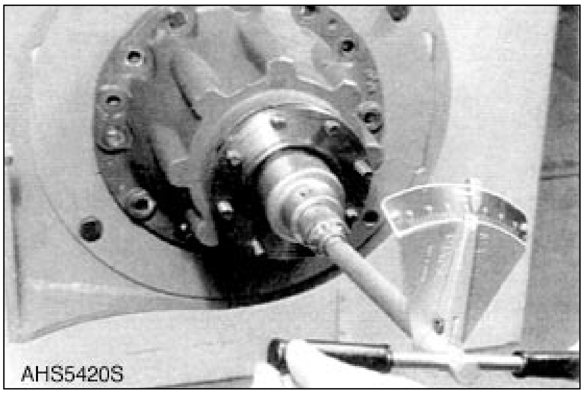


Figure 167

10. Remove the drive flange and install the shaft seal.

⚠ CAUTION!

Pay attention to the contact.

If the shaft seal outer diameter is lubber-coated, the sealing face must be wetted with mineral spirits.

Otherwise use sealing compound Loctite #586.

Fill cavity between sealing lip and dust lip with grease.

NOTE: *See "Special Tools" on page 15.*

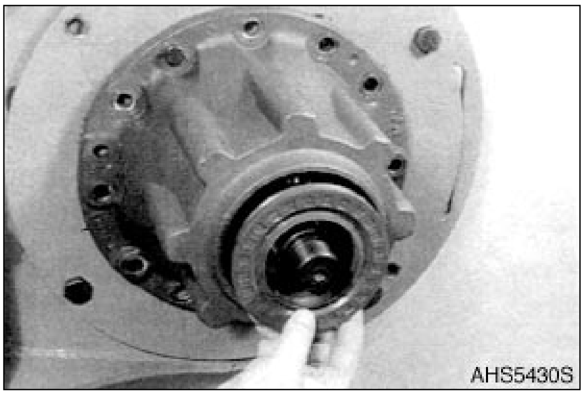


Figure 168

11. Replace drive flange, assemble washer and tighten slotted nut, resp. hex. nut (according to the Version) finally.

NOTE: *Torque limit:*
RK 1,100 Nm (810 ft lb)
LK 1,200 Nm (885 ft lb)
CK 700 Nm (515 ft lb)

NOTE: *The securing of the slotted nuts resp. hex. nut (according to the Version) is carried out after the contact pattern is taken.*

NOTE: *See "Special Tools" on page 15.*

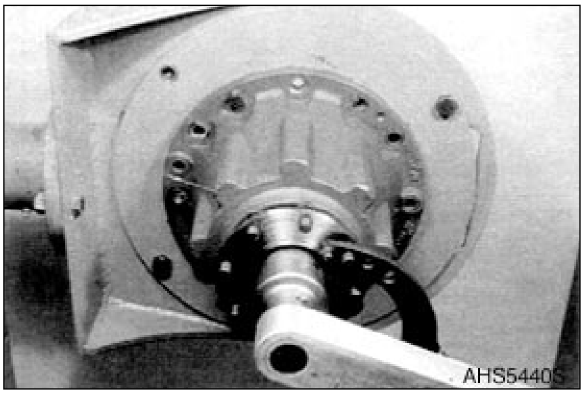


Figure 169

DIFFERENTIAL

1. Heat the crown wheel, center and temporarily fasten it into position.

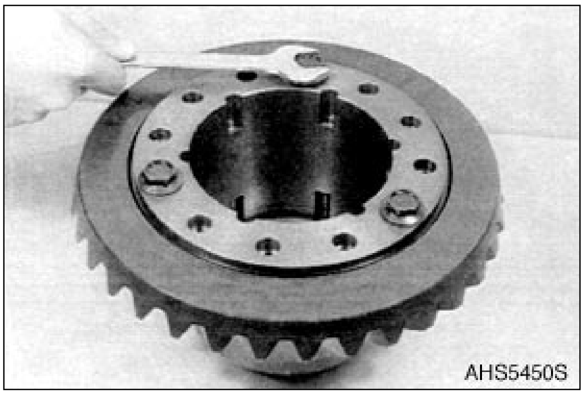


Figure 170

2. Insert the two thrust washers into the differential case half.

NOTE: *Mount the brass washer on top with the lubricating groove facing the side gear.*

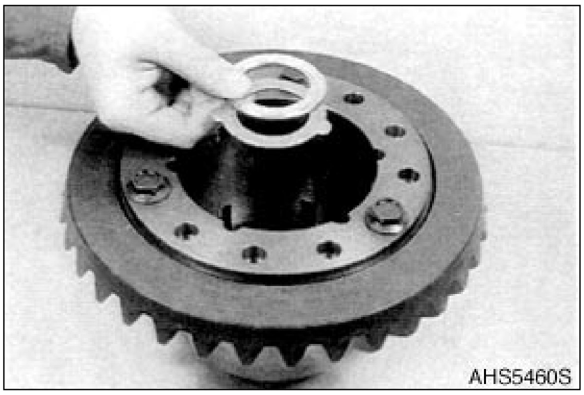


Figure 171

3. Insert circlip and install drive pin.

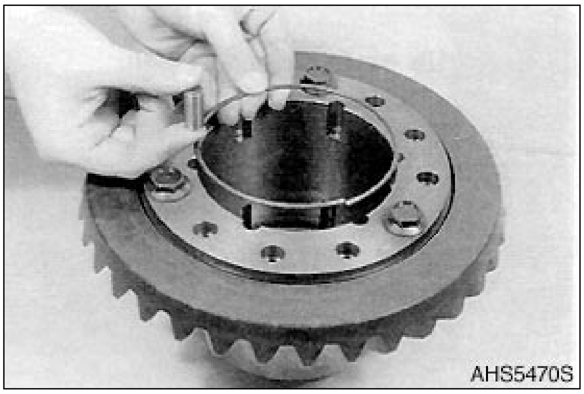


Figure 172

4. Assemble alternating outer and inner plates, starting with one outer plate.

NOTE: *Number and installation position of the outer and inner plates, see corresponding spare parts list (according tO the Version). The total height (thickness) of the plate pack must be equal on both differential sides. Plate thickness of outer plates may be different.*

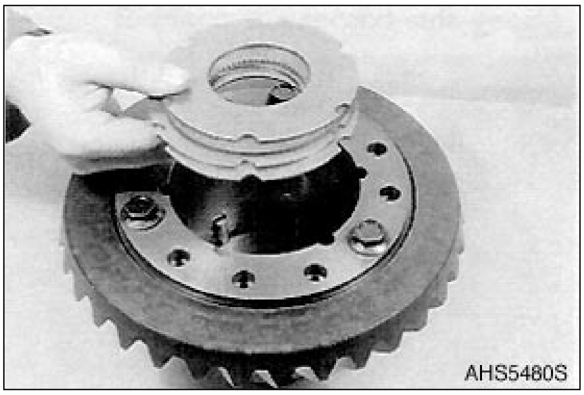


Figure 173

5. Mount pressure ring.

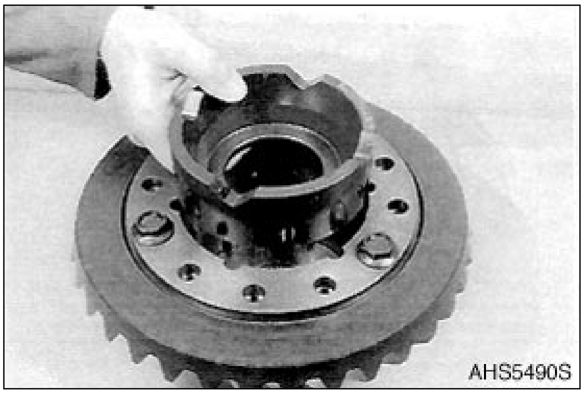


Figure 174

6. Insert side gear and assemble inner plates at the same time.

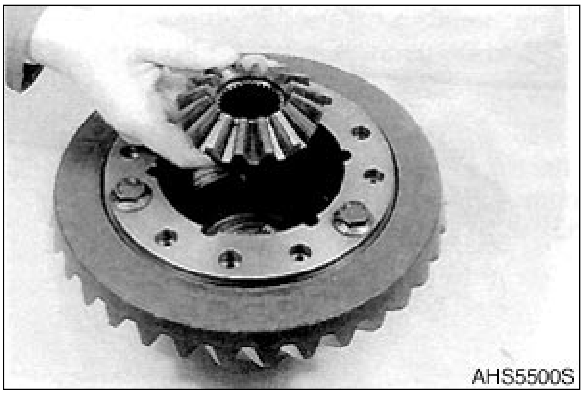


Figure 175

7. Insert the complete differential spider.

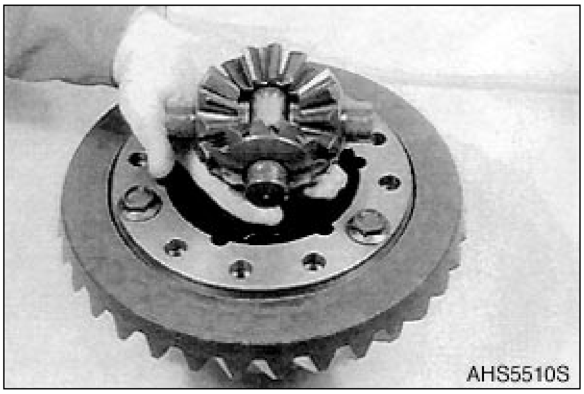


Figure 176

8. Install the second side gear.

   NOTE: *Pay attention to the radial installation position of the pressure ring.*

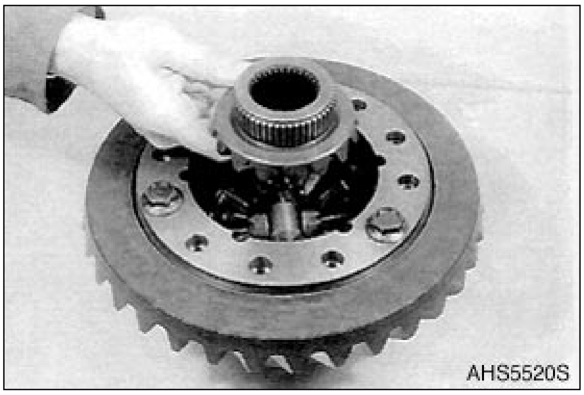


Figure 177

9. Install the second pressure ring and insert all drive pins.

   NOTE: *Pay attention to the radial installation position of the pressure ring.*

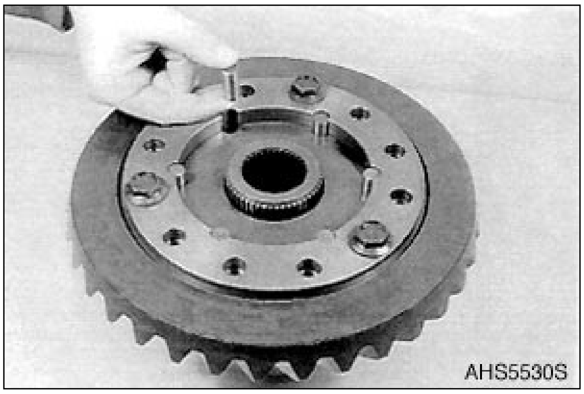


Figure 178

10. Assemble alternating inner and outer plates, starting with one inner plate.

NOTE: *Number and installation position of the inner and outer plates, see corresponding list of spare parts (according to the Version).*

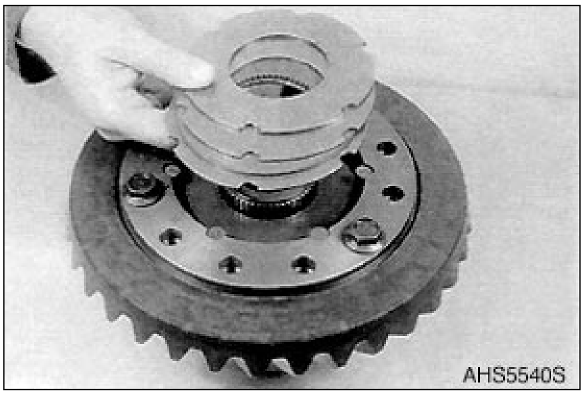


Figure 179

Determine Plate Clearance

1. Differential case

   Measure dimension A from the flange-mounted surface to the outer plate.

   - Dimension A e.g. 3.40 mm (0.1339 in).

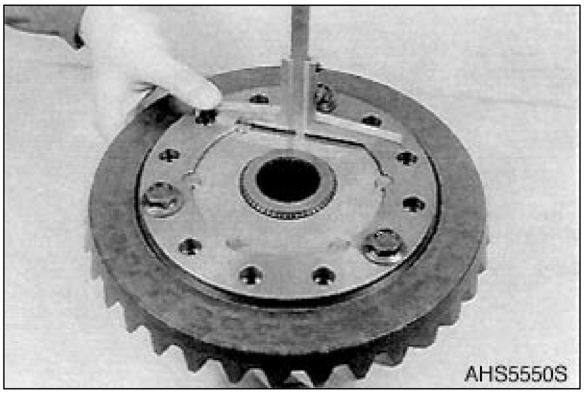


Figure 180

2. Housing cover

   Determine dimension B from the contact face (outer plate) to the flange-mounted surface.

   - Dimension B e.g. 3.10 mm (0.1220 in).

   NOTE: *The proscribed end play (= plate clearance) is 0.2 - 0.8 mm (0.0079 - 0.0315 in), whilst the lower value should be found. The end play is corrected by installing outer plates of corresponding thickness, whilst the plate thickness must be equal on both differential sides.*

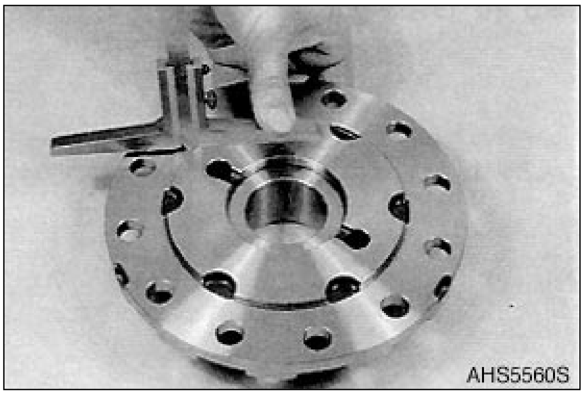


Figure 181

EXAMPLE

Dimension A	3.40 mm (0.1339 in)
Dimension B	- 3.10 mm (0.1220 in)
Difference = Plate clearance	= 0.30 mm (0.0118 in)

A. Make the two thrust washers adhere with grease in the housing cover.

NOTE: *Mount the brass washer on top with the lubricating groove facing the side gear.*

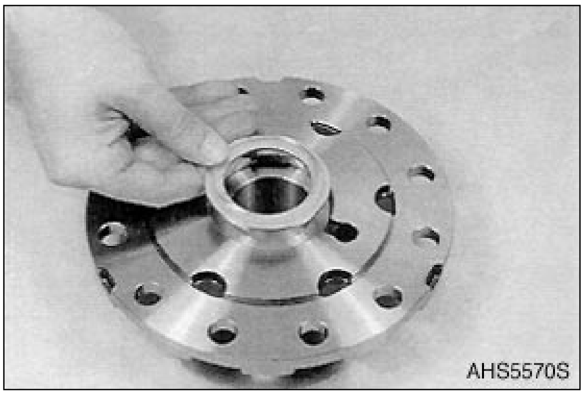


Figure 182

B. Fasten the housing cover using locking screws.

NOTE: *Pay attention to the installation position see Figure 182. Only use of the locking screws one time. Do not reuse them.*

NOTE: *See “Torque Limits for Screws” on page 6.*

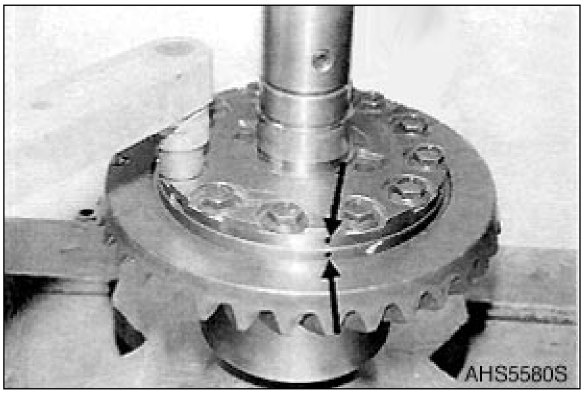


Figure 183

C. Heat the two inner bearing races and place them against shoulder.

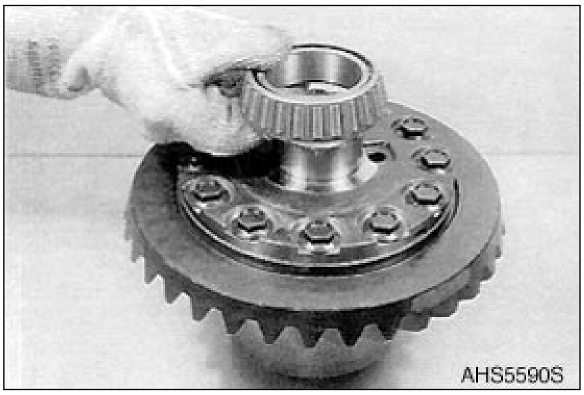


Figure 184

D. Install the two outer bearing races and insert the differential assembly into the housing.

E. Secure the differential using the adjusting nuts.

NOTE: *See “Special Tools” on page 15.*

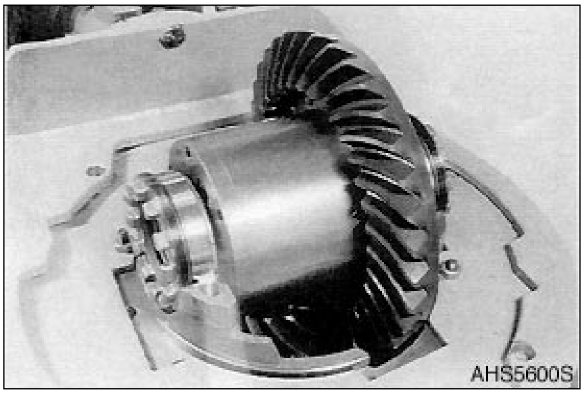


Figure 185

F. Install the two bearing caps and tighten them using hex. head screws.

NOTE: *Pay attention to the match marks, see Figure 186.*

NOTE: *See "Torque Limits for Screws" on page 6.*

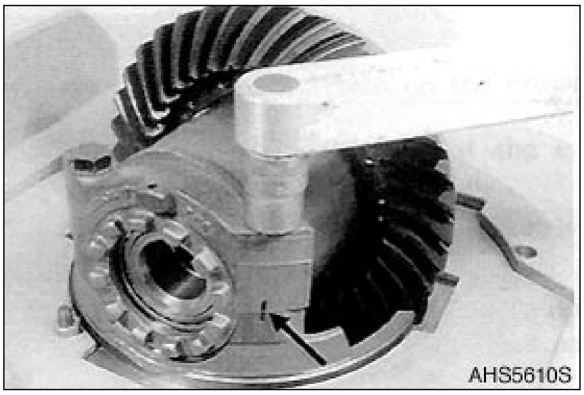


Figure 186

Adjustment of Bearing Preload and Backlash

1. Attach dial indicator right angled on the outer diameter of the tooth flank / crown wheel. Adjust the adjusting nut on the crown wheel side until the required backlash - see value engraved on the crown wheel outer diameter - is obtained.

   NOTE: *See "Special Tools" on page 15.*

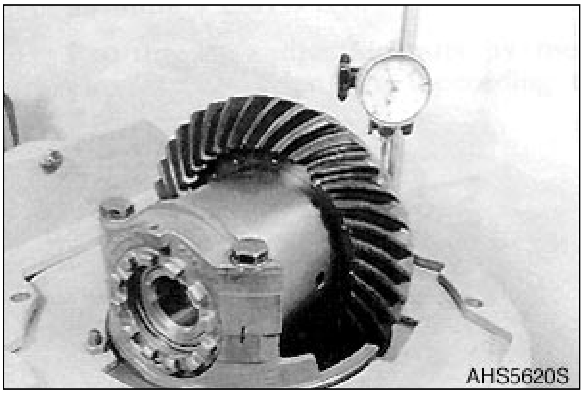


Figure 187

2. Screw in the adjusting nut (opposite the crown wheel side) until the differential bearing is free of play. Now, tighten adjusting nut further for 2 notches to obtain the required bearing preload of the differential bearing 3 - 4 Nm (26.5 - 35.4 in lb).
3. Check backlash again and correct if necessary.

   NOTE: *At this step make several full revolutions of the differential.*

   NOTE: *Determine yoke width e.g. "CK" 258 +0.1 mm (10.1575 + 0.0039 in).*

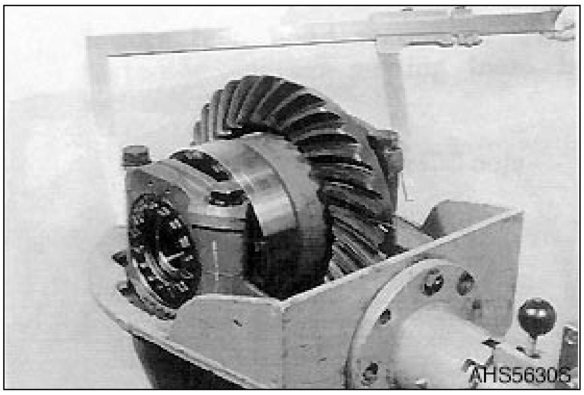


Figure 188

4. Attach dial indicator on the plane face / crown wheel, make at least one revolution of the crown wheel and record the run-out.

   NOTE: *Admitted run-out max. 0.08 mm (0.0031 in).*

   NOTE: *See “Special Tools” on page 15.*

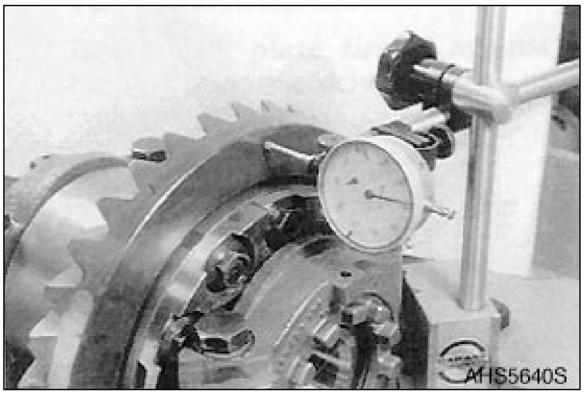


Figure 189

5. Check contact pattern on the crown wheel.

   A. Cover some tooth flanks of the crown wheel with gear marking compound.

   B. Roll the crown wheel over the drive pinion back and forth.

   C. Check the contact pattern and compare it with “Examples of Gear-tooth-contact Patterns for the Gleason Gear-tooth System” on page 11.

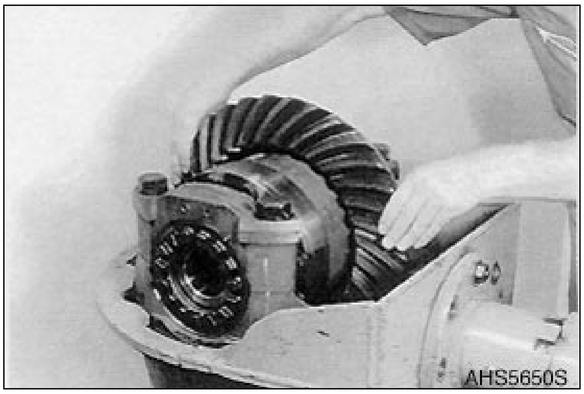


Figure 190

   D. In case of a greater contact pattern deviation a spacing error has been made during the reassembly of the drive pinion which must be corrected.

   E. Lock the two adjusting nuts using roll pins, resp. cotter pins (according to the version).

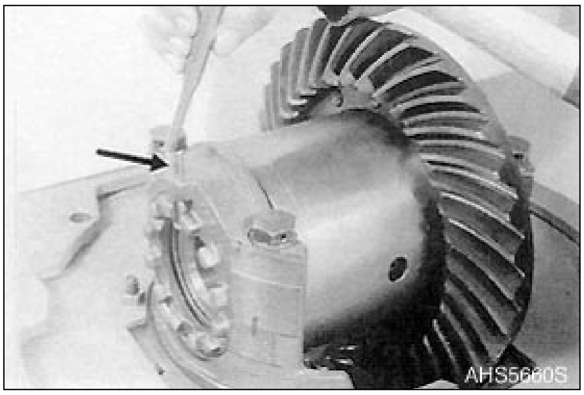


Figure 191

   F. Secure hex. head screws of the bearing cap fastening against getting loose using lock wire (ø 1.6 mm (0.0630 in)).

   NOTE: *See “Special Tools” on page 15.*

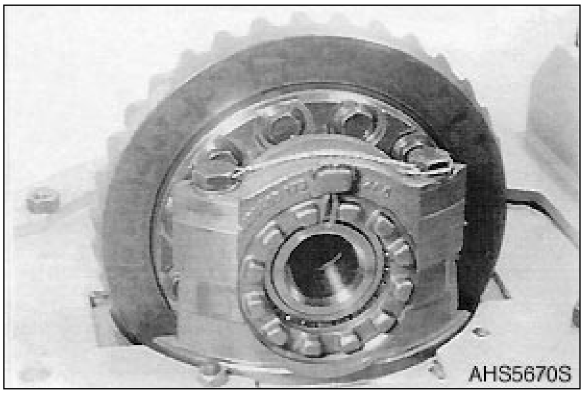


Figure 192

G. Tilt differential carrier.

H. Insert lock plate firmly against shoulder and caulk it on the drive flange, using a suitable tool.

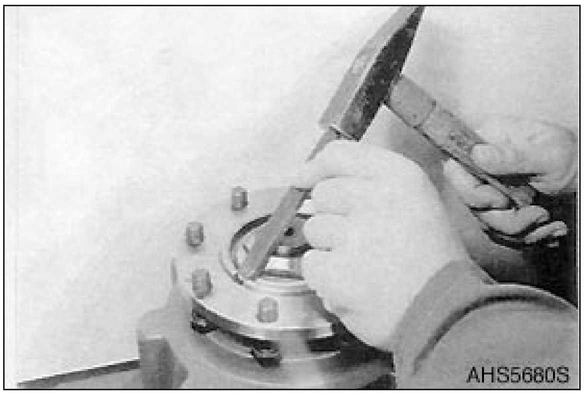


Figure 193

I. Cover flange-mounted surface with sealing compound Loctite #573.

J. Screw in two adjusting screws and place the differential carrier against the axle housing until contact is obtained.

NOTE: *See "Special Tools" on page 15.*

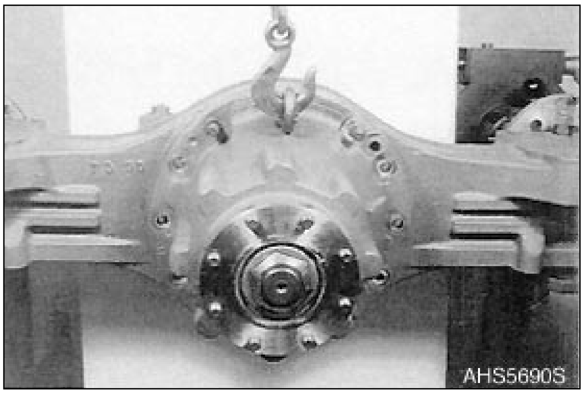


Figure 194

K. Fasten differential carrier on the axle housing using hex. head screws.

NOTE: *Cover hex. head screws with sealing compound Loctite #573.*

NOTE: *See "Torque Limits for Screws" on page 6.*

NOTE: *Now, install the stub shafts again and complete the final drive.*

NOTE: *Before the axle is put into service, follow the "Lubrication Instructions" on page 8.*

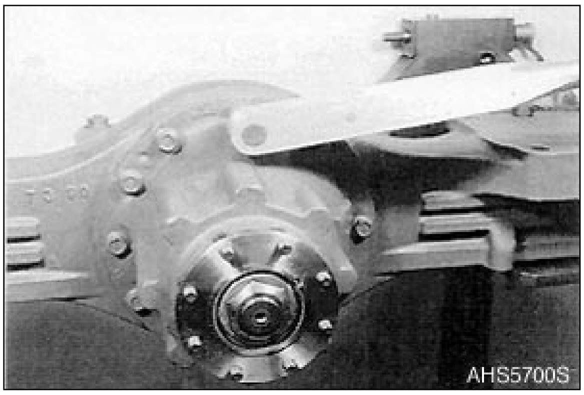


Figure 195

ILLUSTRATED TABLE

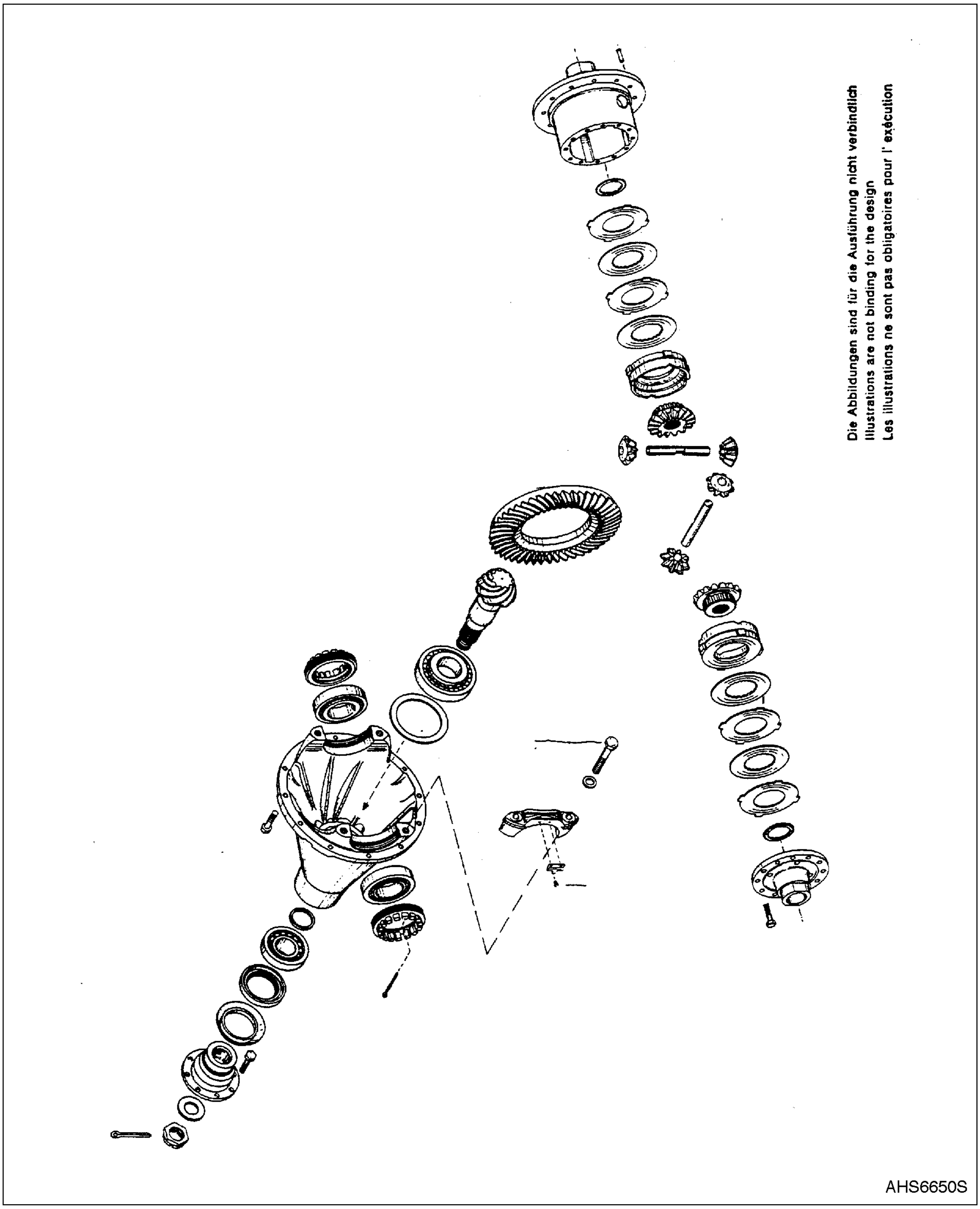


Figure 196

DIFFERENTIAL REASSEMBLY (VERSION - CAST-ON BEARING CAPS)

NOTE: *If crown wheel or drive pinion are damaged, the two parts must be replaced as a set. If a new complete crown wheel set is installed, pay attention that crown wheel and drive pinion have the same mating numbers.*

NOTE: *When replacing a complete crown wheel set or axle carrier, pay attention to the Figure 197.*

DETERMINE THICKNESS OF SHIM

NOTE: *The following measuring operations must be carried out with utmost care. Inexact measurements would cause an incorrect contact pattern and require a replacement of the drive pinion and the differential (partial) after the contact pattern has been taken. See "Examples of Gear-tooth-contact Patterns for the Gleason Gear-tooth System" on page 11.*

1. Install adjusting pieces (3) and temporarily fasten the two bearing caps. Install thrust washer (2) and measuring pin (1) and introduce measuring shaft (7), see Figure 197.

   NOTE: *See "Special Tools" on page 15.*

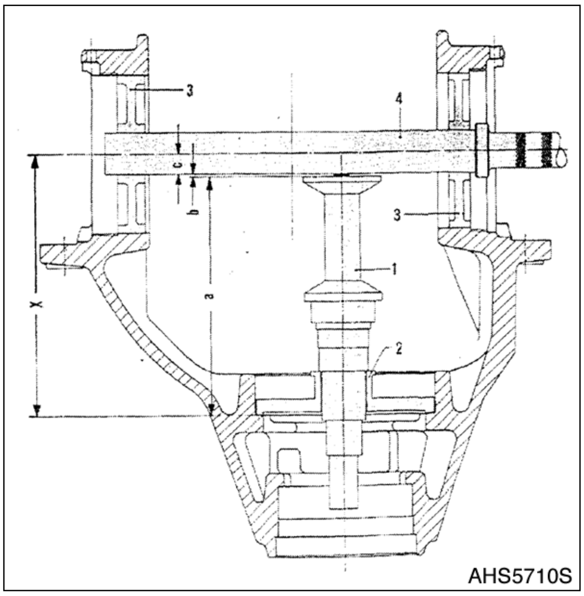


Figure 197

2. Determine gap (Dimension b) between measuring pin and measuring shaft with feeler gauge.

    - Dimension b e.g. 0.70 mm (0.0276 in).

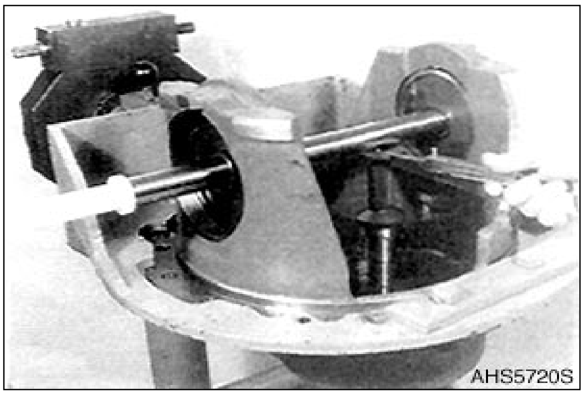


Figure 198

EXAMPLE I

Dimension a (=measuring pin)	226.00 mm (8.8976 in)
Dimension b	+ 0.70 mm (0.0276 in)
Dimension c (1/2 ∅ measuring shaft)	+ 15.00 mm (0.5906 in)
Gives Dimension "X"	= 241.70 mm (9.5157 in)

3. Measure bearing width.

    - Bearing width e.g. 42.45 mm (1.6713 in).

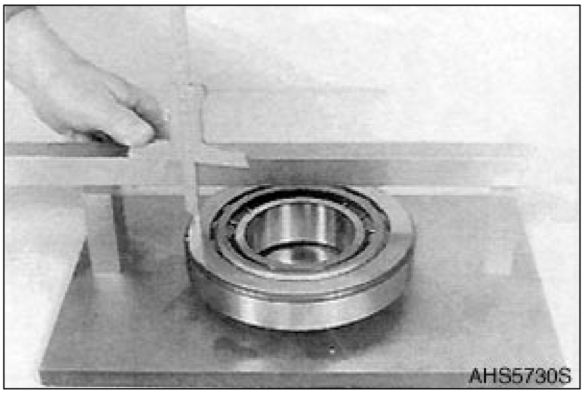


Figure 199

4. Read pinion dimension.
   - Pinion dimension e.g. 198 - 0.1= 197.90 mm (7.7913 in).

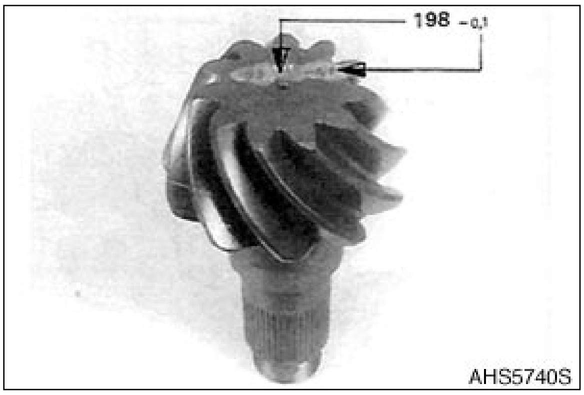


Figure 200

EXAMPLE II

Bearing width	42.45 mm (1.6712 in)
Pinion dimension	+ 197.90 mm (7.7913 in)
Gives Dimension X1	= 240.35 mm (9.4626 in)

EXAMPLE III

Dimension X	241.70 mm (9.5157 in)
Dimension X1	- 240.35 mm (9.4626 in)
Difference = Shim thickness	s = 1.35 mm (0.0531 in)

5. Lay shim (according to the Example s = 1.35 mm (0.0531 in)) into the housing bore.

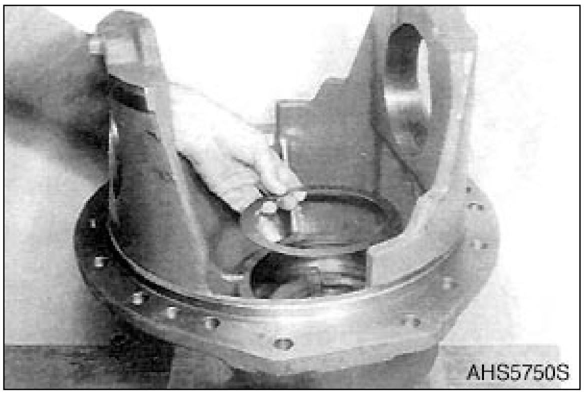


Figure 201

6. Freeze outer bearing race and press it firmly against shoulder.
7. Install the drive flange side outer bearing race correspondingly.

NOTE: *See "Special Tools" on page 15.*

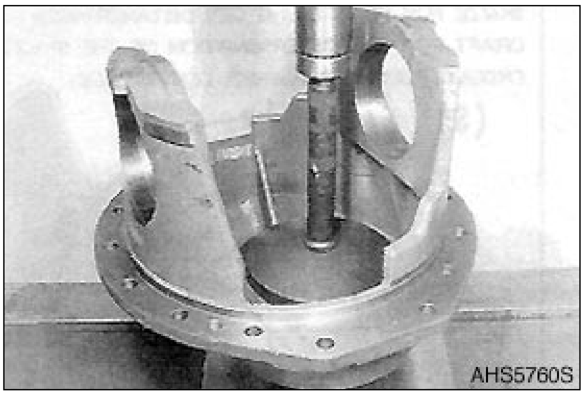


Figure 202

8. Heat inner bearing race, guide it over the drive pinion end until contact is obtained.

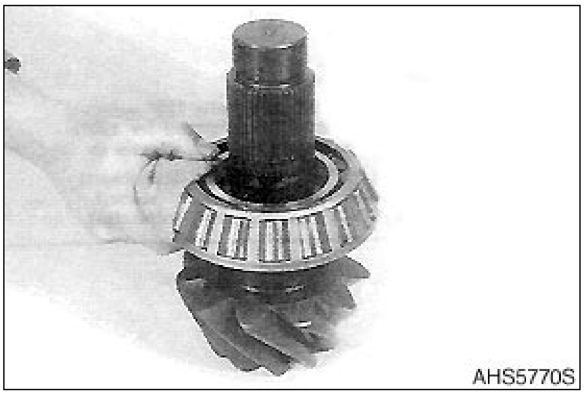


Figure 203

ADJUSTMENT OF DRIVE PINION BEARING ROLLING RESISTANCE

Nominal Value

DK / CK	1.1 - 2.3 Nm (9.7 - 20.3 in lb)
HK	1.5 - 3.0 Nm (13.2 - 17.7 in lb)
LK / RK	3.0 - 4.5 Nm (17.7 - 39.8 in lb)

1. Lay measuring ring over the drive pinion collar.

NOTE: *Configuration and description of the measuring ring, See Figure 205.*

NOTE: *See "Special Tools" on page 15.*

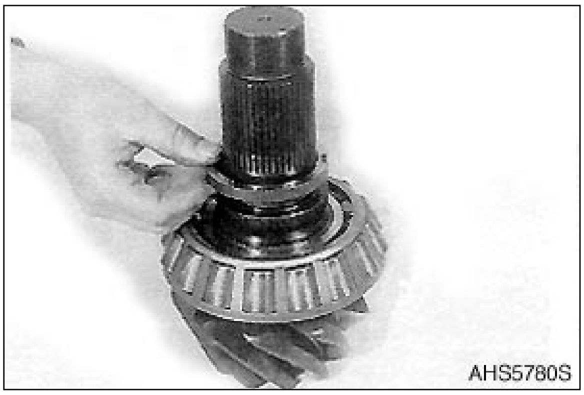


Figure 204

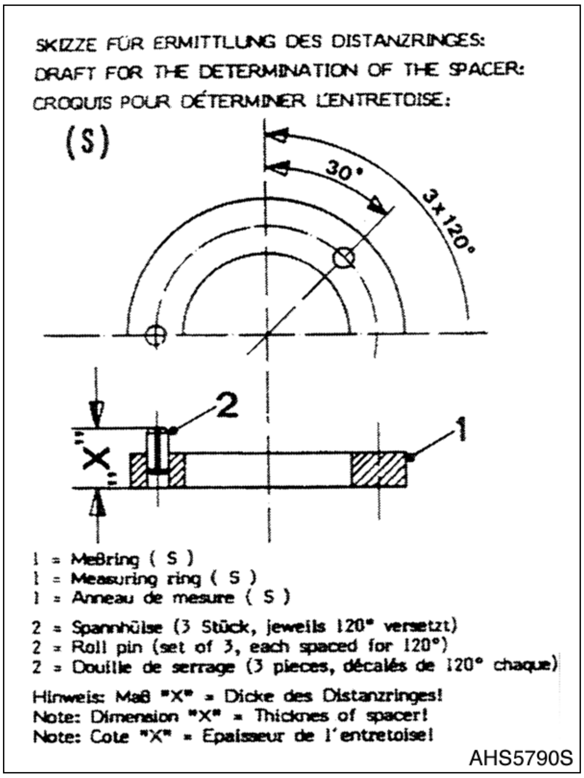


Figure 205

2. If necessary (according to the Version), insert hex. head screws into the drive flange bores and press the dust shield on the collar of the drive flange.

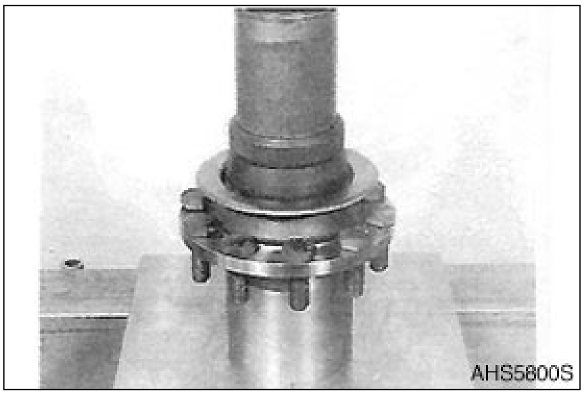


Figure 206

3. Insert the drive pinion into the axle carrier and assemble the heated inner bearing race until contact is obtained.

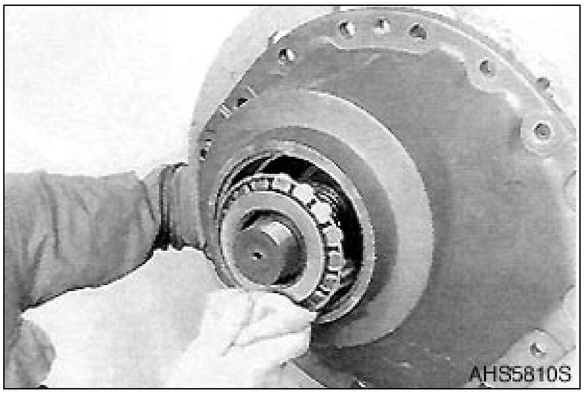


Figure 207

4. Tighten washer and tighten slotted nut the required rolling resistance is obtained.

   NOTE: *When tightening, make several full revolutions of the drive pinion in both directions, and check the rolling resistance continuously.*

   NOTE: *See “Special Tools” on page 15.*

5. Loosen slotted nut, tighten drive flange and remove the pinion again.

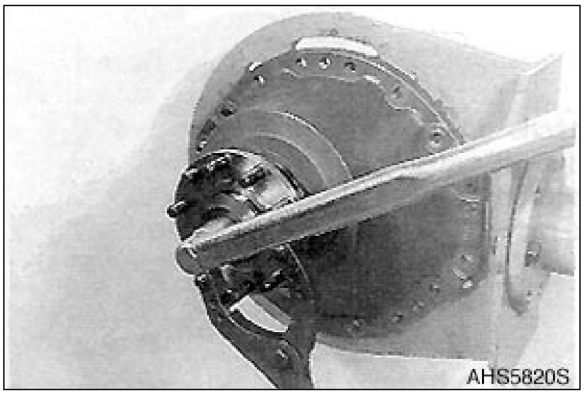


Figure 208

6. Take off measuring ring and determine dimension "X" (see Figure 205).

   • Dimension "X" e.g. s = 7.79 m (0.3067 in).

   NOTE: *Dimension "x" corresponds to the thickness of the spacer to be installed.*

   NOTE: *Lay spacer (e.g. s = 7.79 mm (0.3067 in)) instead of the measuring ring over the drive pinion end. Install thrive pinion again.*

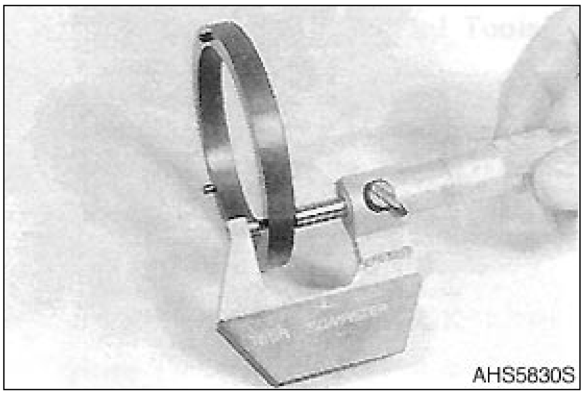


Figure 209

7. Replace thrive flange, install washer and tighten slotted nut.

   NOTE: *Torque limit:*
   RK 1,100 Nm (810 ft lb)
   HK/LK 1,200 Nm (885 ft lb)
   DK/CK 700 Nm (515 ft lb)

   NOTE: *When tightening, make several full revolutions of the drive pinion in both directions.*

8. Check rolling resistance

   NOTE: *If the required rolling resistance is not obtained correct again with a corresponding spacer.*

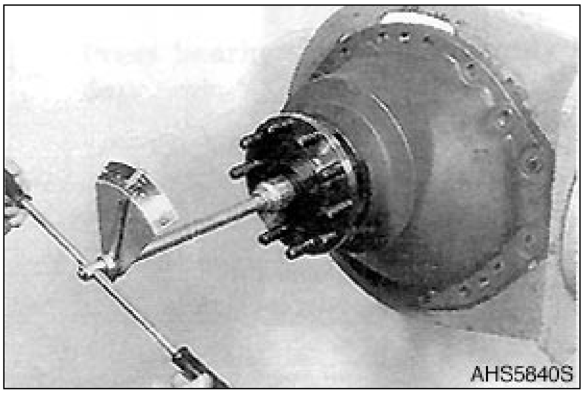


Figure 210

9. Install shaft seal.

10. If the outer diameter of the shaft seal is rubber-coated, wet the sealing lip with mineral spirits, otherwise use the sealing compound Loctite #586. Fill cavity between sealing lip and dust lip with grease.

    NOTE: *Without figure, place dust shield over the isle carrier collar (ø160 mm (6.2992 in)) until contact is obtained.*

    NOTE: *For Version with additional dust shield only.*

    NOTE: *See “Special Tools” on page 15.*

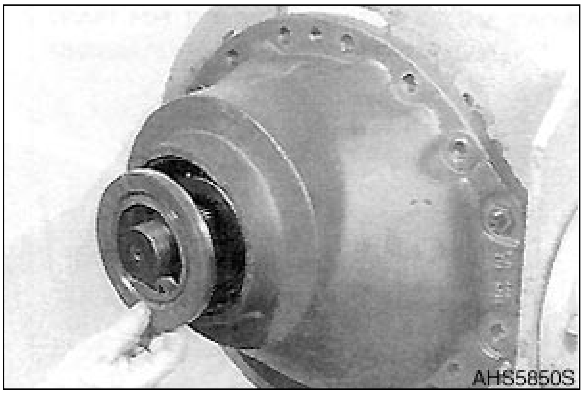


Figure 211

11. Replace drive flange. Assemble washer and tighten slotted nuts resp. hex. nut (according to the Version) finally.

    NOTE: *Torque Limit:*
    RK 1,100 Nm (810 ft lb)
    HK/LK 1,200 Nm (885 ft lb)
    DK/CK 700 Nm (515 ft lb)

    NOTE: *The securing of the slotted nuts resp. hex. nut (according to the Version) is carried out after the contact pattern is taken.*

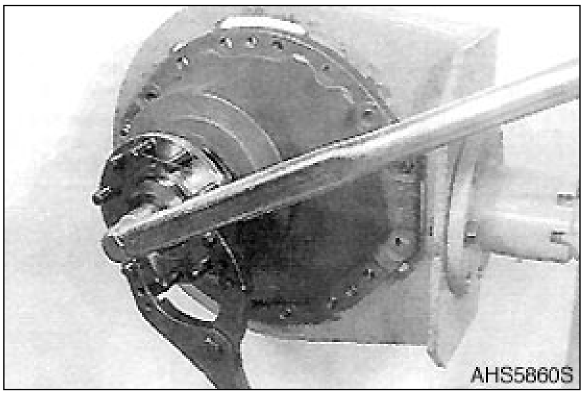


Figure 212

DIFFERENTIAL

1. Heat the crown wheel and place it against the differential case half until contact is obtained.
2. Clamp differential case using press.
3. Tighten locking screws.

    NOTE: *Only single use of the locking screws is admitted.*

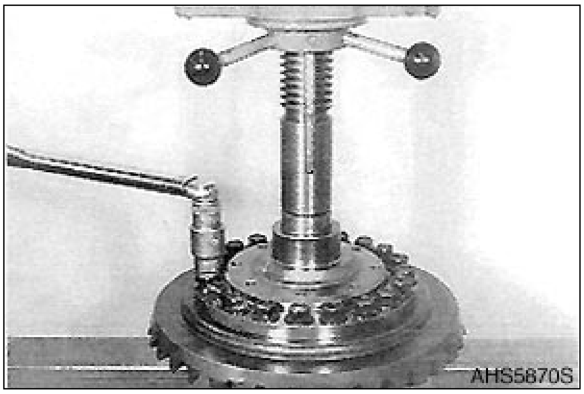


Figure 213

4. Press inner bearing race firmly against shoulder.

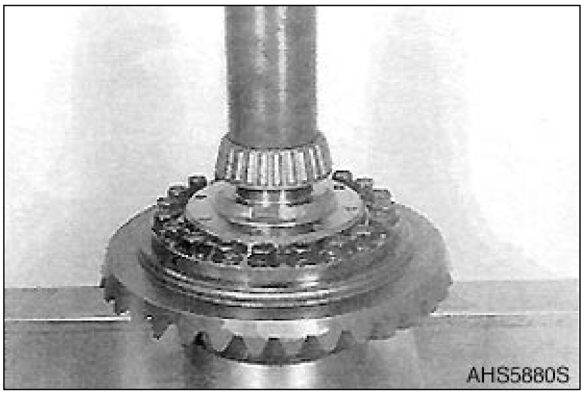


Figure 214

5. Lay the two thrust washers into the differential case half.

    NOTE: *Mount brass washer on top with the lubricating groove facing the side gear.*

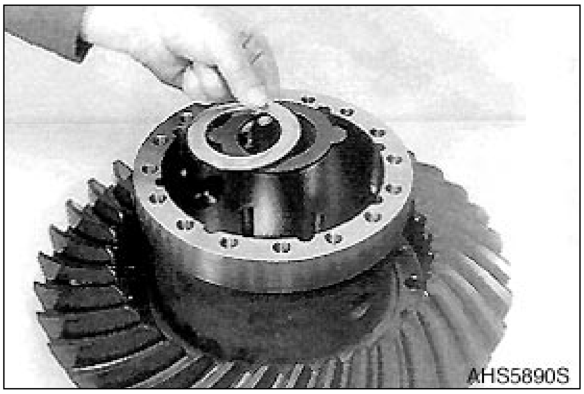


Figure 215

6. Lay snap ring into the ring groove, see Figure 216.

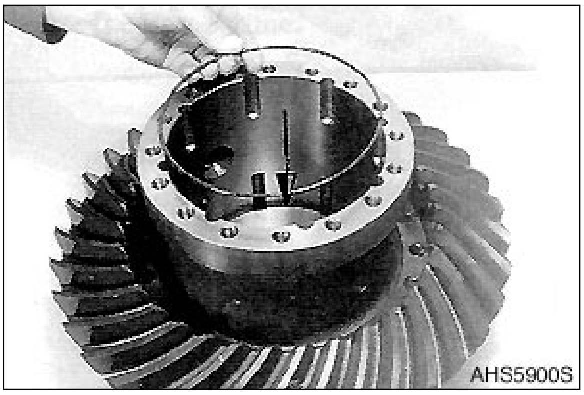


Figure 216

7. Insert drive pin, see Figure 217.

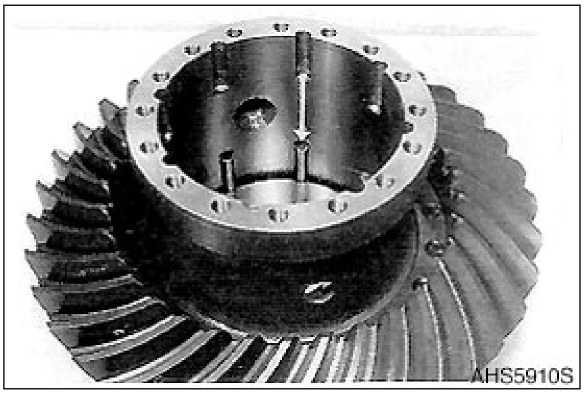


Figure 217

8. Assemble alternating outer and inner plates, starting with one outer plate.

   NOTE: *For number and installation position of outer and inner plates, see corresponding List of Spare Parts (according to the Version). The total height (thickness) of the plate pack must be equal on both differential sides. Plate thickness of outer plates may be different.*

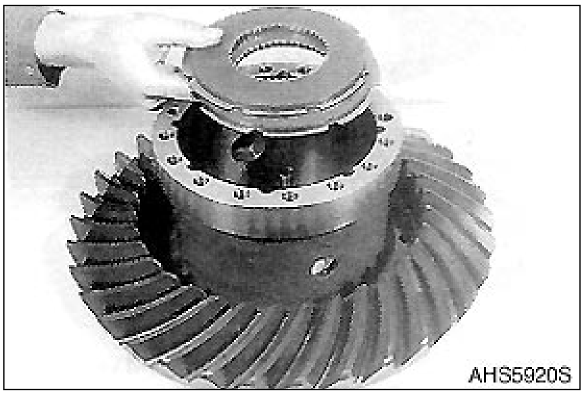


Figure 218

9. Replace pressure ring.

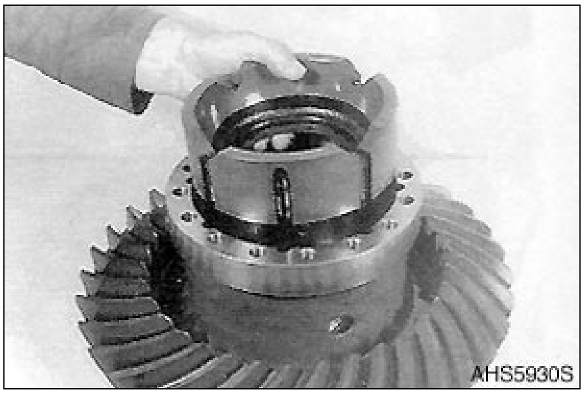


Figure 219

10. Insert side gear and assemble inner plates at the same time.

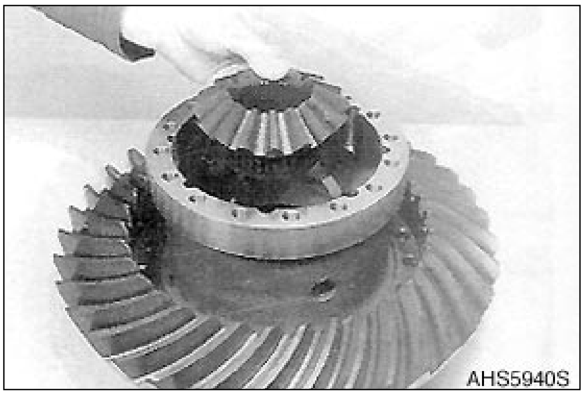


Figure 220

11. Insert the differential spider assembly.

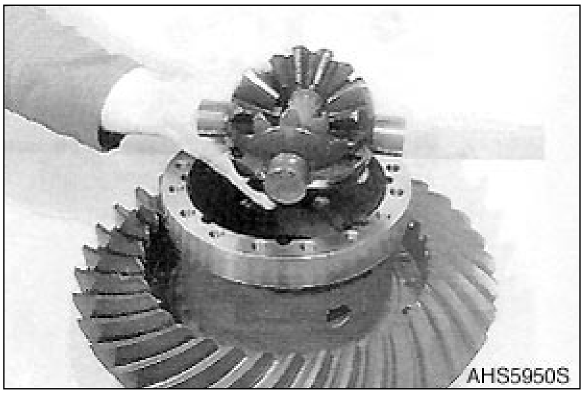


Figure 221

12. Install second side gear.

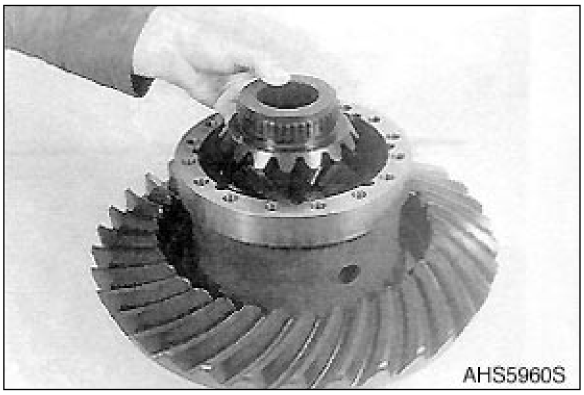


Figure 222

13. Install second pressure ring and insert all drive pins.

    NOTE: *Pay attention to the radial installation position of the pressure ring.*

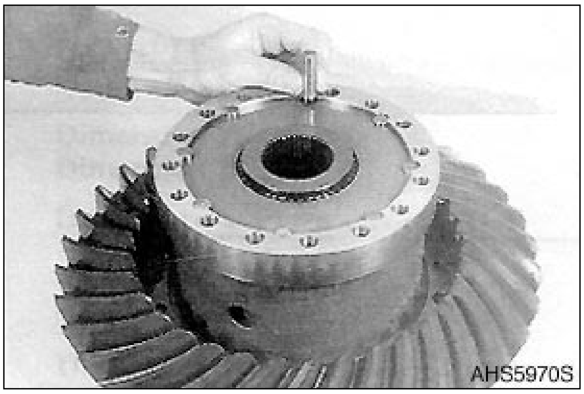


Figure 223

14. Assemble alternating inner and outer plates, starting with one inner plate.

NOTE: *Number and installation position of inner and outer plates, see corresponding List of Spare Parts (according to the Version).*

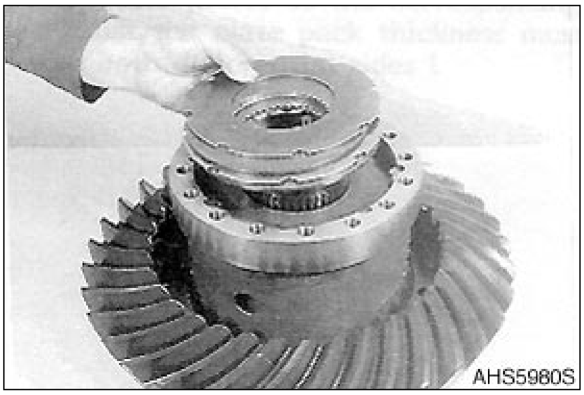


Figure 224

Determination of Plate Clearance

1. Differential case

   Measure dimension A from the flange-mounted surface to the outer plate.

   - Dimension A e.g. 4.00 mm (0.1575 in).

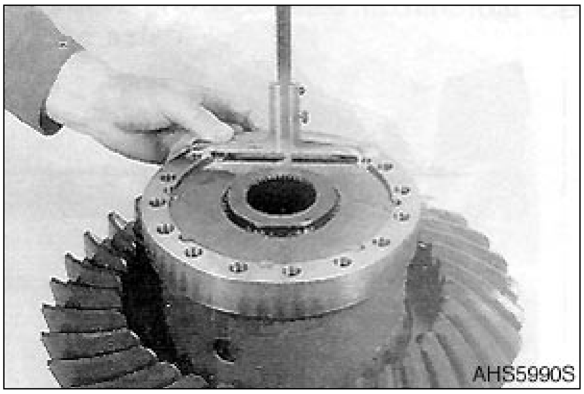


Figure 225

2. Housing cover

   Determine dimension B from the contact face (outer plate) to the flange-mounted surface.

   - Dimension B e.g. 3.80 mm (0.1496 in).

NOTE: *The proscribed end play (= plate clearance) is 0.2 - 0.8 mm (0.0079 - 0.0315 in), whilst the lower value should be found. The end play is corrected by the installation of outer plates of corresponding thickness whilst the plate thickness must be equal on both differential sides.*

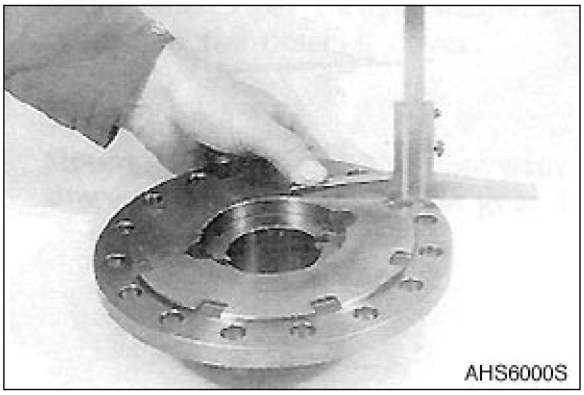


Figure 226

EXAMPLE

Dimension A	4.00 mm (0.1575 in)
Dimension B	- 3.80 mm (0.1496 in)
Differential = Plate clearance	= 0.20 mm (0.0079 in)

3. Insert pre-assembled differential case half in the axle carrier.

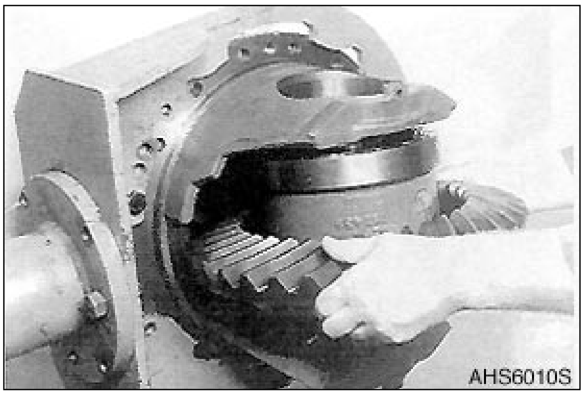


Figure 227

4. Make the two thrust washers adhere with grease in the housing cover.

NOTE: *Mount brass washer on top with the lubricating groove facing the side gear.*

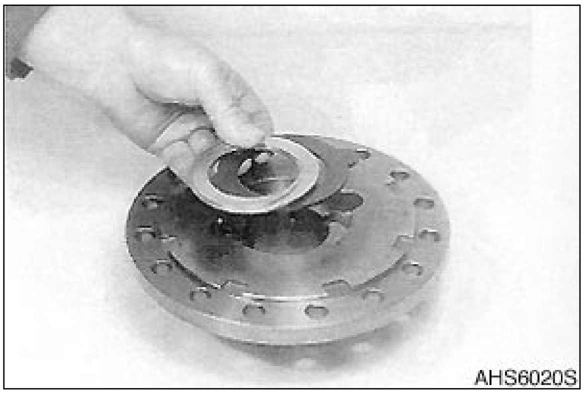


Figure 228

5. Lay housing cover over the differential case.

NOTE: *Pay attention to the installation position (see Figure 229).*

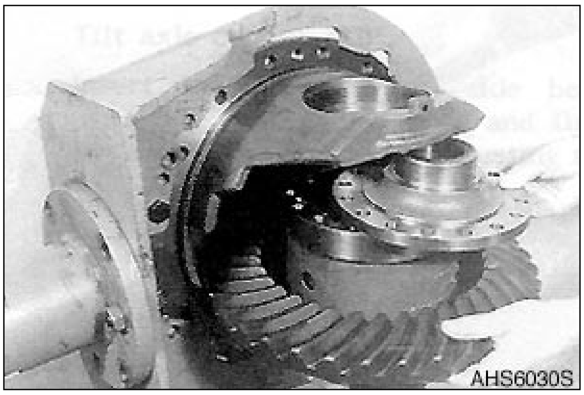


Figure 229

6. Fasten the housing cover using locking screws.

NOTE: *Only use locking screws one time. Do not reuse them.*

NOTE: *See "Special Tools" on page 15.*

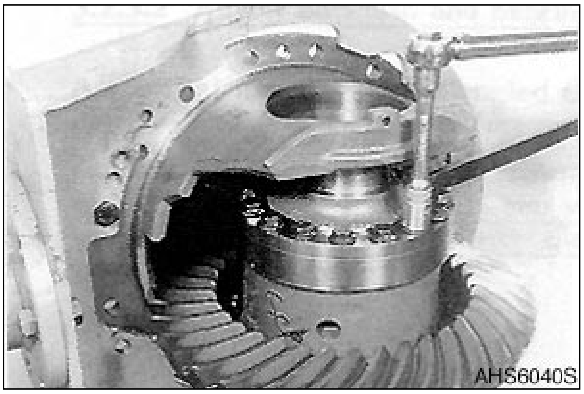


Figure 230

7. Heat inner bearing race and place it against the housing cover until contact is obtained.

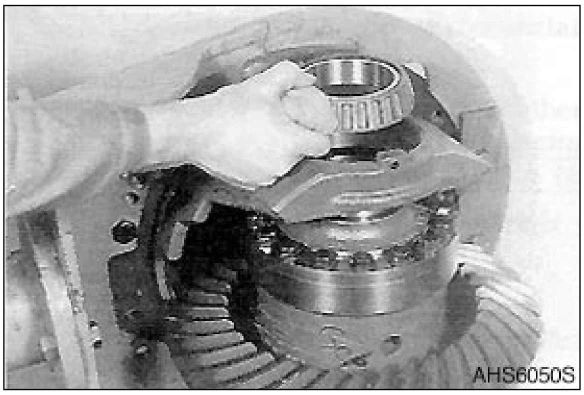


Figure 231

8. Insert outer bearing race into the bearing bore and hold it in place using adjusting nut.

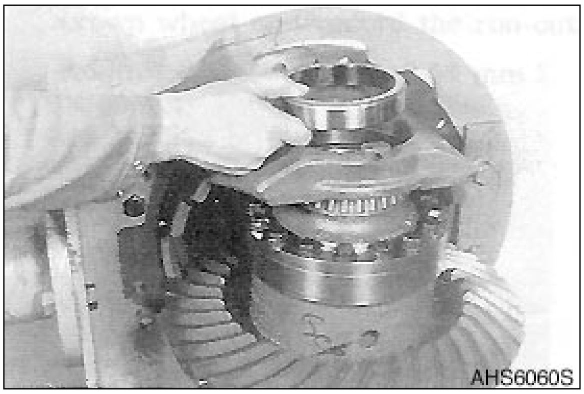


Figure 232

9. Tilt idle carrier 180°.
10. Insert the crown wheel side outer bearing race into the bearing bore and temporarily hold it in position with the second adjusting nut.

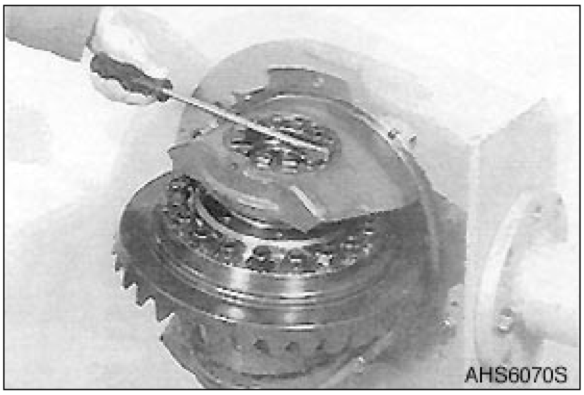


Figure 233

Adjustment of Bearing Preload and Backlash

1. Attach dial indicator right angled on the outer diameter of the tooth flank/crown wheel.
2. Adjust adjusting nut on the crown wheel side until the required backlash - see value engraved on the crown wheel outer diameter - is obtained.

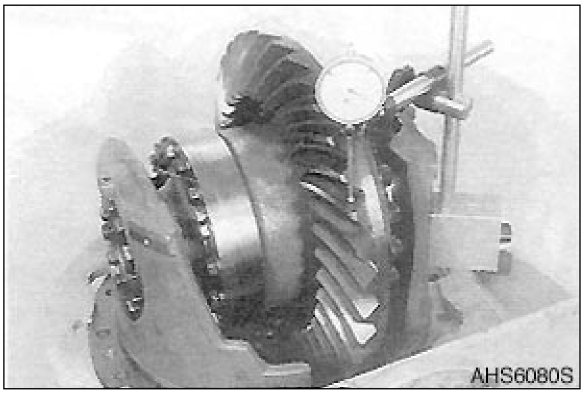


Figure 234

3. Screw in adjusting nut (opposite the crown wheel side) until the differential bearing has no endplay.

4. Now, tighten adjusting nut further for 2 notches to obtained the required bearing preload of the differential bearing 3 - 4 Nm (26.5 - 35.4 in lb).

5. Check backlash again and correct if necessary.

   NOTE: *At this step make several revolutions of the differential. Determine yoke width.*

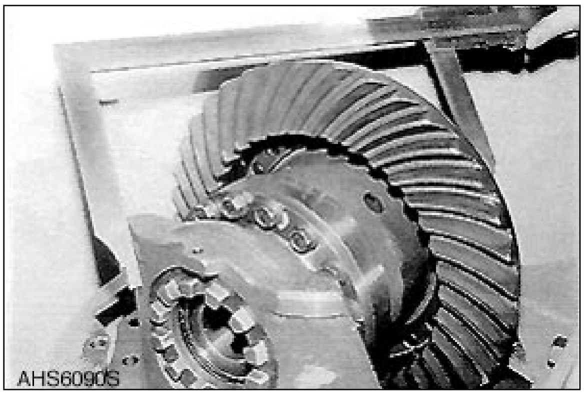


Figure 235

6. Attach dial indicator on the plane face/ crown wheel, make at least one revolution of the crown wheel and record the run-out.

   NOTE: *Admitted run-out max. 0.08 mm (0.0031 in).*

   NOTE: *See "Special Tools" on page 15.*

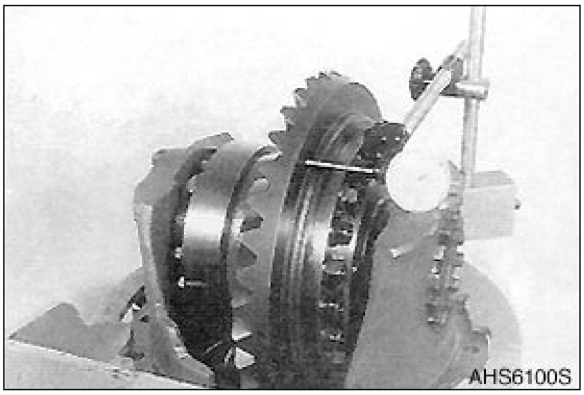


Figure 236

7. Check contact pattern on the crown wheel

   A. Cover some tooth flanks of the crown wheel with gear marking compound.

   B. Roll the clown wheel over the drive pinion back and forth.

   C. Take the contact pattern and compare it with "Examples of Gear-tooth-contact Patterns for the Gleason Gear-tooth System" on page 11.

   D. In case of a greater contact pattern deviation, a spacing error has been made during the reassembly of the drive pinion, which must be corrected.

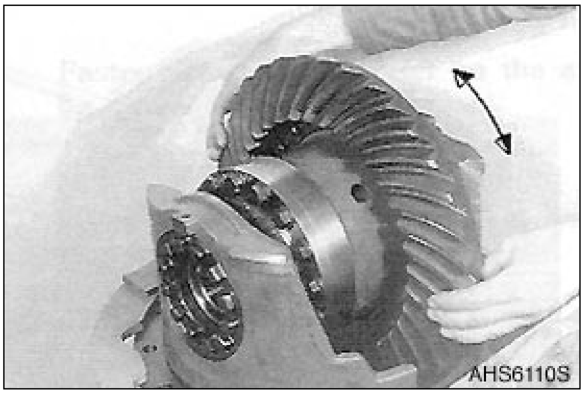


Figure 237

E. Secure the two adjusting nuts.

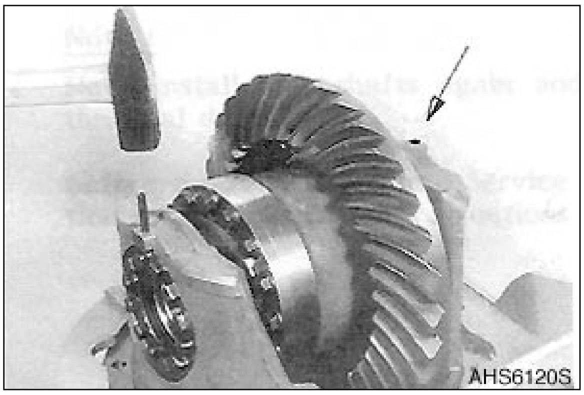


Figure 238

F. Tilt differential carrier.

G. Insert lock plate until contact is obtained and caulk it on the drive flange.

NOTE: *See “Special Tools” on page 15.*

Figure 239

H. Cover flange-mounted surface with the sealing compound Loctite #573.

I. Screw in the two adjusting screws and place the differential carrier against the axle housing until contact is obtained.

NOTE: *See “Special Tools” on page 15.*

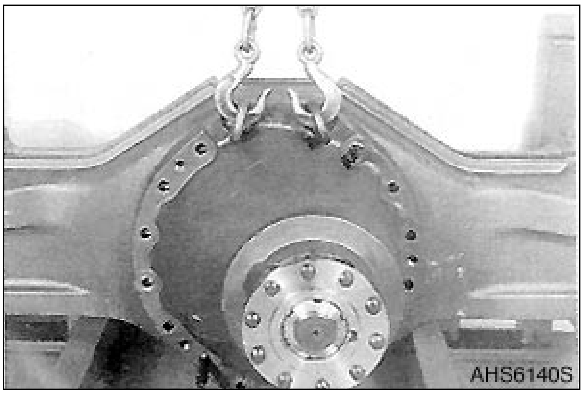


Figure 240

J. Fasten differential carrier on the axle housing using hex. head screws.

NOTE: *Cover threads of hex. head screws with sealing compound.*

NOTE: *Now, install stub shafts again and complete the final drive.*

NOTE: *Before the Axle is put into Service follow the “Lubrication Instructions” on page 8*

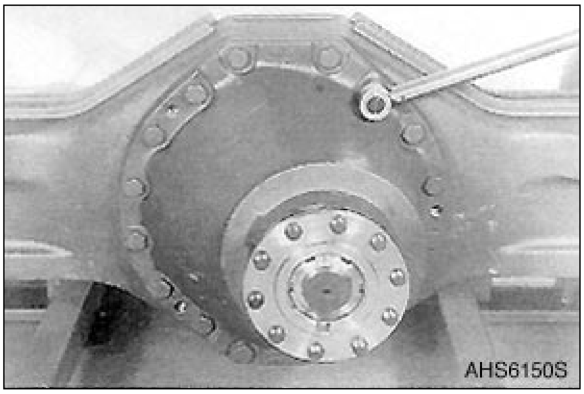


Figure 241

ILLUSTRATED TABLE

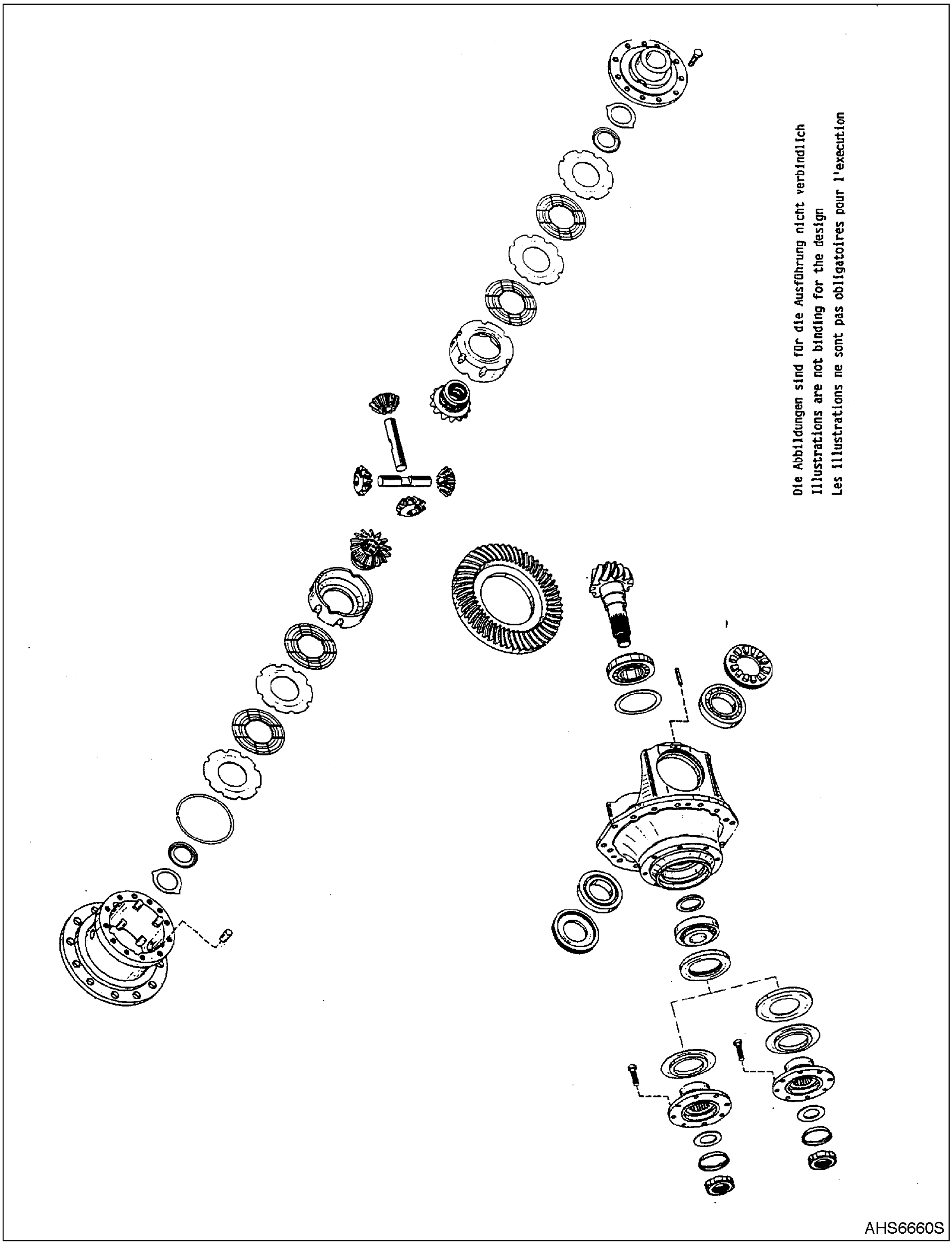


Figure 242

DIFFERENTIAL REASSEMBLY (VERSION - SCREWED AND CAST-ON BEARING CAPS)

NOTE: *If crown wheel or drive pinion are damaged, the two parts must be replaced as a set. If a new complete crown wheel set is installed, pay attention that crown wheel and drive pinion have the same mating numbers.*

NOTE: *When replacing a complete crown wheel set or axle carrier, pay attention to the Figure 243.*

DETERMINE THICKNESS OF SHIM

NOTE: *The following measuring operations must be carried out with utmost care. Inexact measurements would cause an incorrect contact pattern and require a replacement of the drive pinion and the differential (partial) after the contact pattern has been taken.*

1. Install adjusting pieces (3) and temporarily fasten the two bearing caps. Install stop washer (2) and measuring pin (1) and introduce measuring shaft (4) (see Figure 243.

   Special Tools

Reference Number	Description
1	Measuring Pin
2	Stop Washer
3	Adjusting Piece
4	Measuring Shaft

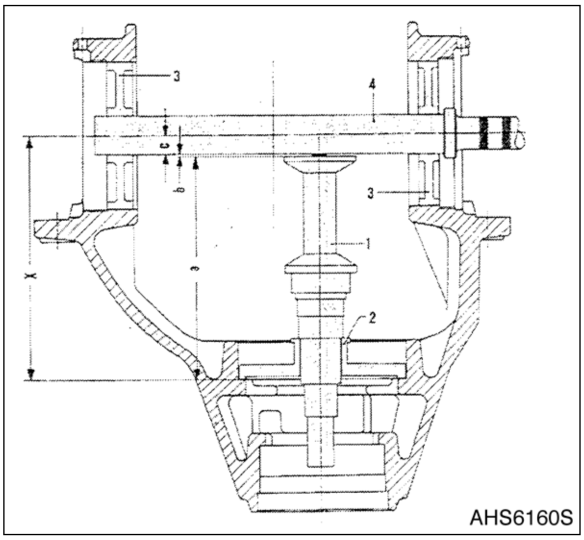


Figure 243

2. Determine gap (Dimension b) between measuring piston and measuring shaft with feeler gauge.
   - Dimension b e.g. 2.50 mm (0.0984 in).

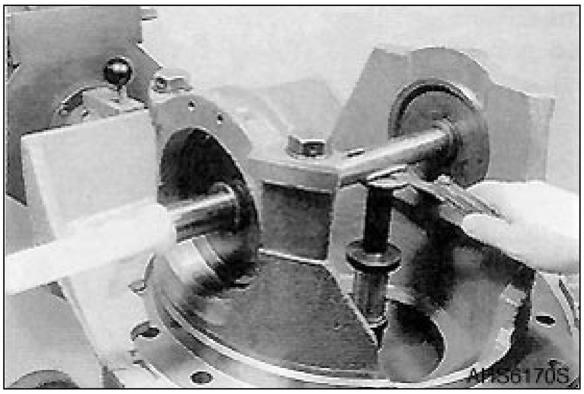


Figure 244

EXAMPLE I

Dimension a (measuring piston)	224.00 mm (8.8189 in)
Dimension b	+ 2.50 mm (0.0984 in)
Dimension C (1/2 ∅ measuring shaft)	+ 15.00 mm (0.5906 in)
Gives Dimension "X"	= 241.50 mm (9.5079 in)

3. Measure bearing width.
    - Bearing width e.g. 42.45 mm (1.6713 in).

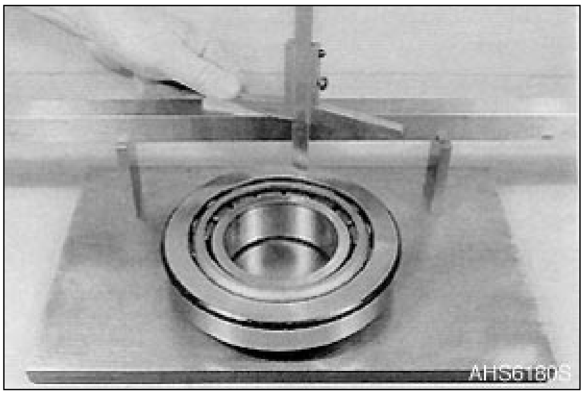


Figure 245

4. Read pinion dimension.
    - Pinion dimension e.g. 197.85 mm (7.7894 in).

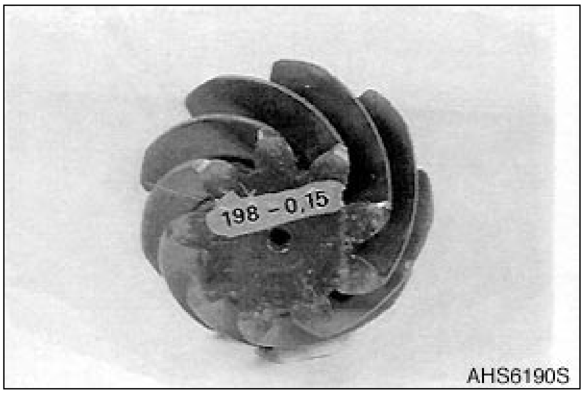


Figure 246

EXAMPLE II

Bearing width	42.45 mm (1.6713 in)
Pinion dimension	+ 197.85 mm (7.7894 in)
Gives Dimension "X" 1	= 240.30 mm (9.4606 in)

EXAMPLE III

Dimension "X"	241.50 mm (9.5079 in)
Dimension "X" 1	- 240.30 mm (9.4606 in)
Difference = Shim thickness	s = 1.20 mm (0.0472 in)

5. Lay shim (according to the Example s = 1.20 mm (0.0472 in)) into the housing bore.

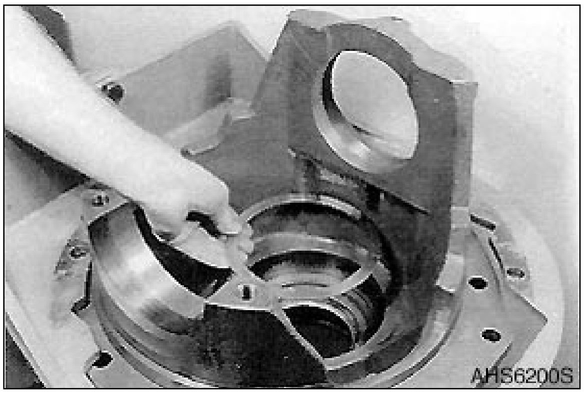


Figure 247

6. Freeze outer bearing race and place it firmly against shoulder.
7. Install the drive flange side outer bearing race accordingly.

   NOTE: *See "Special Tools" on page 15.*

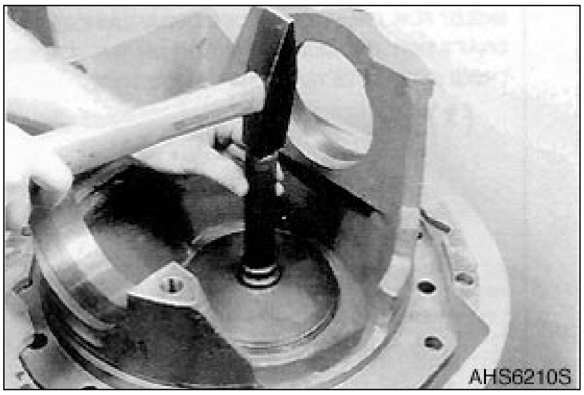


Figure 248

8. Heat inner bearing race, guide it over the drive pinion end until contact is obtained.

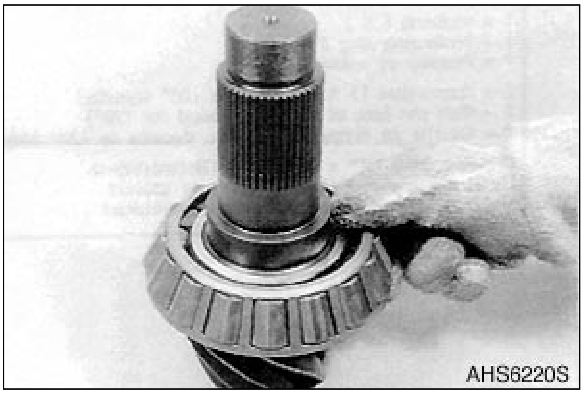


Figure 249

ADJUSTMENT OF DRIVE PINION BEARING ROLLING RESISTANCE

Nominal Value

DK / CK	1.1 - 2.3 Nm (9.7 - 20.3 in lb)
HK	1.5 - 3.0 Nm (13.2 - 17.7 in lb)
LK / RK	3.0 - 4.5 Nm (17.7 - 39.8 in lb)

1. Lay measuring ring over the drive pinion collar.

   NOTE: *Configuration and description of the measuring ring, see Figure 251.*

   NOTE: *See "Special Tools" on page 15.*

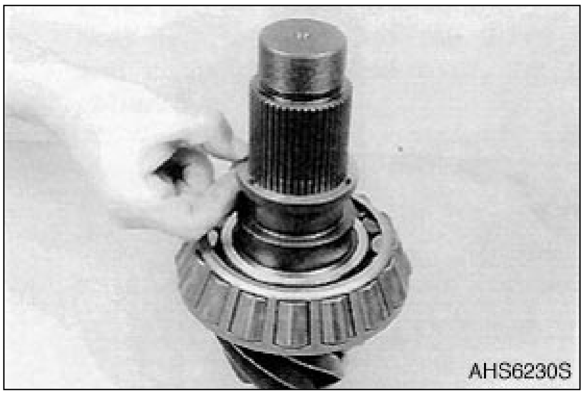


Figure 250

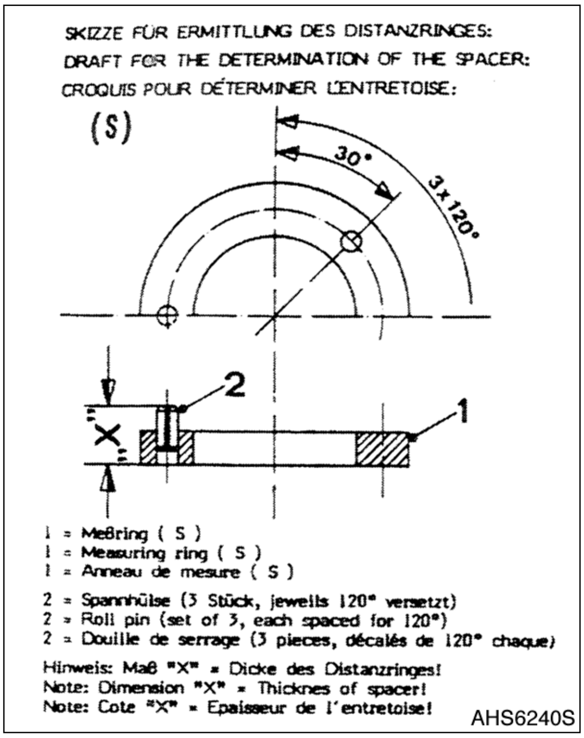


Figure 251

2. If necessary (according to the Version). insert hex. head screws into the drive flange bores and press dust shield over the drive flange collar.

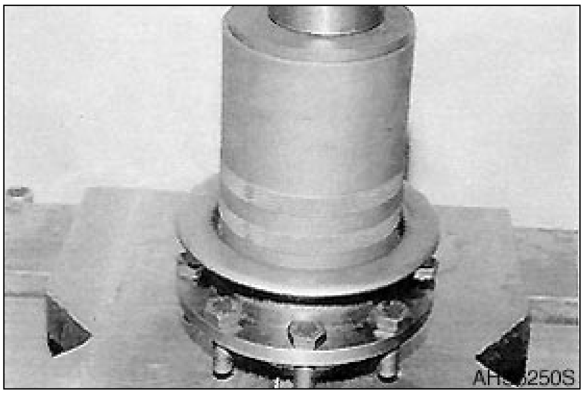


Figure 252

3. Insert drive pinion into the axle carrier and assemble heated inner bearing race until contact is obtained.

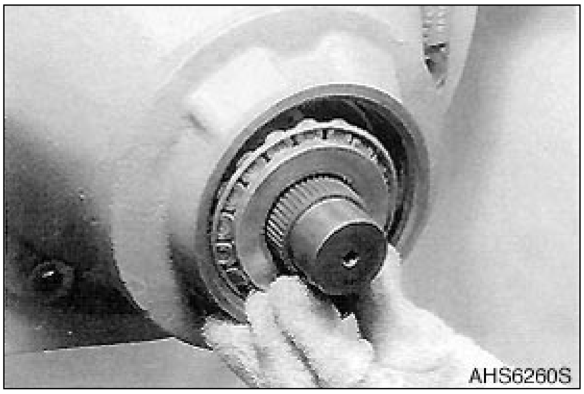


Figure 253

4. Guide drive flange over the drive pinion splines. Install washer and tighten slotted nuts resp. hex. nut (according to the Version) until the required rolling resistance is obtained.

   NOTE: *When tightening, make several revolutions of the thrive pillion in both directions and check rolling resistance continuously.*

   NOTE: *See “Special Tools” on page 15.*

5. Remove slotted nut, pull off drive flange and remove pinion again.

6. Remove measuring ring and determine dimension "X" (see Figure 251).

   - Dimension "X" e.g. s = 7.97 mm (0.3138 in).

   NOTE: *Dimension "X corresponds to the thickness of the spacer to be installed.*

   NOTE: *Lay spacer (e.g. S. = 7.97 mm (0.3138 in)) instead of the measuring ring over the drive pinion end. Install drive pinion again.*

7. Replace drive flange, mount washer and tighten slotted nut.

   NOTE: *Torque limit:*
   DK/CK 700 Nm (515 ft lb)
   RK 1,100 Nm (810 ft lb)
   HK/LK 1,200 Nm (885 ft lb)

   NOTE: *When tightening, make several revolutions of the drive pinion in both directions.*

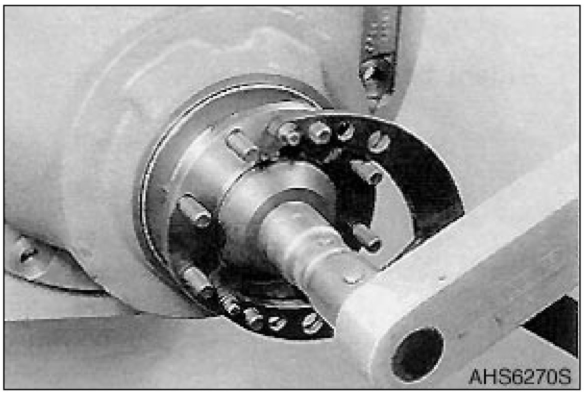


Figure 254

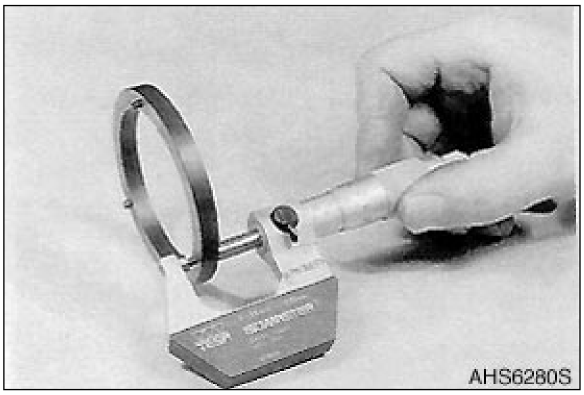


Figure 255

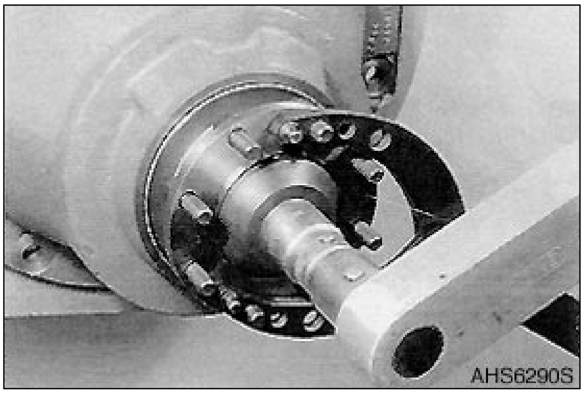


Figure 256

8. Check rolling resistance.

NOTE: *If the required rolling resistance is not obtained correct again with a corresponding spacer.*

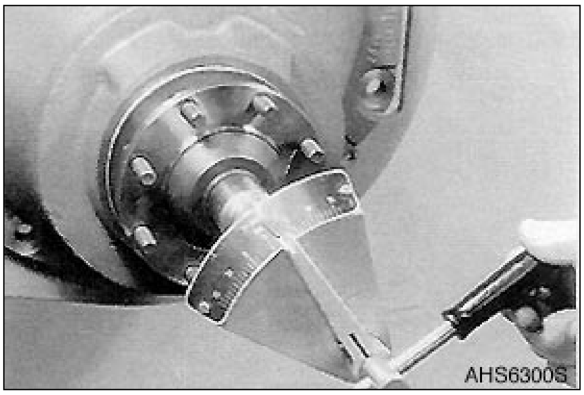


Figure 257

9. Remove drive flange and install shaft seal.

NOTE: *Pay attention to the contact.*

NOTE: *If the outer diameter of the shaft seal is rubber-coated, wet the sealing face with mineral spirits. Otherwise use the sealing compound Loctite #586.*

NOTE: *Fill the cavity between sealing lip and dust lip with grease.*

NOTE: *See "Special Tools" on page 15.*

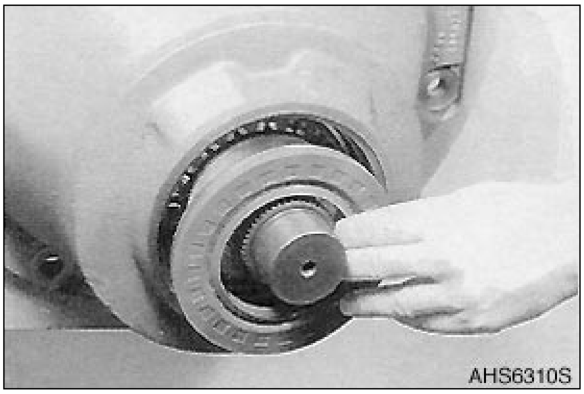


Figure 258

10. Replace drive flange.

11. Assemble washer and tighten slotted nut, resp. hex. nut (according to the Version) finally

NOTE: *Torque limit:*
DK/CK 700 Nm (515 ft lb)
RK 1,100 Nm (810 ft lb)
HK/LK 1,200 Nm (885 ft lb)

NOTE: *The securing of the slotted nut, resp. hex. nut (according to the Version) is carried out after the contact pattern is taken.*

NOTE: *See "Special Tools" on page 15.*

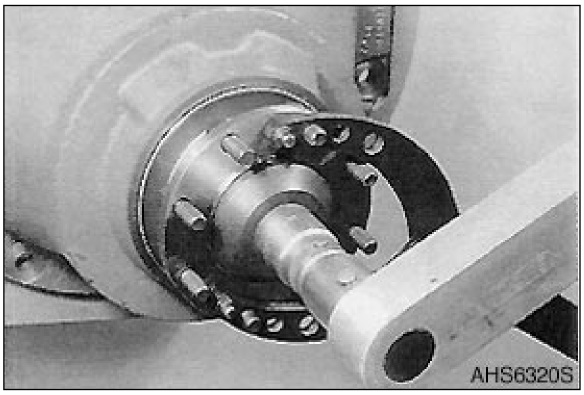


Figure 259

DIFFERENTIAL

1. Heat crown wheel and place it against the differential case half until contact is obtained.

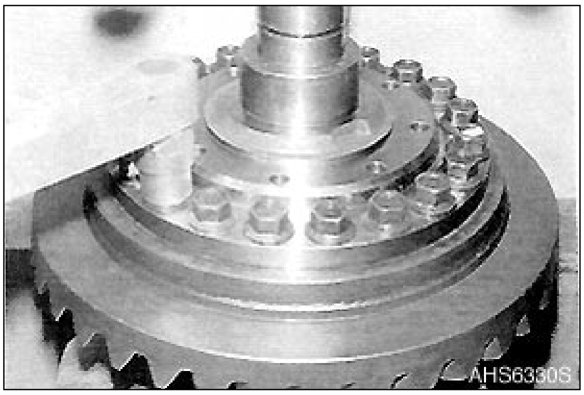


Figure 260

2. Clamp the differential case using a press and tighten locking screws.

   NOTE: *See "Torque Limits for Screws" on page 6.*

   NOTE: *Only single use of the locking screws is admitted.*

3. Press the inner bearing race firmly against shoulder.

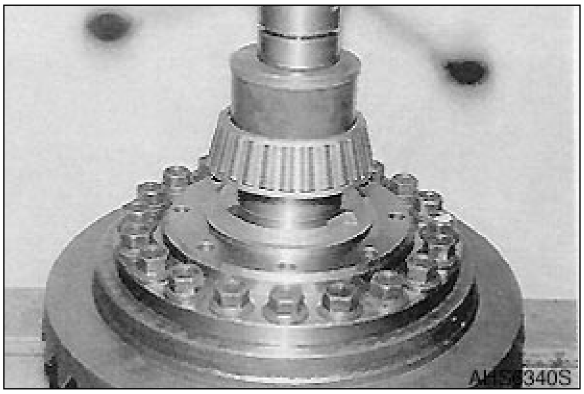


Figure 261

4. Lay the two thrust washers into the differential case half.

   NOTE: *Mount brass washer on top with the lubricating groove facing the side gear.*

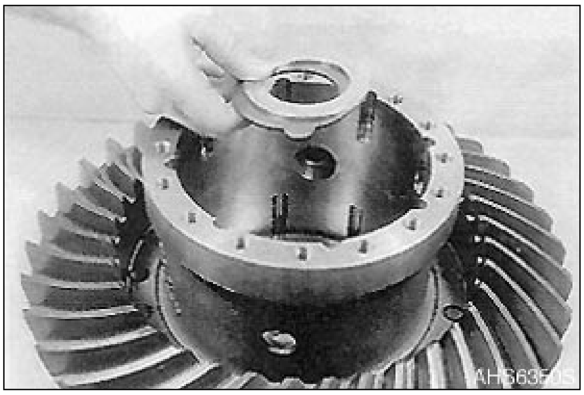


Figure 262

5. Lay snap ring into the ring groove, see Figure 263.

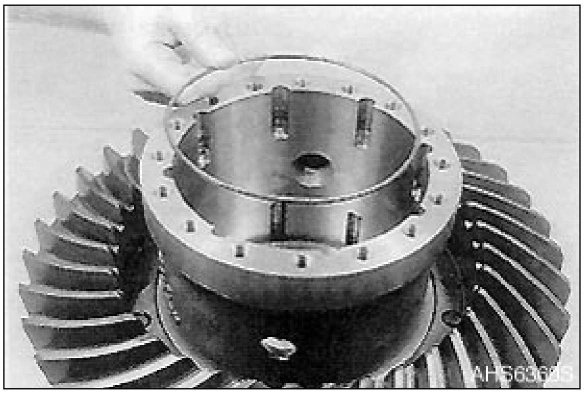


Figure 263

6. Insert drive pin, see Figure 264.

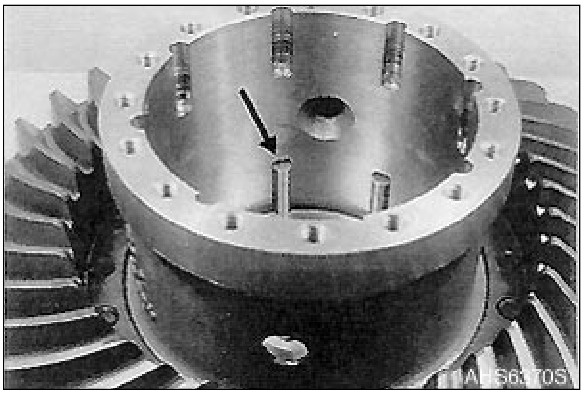


Figure 264

7. Assemble alternating outer and inner plates, starting with one outer plate.

NOTE: *Number and installation position of outer and inner plates, see corresponding list of spare parts. The total height (thickness) of the plate pack must be equal on both differential sides. Plate thickness of outer plates may be different.*

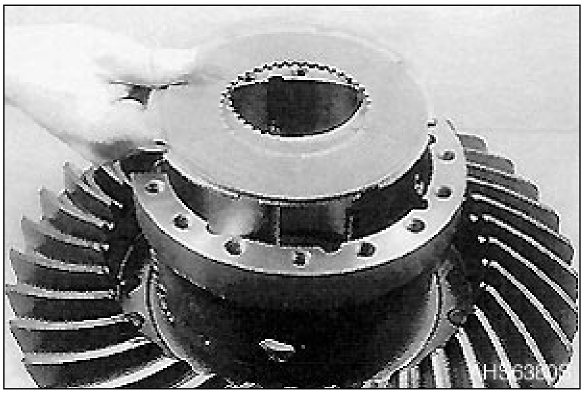


Figure 265

8. Replace pressure ring.

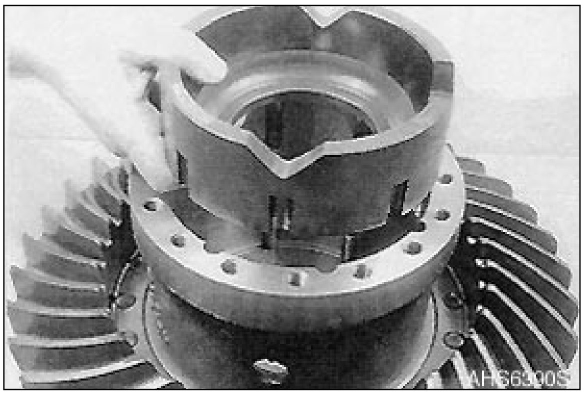


Figure 266

9. Insert side gear and assemble inner plates at the same time.

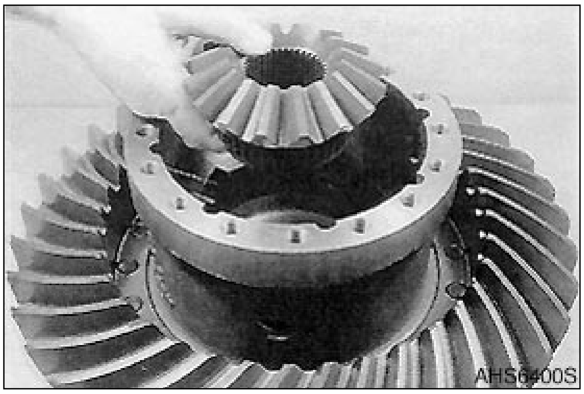


Figure 267

10. Insert the differential spider assembly.

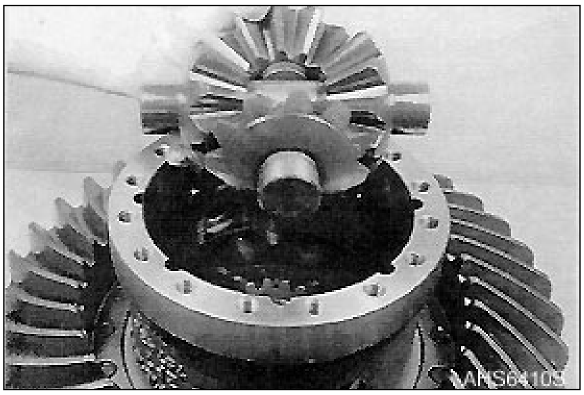


Figure 268

11. Install second side gear.

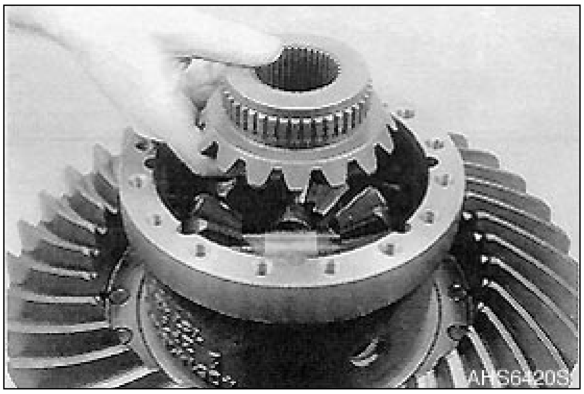


Figure 269

12. Install second pressure ring and insert all drive pins.

    NOTE: *Pay attention to the radial installation position of the pressure ring.*

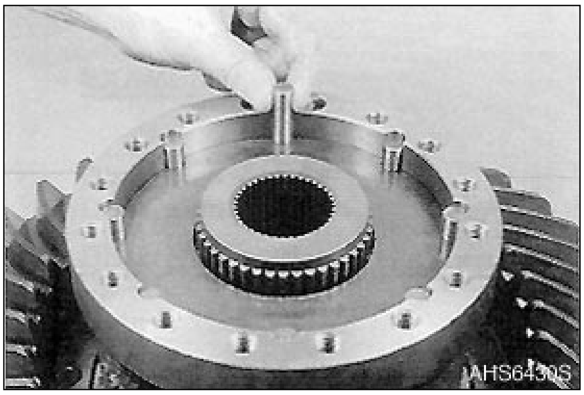


Figure 270

13. Assemble alternating inner and outer plates, starting with one inner plate.

    NOTE: *Number and installation position of inner and outer plates, see corresponding list of spare parts.*

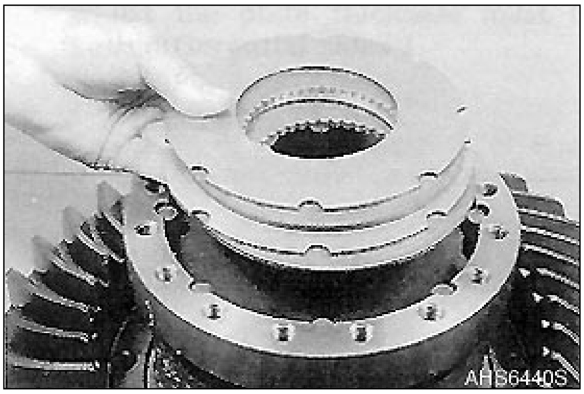


Figure 271

Determination of Plate Clearance

1. Differential case

   Measure dimension A from the flange-mounted surface to the outer plate.

   - Dimension A e.g. 4.20 mm (0.1654 in).

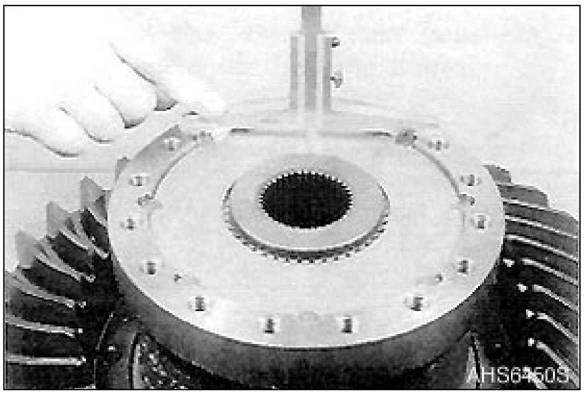


Figure 272

2. Housing cover

   Determine dimension B from the contact face (outer plate) to the flange-mounted surface.

   - Dimension B e.g. 3.80 mm (0.1496 in).

   NOTE: *The proscribed end play (= plate clearance) is 0.2 - 0.8 mm (0.0079 - 0.0315 in), whilst the lower value should be found. The end play is corrected by the installation of outer plates of corresponding thickness whilst the plate thickness must be equal on both differential sides.*

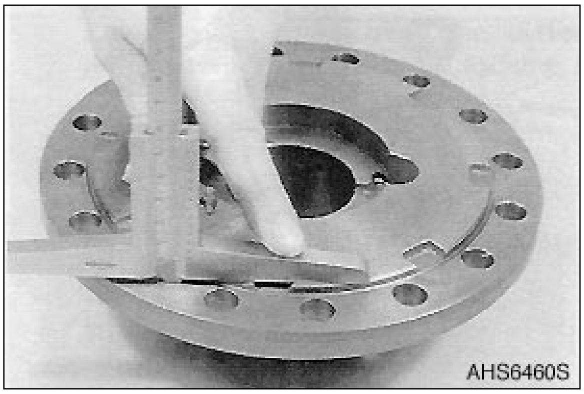


Figure 273

EXAMPLE

Dimension A	3.40 mm (0.1339 in)
Dimension B	- 3.10 mm (0.1221 in)
Differential = Plate clearance	= 0.30 mm (0.0118 in)

3. Make the two thrust washers adhere with grease in the housing cover.

   NOTE: *Mount the brass washer on top wish the lubricating groove facing the side gear.*

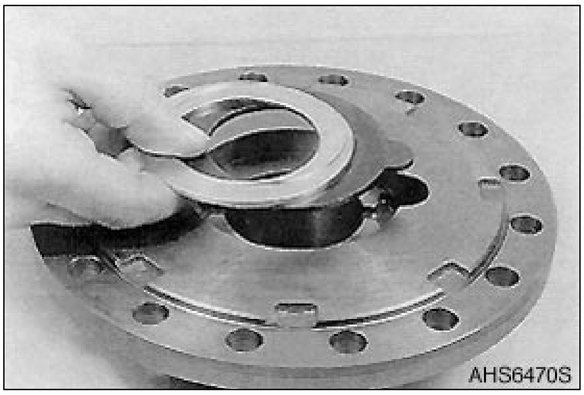


Figure 274

4. Lay housing cover over the differential case and fasten it using locking screws.

   NOTE: *See “Torque Limits for Screws” on page 6.*

   NOTE: *Pay attention to the installation position, see Figure 275. Only single use of locking screws is admitted.*

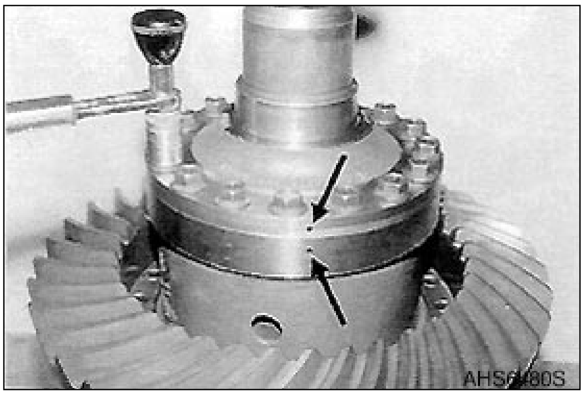


Figure 275

5. Heat inner bearing race and position it on the housing cover until contact is obtained.

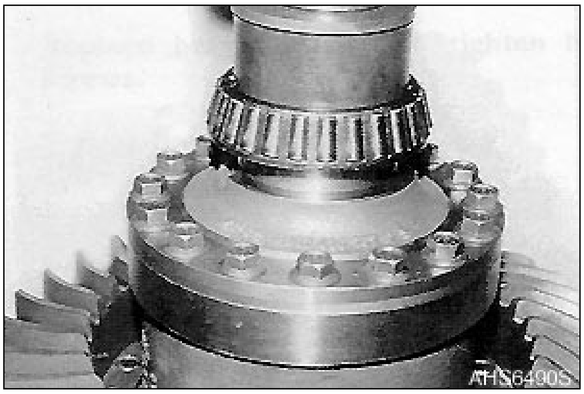


Figure 276

6. Insert 1st outer bearing race into the housing and hold it temporarily using adjusting nut.

Figure 277

7. Mount 2nd outer bearing race and insert the differential assembly into the axle carrier.

   NOTE: *See “Special Tools” on page 15.*

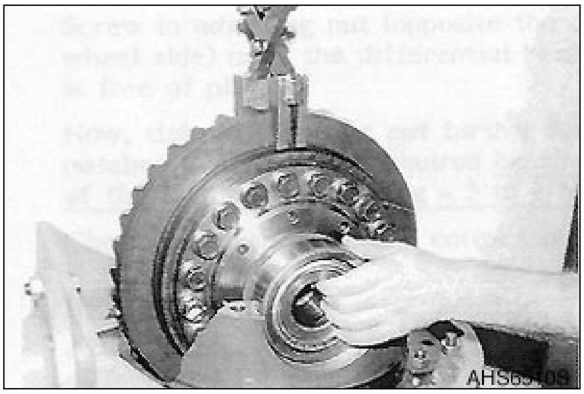


Figure 278

8. Temporarily secure the crown wheel side outer bearing race using the second adjusting nut.

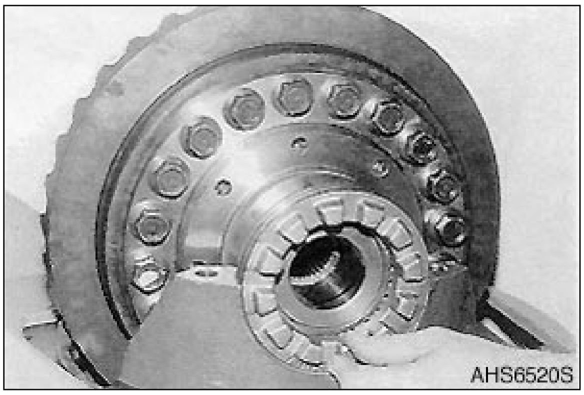


Figure 279

9. Replace bearing caps and tighten hex. head screws.

   NOTE: *See “Torque Limits for Screws” on page 6.*

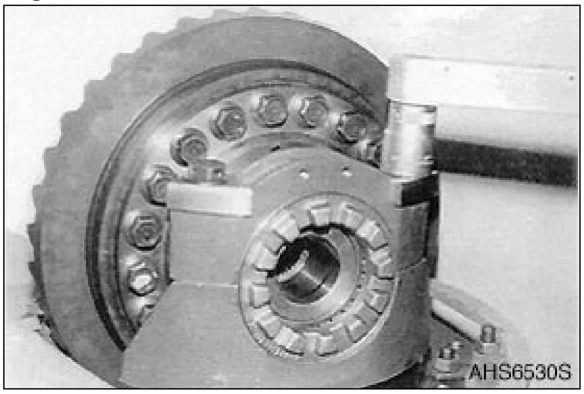


Figure 280

Adjustment of Bearing Preload and Backlash

1. Attach dial indicator right angled on the outer diameter of the tooth flank/crown wheel.

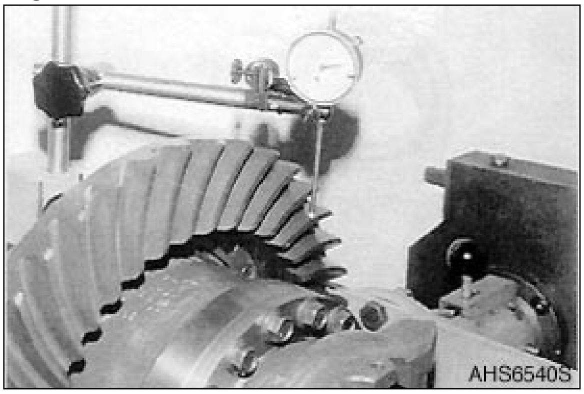


Figure 281

2. Adjust adjusting nut on the crown wheel side until the required backlash (see value engraved on the crown wheel outer diameter) is obtained.

   NOTE: *See “Special Tools” on page 15.*

3. Screw in adjusting nut (opposite the crown wheel side) until the differential bearing is free of play.

4. Now, tighten adjusting nut further for 2 notches to obtain the required bearing preload of the differential bearing 3 - 4 Nm (26.5 - 35.4 in lb). Check backlash again and correct if necessary.

   NOTE: *At this step make several revolutions of the differential.*

5. Determine yoke width. Yoke width e.g. 358.00 $^{+0.05}$ mm(14.0945 $^{+0.0020}$ in) max.

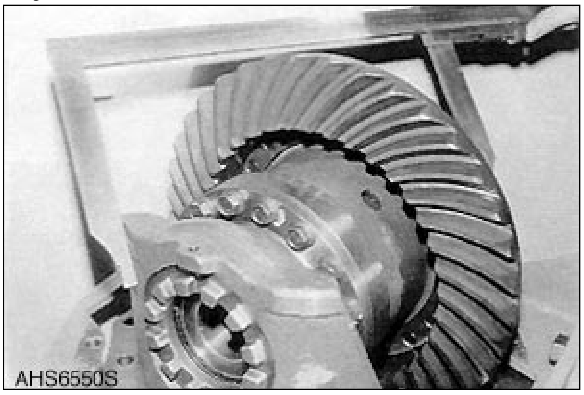


Figure 282

6. Attach dial indicator on the plane face/ crown wheel.

7. Make at least one revolution of the crown wheel and record the run-out.

   NOTE: *Admitted run-out max. 0.08 mm (0.0031 in).*

   NOTE: *See “Special Tools” on page 15.*

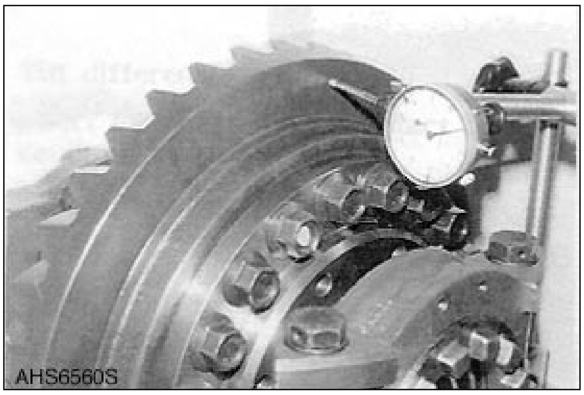


Figure 283

8. Cover some tooth flanks of the crown wheel wish gear marking compound.

9. Roll the crown wheel over the drive pinion back and forth.

10. Check the contact pattern and compare it with “Examples of Gear-tooth-contact Patterns for the Gleason Gear-tooth System” on page 11.

11. In case of a greater contact pattern deviation, a spacing error has been made during the reassembly of the drive pinions which must be corrected.

12. Secure adjusting nut.

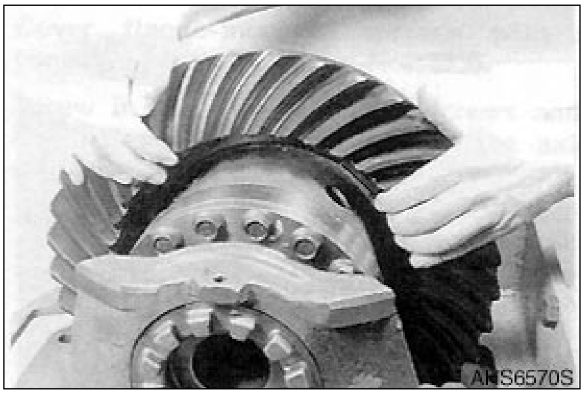


Figure 284

Figure 285

13. Secure adjusting nut and hex. head screws according to the Figure 286.

Figure 286

14. Tilt differential carriers.
15. Insert lock plate until contact is obtained and caulk on the drive flange.

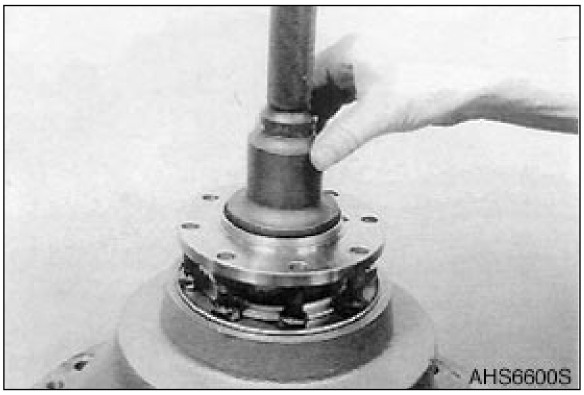


Figure 287

16. Cover flange-mounted surface with sealing compound Loctite #573.
17. Screw in the two adjusting screws and place the differential carrier against the axle housing until contact is obtained.

NOTE: *See “Torque Limits for Screws” on page 6.*

NOTE: *Now, install stub shafts again and complete the final drive.*

Before the Axle is put into Service, follow the “Lubrication Instructions” on page 8

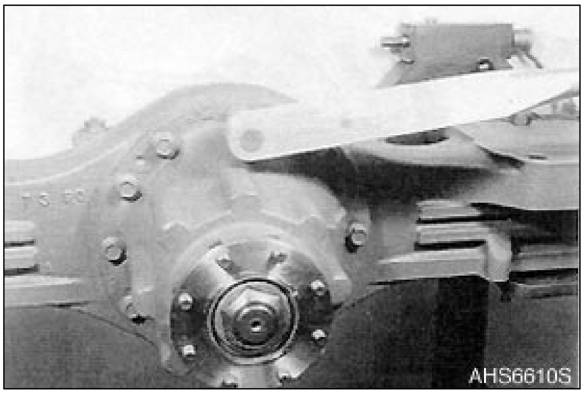


Figure 288

ILLUSTRATED TABLE

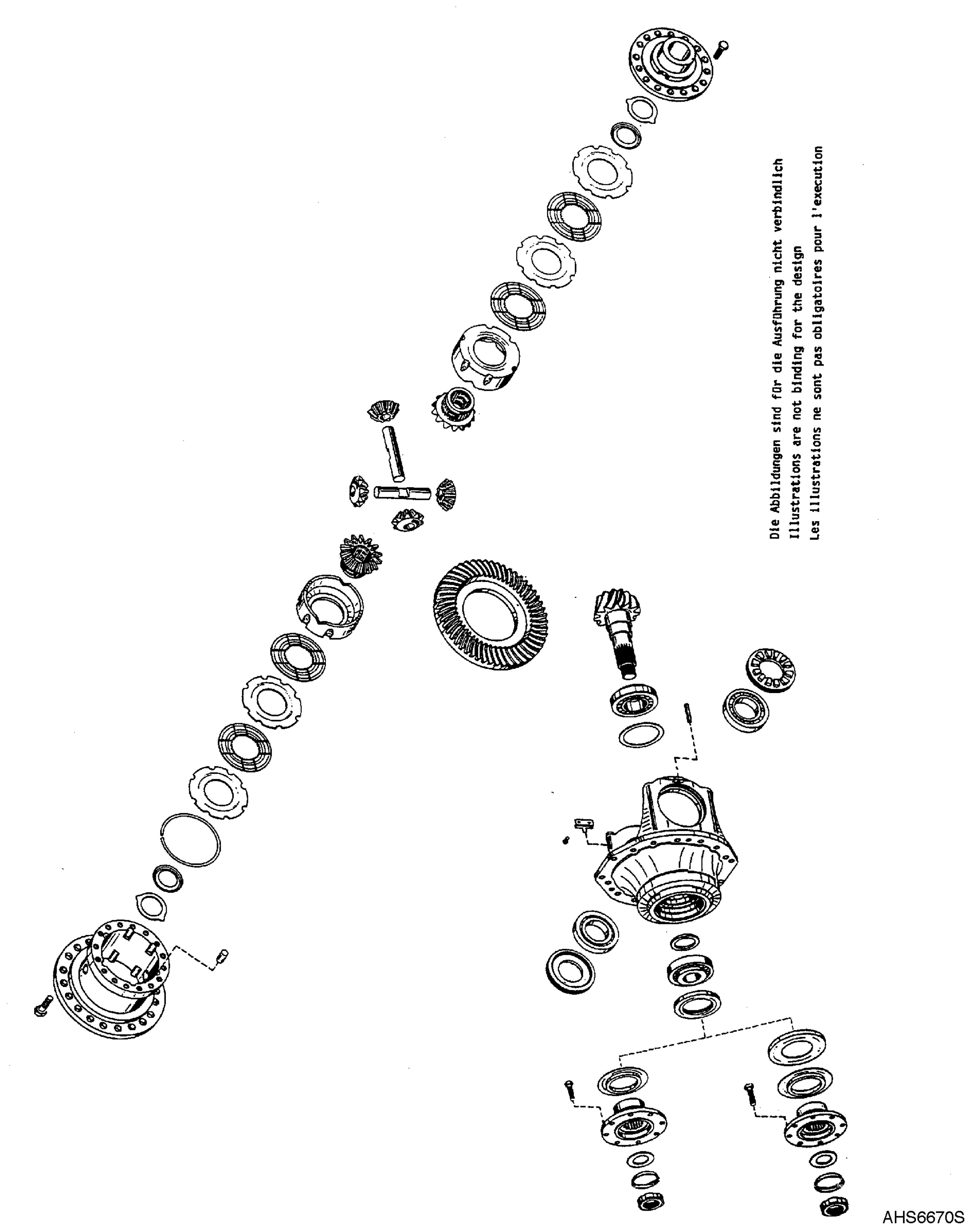


Figure 289

S0605050K

DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

AIR CONDITIONER

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Mega 130	0001 and Up
Mega 160	0001 and Up
Mega 200-V	1001 and Up
Mega 250-V	1001 and Up
Mega 300-V	1001 and Up
Mega 400-V	1001 and Up
Mega 500-V	1001 and Up

November 2001

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GENERAL DESCRIPTION

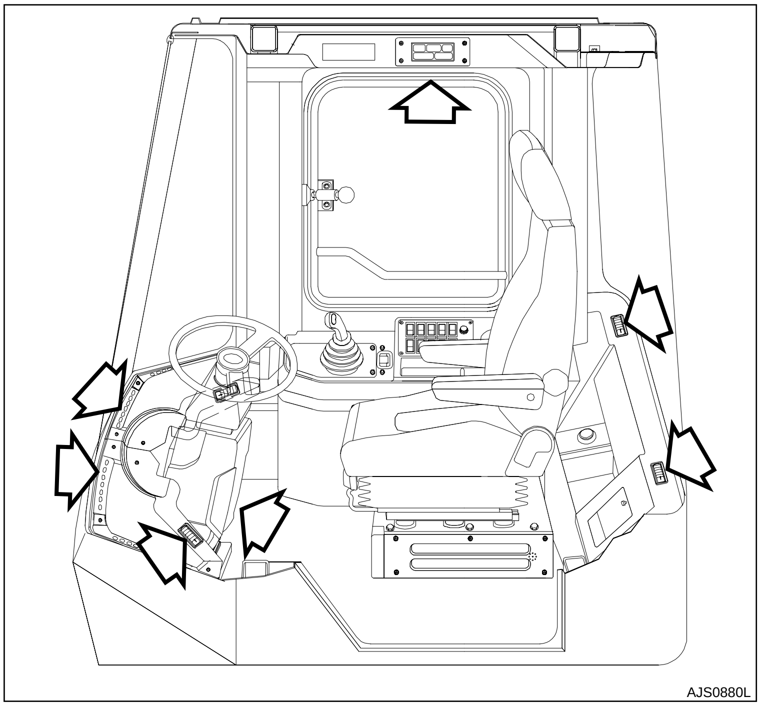


Figure 1

The heater and air conditioner are combined into one blower unit in the right control stand of operator's seat. If necessary, the operator can control inner temperature using the operation panel installed in the top of the right side door.

The unit is equipped with an air filtration system which filters out dirt and dust particles from air being circulated into the operator's cab. This filter (1, Figure 2) should be cleaned out at approximately every 500 hours and replaced with a new one every 1000 hours.

NOTE: *In the event that the unit is being operated in a dusty environment, cleaning and replacement should be performed more frequently.*

WARNING!

All service and inspection of the air-conditioning system should be performed with the starter switch in the "O" (OFF) position.

NOTE: *Refer to appropriate operation and maintenance manual for latest service intervals.*

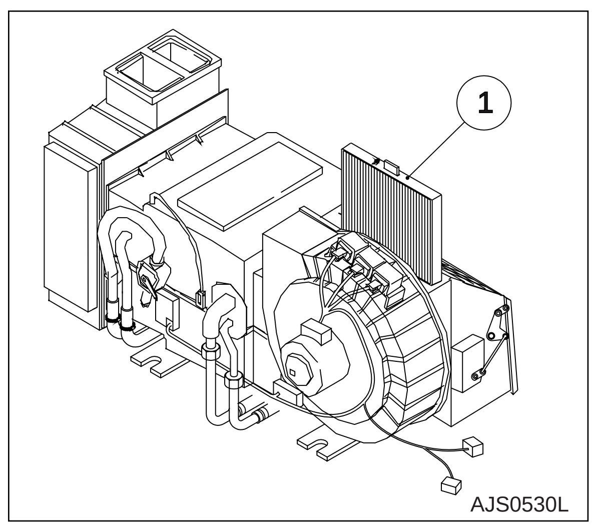


Figure 2

REFRIGERANT CIRCULATION

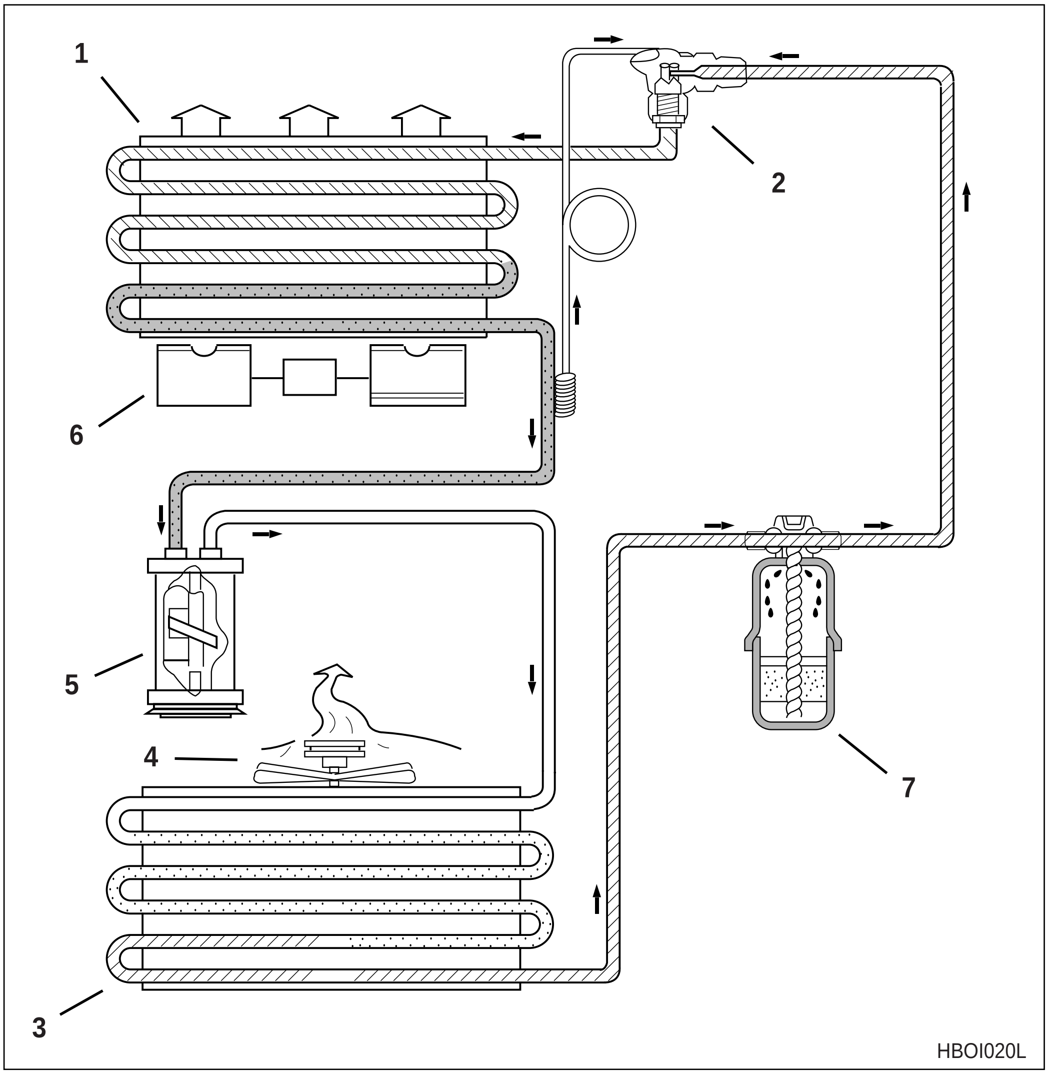


Figure 3

Reference Number	Description
1	Evaporator
2	Expansion Valve
3	Condenser
4	Condenser Fan

Reference Number	Description
5	Compressor
6	Blower Fan
7	Receiver Dryer

Shading	Temperature	Refrigerant State
	High	High Pressure Gas
	High	High Pressure Liquid
	Low	Low Pressure Liquid
	High	High Pressure Gas/Liquid
	Low	Low Pressure Gas

- Refrigerant (R134a) is compressed to approximately 15 kg/cm^2 (213 psi) within the compressor.
- The compressed refrigerant flows into the condenser at high temperature (approximately 80°C (176˚F)).
- The refrigerant in the condenser is cooled to approximately 60° by the condenser fan. At this time the refrigerant changes from the gas to the liquid state, even though the temperature has only been reduced 20°C (68˚F). (From 80° - 60°C (176˚ - 140˚F)).
- The refrigerant in its liquid form is injected into the evaporator through the expansion valve. At this time the pressure is reduced by approximately 2 kg/cm^2 (28 psi) and the temperature is also reduced. As a result, the refrigerant absorbs the heat from the air surrounding the evaporator creating a cooling effect and changes from the gas to the liquid state.
- The refrigerant once again flows into the compressor in the gaseous state and the process is repeated.

WARNING!

Refrigerant gas is pressurized and sealed in the air-conditioning system. Special precautions are required for the proper recharging or release of refrigerant. Release of refrigerant into the atmosphere is strictly regulated by law. Make sure that you are in compliance with all mandated federal, state and municipality requirements, before starting any service or repair of the air conditioner. Refrigerant gas used in the system must meet or exceed specifications for R134a refrigerant, or any subsequently issued environmentally-mandated standard.

CONTROL PANEL

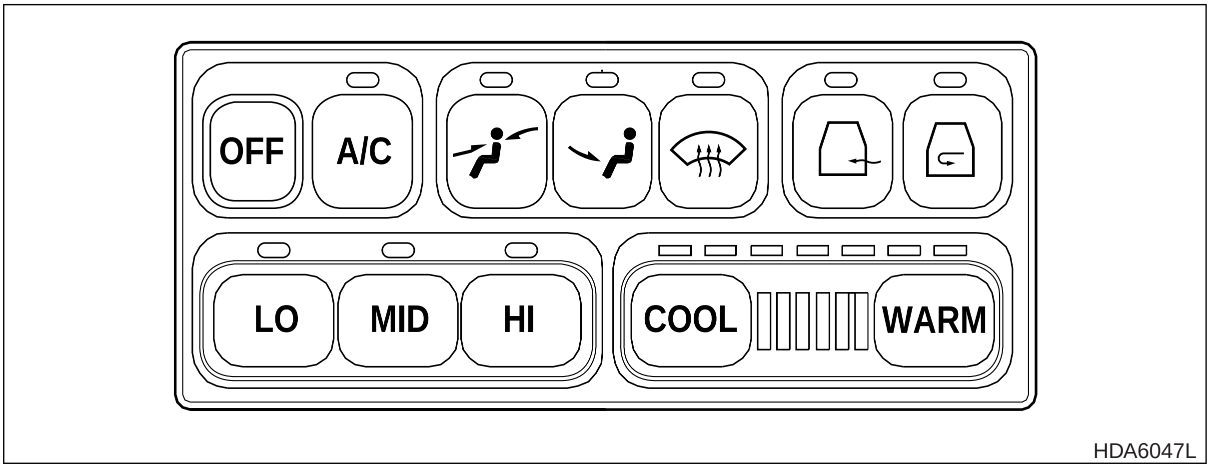


Figure 4

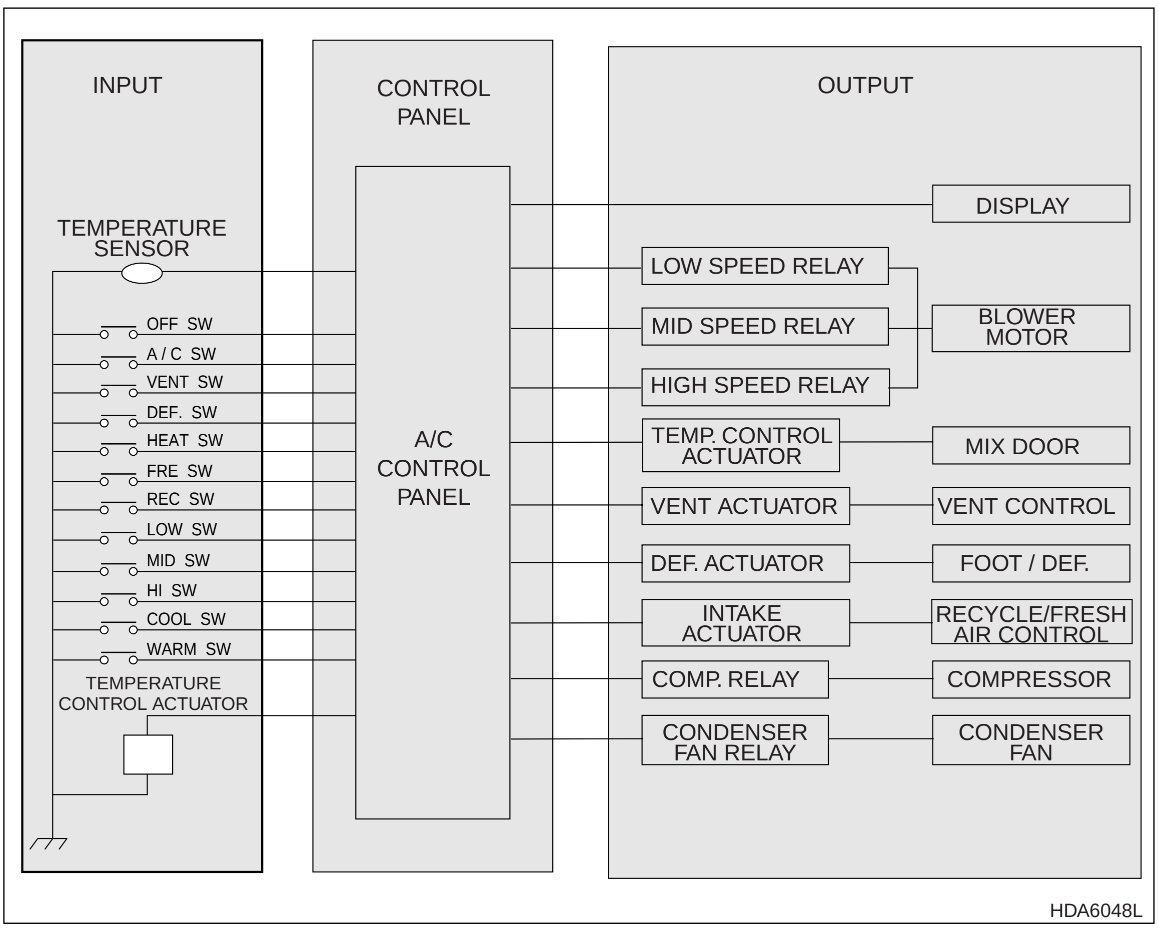
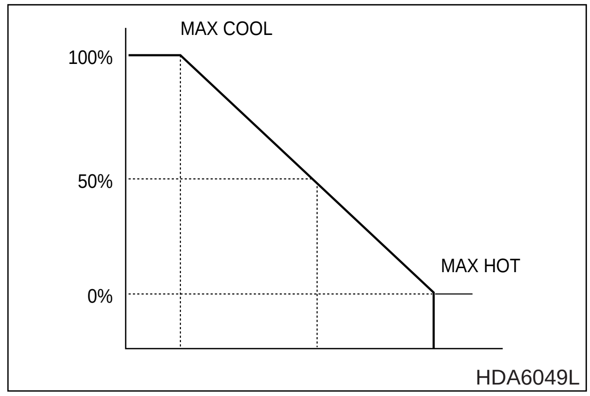
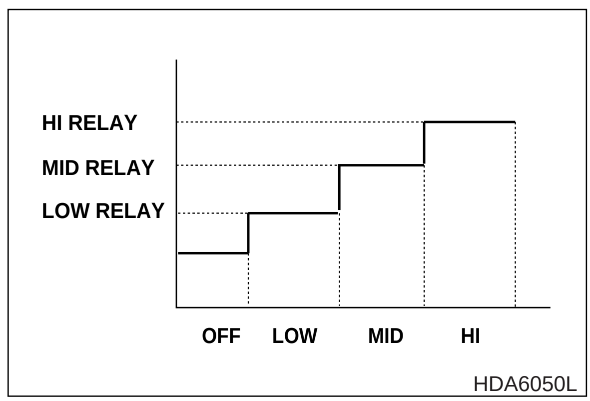
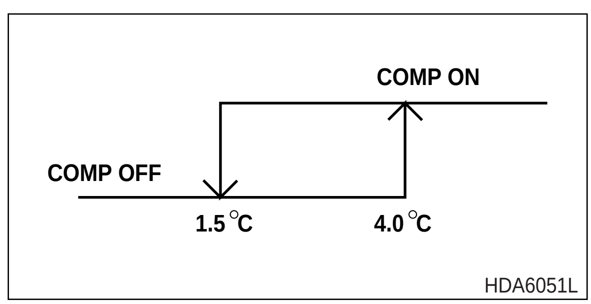


Figure 5

CONTROL SPECIFICATIONS

Control Item	Control Switch	Control Specifications
Temperature Control	"COOL" Switch "WARM" Switch	 **Figure 6** Temperature control switch consists of a 24 step variable selector. The display uses 7, Green / Red two-color LED's to display the selected temperature.
Blower Fan Speed Control	"OFF" Switch "LOW" Switch "MID" Switch "HI" Switch	 **Figure 7**
Compressor Control	Temperature Sensor	 **Figure 8**

TEMPERATURE LEVEL CONTROL AND DISPLAY

Step	LED 1	LED 2	LED 3	LED 4	LED 5	LED 6	LED 7	Position Sensor Voltage	Remark
0	Green	Green	Green	Green	Green	Green	Green	4.50 V ±0.2	MAX. COOL
1	Green	Green	Green	Green	Green	Green	Green	4.33 V ±0.2	
2	Green	Green	Green	Green	Green	Green	Green	4.15 V ±0.2	
3	Red	Green	Green	Green	Green	Green	Green	3.98 V ±0.2	
4	Red	Green	Green	Green	Green	Green	Green	3.80 V ±0.2	
5	Red	Green	Green	Green	Green	Green	Green	3.63 V ±0.2	
6	Red	Red	Green	Green	Green	Green	Green	3.46 V ±0.2	
7	Red	Red	Green	Green	Green	Green	Green	3.28 V ±0.2	
8	Red	Red	Green	Green	Green	Green	Green	3.11 V ±0.2	
9	Red	Red	Red	Green	Green	Green	Green	2.93 V ±0.2	
10	Red	Red	Red	Green	Green	Green	Green	2.76 V ±0.2	
11	Red	Red	Red	Green	Green	Green	Green	2.59 V ±0.2	
12	Red	Red	Red	Red	Green	Green	Green	2.41 V ±0.2	
13	Red	Red	Red	Red	Green	Green	Green	2.24 V ±0.2	
14	Red	Red	Red	Red	Green	Green	Green	2.07 V ±0.2	
15	Red	Red	Red	Red	Red	Green	Green	1.89 V ±0.2	
16	Red	Red	Red	Red	Red	Green	Green	1.72 V ±0.2	
17	Red	Red	Red	Red	Red	Green	Green	1.54 V ±0.2	
18	Red	Red	Red	Red	Red	Red	Green	1.37 V ±0.2	
19	Red	Red	Red	Red	Red	Red	Green	1.20 V ±0.2	
20	Red	Red	Red	Red	Red	Red	Green	1.02 V ±0.2	
21	Red	Red	Red	Red	Red	Red	Red	0.85 V ±0.2	
22	Red	Red	Red	Red	Red	Red	Red	0.67 V ±0.2	
23	Red	Red	Red	Red	Red	Red	Red	0.50 V ±0.2	MAX. HOT

AIR DISCHARGE ACCORDING TO PATH SELECTION

Vent

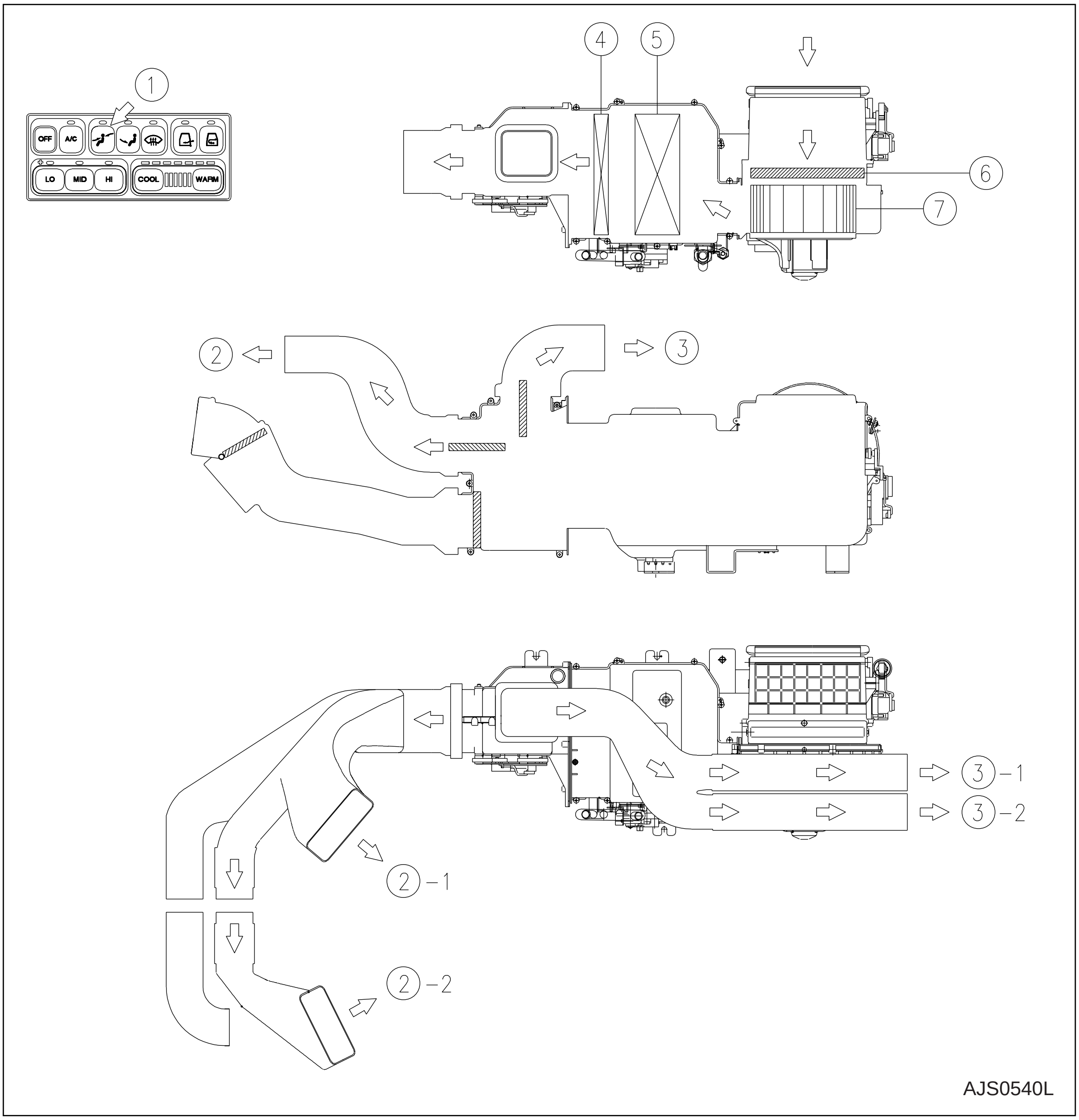


Figure 9

Reference Number	Description
1	Select Switch
2	Front Vent
2-1	Front Vent (R)
2-2	Front Vent (L)
3	Rear Vent
3-1	Rear Vent (R)

Reference Number	Description
3-2	Rear Vent (L)
4	Heater Core
5	Evaporator Core
6	Air Filter
7	Blower Motor

Foot

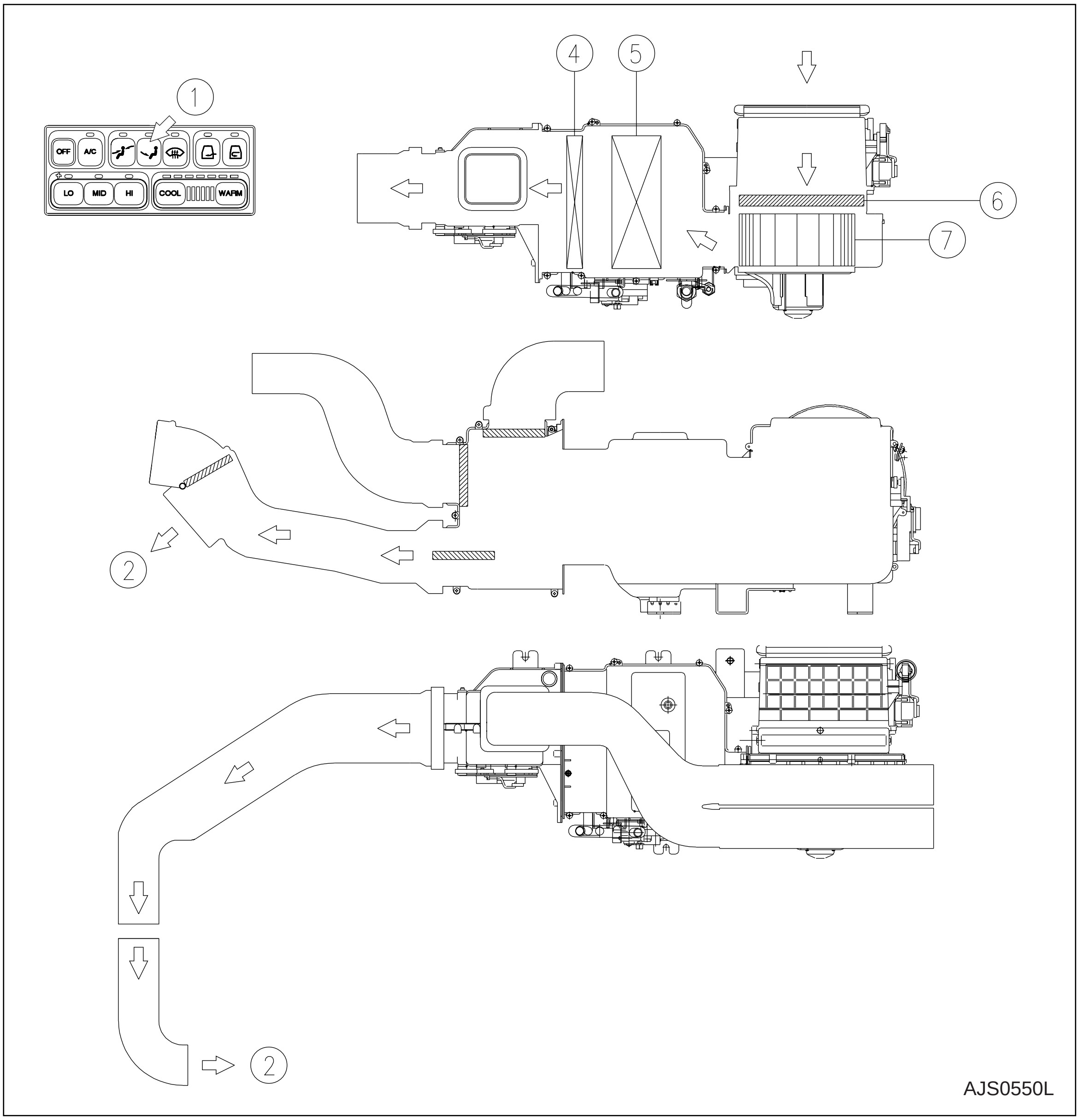


Figure 10

Reference Number	Description
1	Select Switch
2	Foot Vent
4	Heater Core

Reference Number	Description
5	Evaporator Core
6	Air Filter
7	Blower Motor

Defroster

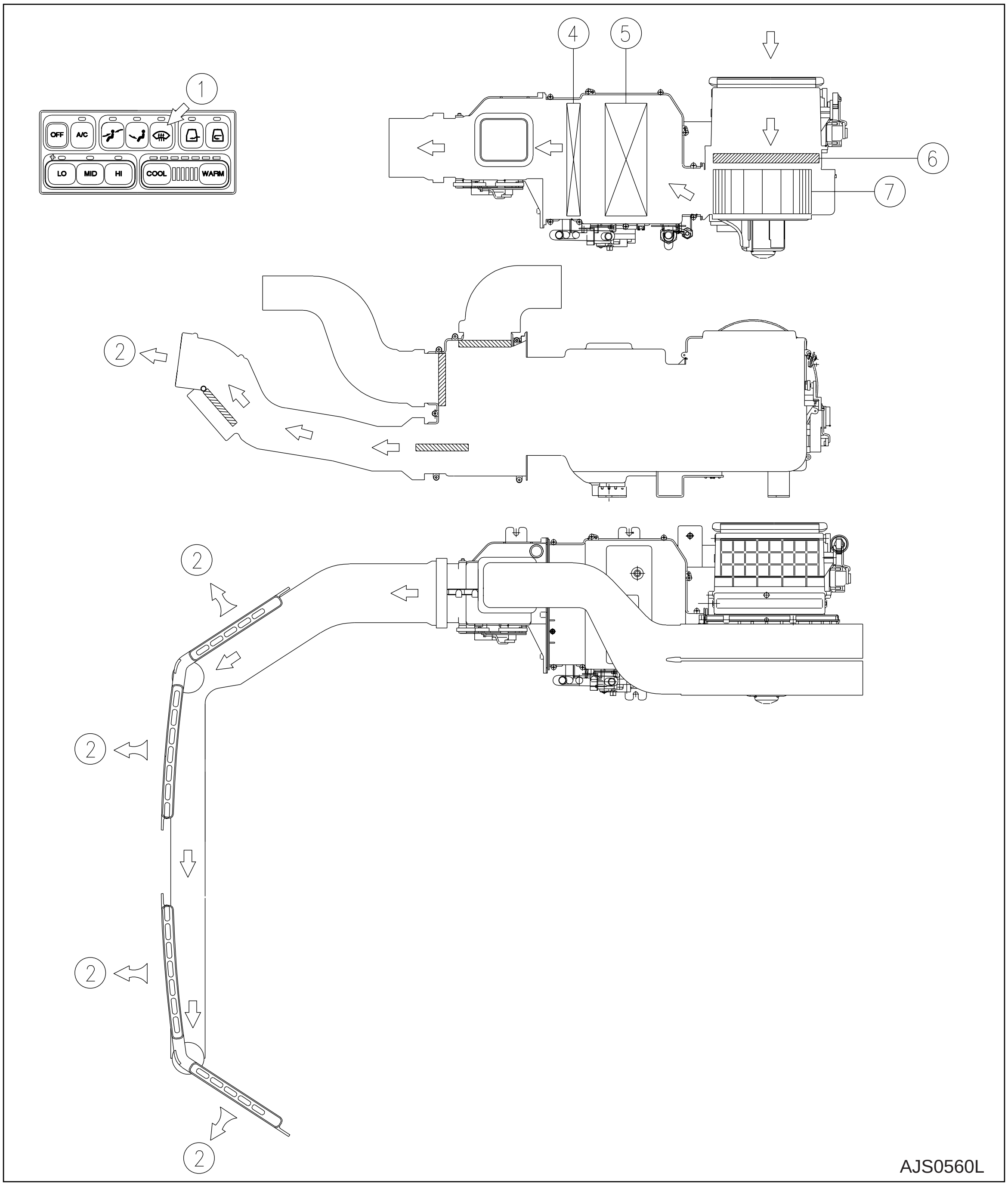


Figure 11

Reference Number	Description
1	Select Switch
2	Defroster Vent
4	Heater Core

Reference Number	Description
5	Evaporator Core
6	Air Filter
7	Blower Motor

AIR-CONDITIONING SYSTEM CIRCUIT DIAGRAM

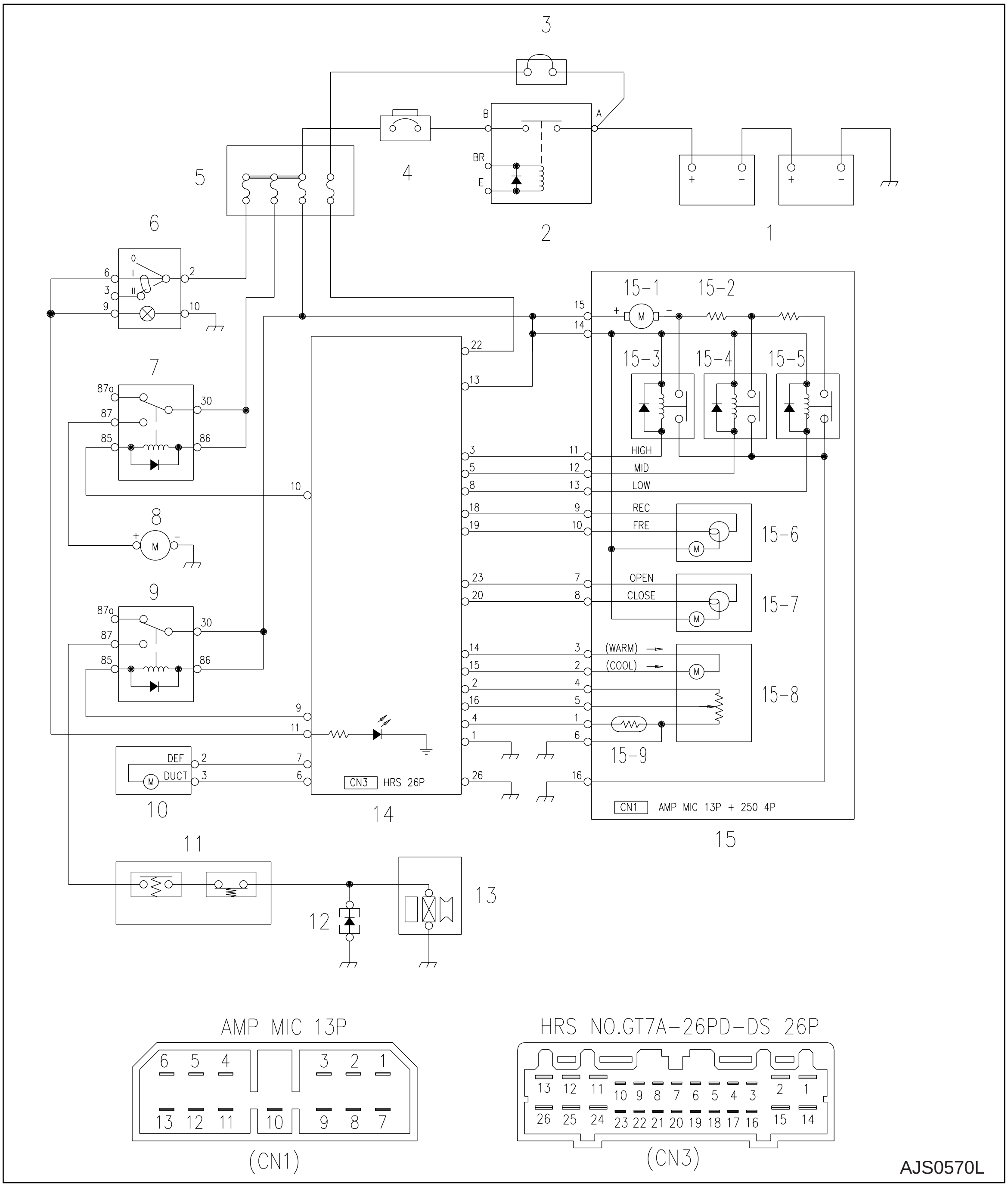


Figure 12

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker
5	Fuse Box
6	Headlight Switch
7	Condenser Fan Relay
8	Condenser Fan Motor
9	Compressor Relay
10	Foot / Defrost Control Actuator
11	Receiver Drier
12	Diode
13	Compressor

Reference Number	Description
14	A/C Control Panel
15	A/C Unit
15-1	Blower Motor
15-2	Resister
15-3	High Speed Relay
15-4	Mid Speed Relay
15-5	Low Speed Relay
15-6	Recirculate / Fresh Air Control Actuator
15-7	Vent Actuator
15-8	Temperature Control Actuator
15-9	Temperature Sensor (Evaporator)

TROUBLESHOOTING

Refrigerant Pressure Check

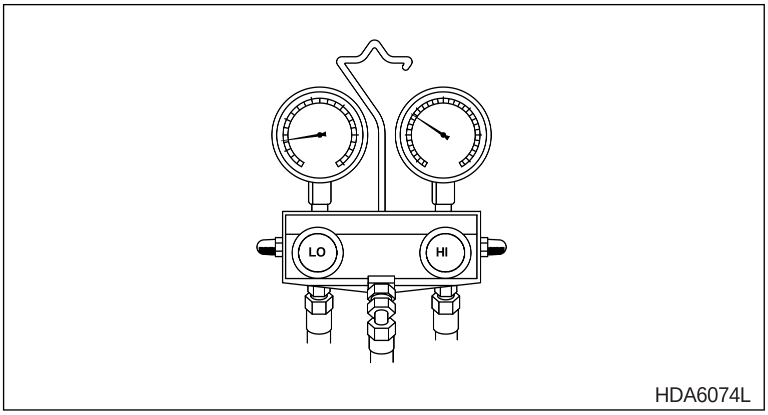


Figure 13

1. Open all doors and windows.
2. Install manifold gauge set.
3. Start engine and maintain engine speed at 1,800 - 2,000 rpm.
4. Check high / low pressure of refrigerant.

1	**High Pressure: 8 - 10 kg/cm^2 (114 - 142 psi)** **Low Pressure: Approximately 1 kg/cm^2 (14 psi)**		
Possible Cause: Low Refrigerant Level			
Step	**Inspection Item**		**Remedy**
1	Check for traces of refrigerant oil.	Yes	Reassemble using correct tightening torque.
		No	Go to next step.
2	Using a leak detection device or soapy water check for refrigerant leakage at all major components and joints.	Yes	Repair leaking component.
		No	Recharge system to correct pressure.

2	**High Pressure: Over 23 kg/cm^2 (327 psi)** **Low Pressure: Approximately 2.5 - 3.0 kg/cm^2 (36 - 43 psi)**		
Possible Cause: Overcharge, Frost on condenser			
Step	**Inspection Item**		**Remedy**
1	Check for condenser pin damage or contamination.	Yes	Clean, repair or replace condenser.
		No	Refrigerant overcharge.

<table>
<tr><th>3</th><th colspan="4">High Pressure: Approximately 20 - 25 kg/cm^2 (284 - 356 psi)
Low Pressure: Approximately 2.5 - 3.5 kg/cm^2 (36 - 50 psi)</th></tr>
<tr><td colspan="5">Possible Cause: Air in system.</td></tr>
<tr><td colspan="5">1. Recover any remaining refrigerant.
2. Vacuum out system.
3. Recharge system.
NOTE: If the system has been exposed to the air for a long period of time, replace the receiver dryer.</td></tr>
</table>

<table>
<tr><th>4</th><th colspan="3">High Pressure: Over 6 kg/cm^2 (85 psi)
Low Pressure: Approximately 760 mmHg (Negative Pressure)</th></tr>
<tr><td colspan="4">Possible Cause: Refrigerant does not circulate</td></tr>
<tr><th>Step</th><th colspan="2">Inspection Item</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">1. Connect manifold gauge and start engine.
2. Turn on air conditioner.
3. Set blower switch to HIGH position.
4. Turn air conditioner OFF and wait 10 minutes.
5. Recheck high / low pressure readings.
High Pressure: 13 - 19 kg/cm^2 (185 - 270 psi)
Low Pressure: 1.5 - 3.3 kg/cm^2 (21 - 47 psi)</td><td>Yes</td><td>Moisture in system, replace receiver dryer.</td></tr>
<tr><td>No</td><td>Contaminated system, replace expansion valve.
(Replace evaporator core assembly.)</td></tr>
</table>

<table>
<tr><th>5</th><th colspan="4">High Pressure: Over 6 - 18 kg/cm^2 (85 - 256 psi)
Low Pressure: 500 mmHg (Negative Pressure) - Dial indicator needle unstable.</th></tr>
<tr><td colspan="5">Possible Cause: Moisture in system has iced up the expansion valve.
NOTE: When the absorbed moisture freezes the pressure readings may look normal. Careful readings should be made to determine whether pressure is in normal range.</td></tr>
<tr><td colspan="5">1. Recover any remaining refrigerant.
2. Vacuum out system.
3. Recharge system.
NOTE: If the system has been exposed to the air for a long period of time, replace the receiver dryer.</td></tr>
</table>

<table>
<tr><th>6</th><th colspan="3">High Pressure: Over 22 - 23 kg/cm^2 (313 - 327 psi)
Low Pressure: 2.5 kg/cm^2 (36 psi)</th></tr>
<tr><td colspan="4">Possible Cause: Refrigerant pressure problem due to defective expansion valve or temperature sensor.</td></tr>
<tr><th>Step</th><th colspan="2">Inspection Item</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Inspect whether the temperature sensor is installed properly.</td><td>Yes</td><td>Replace expansion valve.</td></tr>
<tr><td>No</td><td>Exchange duct sensor.</td></tr>
</table>

<table>
<tr><td>7</td><td>High Pressure: Over 7 - 11 kg/cm^2 (100 - 156 psi)
Low Pressure: 4 - 6 kg/cm^2 (57 - 85 psi)</td></tr>
<tr><td colspan="2">Possible Cause: Low refrigerant pressure due to poor compressor compression</td></tr>
<tr><td colspan="2">Inspect and replace compressor if necessary.</td></tr>
</table>

WEIGHT OF R134A GAS USED IN MACHINES

Model	Weight of Gas
Mega 130	850 ±20 grams (30 ±0.7 oz.)
Mega 160	850 ±20 grams (30 ±0.7 oz.)
Mega 200-III	850 ±20 grams (30 ±0.7 oz.)
Mega 200-V	850 ±20 grams (30 ±0.7 oz.)
Mega 250-III	850 ±20 grams (30 ±0.7 oz.)
Mega 250-V	850 ±20 grams (30 ±0.7 oz.)
Mega 300-III	950 ±20 grams (33 ±0.7 oz.)
Mega 300-V	850 ±20 grams (30 ±0.7 oz.)
Mega 400-III	950 ±20 grams (33 ±0.7 oz.)
Mega 400-III PLUS	850 ±20 grams (30 ±0.7 oz.)
Mega 400-V	850 ±20 grams (30 ±0.7 oz.)
Mega 500-V	850 ±20 grams (30 ±0.7 oz.)
Solar 130-III	950 ±20 grams (33 ±0.7 oz.)
Solar 130LC-V	850 ±20 grams (30 ±0.7 oz.)
Solar 130W-III	950 ±20 grams (33 ±0.7 oz.)
Solar 130W-V	850 ±20 grams (30 ±0.7 oz.)
Solar 170LC-V	850 ±20 grams (30 ±0.7 oz.)
Solar 170W-III	1100 ±20 grams (38 ±0.7 oz.)
Solar 200W-III	1100 ±20 grams (38 ±0.7 oz.)
Solar 200W-V	850 ±20 grams (30 ±0.7 oz.)
Solar 220LC-III	950 ±20 grams (33 ±0.7 oz.)
Solar 220LC-V	850 ±20 grams (30 ±0.7 oz.)
Solar 220LL	850 ±20 grams (30 ±0.7 oz.)
Solar 250LC-V	850 ±20 grams (30 ±0.7 oz.)
Solar 280LC-III	1250 ±20 grams (44 ±0.7 oz.)
Solar 290LC-V	850 ±20 grams (30 ±0.7 oz.)
Solar 290LL	850 ±20 grams (30 ±0.7 oz.)
Solar 330-III	1250 ±20 grams (44 ±0.7 oz.)
Solar 330LC-V	850 ±20 grams (30 ±0.7 oz.)
Solar 400LC-III	1250 ±20 grams (44 ±0.7 oz.)
Solar 400LC-V	850 ±20 grams (30 ±0.7 oz.)
Solar 450LC-III	1250 ±20 grams (44 ±0.7 oz.)
Solar 450LC-V	850 ±20 grams (30 ±0.7 oz.)
Solar 70-III	800 ±20 grams (28 ±0.7 oz.)

REFRIGERANT SYSTEM REPAIRS

WARNING!

Always wear protective glasses and gloves when handling refrigerant. If refrigerant comes in contact with the skin or eyes, immediately flush with clean, running water and consult a physician.

Select a clean and well-ventilated area to work.

The refrigerant container is under high pressure and should be stored below 40˚C (104˚F). Be careful not to drop the container from a high location

The contents are under high pressure and should not be used with compressed air or near an open flame.

REFRIGERANT SAFE HANDLING PROCEDURES

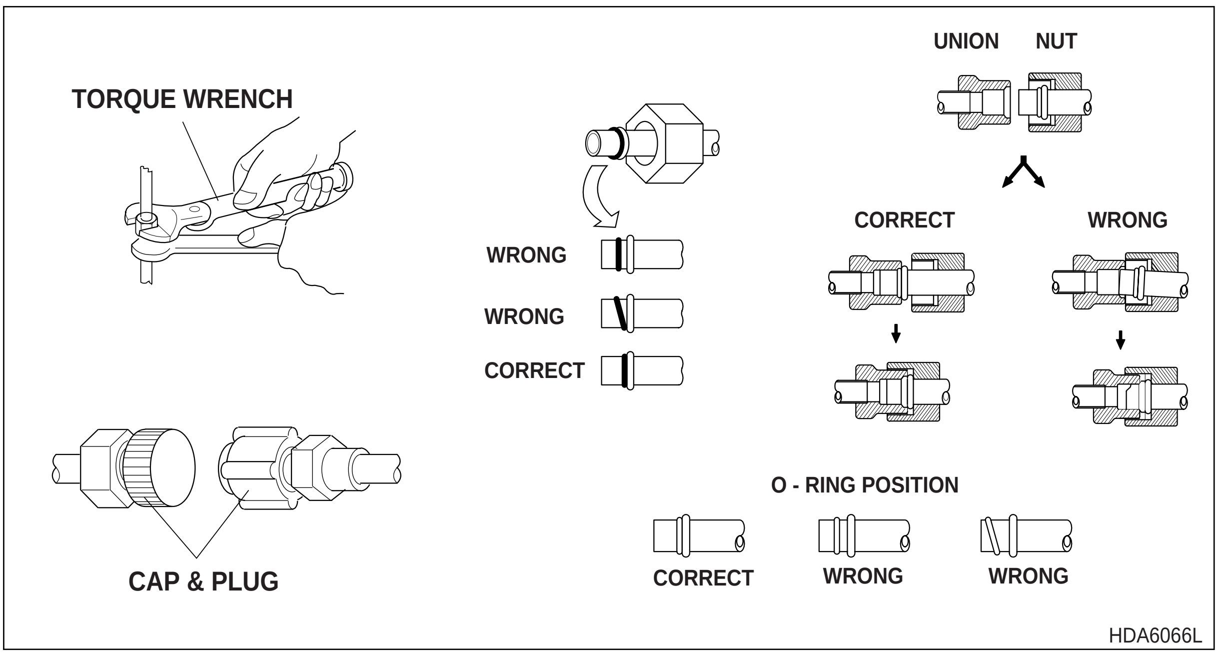


Figure 14

The following procedures should be observed for safe handling of refrigerant during vacuum and charging process.

1. Use an approved recovery / charging device which can safely perform vacuum and charge work simultaneously.
2. The new refrigerant has improved cooling characteristics than the old type and care should be used not to overcharge the system.
3. Do not over tighten connections when working on refrigerant system.
4. The new refrigerant system standards require new tools, equipment and parts. DO NOT attempt to use equipment use in servicing the old refrigerant system.

5. The new refrigerant oil (PAG type) has a high moisture absorption characteristic. When the refrigerant system vacuum seal has been broken, immediately plug up all openings to prevent moisture from entering into the system.
6. When joining unions which use O-ring seals, lightly coat O-rings with refrigerant oil. Be careful not to drip oil on the threads of the nut.
7. Be certain the O-rings are seated properly on the refrigerant line lip. Always use new O-rings when reassembling parts. Do not reuse old O-rings.
8. Use a vacuum pump to evacuate refrigerant system of air.
9. When charging the refrigerant system with the engine running, do not open the high pressure valve on the manifold gauge as the reverse flow of high pressure refrigerant will rupture the hose.
10. When releasing the high pressure hose after completing the charging process, quickly disconnect the hose to minimize refrigerant released to the air.

REPAIR AND REPLACEMENT PROCEDURE

1. Work Procedure.
   A. Before repairing or replacing any refrigerant components first, return all refrigerant oil to the compressor and perform recovery procedures.
2. Operating Condition.
   A. Run engine at maximum engine speed.
   B. Select "HI" blower fan speed and select A/C switch to "ON."
   C. Set the temperature control switch for maximum cooling and leave running for approximately 20 minutes.

   NOTE: *The manifold gauge dial pointer can vary depending on the outdoor temperatures.*

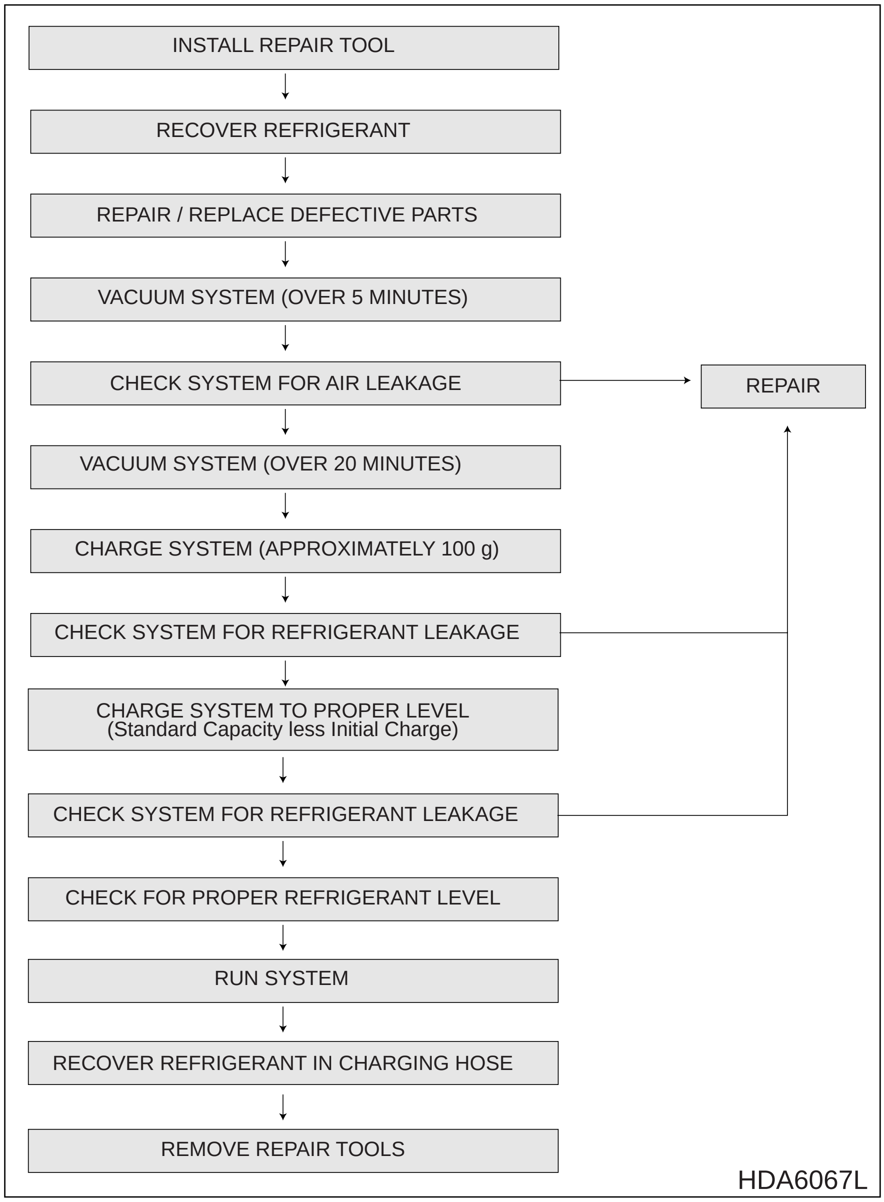

INSTALL REPAIR TOOL
RECOVER REFRIGERANT
REPAIR / REPLACE DEFECTIVE PARTS
VACUUM SYSTEM (OVER 5 MINUTES)
CHECK SYSTEM FOR AIR LEAKAGE
REPAIR
VACUUM SYSTEM (OVER 20 MINUTES)
CHARGE SYSTEM (APPROXIMATELY 100 g)
CHECK SYSTEM FOR REFRIGERANT LEAKAGE
CHARGE SYSTEM TO PROPER LEVEL
(Standard Capacity less Initial Charge)
CHECK SYSTEM FOR REFRIGERANT LEAKAGE
CHECK FOR PROPER REFRIGERANT LEVEL
RUN SYSTEM
RECOVER REFRIGERANT IN CHARGING HOSE
REMOVE REPAIR TOOLS
HDA6067L

Figure 15

REFRIGERANT RECOVERY

Reference Number	Description
1	To Compressor
2	Low Pressure Side
3	High Pressure Side
4	From Receiver
5	Refrigerant Recovery Tank

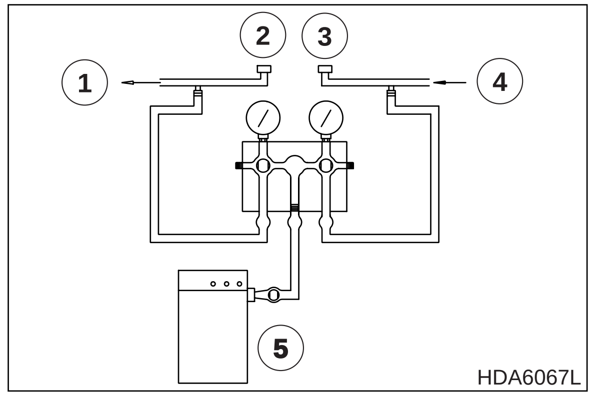


Figure 16

1. Attach the manifold gauges and the refrigerant recovery unit to the refrigerant lines as shown.

   NOTE: *Be careful not to switch the connections for the low and high pressure valves.*

2. Open the high pressure valve slowly to release the refrigerant to the recovery unit.

   NOTE: *Open the valve slowly, while checking to see that refrigerant is not leaking out.*

3. When the manifold gauge dial falls below 3.5 kg/cm^2 (50 psi), slowly open the low pressure valve.

4. Open both the high and low pressure valves slowly until the manifold gauge dials indicates 0 kg/cm^2 (0 psi).

VACUUMING REFRIGERANT SYSTEM

Reference Number	Description
1	To Compressor
2	Low Pressure Side
3	High Pressure Side
4	From Receiver
5	Vacuum Pump

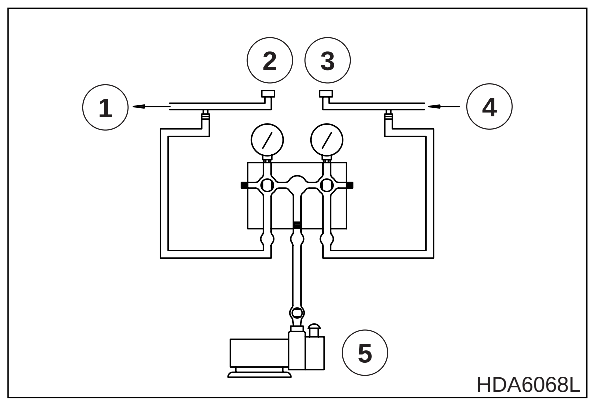


Figure 17

1. Vacuuming Procedure.

   NOTE: *When the A/C system has been exposed to the air, it must be vacuumed out. Perform vacuum process for 30 minutes for complete moisture and air evacuation.*

   A. Attach the manifold gauges and vacuum pump to the refrigerant system as shown.

   B. Turn on the vacuum pump and open both valves.

   C. When the low pressure gauge shows approximately 710 mmHg, close both valves and turn off vacuum pump.

2. Check system for vacuum leak.

   Allow system to sit for 10 minutes and check whether the system is holding the pressure. If the pressure has dropped, it must be repaired before proceeding to the next step.

3. Vacuuming Procedure.

   If the system is holding the pressure and it has not changed for 10 minutes, vacuum out the system for an additional 20 minutes.

   A. Turn on the vacuum pump and slowly open both valves.

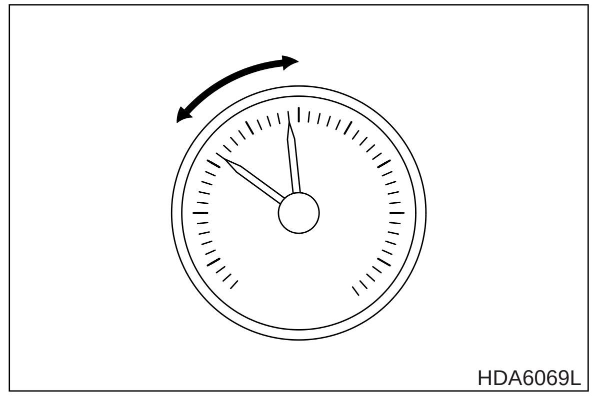


Figure 18

   B. Allow vacuum pump to run for additional 20 minutes until the low pressure gauge dial reads approximately 750 mmHg.

   C. Close both valves and stop the vacuum pump.

4. Installation Of Refrigerant Container.

Reference Number	Description
1	Handle
2	Hose Connection
3	Mounting Disk

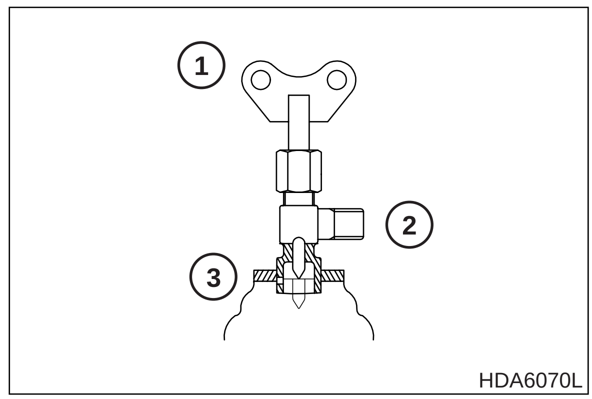


Figure 19

   A. Before mounting valve on the container, make sure the handle is in the counterclockwise most position, with the puncture pin retracted and the mounting disk is in the raised position.

   B. Attach the manifold gauge center hose to the valve assembly.

   C. Turn the disc in the clockwise direction and securely mount valve onto refrigerant container.

   D. Turn the valve handle in the clockwise direction and puncture the container seal with the pin.

   E. Once the can has been punctured, turn the handle in the counter clockwise direction so the refrigerant can flow into the manifold gauge center hose. At this time, do not open the low and high pressure valves of the manifold gauge.

   F. Press the manifold gauge low side valve to eliminate the trapped air in the hose.

LEAKAGE CHECK

NOTE: *Perform the leakage check after completing vacuuming process.*

1. After attaching the manifold gauge, open the high side valve.

2. Charge system until the low side gauge dial indicates a pressure of 1 kg/cm^2 (14 psi) and close the high side valve.

3. Using a refrigerant leak detector or soapy water check each joint for leakage.

Reference Number	Description
1	Refrigerant Leak Detection Device

4. If a leak is detected, check for O-ring damage or correct tightening torque and replace or repair as necessary.
5. If no leaks are detected, proceed with the charging process.

WARNING!

For accurate refrigerant leak detection, perform leak detection procedure in a well-ventilated area.

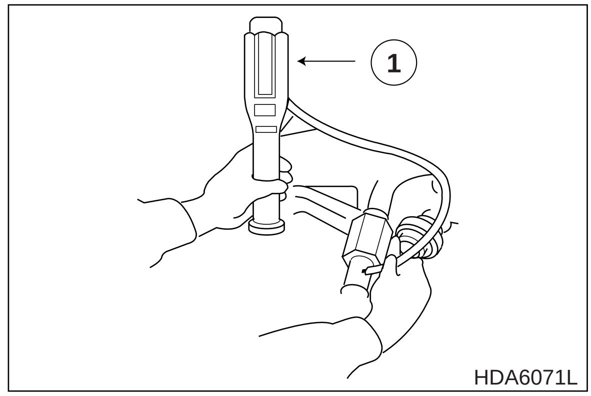


Figure 20

REFRIGERANT CHARGING

1. Perform the vacuuming procedure, vacuum holding and leaking tests as described in the proceeding headings.

NOTE: *First charge the refrigerant system with 100 g (3.5 ounces) of refrigerant with the engine off. Then using the manifold gauges as a guide fully charge the system with the engine running.*

When exchanging refrigerant containers, press the manifold gauge low side valve to eliminate air from the charging hose.

Reference Number	Description
1	To Compressor
2	Low Pressure Side
3	High Pressure Side
4	From Receiver
5	Refrigerant Supply Container

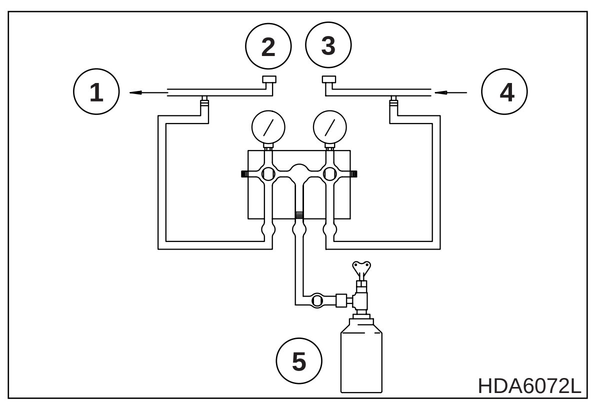


Figure 21

2. Charge the system by opening the manifold gauge low side valve.

   Initial charge amount: 100 g (3.5 ounces).

3. If refrigerant does not flow freely into system, try starting engine first before operating air conditioner.
   - Temperature control switch setting: Maximum Cooling
   - Blower Speed Setting: Hi (3 step)
   - Engine Speed: 1,300 - 1,500 rpm

WARNING!

When charging refrigerant system with the engine running;

- **Always keep refrigerant supply container in the upright position.**
- **Never open the high side pressure valve.**

4. Open the manifold gauge low side valve and charge system to standard capacity.

Gauge Dial	Standard Reading
High Side Gauge	13 - 20 kg/cm^2 (185 - 285 psi)
Low Side Gauge	1.5 - 3.5 kg/cm^2 (21 - 50 psi)

NOTE: *These standards are for outside temperatures between 30° - 35°C (86° - 95°F). The gauge readings may vary for extreme temperature conditions.*

WARNING!

- **When outside temperature is low, warm the refrigerant supply container with warm water not exceeding 40°C (104°F). Do not allow water to come in contact with the charging adapter valve handle.**
- **When outside temperature is high, cool off refrigerant supply container and condenser to aid the refrigerant charging process.**

5. Close low pressure side valve.
6. Shut off engine and close refrigerant supply container adapter valve. Disconnect manifold gauge hoses from vehicle.

INSPECTING SYSTEM FOR LEAKAGE

After completing charging procedures, clean all joints and connections with a clean dry cloth. Using a refrigerant leak detecting device or soapy water, inspect system for leaks starting from the high pressure side.

NOTE: *When the refrigerant circulation has been stopped the high pressure will start to decrease and the low pressure will start to increase until they are equalized. Starting the inspection from the high side will result in a accurate test.*

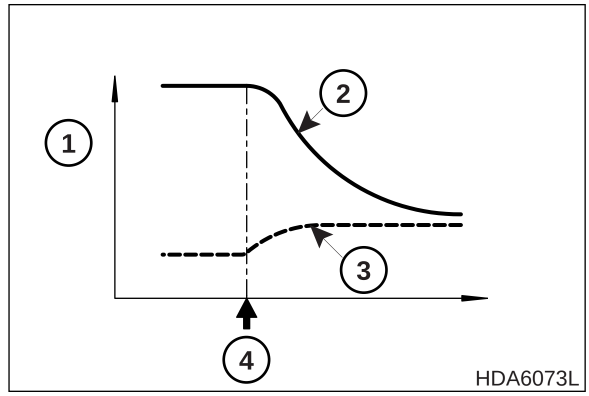


Figure 22

Reference Number	Description
1	Pressure
2	High Pressure
3	Low Pressure
4	Compressor Stop

Inspection Procedure

1. High pressure side.

   Compressor outlet → condenser inlet → receiver dryer inlet → air conditioner unit inlet

2. Low pressure side.

   Compressor inlet → air conditioner unit outlet

3. Compressor.

   Compressor shaft area, bolt hole area and magnetic clutch area.

4. Receiver dryer.

   Pressure switch and plug area.

5. Connection valve area.

   Inspect all valve areas.

   Verify all valves are capped to prevent leaking.

   Check for foreign matter inside of valve cap.

6. Interior of air conditioner unit.

   After stopping engine, insert detector probe into drain hose. (Leave inserted for 10 seconds minimum.)

   NOTE: *When inspecting leakage from the air conditioner unit, perform the inspection in a well-ventilated area.*

S0607080K

DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

TRANSMISSION AND TORQUE CONVERTER (ZF 4WG-310)

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Mega 500-V	1001 and Up

May 2001

TABLE OF CONTENTS

DRIVE TRAIN DESCRIPTION

Figure 1, shows layout of drive train assemblies. The engine (1, Figure 1) drives a torque converter (2), which drives a power shift transmission (3). Two output shafts extend out of the transmission. Each output shaft has a drive shaft attached to it. Front drive shaft (4) drives a final drive shaft (6) that drives the front differential (7).

A parking brake (8, Figure 1) is mounted on the front differential input shaft. The front differential is enclosed in the front axle housing (9). Each end of the front axle housing contains reduction gearing (10). Each end of the front axle housing also contains a service brake (11). Rear drive shaft (5) drives the rear differential (12). The rear differential is enclosed in the rear axle housing (13). Each end of the rear axle housing contains reduction gearing (10). Each end of the rear axle housing also contains a service brake (11).

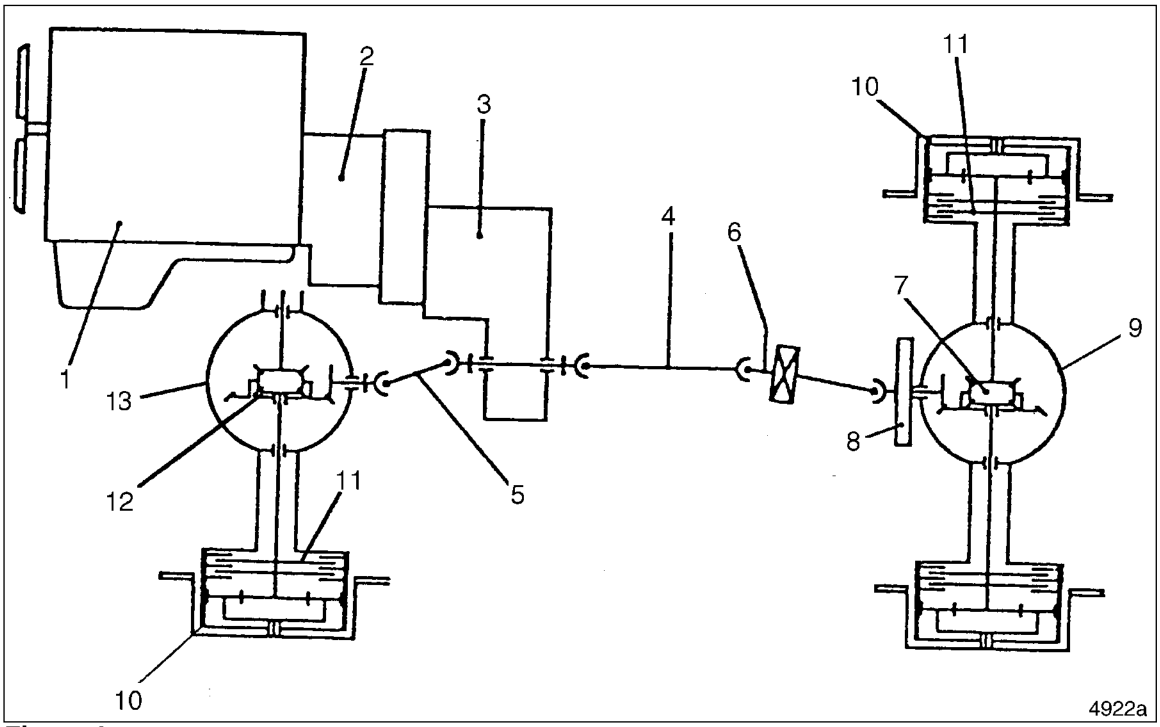


Figure 1

Reference Number	Description
1	Engine
2	Torque Converter
3	Transmission
4	Front Drive Shaft
5	Final Drive Shaft
6	Rear Drive Shaft
7	Front Differential

Reference Number	Description
8	Parking Brake
9	Front Axle Housing
10	Reduction Gearing
11	Service Brake
12	Rear Differential
13	Rear Axle Housing

TRANSMISSION AND TORQUE CONVERTER

The machine contains a powershift transmission that has four forward speeds and three speeds in reverse. Gear changes are made by an elector-hydraulic control valve that is mounted on transmission. Moving gear select lever in cab, generates an electrical signal that is transmitted to the control valve. The control valve contains proportional valves that direct pressurized fluid to various clutches that control the forward and reverse gears.

Item		Mega 500-V
Torque Converter	Model	4WG-310 (Full Auto)
	Type	3-Element, 1-Stage, Single-phase, E/G mounted with flexible plate
	Oil Cooler	Water-cooled (multiplate) and Air-cooled
	Charging Pump	130 *l*/min at 2,000 rpm
	Hydraulic Pump P.T.O	1:1
	T/C Size	∅ 370 mm (14.5669 in)
	Stall Ratio	2,985
	Safety Relief	11 Bar (160 psi)
Transmission	Type	Full Power Shift, Counter shaft
	Speeds	4 Forward / 3 Reverse
	Ratio	F: 3.73 / 2.206 / 1.969 / 0.624 R: 3.73 / 2.206 / 0.969
	Power Shift Control Pressure	16 - 18 Bar (232 - 261 psi)
	Shift Control	Electric Shift with Proportional Valve
Oil Capacity		50 *l* (13.2 U.S. gal)
Dry Weight		750 kg (1,653 lb)
Output Flange	Front	9C Mechanics
	Rear	9C Mechanics

POWERSHIFT TRANSMISSION

The multispeed reversing transmission in countershaft design is power shiftable by hydraulically actuated multidisk clutches.

All gears are constantly meshing and carried on antifriction bearings.

The gear wheels, bearings and clutches are cooled and lubricated with oil.

The 4-speed reversing transmission is equipped with 6 multidisk clutches.

At the shifting, the actual plate pack is compressed by a piston, movable in axial direction, which is pressurized by pressure oil.

A compression spring takes over the pushing back of the piston, thus the release of the plate pack. As to the layout of the transmission and the specifications of the closed clutches in the single speeds, See “Schedule of Measuring Points and Connection 4WG-310” on page 8. and “Oil Circuit Diagram 4WG-310 Forward 1st Speed” on page 11.

TRANSMISSION CONTROL

Transmission control, See “Schedule of Measuring Points and Connection 4WG-310” on page 8., Electro-hydraulic unit on page 10 and “Oil Circuit Diagram 4WG-310 Forward 1st Speed” on page 11.

The transmission pump, necessary for the oil supply of the converter, and for the transmission control, is sitting in the transmission on the engine-dependent input shaft.

The feed rate of the pump is Q = 130 *l*/min. at n_{Engine} = 2000 min^{-1}.

This pump is sucking the oil via the coarse filter out of the oil sump and delivers it via the ZF-Fine filter - the filters is fitted externally from the transmission - to the main pressure valve.

<u>ZF-Fine filter</u>

Filtration ratio according to ISO 4572: $\beta_{30} \geq 75$ $\beta_{15} = 25$ $\beta_{10} = 5.0$

Filter surface at least: 2 x 6,700 cm^2 = 13,400 cm^2

Dust capacity according to ISO 4572 at least: 17 g

The six clutches of the transmission are selected via the 6 proportional valves P1 to P6.

The proportional valve (pressure regulator unit) is composed of pressure regulator (e.g. Y6). follow-on slide and vibration damper.

The control pressure of 9 bar (130 psi) for the actuation of the follow-on slides is created by the pressure reducing valve. The pressure oil (16+2 bar (232+29 psi)) is directed via the follow-on slide to the respective clutch.

Due to the direct proportional selection with separated pressure modulation for each clutch, the pressure to the clutches, which are engaged in the gear change, will be controlled. In this way, a hydraulic intersection of the clutches to be engaged and disengaged becomes possible. This is creating spontaneous shifts without traction force interruption.

At the shifting, the following criteria will be considered:

- Speed of engine, turbine, central gear train and output.
- Transmission temperature.
- Shifting mode (up-, down-, reverse shifting and speed engagement out of Neutral).
- Load condition (full and part load, traction, overrun inclusive consideration of load cycles during the shifting).

The main pressure valve is limiting the max. control pressure to 16+2 bar (232+29 psi) and releases the main stream to the converter and lubricating circuit.

In the inlet to the converter, a converter safety valve is installed which protects the converter from high internal pressure (opening pressure 11 bar (160 psi).

Within the converter, the oil serves to transmit the power according to the well-known hydro-dynamic principle.

To avoid cavitation, the converter must be always completely filled with oil.

This is achieved by a converter pressure backup valve, rear-mounted to the converter, with an opening pressure of at least 5 bar (73 psi).

The oil, escaping out of the converter, is directed to a heat exchanger.

From the heat exchanger, the oil is directed to the transmission and there to the lubricating oil circuit, so that all lubricating points are supplied with cooled oil.

The allocation of the pressure regulators to the single speeds can be seen on the “Schedule of Measuring Points and Connection 4WG-310” on page 8 and “Oil Circuit Diagram 4WG-310 Forward 1st Speed” on page 11.

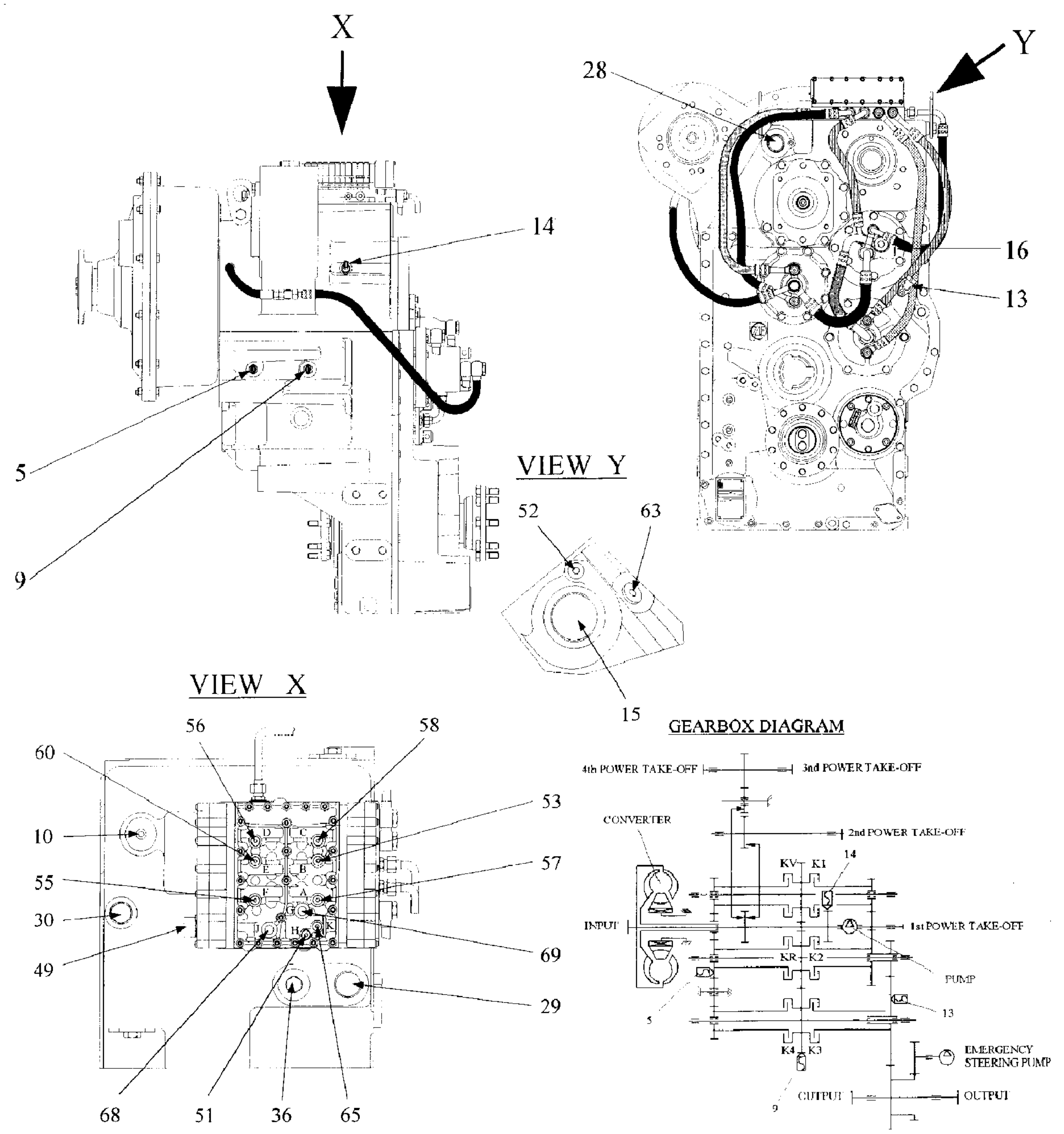
SCHEDULE OF MEASURING POINTS AND CONNECTION 4WG-310

The marked positions (e.g. 53) correspond with the positions on the “Oil Circuit Diagram 4WG-310 Forward 1st Speed” on page 11.

The measurements have to be carried out at hot transmission (about 80° - 90°C).

No.	Denomination of the Position	Connection	Marking on the Valve Block
Measuring Points for Pressure Oil and Temperature			
51	In front of the converter - Opening pressure 11 bar	M10 x 1	H
52	Behind the converter - Opening pressure 5 bar	M14 x 1.5	
53	Clutch Forward 16 + 2 bar (232+29 psi) KV	M10 x 1	B
55	Clutch Reverse 16 + 2 bar (232+29 psi) KR	M10 x 1	E
56	Clutch Reverse 16 + 2 bar (232+29 psi) K1	M10 x 1	D
57	Clutch Reverse 16 + 2 bar (232+29 psi) K2	M10 x 1	A
58	Clutch Reverse 16 + 2 bar (232+29 psi) K3	M10 x 1	C
60	Clutch Reverse 16 + 2 bar (232+29 psi) K4	M10 x 1	F
63	Behind the Converter Temperature 100°C, Short-time 120°C	M14 x 1.5	
65	System Pressure 16 + 2 bar (232+29 psi) K4	M10 x 1	K
10	Breather	M10 x 1	
15	Connection to the Heat Exchanger	-------	
16	Connection from the Heat Exchanger	-------	
28	To the Filter	M42 x 2	
29	From the Filter	M42 x 2	
30	From the Filter Bypass	M42 x 2	
36	Oil Filter Plug	M42 x 2	
49	Plug Connection on the Electrohydraulic Control Unit		
68	System Pressure (Option)	M16 x 1.5	G
69	Control System (Option)	M16 x 1.5	J

No.	Denomination of the Position	Connection	Marking on the Valve Block
Inductive Transmitters and Speed Sensor			
5	Inductive Transmitter n Turbine	M18 x 1.5	
9	Inductive Transmitter n Central Gear Train	M18 x 1.5	
13	Speed Sensor n Output and Speedometer	-------	
14	Inductive Transmitter n Engine	M18 x 1.5	



CODING

		• PRESSURE REGULATOR ACTIVE						ENGAGED CLUTCHES	
DRIVING DIRECTION	SPEED	Y1	Y2	Y3	Y4	Y5	Y6		
FORWARD	1			•		•		K1	KV
	2					•	•	KV	K2
	3				•	•		K3	KV
	4	•			•			K4	K3
REVERSE	1		•	•				KR	K1
	2		•				•	KR	K2
	3		•		•			KR	K3
NEUTRAL									
ENGAGED CLUTCH		K4	KR	K1	K3	KV	K2		
POSITIONS ON THE VALVE BLOCK		F	E	D	C	B	A		
CONSEC. NO. OF THE MEASUREMENT POINTS		60	55	56	58	53	57		

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Figure 2

OIL CIRCUIT DIAGRAM 4WG-310 FORWARD 1ST SPEED

The marked positions (e.g. 53) correspond with the positions on “Schedule of Measuring Points and Connection 4WG-310” on page 8.

Reference Number	Positions
WT	Heat Changer
WGV	Converter Back Pressure Valve 5 bar (73 psi)
WSV	Converter Safety Valve 11 bar (160 psi)
HDV	Main Pressure Valve 16+2 bar (232+29 psi)
RV-9	Pressure Reducing Valve 9 bar (131 psi)
NFS	Follow-on Slide
D	Vibration Damper
B	Orifice
P1	Proportional Valve - Clutch KR
P2	Proportional Valve - Clutch K4
P3	Proportional Valve - Clutch K1
P4	Proportional Valve - Clutch K3
P5	Proportional Valve - Clutch KV
P6	Proportional Valve - Clutch K2
Y1 -Y6	Pressure Regulator
TEMP	Temperature Sensor

CODING

		• PRESSURE REGULATOR ACTIVE						ENGAGED CLUTCHES	
DRIVING DIRECTION	SPEED	Y1	Y2	Y3	Y4	Y5	Y6		
FORWARD	1			•		•		K1	KV
	2					•	•	KV	K2
	3				•	•		K3	KV
	4	•			•			K4	K3
REVERSE	1		•	•				KR	K1
	2		•				•	KR	K2
	3		•		•			KR	K3
NEUTRAL									
ENGAGED CLUTCH		K4	KR	K1	K3	KV	K2		
POSITIONS ON THE VALVE BLOCK		F	E	D	C	B	A		
CONSEC. NO. OF THE MEASUREMENT POINTS		60	55	56	58	53	57		

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Figure 3

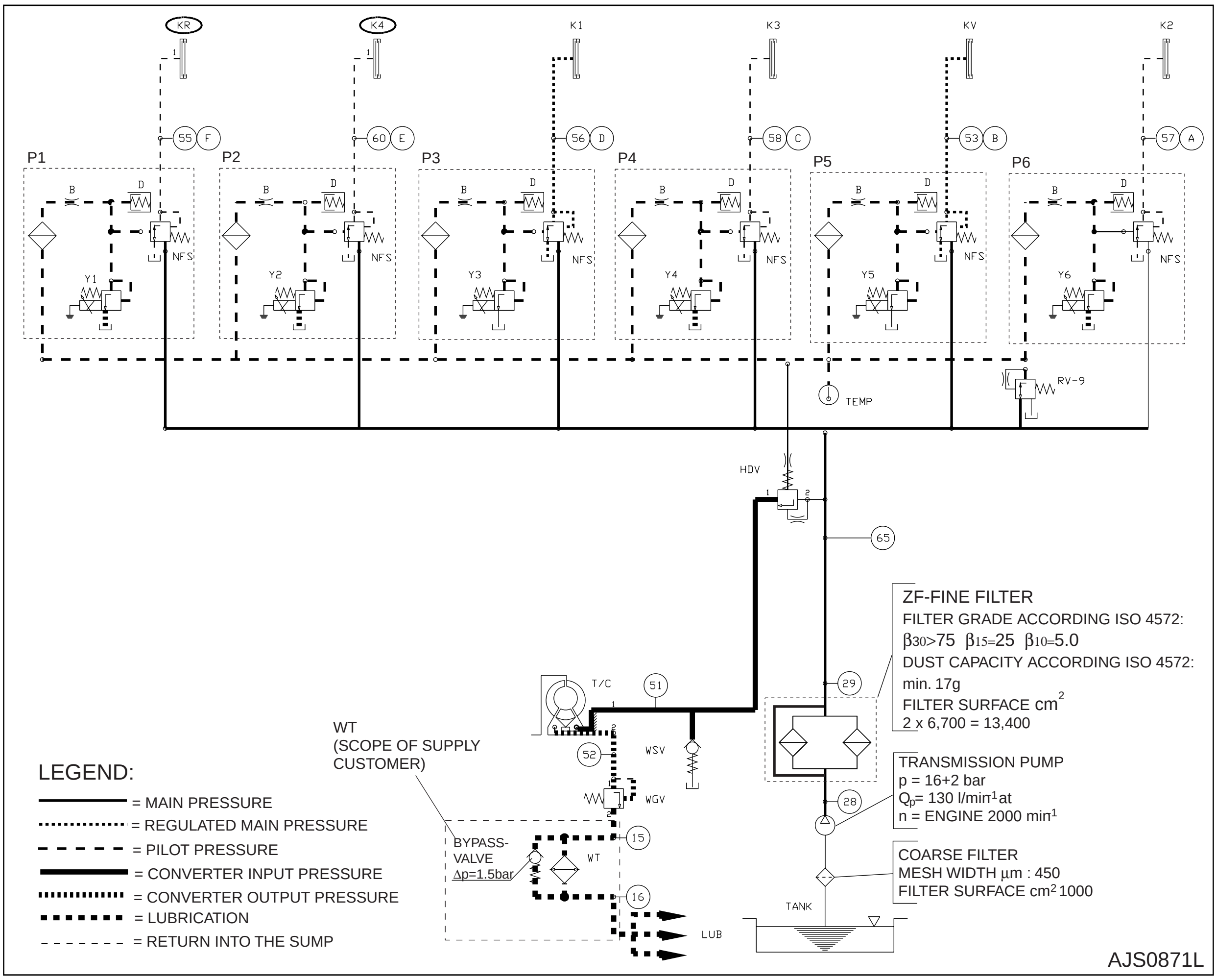
KR
K4
K1
K3
KV
K2
55 F
60 E
56 D
58 C
53 B
57 A
P1
P2
P3
P4
P5
P6
B
D
NFS
Y1
Y2
Y3
Y4
Y5
Y6
TEMP
RV-9
HDV
65
ZF-FINE FILTER
FILTER GRADE ACCORDING ISO 4572:
$\beta_{30}>75$ $\beta_{15}=25$ $\beta_{10}=5.0$
DUST CAPACITY ACCORDING ISO 4572:
min. 17g
FILTER SURFACE cm^2
2 x 6,700 = 13,400
T/C
51
29
WT
(SCOPE OF SUPPLY
CUSTOMER)
52
WSV
WGV
28
TRANSMISSION PUMP
p = 16+2 bar
Q_p= 130 l/min^{-1} at
n = ENGINE 2000 min^{-1}
LEGEND:
= MAIN PRESSURE
= REGULATED MAIN PRESSURE
= PILOT PRESSURE
= CONVERTER INPUT PRESSURE
= CONVERTER OUTPUT PRESSURE
= LUBRICATION
= RETURN INTO THE SUMP
BYPASS-
VALVE
Δp=1.5bar
15
16
LUB
TANK
COARSE FILTER
MESH WIDTH µm : 450
FILTER SURFACE cm^2 1000
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Figure 4

TRANSMISSION ELECTRIC COMPONENTS

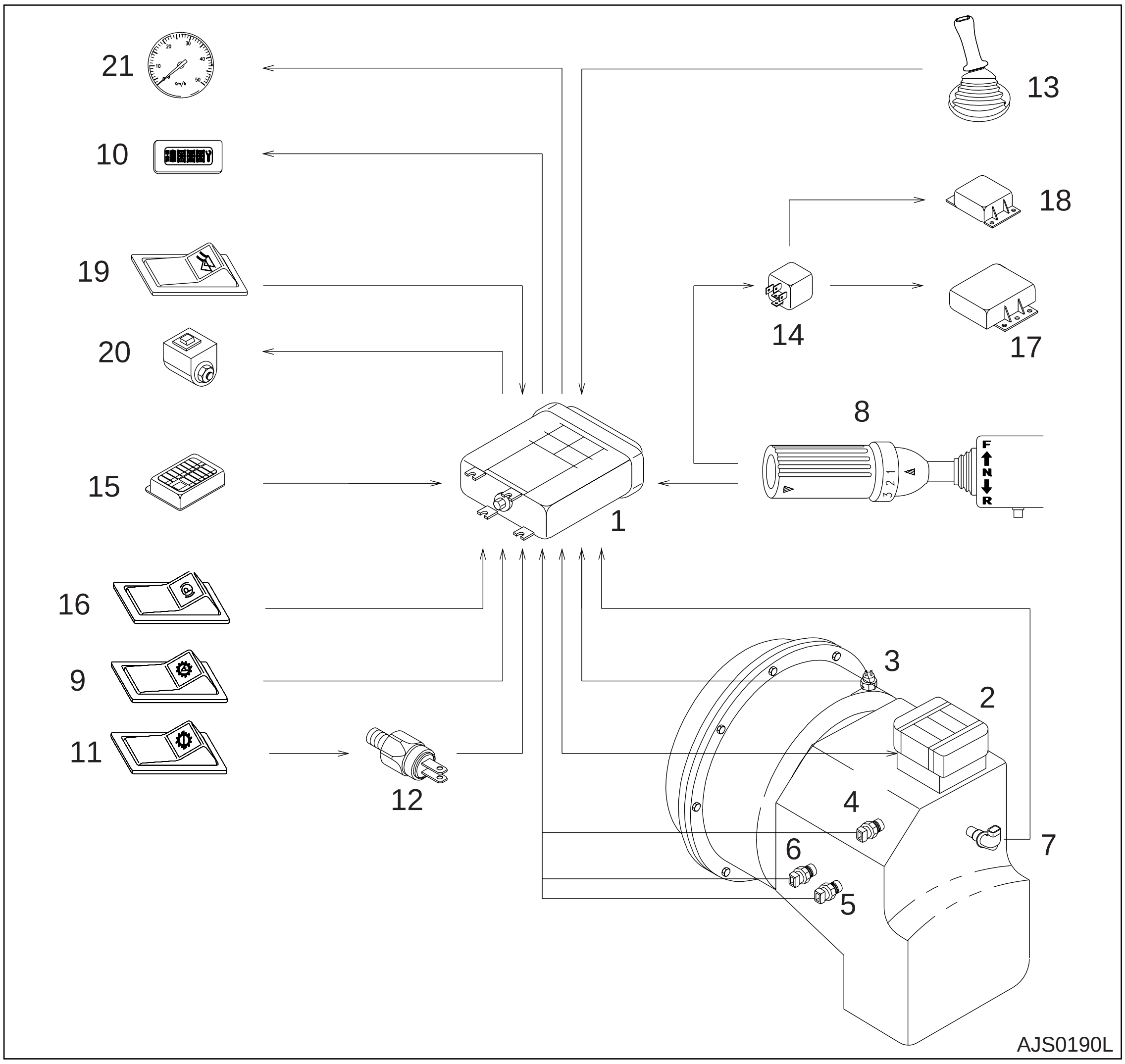

Figure 5

Reference Number	Description
1	Transmission Control Unit (TCU)
2	Transmission Control Valve
3	Transmission Oil Temperature Sensor
4	Engine Pick-Up Sensor
5	Central Gear Pick-up Sensor
6	Turbine Pick-up Sensor
7	Output Speed Sensor
8	Shift Lever Switch
9	Auto Select Switch
10	Display

Reference Number	Description
11	Transmission Cutoff Switch
12	Transmission Cutoff Pressure Switch
13	Downshift Switch
14	Safety Starter Switch
15	Fuse Box
16	Parking Brake Switch
17	Control Unit
18	Starter Controller
19	LIS Switch (Option)
20	LIS Solenoid Valve
21	Speedometer

TCU (TRANSMISSION CONTROL UNIT)

1. Sending a control signal transmitted from the shift lever to the control valve, generates a speed.
2. At the auto mode, transmits the appreciate signals to the control valves according to the load and engine rpm.
3. Detecting a fault, controls various clutches.

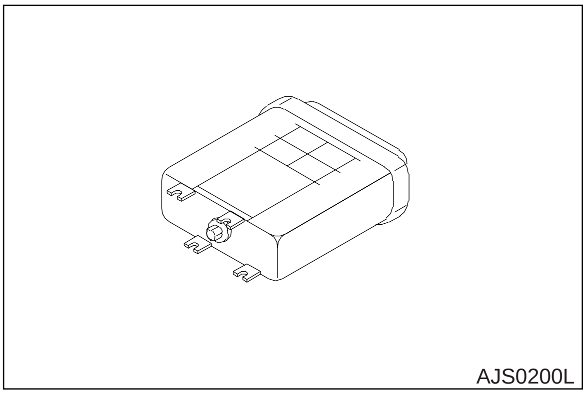

Figure 6

TRANSMISSION CONTROL VALVE

1. The transmission control valve contains a temperature sensor and proportional solenoid valves (Y1 - Y6) that direct pressurized fluid to various clutches that generates a speed with control the shift gears.
2. Specification of the proportional solenoid valve.
   - Resistance: 19 ±1.9 ohm at 20˚C (68˚F)
   - Pressure: 0.8 kg/cm^2 → 8.3 kg/cm^2
3. The contained temperature sensor detects the temperature of the control valve and transmits the electrical signal to the TCU, and serves TCU determines gears to change.
   - Neutral: At temperature less than -30˚C (-22˚F)
   - 1st or 2nd gear: At temperature less than -10˚C (14˚F)
   - Normal Operation: At temperature greater than -10˚C (14˚F)

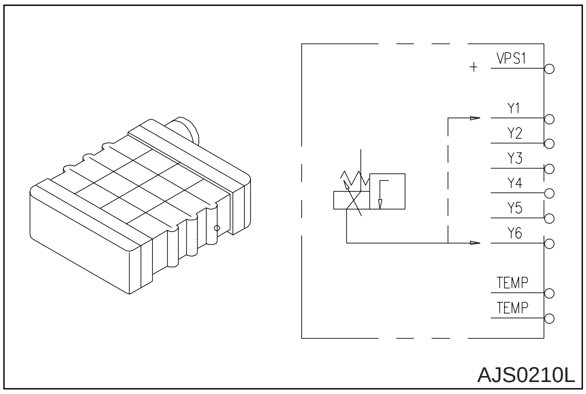

Figure 7

TRANSMISSION OIL TEMPERATURE SENSOR

1. Detecting a oil temperature of transmission and send a control signal to transmission oil temperature gauge.
2. Specification
   - Resistance

     216 ±30 Ohm (at 60˚C (140˚F))

     81.2 ±10 Ohm (at 90˚C (194˚F))

     36.5 ±3.5 Ohm (at 120˚C (248˚F))

     18.7 ±2.1 Ohm (at 150˚C (302˚F))

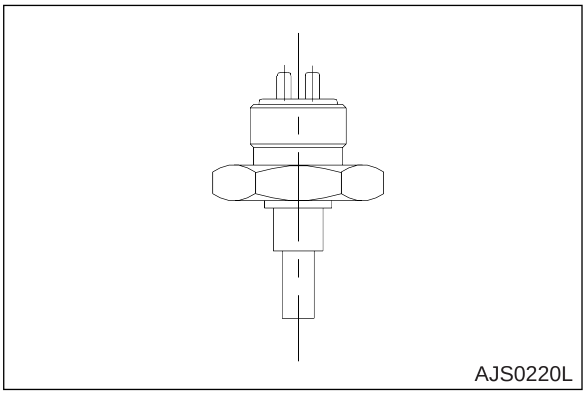

Figure 8

ENGINE PICK-UP SENSOR

1. Detect a revolution of gear array in engine side.
2. Specification
    - Resistance: 1050Ω ± 10% (at 20˚C (68˚F)).
    - Fasten torque: 30 Nm (22 ft lb).
    - Gap: 0.5 + 0.3 mm (0.0197 + 0.0118 in).
    - Output: 4 Pulse/Rev.

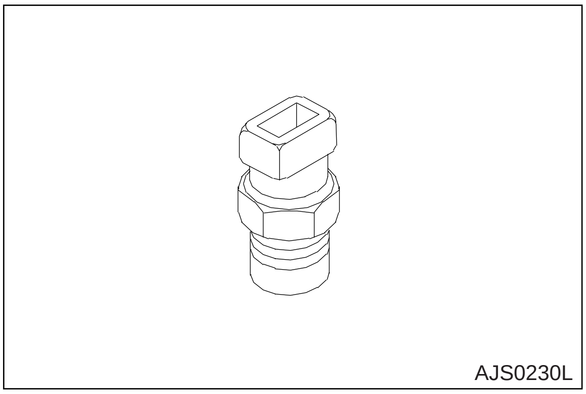

Figure 9

CENTRAL GEAR PICK-UP SENSOR

1. Detect a revolution of central gear array
2. Specification
    - Resistance: 1050Ω ±10% (at 20˚C (68˚F)).
    - Fasten torque: 30 Nm (22 ft lb).
    - Gap: 0.5 + 0.3 mm (0.0197 + 0.0118 in).
    - Output: 91 Pulse/Rev.

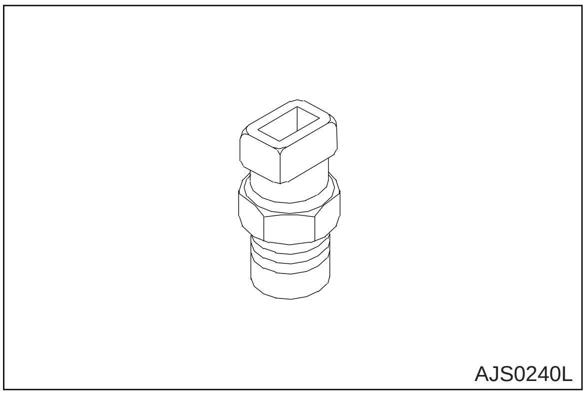

Figure 10

TURBINE PICK-UP SENSOR

1. Detect a revolution of gear array in turbine side.
2. Specification
    - Resistance: 1050Ω ± 10% (at 20˚C (68˚F)).
    - Fasten torque: 30 Nm (22 ft lb).
    - Gap: 0.5 + 0.3 mm (0.0197 + 0.0118 in).
    - Output: 59 Pulse/Rev.

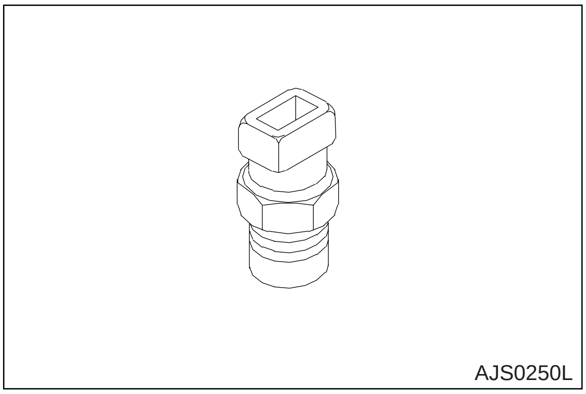

Figure 11

OUTPUT SPEED SENSOR

1. Detect a revolution of gear array in transmission output side
2. Specification
   - Voltage Supply: 20 V - 32 V.
   - Operation Frequency: 2 Hz - 5 KHz.
   - Fasten torque (M8): 23 Nm (17 ft lb).
   - Gap: 1.0 + 0.5 mm (0.0394 + 0.0197 in).
   - Output: 60 Pulse/Rev.

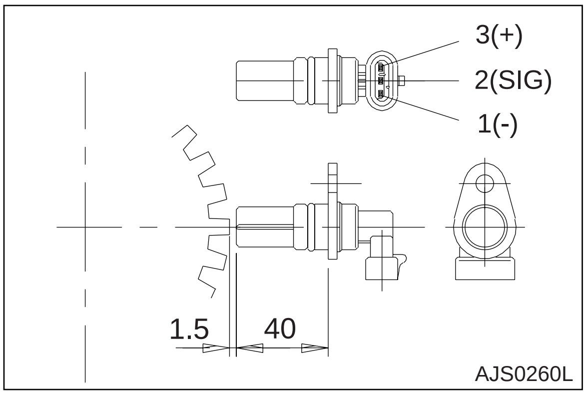

Figure 12

SHIFT LEVER SWITCH (DW-3)

1. Forward, Reverse and Shift
   - F: Forward
   - N: Neutral
   - R: Reverse
   - 1,2,3,4: Shift Step

     * Forward shift range: 1 - 4

     * Reverse shift range: 1 - 3
2. Kick-Down (Down Shift) Switch
   - KD: Kick-Down Switch
3. Lever Lock Key
   - N: Neutral (The lever is not moved.)
   - D: Driving (The lever is released.)
4. Switch Circuit

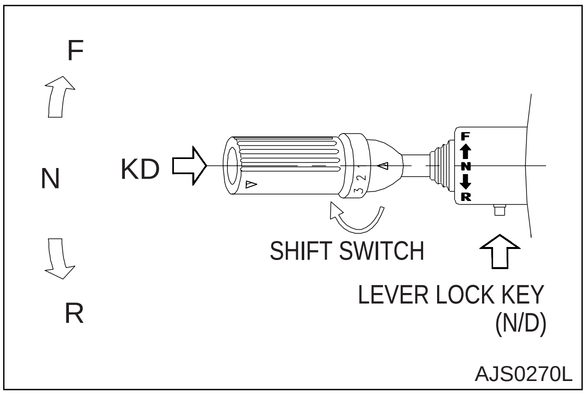

Figure 13

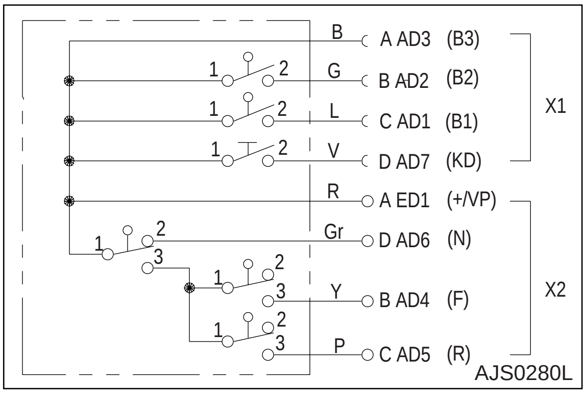

Figure 14

5. Terminal position and color

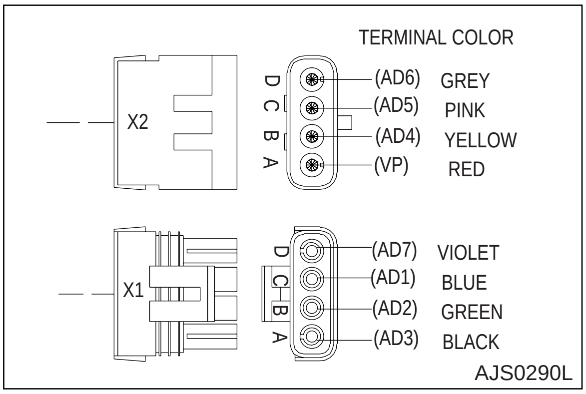

Figure 15

6. Switch Connection

TERMINAL \ GEAR		FORWARD				REVERSE				NEUTRAL				KICK DOWN
		1	2	3	4	1	2	3	4	1	2	3	4	
ED1	VP	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛
AD1	B1	⊛			⊛	⊛			⊛	⊛			⊛	
AD2	B2			⊛	⊛			⊛	⊛			⊛	⊛	
AD3	B3	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	
AD4	V	⊛	⊛	⊛	⊛									
AD5	R					⊛	⊛	⊛	⊛					
AD6	AS									⊛	⊛	⊛	⊛	
AD7	KD													⊛

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Figure 16

AUTO SELECT SWITCH

1. This is an auto/manual select switch.
2. When the switch is in the "I" - (AUTO) position, gears are "AUTOMATICALLY" changed to the appropriate speed up to the limit set by the gear lever and according to travel load and engine rpm
3. Automatic shifting takes place between gears.
   - Forward: 2nd - 3rd - 4th
   - Reverse: 2nd - 3rd
4. When the switch is in the "O" - (Manual) position, travel mode is switched to "MANUAL" and allows operator to choose speeds manually.

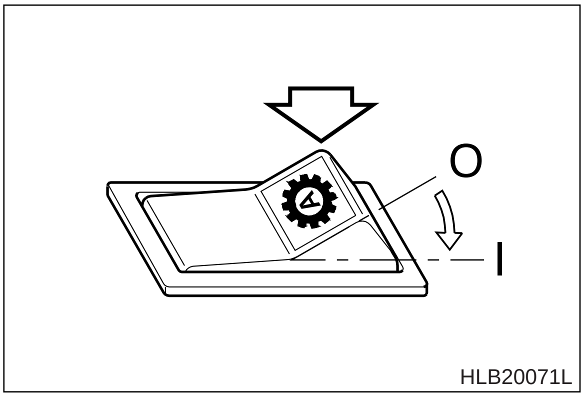

Figure 17

DISPLAY

Fault codes are given in a separate section "Transmission Error Codes (ZF)."

TRANSMISSION FAULTS CODES

The transmission has a monitoring system that indicates when a malfunction is occurring.

FAULT DISPLAY

If a fault is detected, the display shows a spanner symbol (g) for a fault. The display shows the fault code, if the gear selector is in neutral.

If more than one fault is detected, each fault code is shown for about 1 second.

CAN - MESSAGE

The TCU sends the fault code of a detected fault in the specified CAN - message, while the fault is active.

If more than one fault is detected, the fault code scrolls.

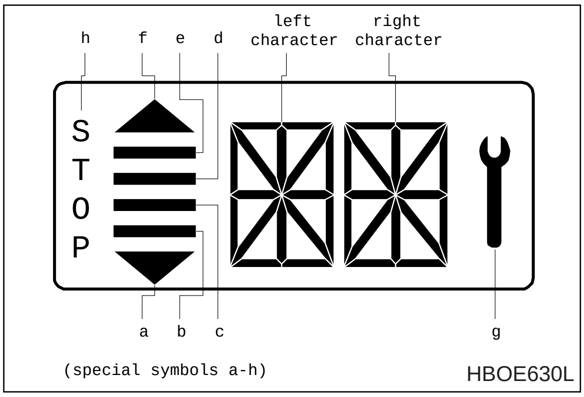

Figure 18

DESCRIPTION OF FAULT CODES

First Number	Meaning of Number
1 Hex	Digital Input Signal
2 Hex	Analog Input Signal
3 Hex	Speed Signal
4 Hex	Can Signal Error
5 Hex	Can Signal Error
6 Hex	Can Signal Error
7 Hex	Analog Current Output Signal
8 Hex	Analog Current Output Signal
9 Hex	Digital Output Signal
A Hex	Digital Output Signal
B Hex	Transmission Fault, Clutch Error
C Hex	Logical Fault
D Hex	Power Supply
E Hex	High Speed Signal
F Hex	General Fault

ABBREVIATIONS

Throughout this section the following abbreviations are used to indicate various conditions.

Abbreviations	
O.C.	Open Circuit
S.C.	Short Circuit
OP-Mode	OPeration Mode
TCU	Transmission Control Unit
ABS	Anti Blocking System
ASR	Anti Slipping Regulation
EEC	Electronic Engine Controller
PTO	Power Take Off
CCO	Clutch Cut Off

DEFINITION OF OPERATION MODES

Normal

There is no failure detected in transmission system or failure has no or slight effects on transmission control. TCU will work without or in special cases with little limitations. (see following table)

Substitute Clutch Control

TCU cannot change gears or direction under control of normal clutch modulation. TCU uses substitute strategy for clutch control. All modulations are only time controlled. (Comparable with EST 25)

Limp-home

The detected failure in the system has strong limitations to transmission control. TCU can engage only one gear in each direction. In some cases only one direction will be possible. TCU will shift the transmission into neutral at the first occurrence of the failure. First, the operator must shift the gear selector into neutral position. If output speed is less than a threshold for neutral to gear and the operator shifts the gear selector into forward or reverse, the TCU will select the limp-home gear. If output speed is less than a threshold for reversal speed and TCU has changed into the limp-home gear and the operator selects a shuttle shift, TCU will shift immediately into the limp-home gear of the selected direction. If output speed is greater than the threshold, TCU will shift the transmission into neutral. The operator has to slow down the vehicle and must shift the gear selector into neutral position.

Transmission Shut Down

TCU has detected a severe failure that disables control of the transmission. TCU will shut off the solenoid valves for the clutches and also the common power supply (VPS1). Transmission shifts to Neutral. The park brake will operate normally, also the other functions which use ADM 1 to ADM 8. The operator has to slow down the vehicle. The transmission will stay in neutral.

TCU Shut Down

TCU has detected a severe failure that disables control of system. TCU will shut off all solenoid valves and also both common power supplies (VPS1, VPS2). The park brake will engage, also all functions are disabled which use ADM 1 to ADM 8. The transmission will stay in neutral.

TABLE OF FAULT CODES

Fault codes are given in a separate section "Transmission Error Codes (ZF)."

MEASUREMENT OF RESISTANCE AT ACTUATOR/SENSORS AND CABLE

Actuator

open circuit: $R_{12} \approx R_{1G} \approx R_{2G} \approx \infty$

short cut to ground: $R_{12} \approx R$; $R_{1G} \approx 0$, $R_{2G} \approx R$ or $R_{1G} \approx R$, $R_{2G} \approx 0$ (for S.C. to ground, G is connected to vehicle ground)

short cut to battery: $R_{12} \approx R$; $R_{1G} \approx 0$, $R_{2G} \approx R$ or $R_{1G} \approx R$, $R_{2G} \approx 0$ (for S.C. to battery, G is connected to battery voltage).

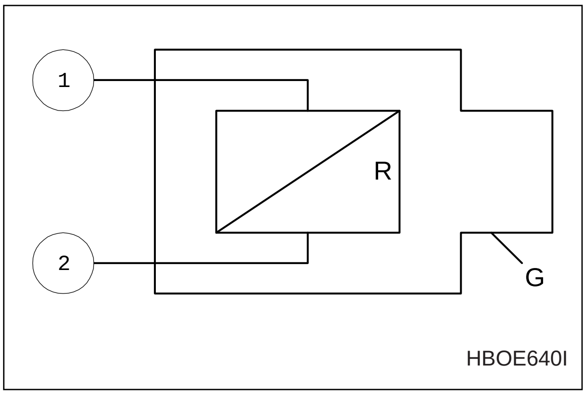

Figure 19

Cable

open circuit:

$R_{12} \approx R_{1P} \approx R_{1C} \approx R_{2P} \approx R_{2C} \approx \infty$

short cut to ground:

$R_{12} \approx 0$; $R_{1C} \approx R_{2C} \approx 0$, $R_{1P} \approx R_{2P} \approx \infty$

short cut to battery:

$R_{12} \approx 0$, $R_{1C} \approx R_{2C} \approx \infty$, $R_{1P} \approx R_{2P} \approx 0$

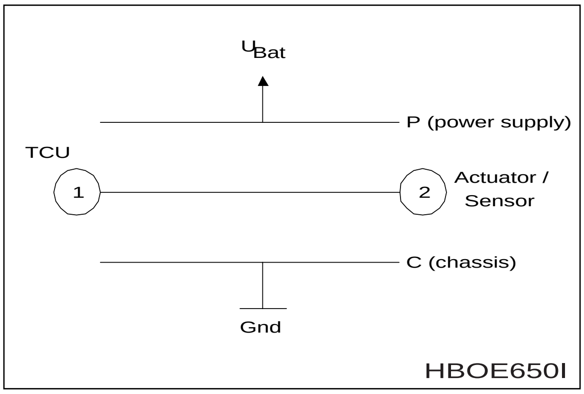

Figure 20

TRANSMISSION ELECTRICAL CIRCUITS

TRANSMISSION CONTROLLER CIRCUIT

4WG-310 T/M CONNECTION

CLUTCH	SOLENOID VALVE	FORWARD				REVERSE		
		1	2	3	4	1	2	3
KV	Y5	○	○	○				
KR	Y2					○	○	○
K1	Y3	○				○		
K2	Y6		○				○	
K3	Y4			○	○			○
K4	Y1				○			

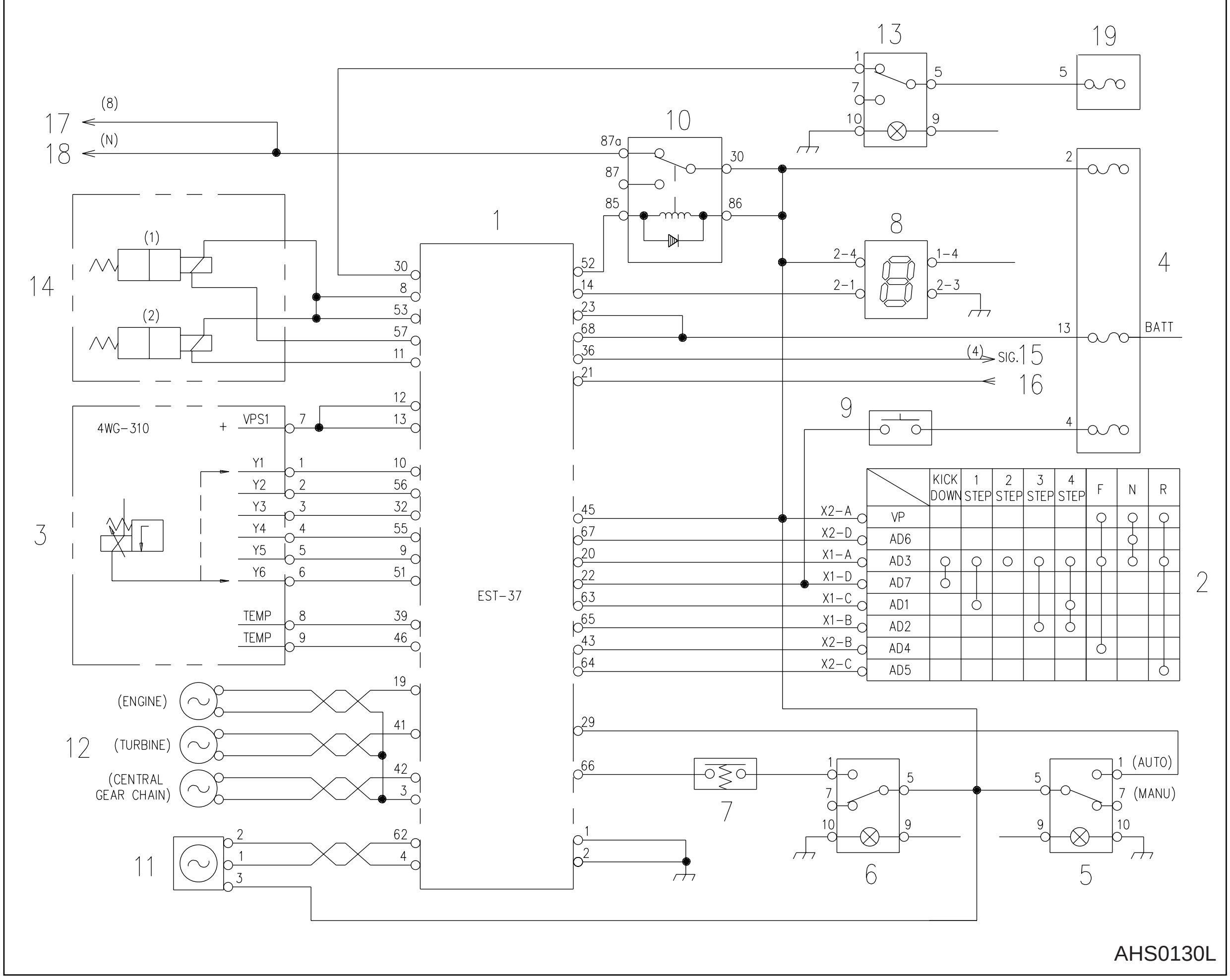

Figure 21

Reference Number	Description
1	Transmission Controller
2	Transmission Selector Switch
3	Transmission Control Valve
4	Fuse Box 1
5	Auto Selector Switch
6	Transmission Cutoff Selector Switch
7	Transmission Cutoff Pressure Switch
8	Display
9	Downshift Switch

Reference Number	Description
10	Safety Starter Switch
11	Output Speed Sensor
12	Speed Pick-up
13	LIS Select Switch
14	LIS Solenoid
15	Speedometer
16	Parking Brake Switch
17	Control Unit
18	Starter Controller
19	Fuse Box 2

The transmission proportioning solenoid valves are shown here as (Y1 thru Y6, Figure 21).

TRAVELING CIRCUITS

Neutral

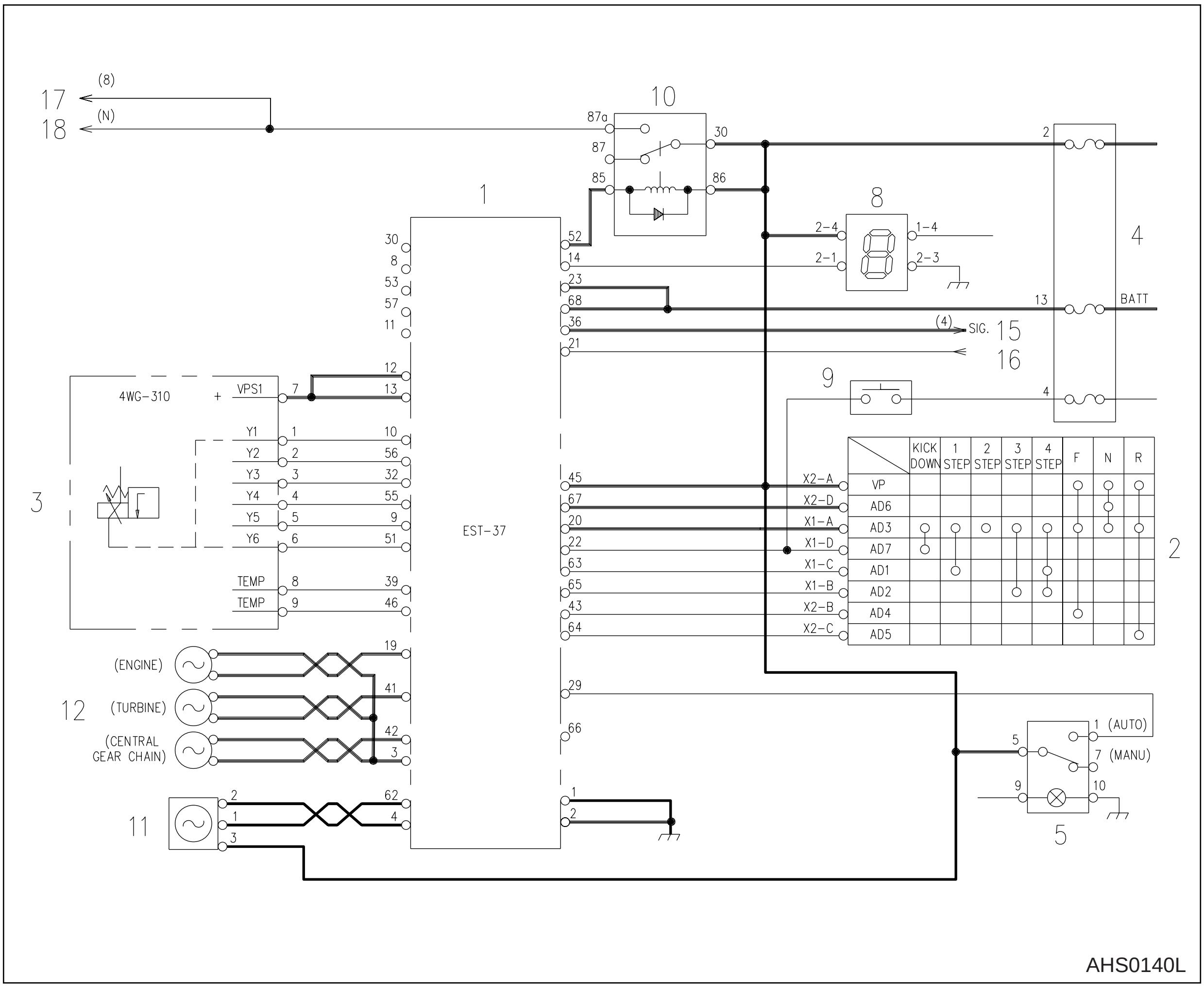

Figure 22

Reference Number	Description
1	Transmission Controller
2	Transmission Selector Switch
3	Transmission Control Valve
4	Fuse Box
5	Auto Selector Switch
6	Transmission Cutoff Selector Switch
7	Transmission Cutoff Pressure Switch
8	Display

Reference Number	Description
9	Downshift Switch
10	Safety Start Switch
11	Output Speed Sensor
12	Speed Pick-up
13	LIS Select Switch
14	LIS Solenoid
15	Speedometer
16	Parking Brake Switch
17	Control Unit
18	Starter Controller

When all transmission solenoid valves are de-energized (OFF) the transmission is in "NEUTRAL."

Forward First Gear

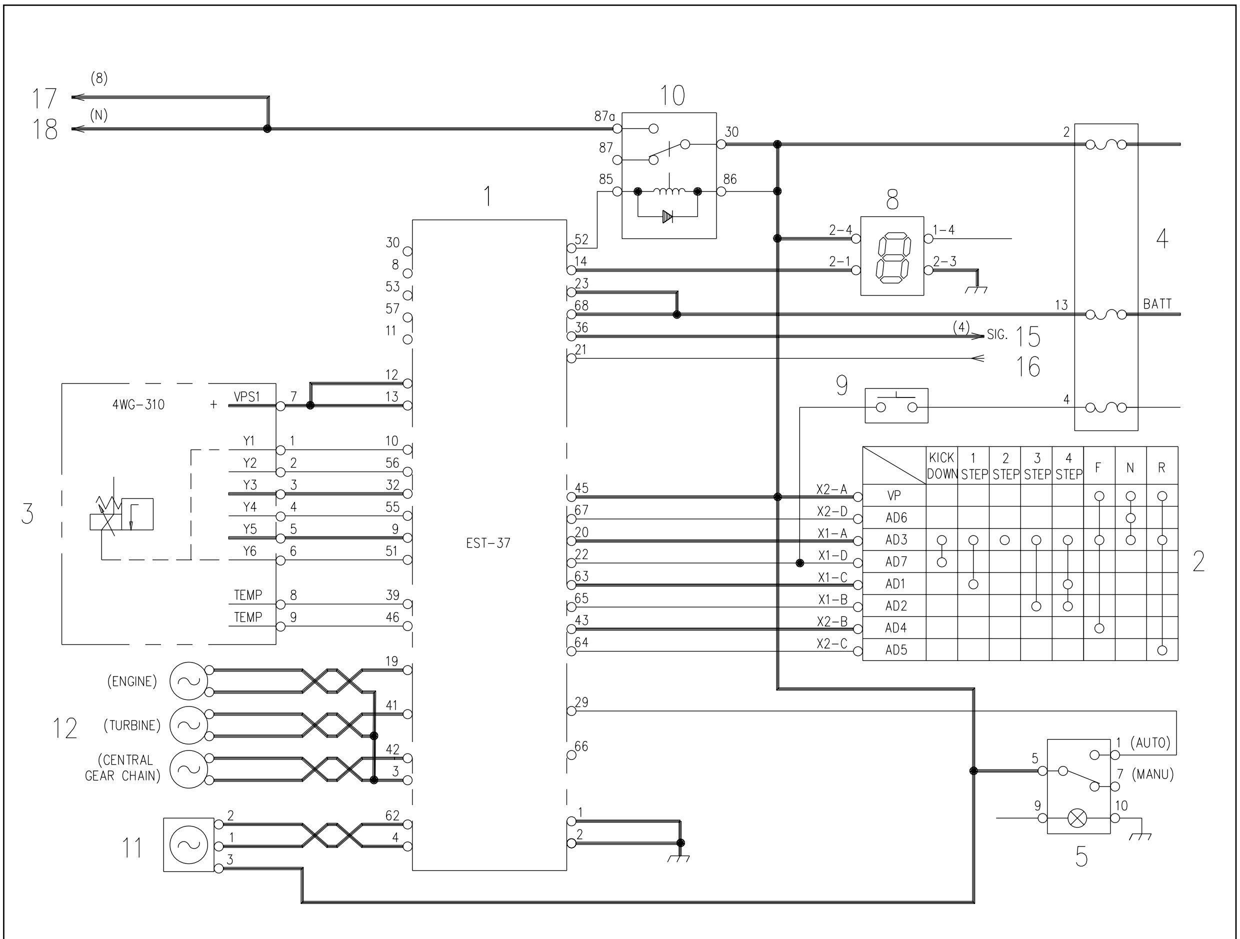

Figure 23

Reference Number	Description
1	Transmission Controller
2	Transmission Selector Switch
3	Transmission Control Valve
4	Fuse Box
5	Auto Selector Switch
6	Transmission Cutoff Selector Switch
7	Transmission Cutoff Pressure Switch
8	Display

Reference Number	Description
9	Downshift Switch
10	Safety Start Switch
11	Output Speed Sensor
12	Speed Pick-up
13	LIS Select Switch
14	LIS Solenoid
15	Speedometer
16	Parking Brake Switch
17	Control Unit
18	Starter Controller

Transmission solenoid valves (Y3 and Y5, Figure 23) are energized when in forward first gear.

Forward Second Gear

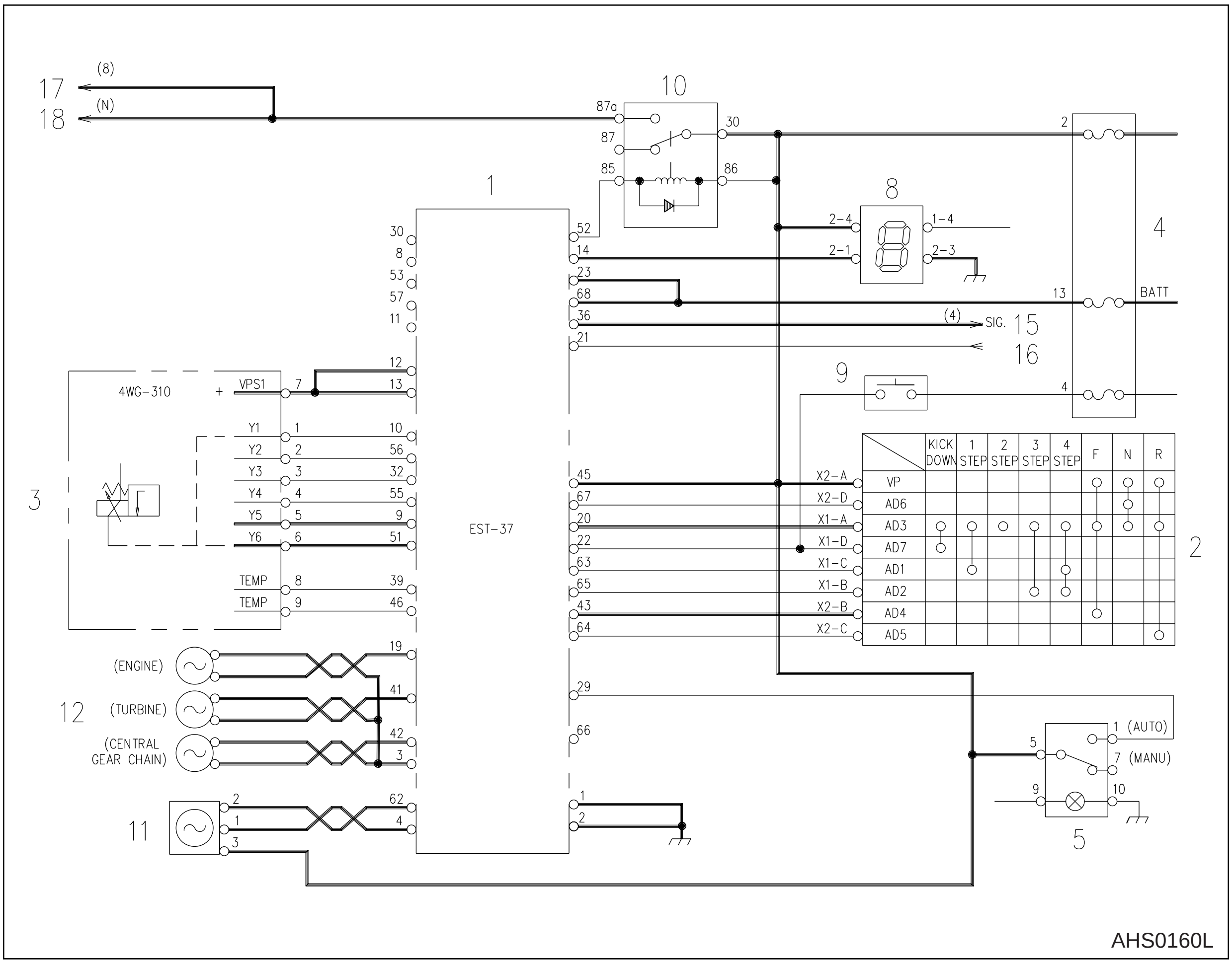

Figure 24

Reference Number	Description
1	Transmission Controller
2	Transmission Selector Switch
3	Transmission Control Valve
4	Fuse Box
5	Auto Selector Switch
6	Transmission Cutoff Selector Switch
7	Transmission Cutoff Pressure Switch
8	Display

Reference Number	Description
9	Downshift Switch
10	Safety Start Switch
11	Output Speed Sensor
12	Speed Pick-up
13	LIS Select Switch
14	LIS Solenoid
15	Speedometer
16	Parking Brake Switch
17	Control Unit
18	Starter Controller

Transmission solenoid valves (Y5 and Y6, Figure 24) are energized when in forward second gear.

Forward Third Gear

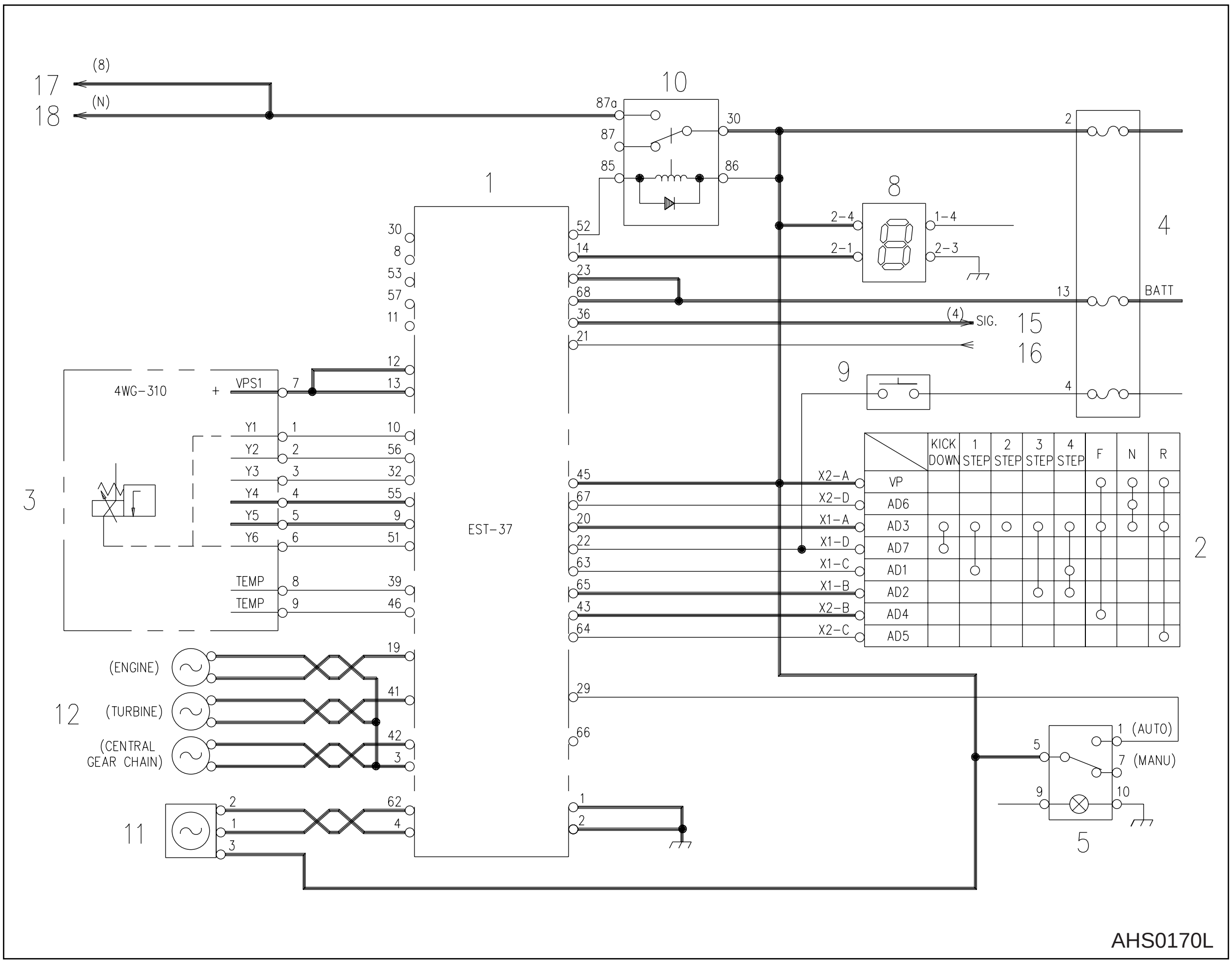

Figure 25

Reference Number	Description
1	Transmission Controller
2	Transmission Selector Switch
3	Transmission Control Valve
4	Fuse Box
5	Auto Selector Switch
6	Transmission Cutoff Selector Switch
7	Transmission Cutoff Pressure Switch
8	Display

Reference Number	Description
9	Downshift Switch
10	Safety Start Switch
11	Output Speed Sensor
12	Speed Pick-up
13	LIS Select Switch
14	LIS Solenoid
15	Speedometer
16	Parking Brake Switch
17	Control Unit
18	Starter Controller

Transmission solenoid valves (Y4 and Y5, Figure 25) are energized when in forward third gear.

Forward Fourth Gear

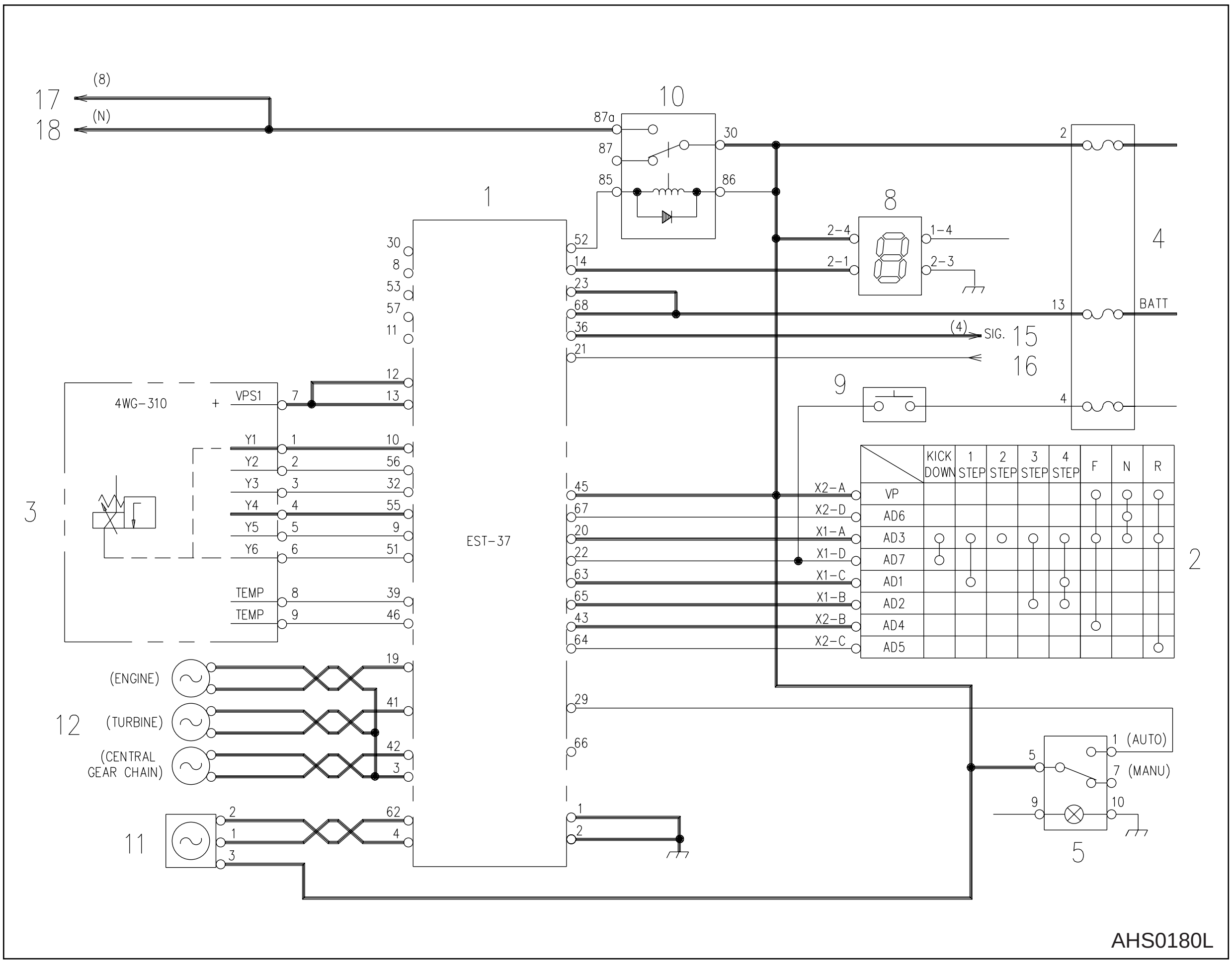

Figure 26

Reference Number	Description
1	Transmission Controller
2	Transmission Selector Switch
3	Transmission Control Valve
4	Fuse Box
5	Auto Selector Switch
6	Transmission Cutoff Selector Switch
7	Transmission Cutoff Pressure Switch
8	Display

Reference Number	Description
9	Downshift Switch
10	Safety Start Switch
11	Output Speed Sensor
12	Speed Pick-up
13	LIS Select Switch
14	LIS Solenoid
15	Speedometer
16	Parking Brake Switch
17	Control Unit
18	Starter Controller

Transmission solenoid valves (Y2 and Y4, Figure 26) are energized when in forward fourth gear.

Reverse First Gear

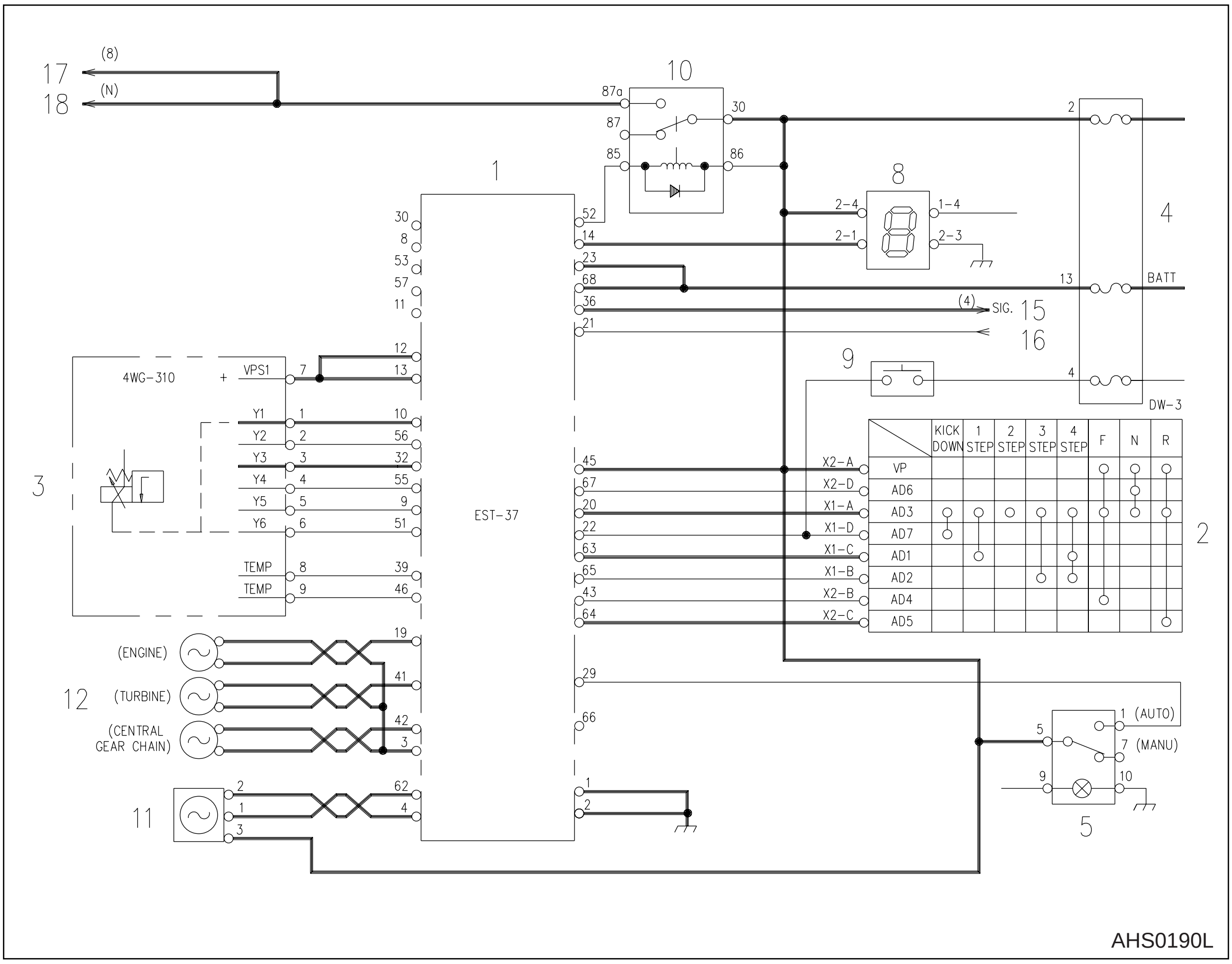

Figure 27

Reference Number	Description
1	Transmission Controller
2	Transmission Selector Switch
3	Transmission Control Valve
4	Fuse Box
5	Auto Selector Switch
6	Transmission Cutoff Selector Switch
7	Transmission Cutoff Pressure Switch
8	Display

Reference Number	Description
9	Downshift Switch
10	Safety Start Switch
11	Output Speed Sensor
12	Speed Pick-up
13	LIS Select Switch
14	LIS Solenoid
15	Speedometer
16	Parking Brake Switch
17	Control Unit
18	Starter Controller

Transmission solenoid valves (Y1 and Y3, Figure 27) are energized when in reverse first gear.

Reverse Second Gear

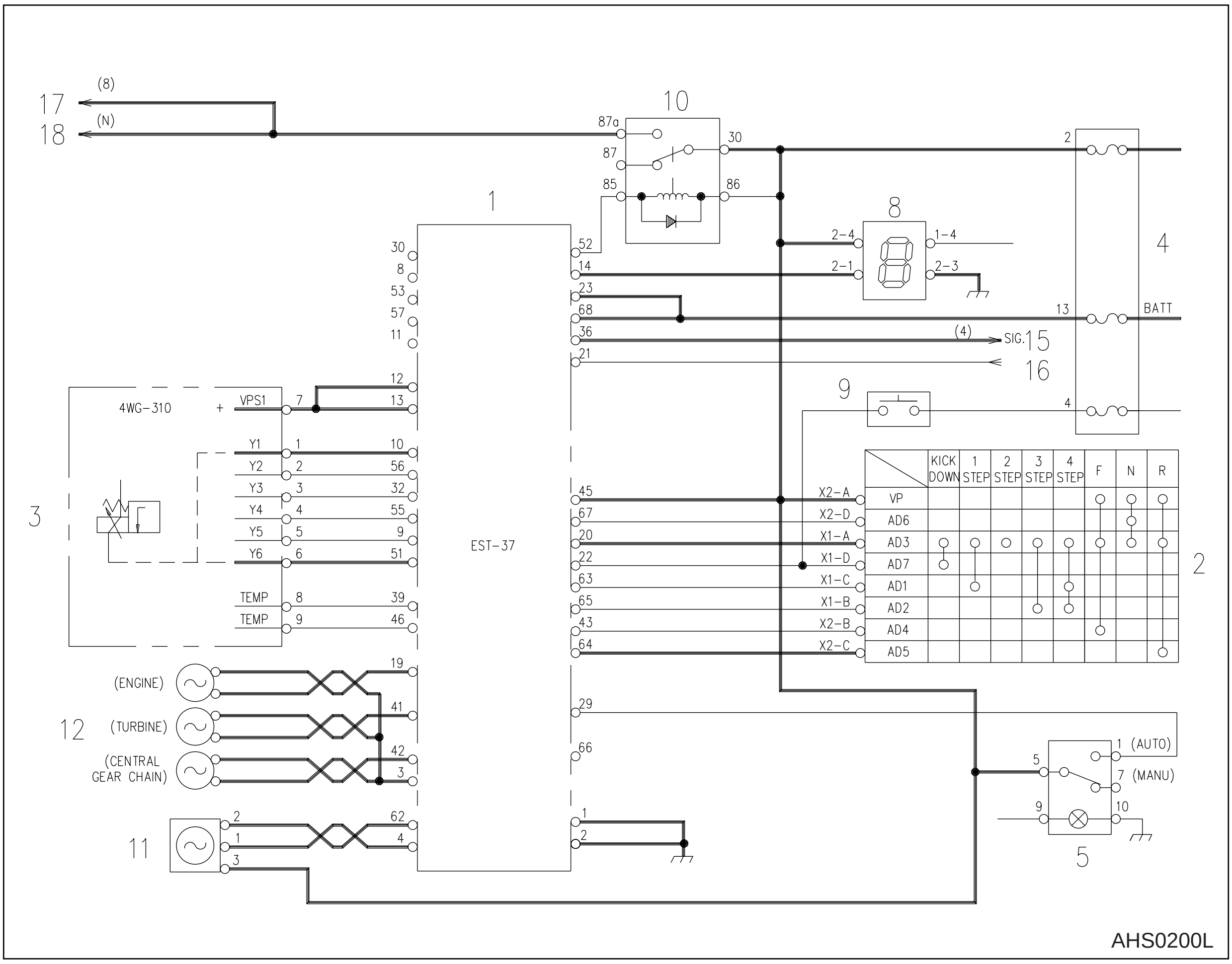

Figure 28

Reference Number	Description
1	Transmission Controller
2	Transmission Selector Switch
3	Transmission Control Valve
4	Fuse Box
5	Auto Selector Switch
6	Transmission Cutoff Selector Switch
7	Transmission Cutoff Pressure Switch
8	Display

Reference Number	Description
9	Downshift Switch
10	Safety Start Switch
11	Output Speed Sensor
12	Speed Pick-up
13	LIS Select Switch
14	LIS Solenoid
15	Speedometer
16	Parking Brake Switch
17	Control Unit
18	Starter Controller

Transmission solenoid valves (Y1 and Y6, Figure 28) are energized when in reverse second gear.

Reverse Third Gear

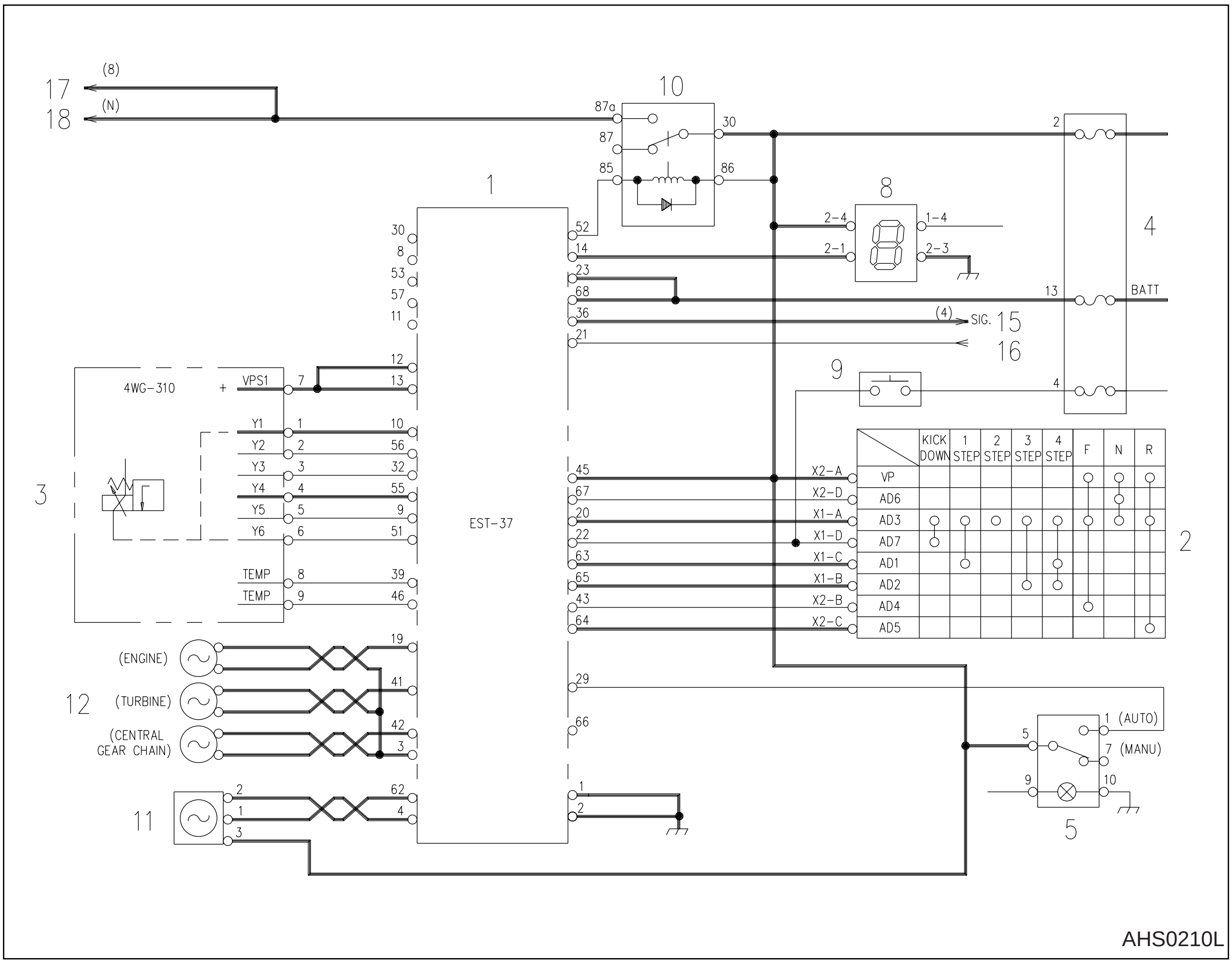

Figure 29

Reference Number	Description
1	Transmission Controller
2	Transmission Selector Switch
3	Transmission Control Valve
4	Fuse Box
5	Auto Selector Switch
6	Transmission Cutoff Selector Switch
7	Transmission Cutoff Pressure Switch
8	Display

Reference Number	Description
9	Downshift Switch
10	Safety Start Switch
11	Output Speed Sensor
12	Speed Pick-up
13	LIS Select Switch
14	LIS Solenoid
15	Speedometer
16	Parking Brake Switch
17	Control Unit
18	Starter Controller

Transmission solenoid valves (Y1 and Y4, Figure 29) are energized when in reverse third gear.

DOWNSHIFT

Overview

1. There are two downshift switches down Figure 30, and it is possible for operators to select one of them according to the condition.
2. If the downshift switch is depressed during the machine moving, downshifting takes place automatically. As a result, fast digging and moving is possible. But at the manual mode the kick-down can only be activated.
3. If a change or traveling direction takes place or the downshift switch is depressed a second time, downshifting is released automatically.

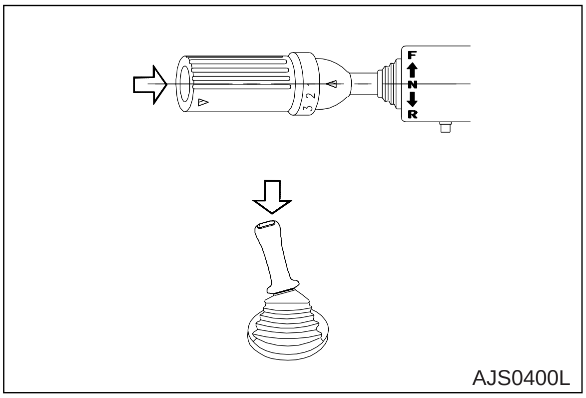

Figure 30

Kick-down: Forward Second Gear to Forward First Gear (Auto Selector Switch "O" - Manual Mode)

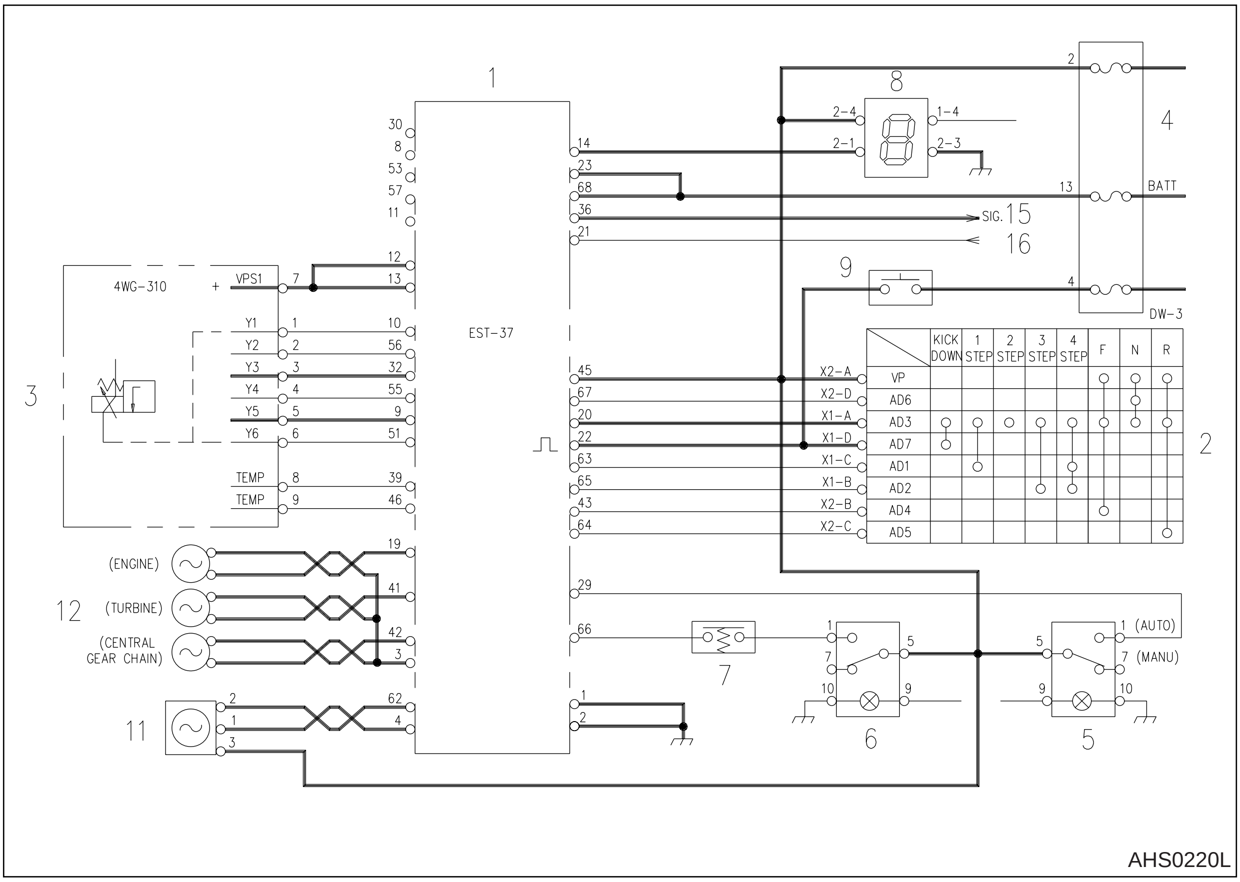

Figure 31

Reference Number	Description
1	Transmission Controller
2	Transmission Selector Switch
3	Transmission Control Valve
4	Fuse Box
5	Auto Selector Switch
6	Transmission Cutoff Selector Switch
7	Transmission Cutoff Pressure Switch
8	Display

Reference Number	Description
9	Downshift Switch
10	Safety Start Switch
11	Output Speed Sensor
12	Speed Pick-up
13	LIS Select Switch
14	LIS Solenoid
15	Speedometer
16	Parking Brake Switch

With the auto selector switch (Figure 32) is in the "O" (MANUAL) and the forward second gear is selected, if either downshift switch (Figure 30) is activated, a pulse is sent to the "22" transmission controller. This signal energizes solenoid valves, (Y3 and Y5), which shifts the transmission to the forward first gear. When either switch (Figure 30) is selected a second time, the transmission pulse signal of the "22" terminal is interrupted and solenoid valve, Y5 and Y6, are energized and the transmission returns to the forward second gear.

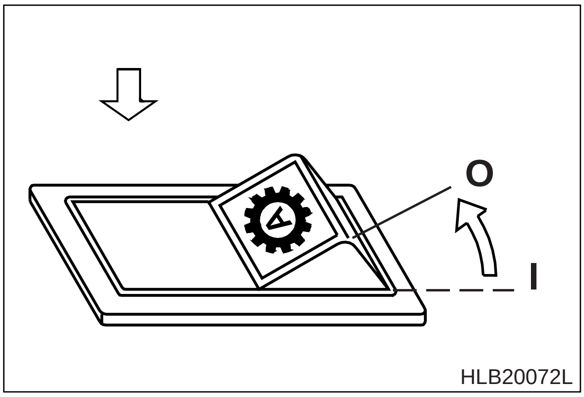

Figure 32

Downshift (Auto Selector Switch "I" - Auto Mode)

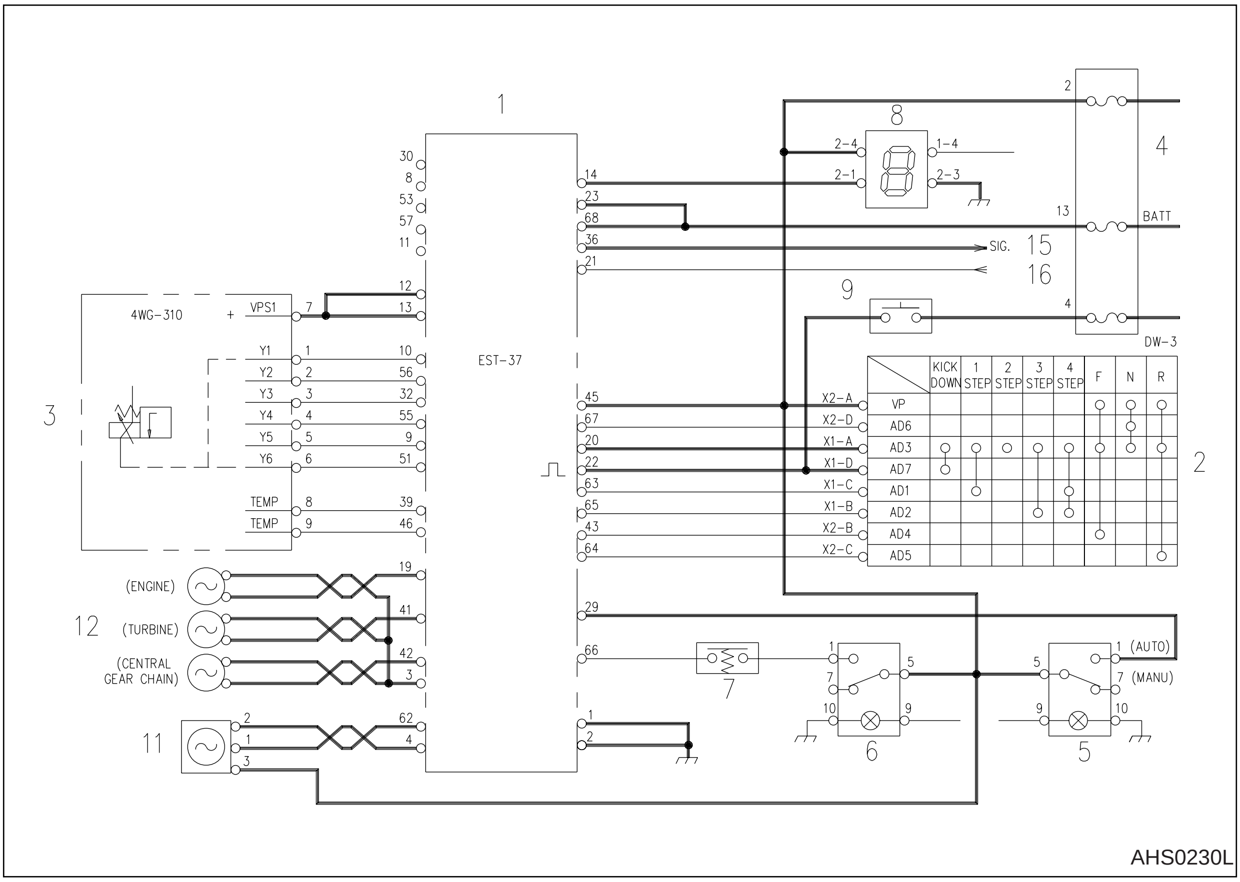

Figure 33

Reference Number	Description
1	Transmission Controller
2	Transmission Selector Switch
3	Transmission Control Valve
4	Fuse Box
5	Auto Selector Switch
6	Transmission Cutoff Selector Switch
7	Transmission Cutoff Pressure Switch
8	Display

Reference Number	Description
9	Downshift Switch
10	Safety Start Switch
11	Output Speed Sensor
12	Speed Pick-up
13	LIS Select Switch
14	LIS Solenoid
15	Speedometer
16	Parking Brake Switch

When the auto selector switch (Figure 33) is in the "I" position, the "29" terminal of transmission controller is energized. This allows the transmission to automatically upshift and downshift gears depending on the load and on the engine speed.

If either downshift switch (Figure 30) is activated, a pulse signal is sent to the "22" terminal of transmission controller. This signal shifts the transmission to the next lowest gear.

Automatic Gear Selection	Downshift Switch "Activated"
Fourth Gear	Downshift to Third Gear
Third Gear	Downshift to Second Gear
Second Gear	Downshift to First Gear
First Gear	Remains in First Gear

When either downshift (Figure 30) is depressed a second time, the transmission pulse signal of the "22" is interrupted and the transmission returns to normal operation.

NOTE: *The fourth to the third gear changes without any rpm change when the downshift switch is pressed.*

NOTE: *The third to the second gear, and the third to the first gear, changes occur when the rpm is reduced 200 - 300 rpm from current setting.*

TRANSMISSION CUTOFF

When the brake pedal is depressed while transmission cutoff switch (Figure 34) is in the "I" position, the transmission cutoff pressure switch turns "ON" and current is supplied to the "66" terminal of the transmission controller.

All current being supplied to the transmission solenoid valves (Y1 thru Y6) is cut off and the transmission is in "NEUTRAL."

NOTE: *To protect transmission, transmission cutoff switch does not function in third and fourth gears.*

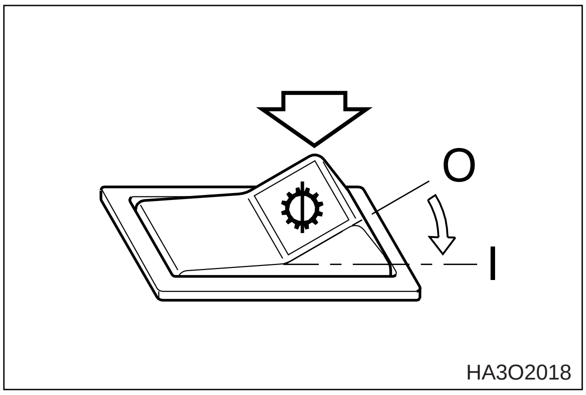

Figure 34

⚠ CAUTION!

When the machine is traveling or working in the place of inclination, the transmission cutoff switch (Figure 34) must be placed in position 'O' for the purse of using engine braking and the normal braking function at the same time.

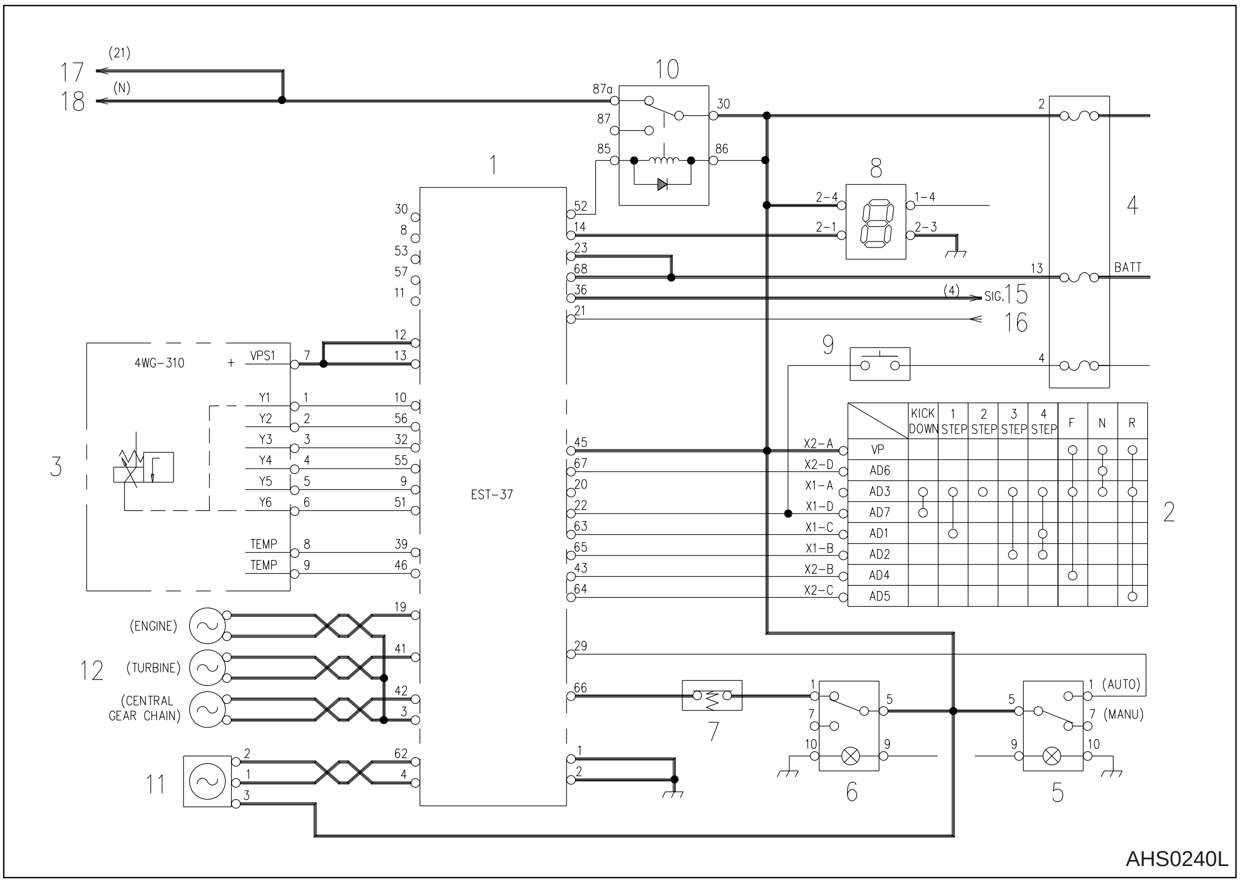

Figure 35

Reference Number	Description
1	Transmission Controller
2	Transmission Selector Switch
3	Transmission Control Valve
4	Fuse Box
5	Auto Selector Switch
6	Transmission Cutoff Selector Switch
7	Transmission Cutoff Pressure Switch
8	Display

Reference Number	Description
9	Downshift Switch
10	Safety Start Switch
11	Output Speed Sensor
12	Speed Pick-up
13	LIS Select Switch
14	LIS Solenoid
15	Speedometer
16	Parking Brake Switch
17	Control Unit
18	Starter Controller

INSTALLATION VIEW

INNER SECTION

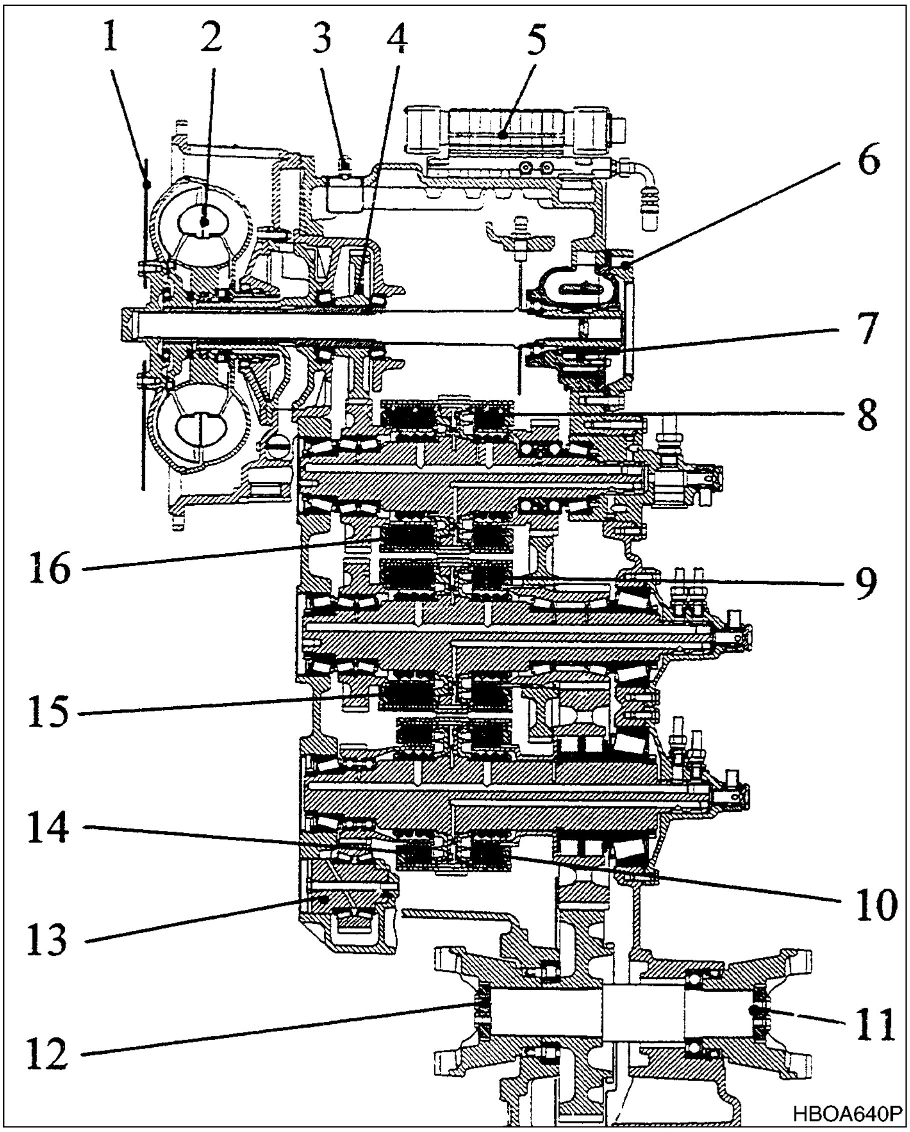

Figure 36

Reference Number	Description
1	Engine Connection - Direct Mounting
2	Converter
3	Breather
4	Drive
5	Electro-hydraulic Shift Control
6	1st Power Take Off
7	Converter Charge and Control Pressure Pump

Reference Number	Description
8	Clutch K1
9	Clutch K2
10	Clutch K3
11	Output - Front Axle
12	Output - Rear Axle
13	Layshaft
14	Clutch K4
15	Clutch Kr
16	Clutch Kv

FRONT VIEW

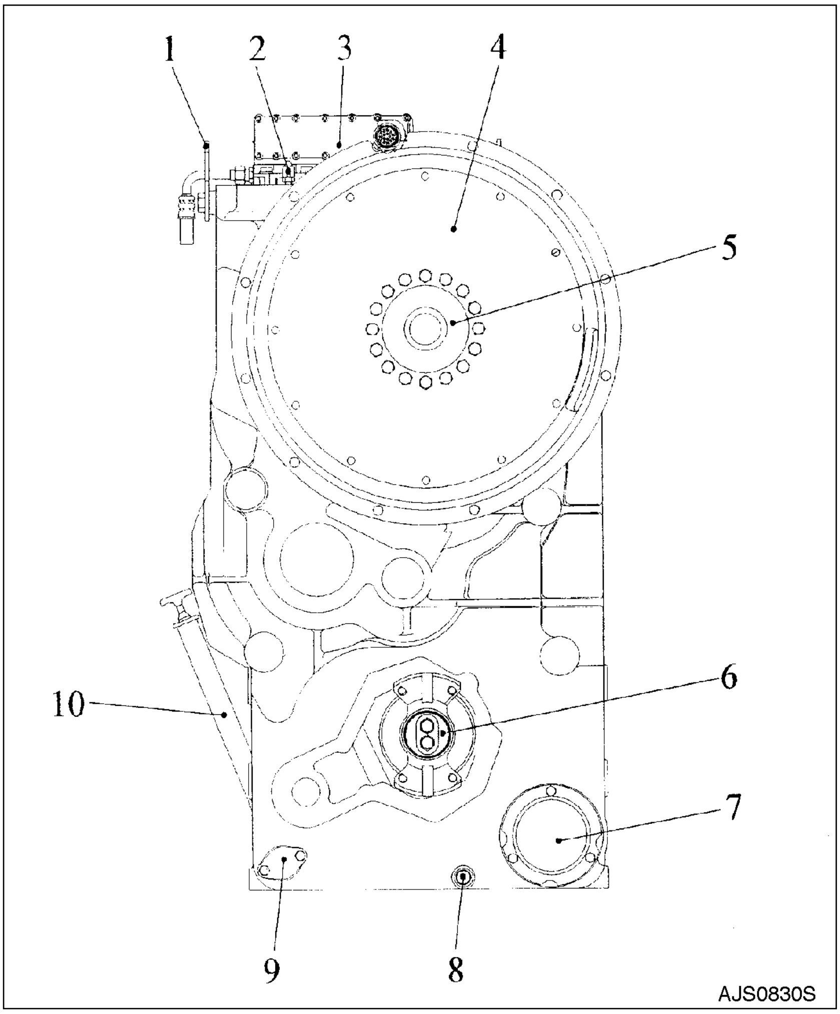

Figure 37

Reference Number	Description
1	Lifting Lugs
2	Breather
3	Electro-hydraulic Shift Control
4	Diaphragms - Direct Mounting
5	Converter
6	Output Flange (Converter-side)

Reference Number	Description
7	Coarse Filter
8	Oil Drain Plug
9	Attachment Possibility for Oil Filter Tube with Oil Dipstick (Converter-side)
10	Oil Filler Tube with Oil Dipstick (Rear-side)

SIDE VIEW

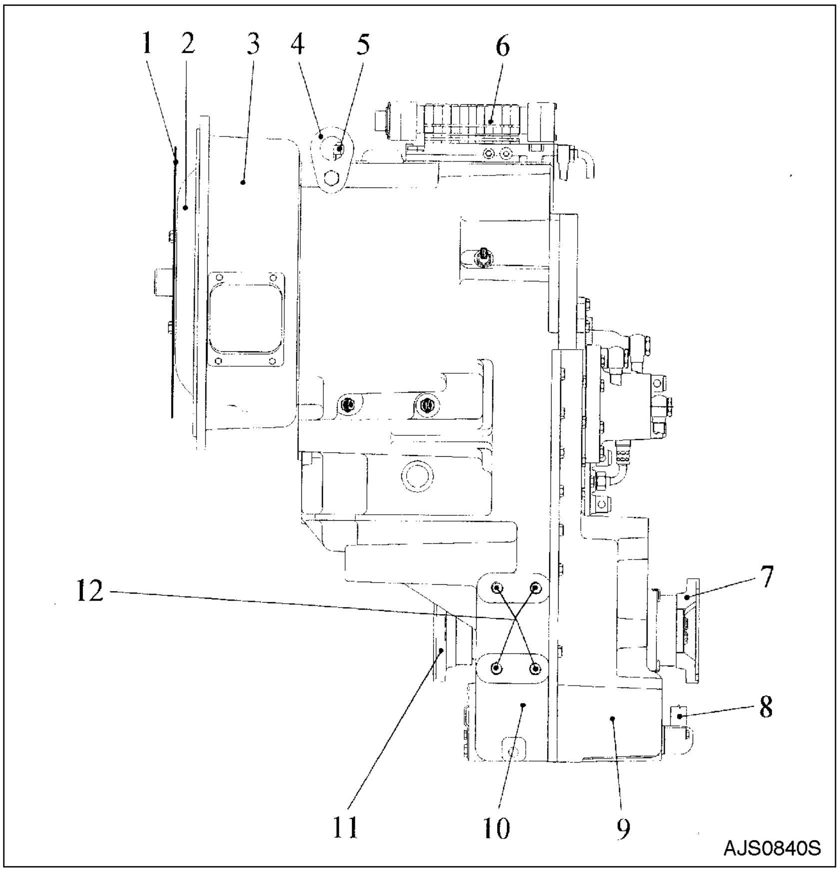

Figure 38

Reference Number	Description
1	Diaphragms for Direct Mounting
2	Converter
3	Converter Bell
4	Lifting Lug
5	Breather
6	Electro-hydraulic Shift Control

Reference Number	Description
7	Output Flange (Rear -side)
8	Oil Filler Tube with Oil Dipstick (Rear-side)
9	Cover
10	Gearbox Housing
11	Output Flange (Converter-side)
12	Transmission Suspension M20

REAR VIEW

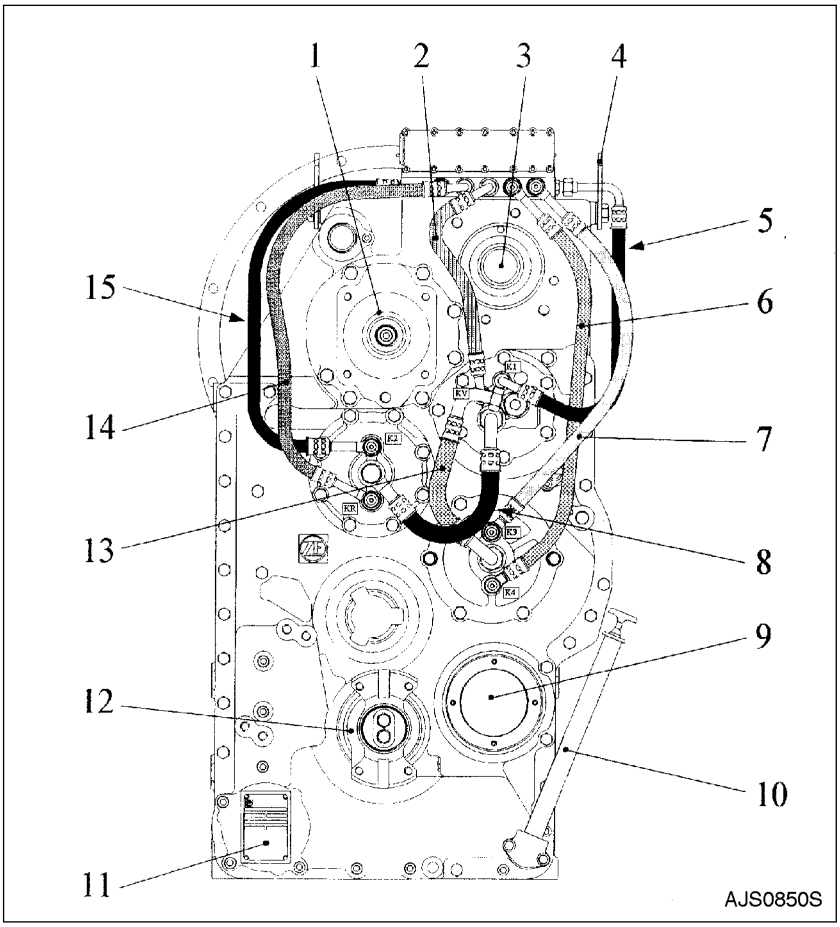

Figure 39

Reference Number	Description
1	1st Power Take-off
2	Pressure Line Clutch KV
3	2nd Power Take-off
4	Lifting Lug
5	Pressure Oil Line Clutch K1
6	Pressure Oil Line Clutch K4
7	Pressure Oil Line Clutch K3
8	Lubricating Oil Line "S1" Clutch KR / K2

Reference Number	Description
9	Attachment Possibility for Emergency Steering Pump
10	Oil Filter Tube With Oil Dipstick
11	Model Identification Plate
12	Output Flange (Rear-side)
13	Lubricating Oil Line "S2" Clutch K4 / K3
14	Pressure Oil Line Clutch KR
15	Pressure Oil Line Clutch K2

HYDRAULIC CONTROL UNIT (HSG-94)

Figure 40, shows a sectional view of the HSG-94.

IMPORTANT
Different versions in relation to the position of the cable harness are possible.
In this connection, pay attention to the Specifications of the Vehicle Manufacturer.

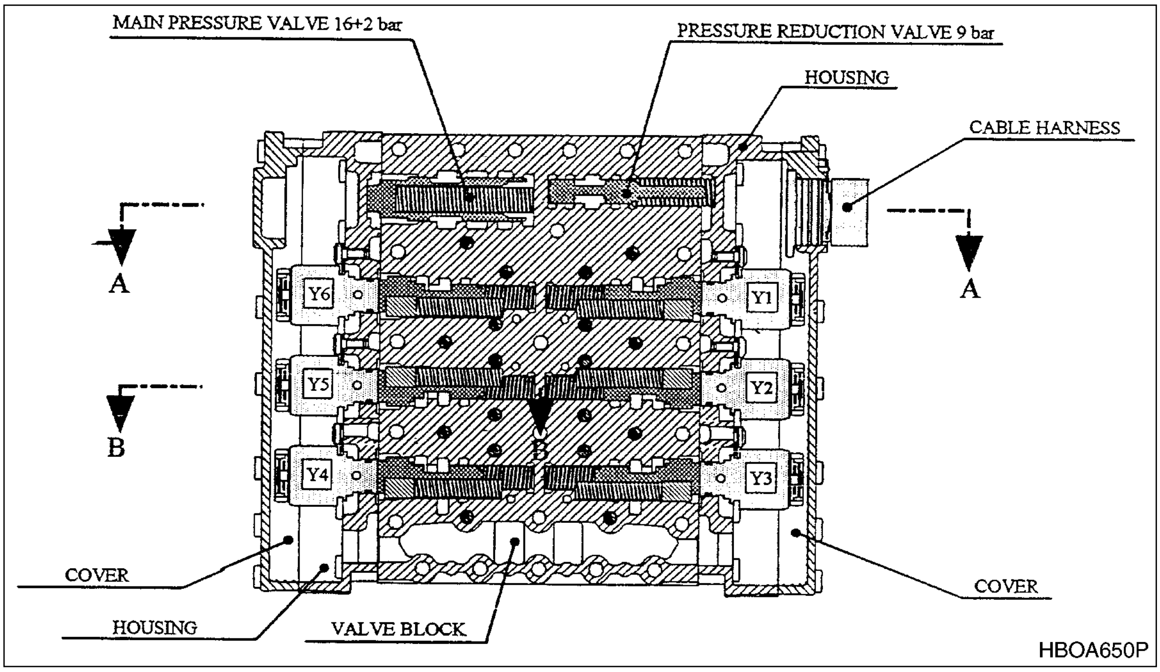

Figure 40

Section A -A

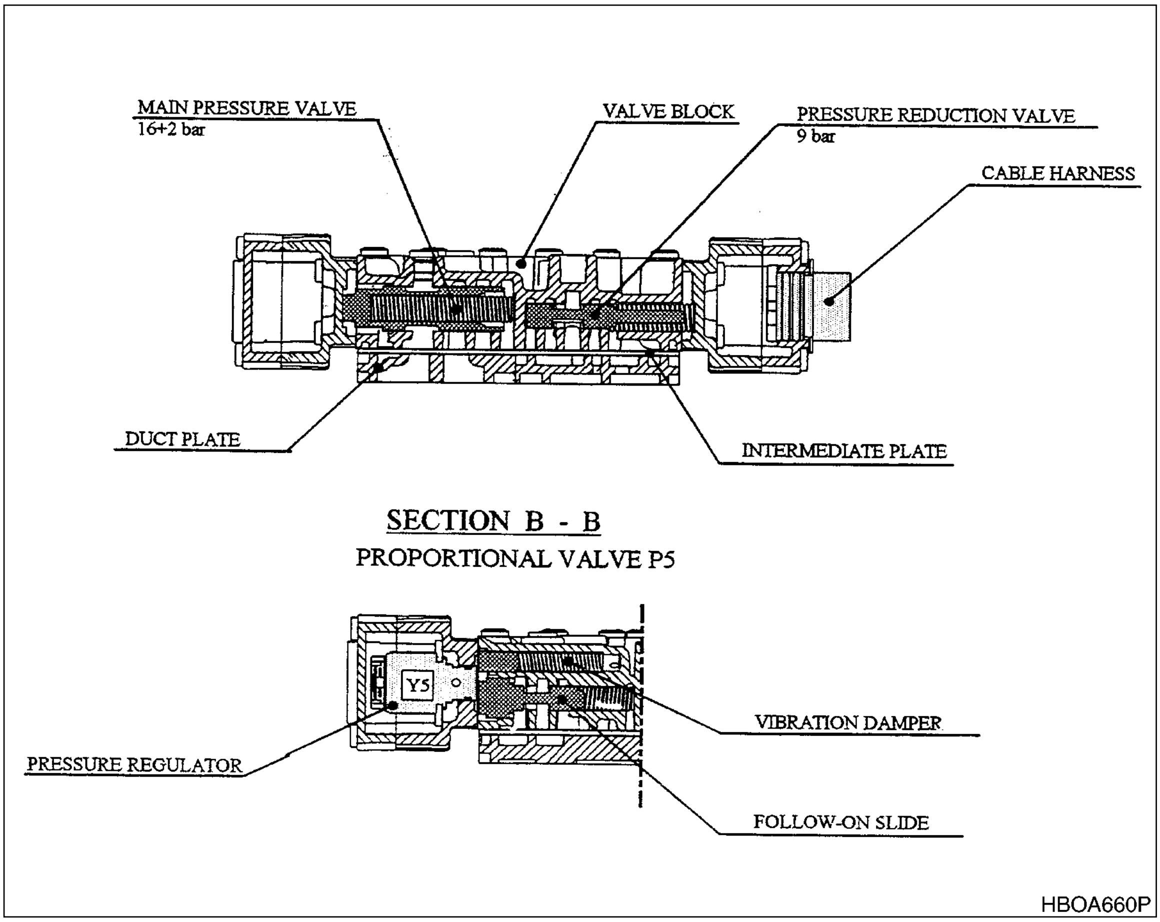

Figure 41

DISASSEMBLY

1. Loosen socket head screws and remove selector housing.

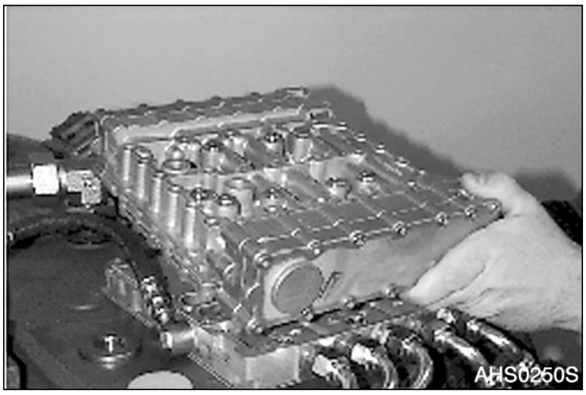

Figure 42

2. 2. Separate hose lines from the intermediate plate.

3. Loosen socket head screws and separate intermediate plate and gaskets and intermediate sheet from gearbox housing.

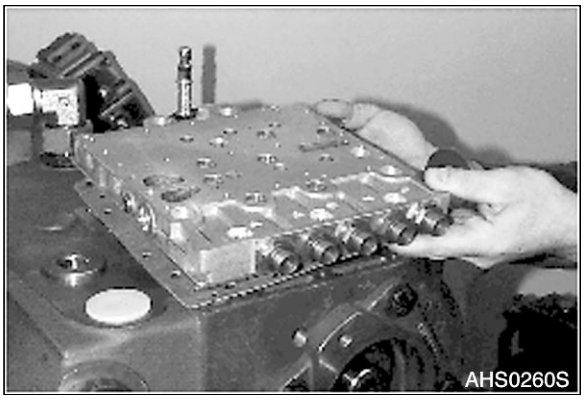

Figure 43

4. Mark installation position of the cable harness to the valve block.

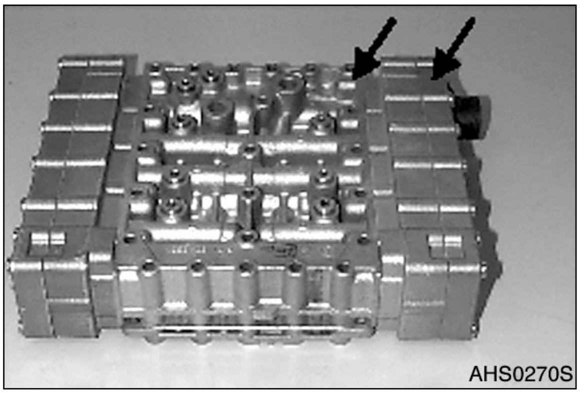

Figure 44

5. Loosen socket head screws.

6. Separate duct plate, gaskets and intermediate sheet from the valve block.

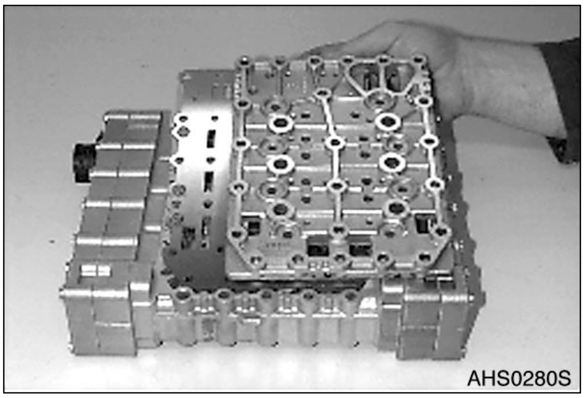

Figure 45

7. Remove retaining clip.

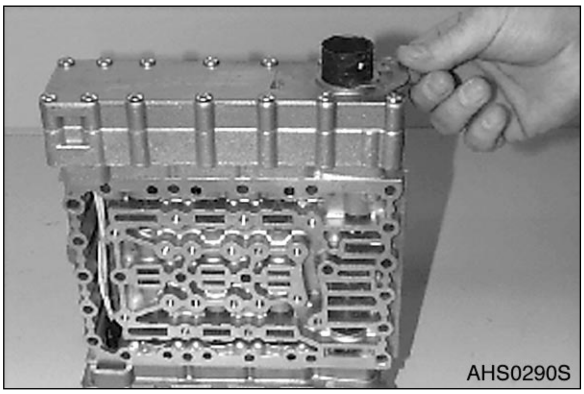

Figure 46

8. Loosen socket head screws and remove cover.

9. Remove opposite cover.

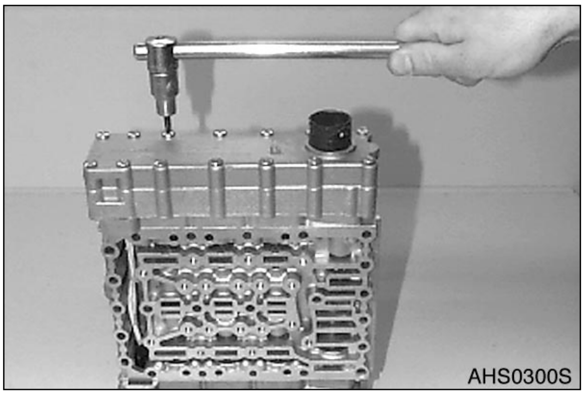

Figure 47

10. Demount pressure regulator and remove cable harness.

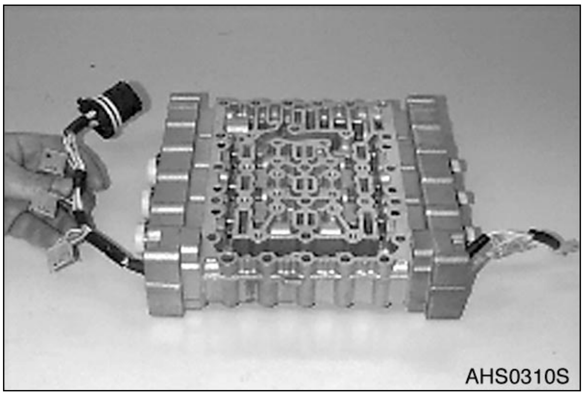

Figure 48

11. Loosen socket head screws, remove retaining plates and demount pressure regulator.

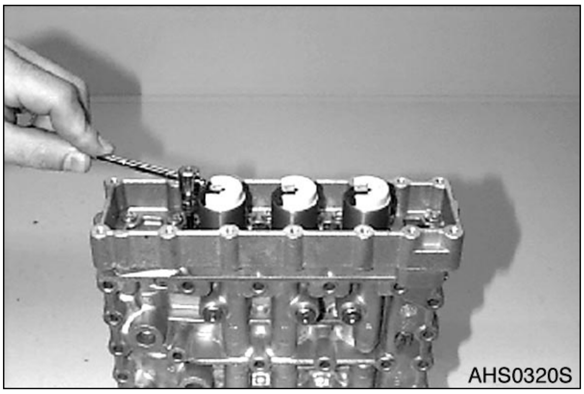

Figure 49

12. Loosen two socket head screws and locate the housing provisionally using adjusting screws. (Housing is spring-loaded). Now, loosen the remaining socket head screws.

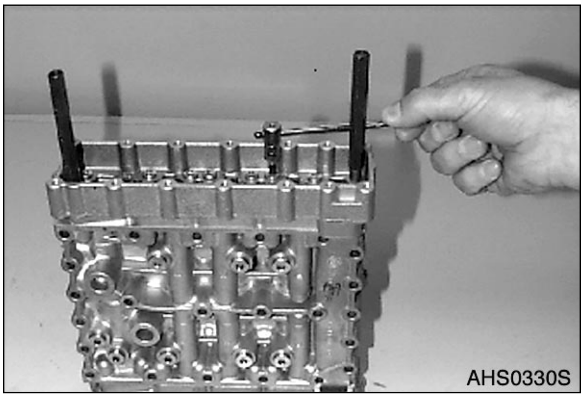

Figure 50

13. Separate housing from valve body by uniform loosening of the adjusting screws.

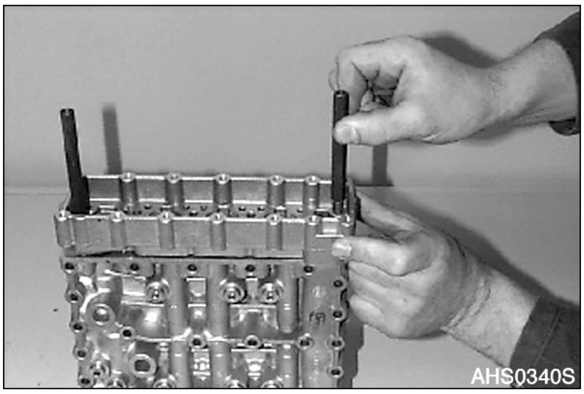

Figure 51

14. Remove components.

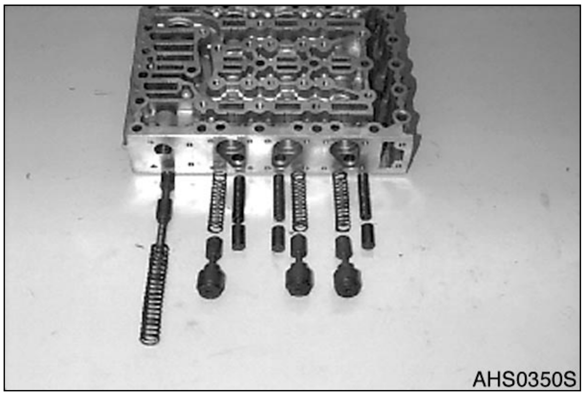

Figure 52

15. Remove opposite pressure regulators, housing and components accordingly.

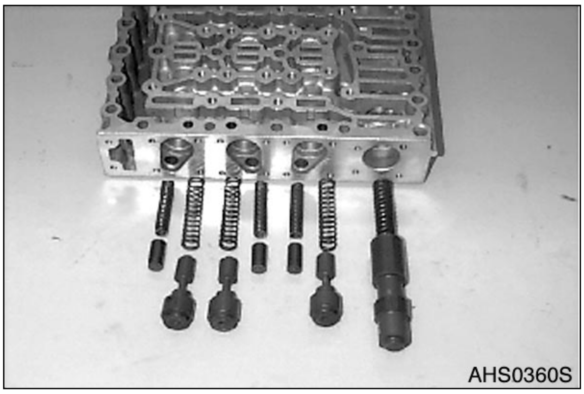

Figure 53

REASSEMBLY

NOTE: *Check all components for damage and replace if necessary. Prior to installation, check free travel of all moving parts in housing. Spools can be exchanged individually. Oil components before reassembly according to ZF-List of lubricants TE-ML 03.*

Insert diaphragms with concave side facing upward until contact is obtained.

NOTE: *Installation position, see arrows.*

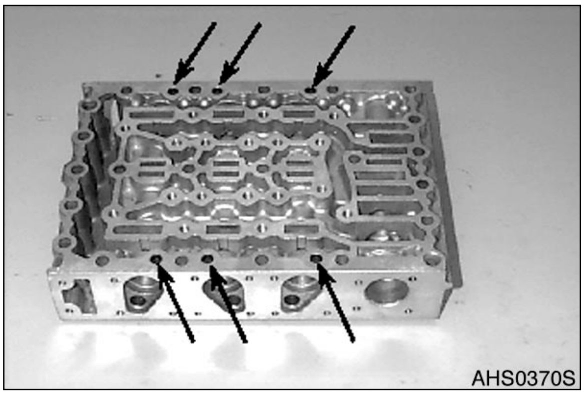

Figure 54

1. Figure 55, shows the following components:

Reference Number	Description
1	Vibration Damper (3x Spool and Compression Spring)
2	Follow On Site (3x Spool And Compression Spring)
3	Pressure Reducing Valve (1x Spool And Compression Spring)

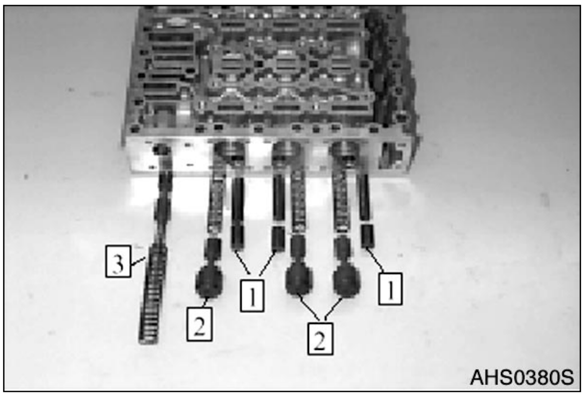

Figure 55

2. Install components according to Figure 55.

NOTE: *Preload compression spring of the follow-on slides and locate spool provisionally using cylindrical pins Ø 5.0 mm (0.1969 in) (assembly aid), See Figure 56.*

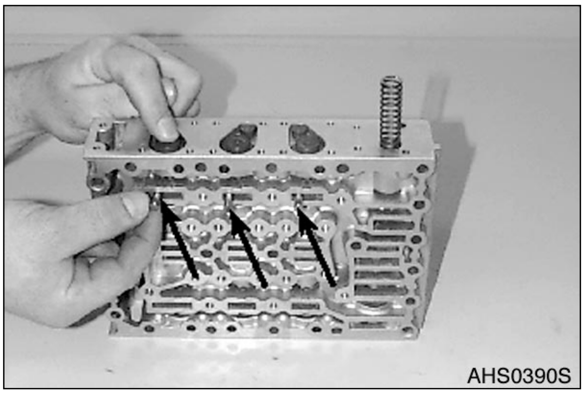

Figure 56

3. Install two adjusting screws.
4. Line up flat gasket (Arrow) and housing cover (Figure 57). Now, bring housing cover using adjusting screws uniformly against shoulder (Figure 58).

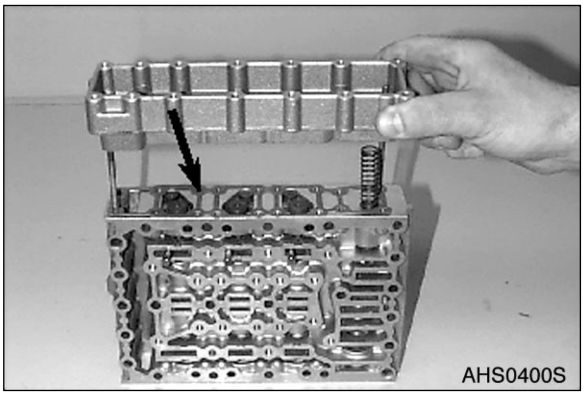

Figure 57

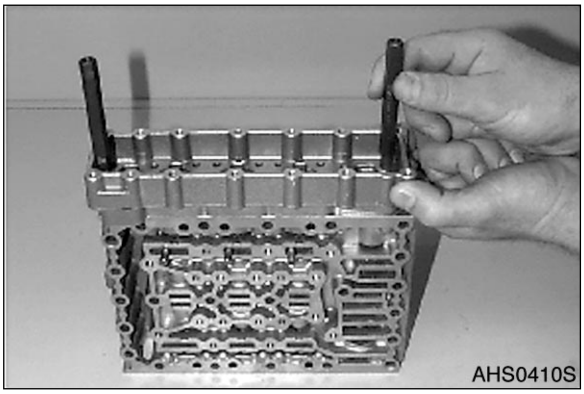

Figure 58

5. Preload spool and remove the cylindrical pins (assembly aid) again.

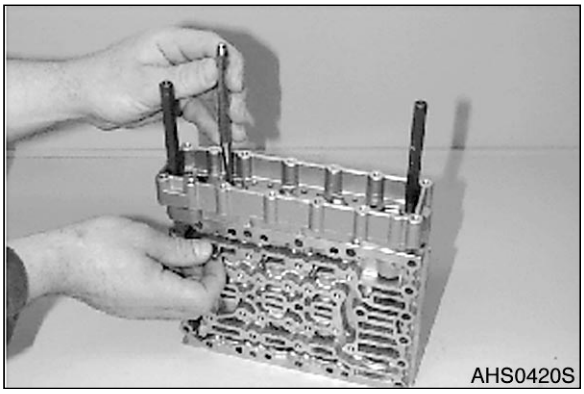

Figure 59

6. Fasten housing cover using socket head screws.

   NOTE: *Torque limit 5.5 Nm (4 ft lb).*

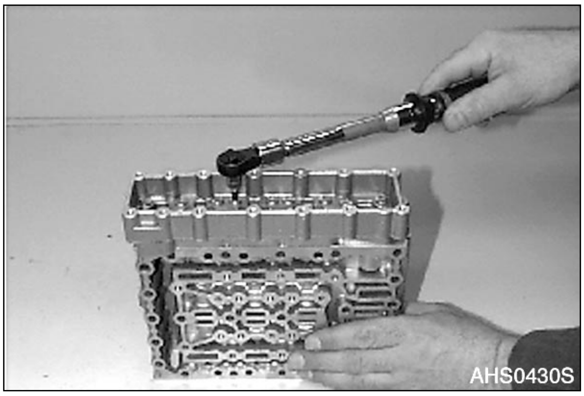

Figure 60

7. Introduce pressure regulators and secure them using retaining plates and socket head screws.

NOTE: *Install retaining plates, with the claw facing downward. Pay attention to the radial installation position of the pressure regulators, Figure 61.*

NOTE: *Torque limit 5.5 Nm (4 ft lb).*

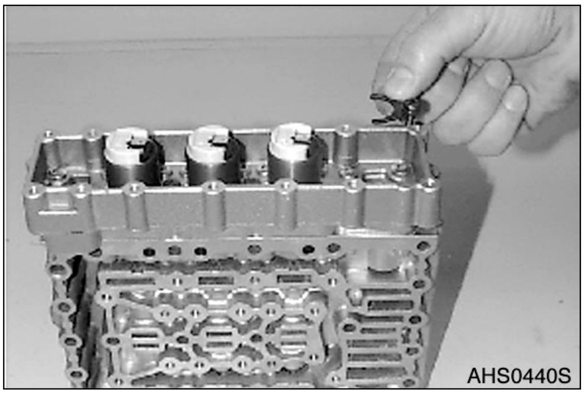

Figure 61

8. Pre-assemble opposite side.

A. Figure 62, shows the following components:

Reference Number	Description
1	Main Pressure Valve (1x Spool and Compression Spring.)
2	Follow On Slide (3x Spool and Compression Spring)
3	Vibration Damper (3x Spool and Compression Spring)

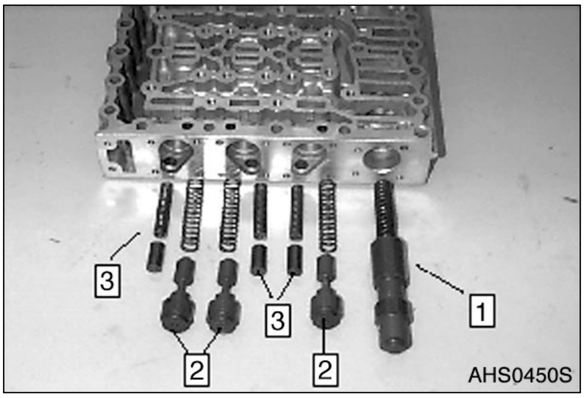

Figure 62

B. Install components according to Figure 62.

C. Preload compression springs of the follow-on slides and secure the spools provisionally with cylindrical pins aid), see arrows.

D. Install two adjusting screws.

E. Line up flat gasket (1, Figure 63) and housing cover and bring them uniformly against shoulder, using adjusting screws.

F. Now, fasten housing cover using socket head screws.

NOTE: *Torque limit 5.5 Nm (4 ft lb).*

G. Remove cylindrical pins (assembly aid) again.

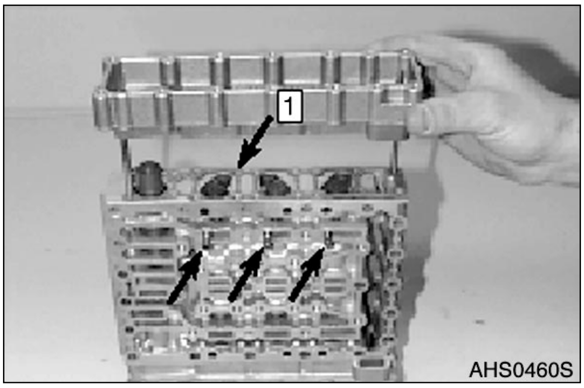

Figure 63

H. Introduce pressure regulators and secure them using retaining plates and socket head screws.

NOTE: *Install retaining plates, with the claw facing downward.*

I. Pay attention to radial installation position of pressure regulators, see Figure 64.

NOTE: *Torque limit 5.5 Nm (4 ft lb).*

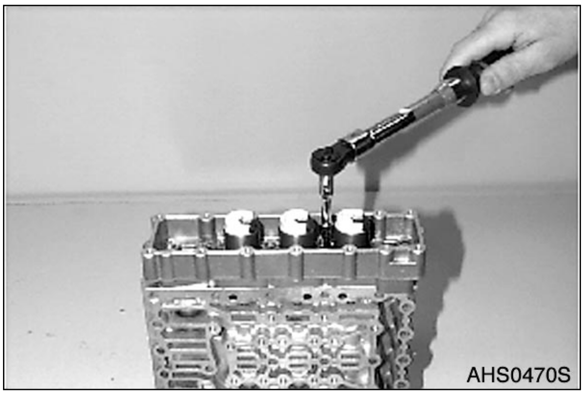

Figure 64

J. Install cable harness and connect pressure regulators (6x).

NOTE: *Pay attention to installation position of cable harness, see markings (Figure 43).*

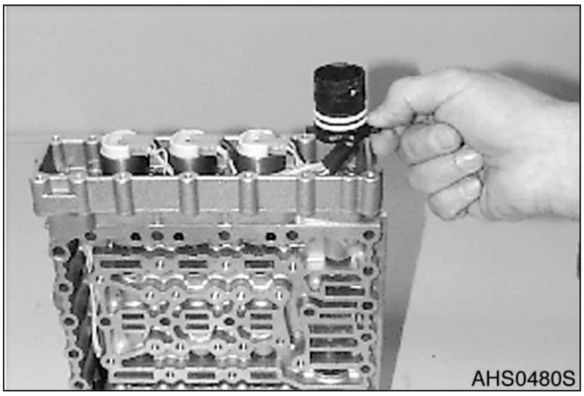

Figure 65

K. Mount flat gasket (Figure 66).

L. Introduce female connector, with the groove facing the guide nose of the cover, until contact is obtained.

M. Fasten cover with socket head screws.

NOTE: *Torque limit 0.56 kg•m (4.06 ft lb).*

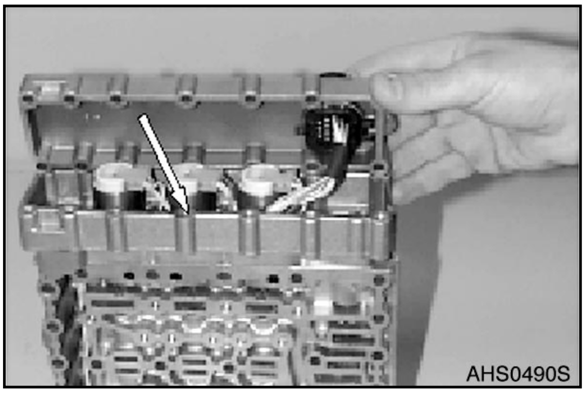

Figure 66

N. Locate the female connector using retaining clip.

O. Install opposite cover.

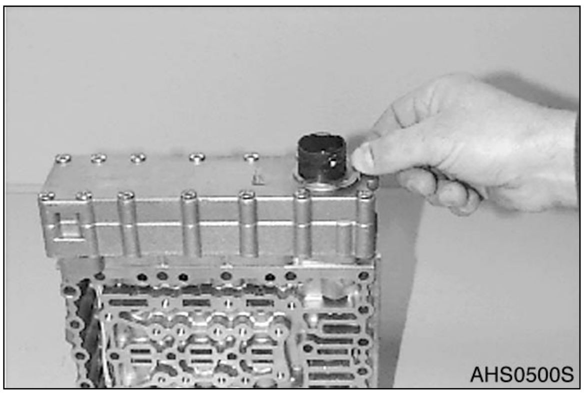

Figure 67

P. Install two adjusting screws and mount gasket I.

NOTE: *Pay attention to different gaskets, see Figure 68 and Figure 71.*

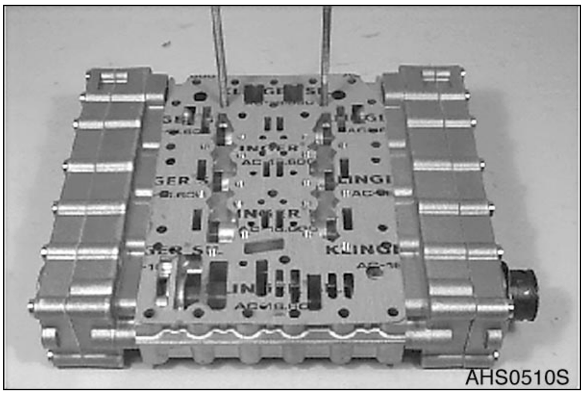

Figure 68

9. Intermediate plate-version with screens:

A. Insert screens (6x) flash mounted into bore of intermediate plate, see Figure 69.

NOTE: *Pay attention to installation position- screens are facing upward (facing duct plate).*

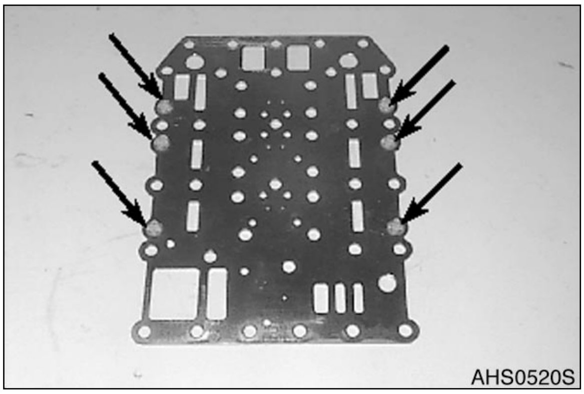

Figure 69

B. Mount intermediate plate, with the strainers facing upward.

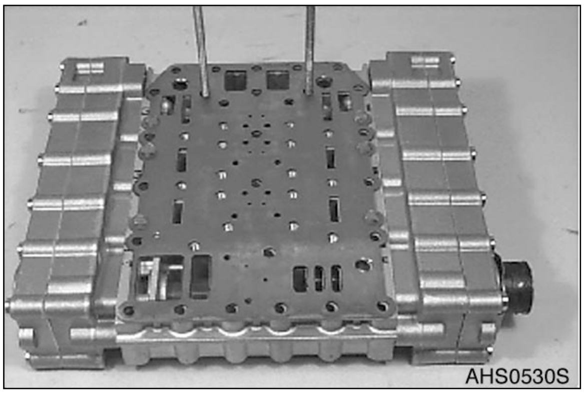

Figure 70

C. Mount gasket II.

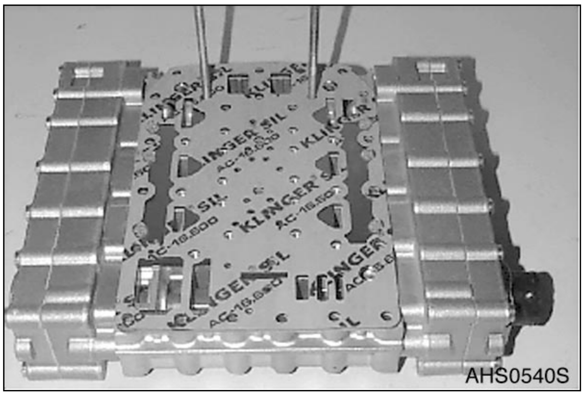

Figure 71

D. Mount duct plate and fasten it uniformly using socket head screws.

NOTE: *Torque limit 9.5 Nm (7 ft lb).*

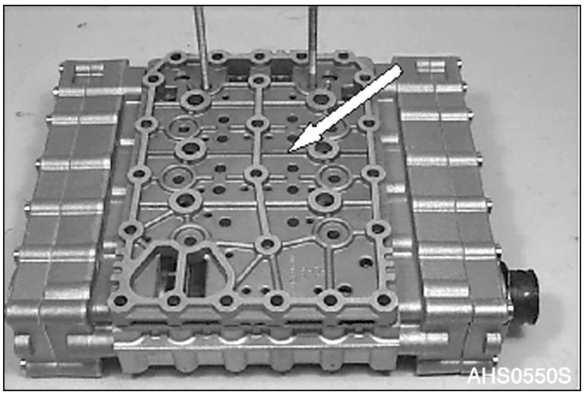

Figure 72

E. Equip screw plugs (8x) with new O-rings and install them.

NOTE: *Torque limit 6 Nm (4.4 ft lb).*

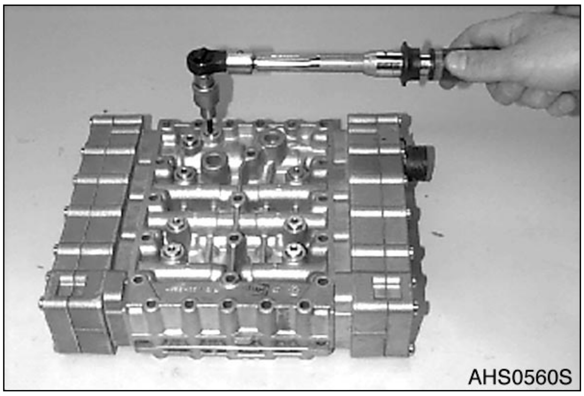

Figure 73

10. Attach Hydraulic control unit (HSG-94) (Figure 74 - Figure 84).

    A. Screw orifice into the housing bore (Figure 74) and secure it using center punch.

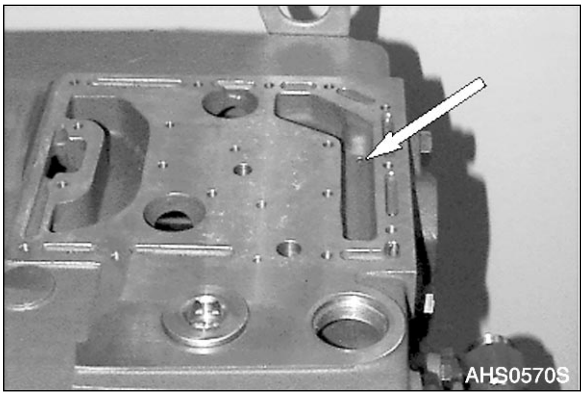

Figure 74

B. Install connecting fittings 1- 6.

C. Install screw plugs 7.

NOTE: *Torque limit Screw plugs (M10x1) 6 Nm (4.4 ft lb).*

NOTE: *Install always new O-rings.*

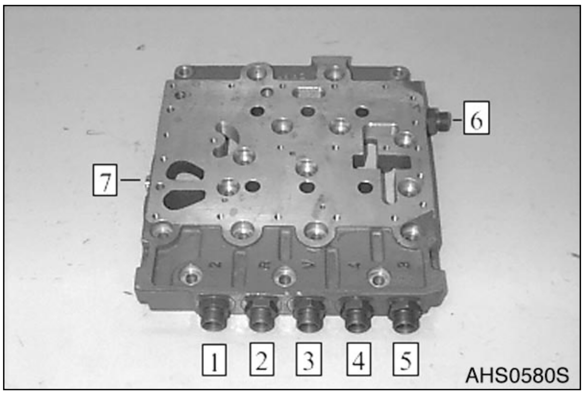

Figure 75

D. Install two adjusting screws (M8) and mount housing gasket.

CAUTION!

At the following steps (Figure 75 - Figure 81), pay attention to the installation positions of the different gaskets.

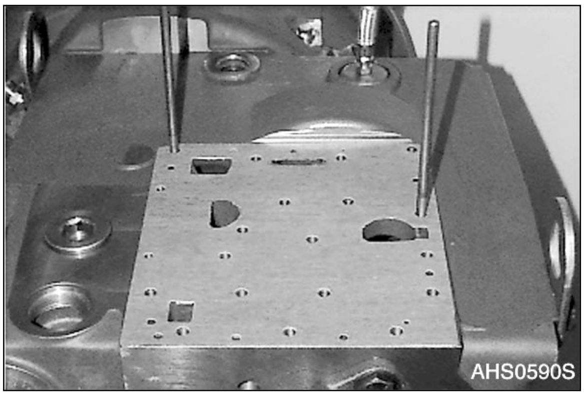

Figure 76

E. Mount intermediate plate.

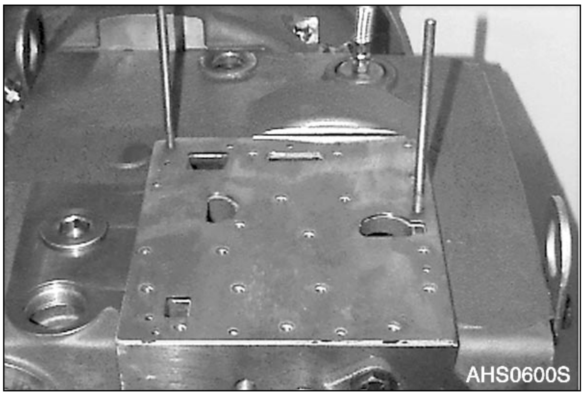

Figure 77

F. Mount 2nd gasket.

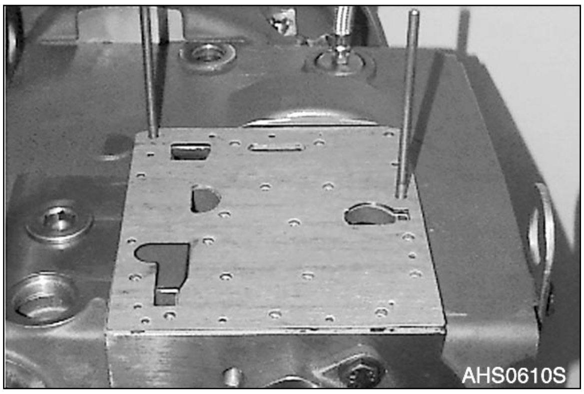

Figure 78

G. Mount plate and fasten it uniformly using socket head screws.

NOTE: *Torque limit (M8/10.9) 23 Nm (17 ft lb).*

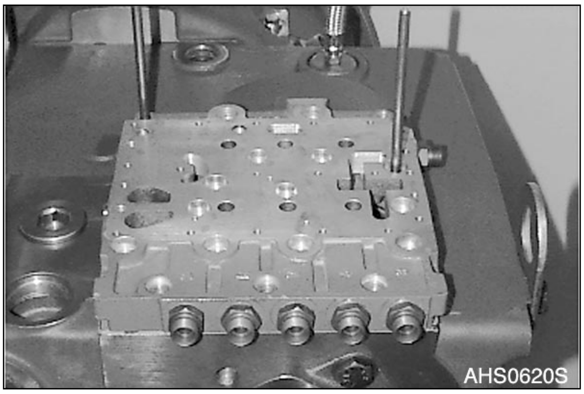

Figure 79

H. Install 2 adjusting screws (M6).

I. Mount gasket (Figure 80).

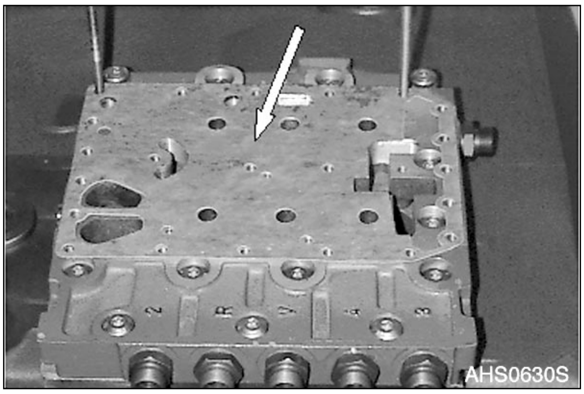

Figure 80

J. Fasten complete valve block uniformly with socket head screws (2 pieces M6 x 105 and 21 pieces M6 x 80 mm).

CAUTION!

Pay attention to the position of the two socket head screws (M6 x 105), see Allows.

NOTE: *Torque limit 9.5 Nm (7 ft lb).*

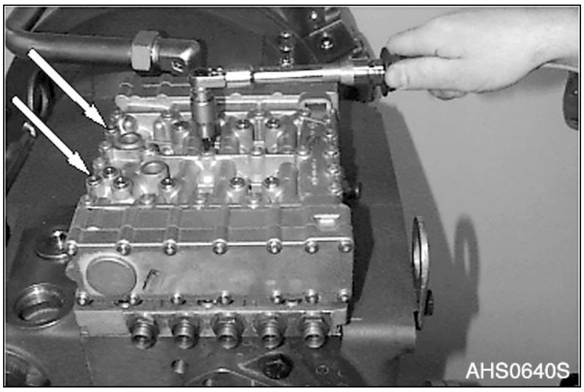

Figure 81

TRANSMISSION DISASSEMBLY

1. Fasten transmission on an appropriate support stand.

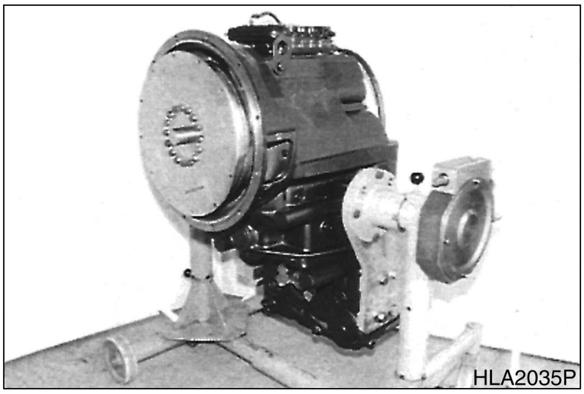

Figure 82

2. Disassemble complete shift control, remove pressure lines and duct plate.

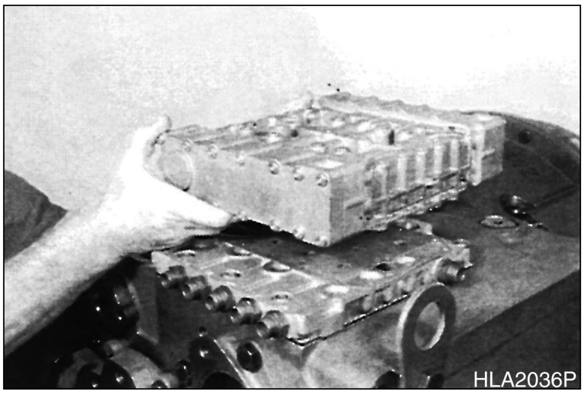

Figure 83

CONVERTER-INPUT

1. Separate torque converter from transmission, using lifting device.

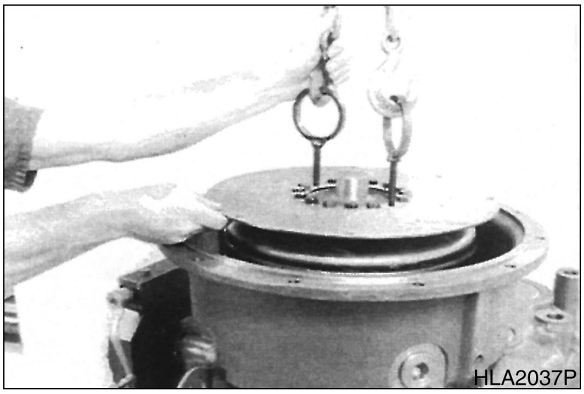

Figure 84

2. Loosen hex. head screws and lift complete retarder along with converter out of the converter bell, using lifting device.

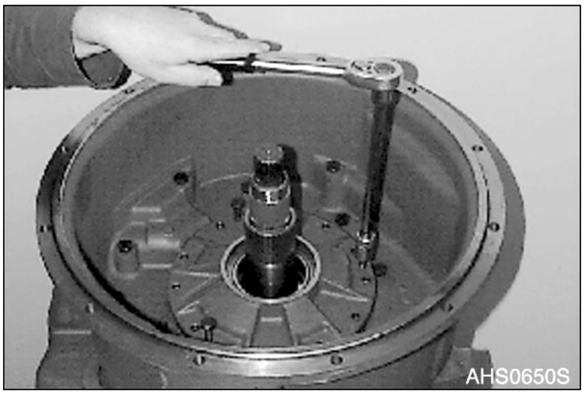

Figure 85

3. Pull oil feed flange out of converter bell, using special device (S).

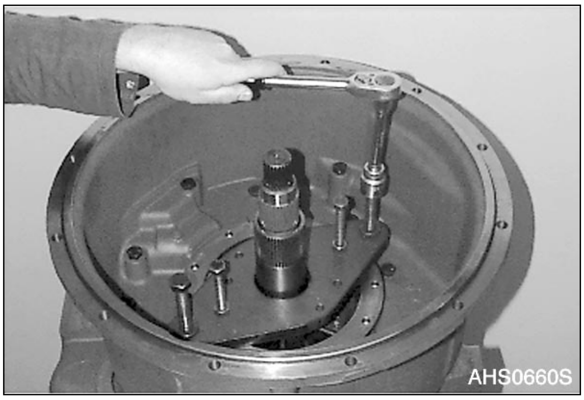

Figure 86

4. Remove converter safety valve (ball and spring, see Figure 87).

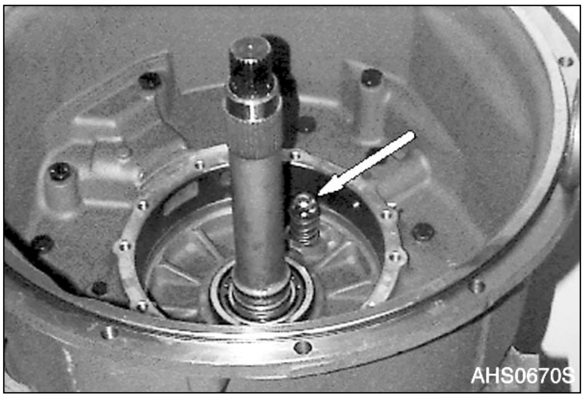

Figure 87

5. Loosen screw connection (M8 and M12). Separate converter bell from the transmission, using lifting device.

Figure 88

6. Remove shim.

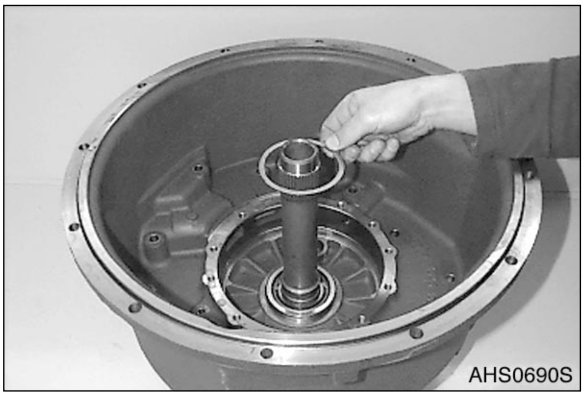

Figure 89

7. Remove both rectangular rings (Figure 90).

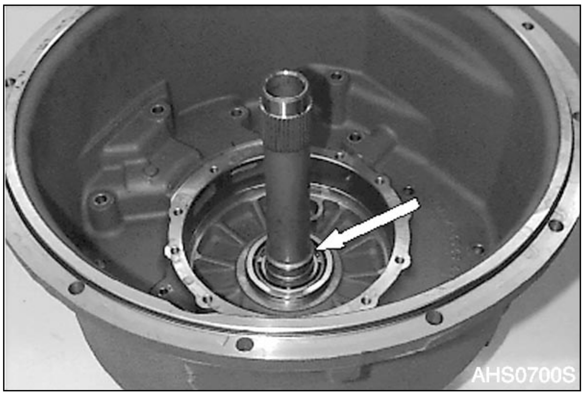

Figure 90

8. Press input shaft out of the spur gear bearing.
9. Remove released inner bearing race and spur gear.

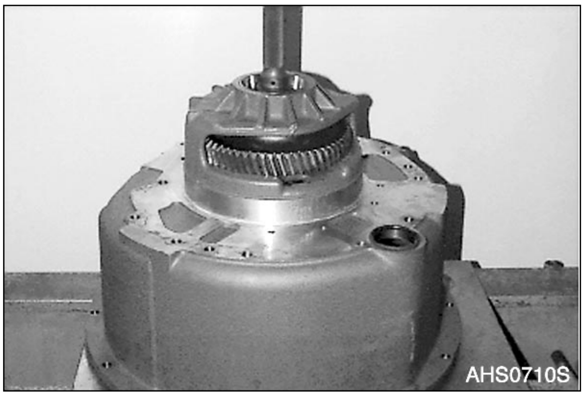

Figure 91

10. Press inner bearing race from the input shaft.

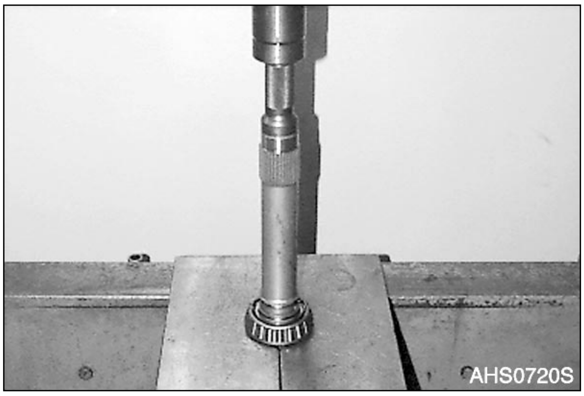

Figure 92

11. Remove converter pressure backup valve.

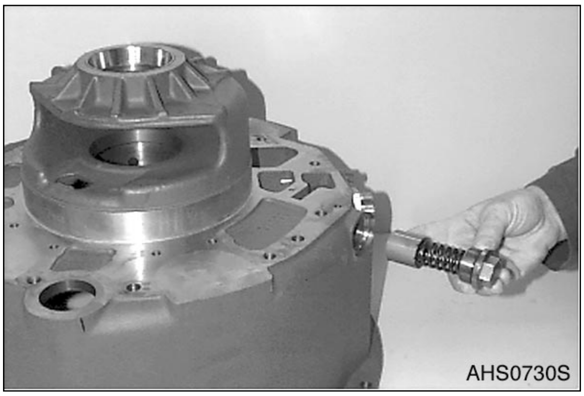

Figure 93

DRIVE SHAFT PUMP POWER TAKE-OFF

1. Pull the complete input shaft out of the gearbox housing, resp. out of the pump.

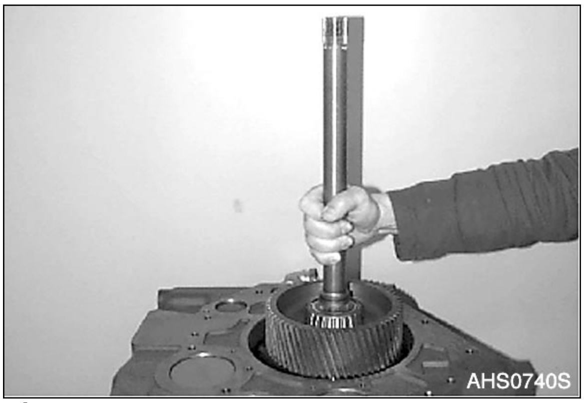

Figure 94

2. Squeeze rectangular ring out (Figure 95).

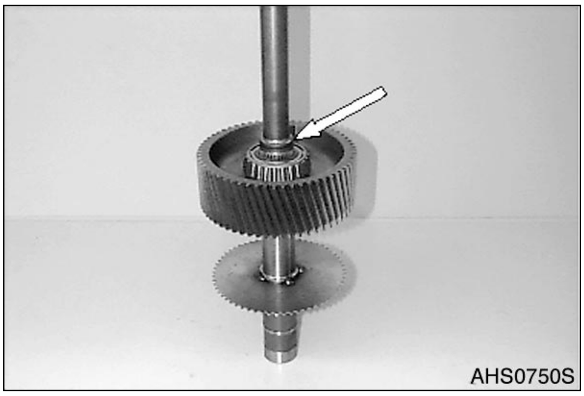

Figure 95

3. Separate spur gear from the shaft and squeeze circlip out (Figure 96).

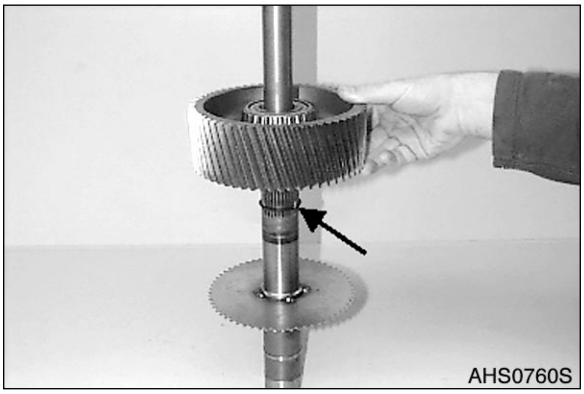

Figure 96

4. Pull inner bearing race from spur gear.

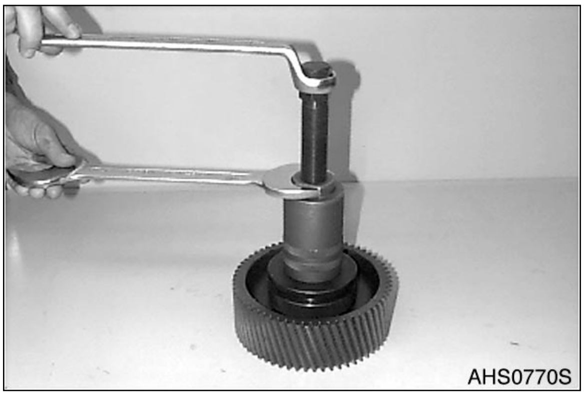

Figure 97

5. Pull inner bearing race from spur gear.

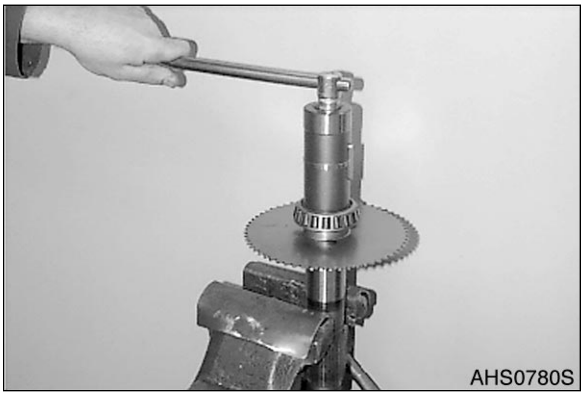

Figure 98

6. Pull inner bearing race and drive from shaft.

   NOTE: *Support puller on end face/ drive shaft. Pay attention to released shims.*

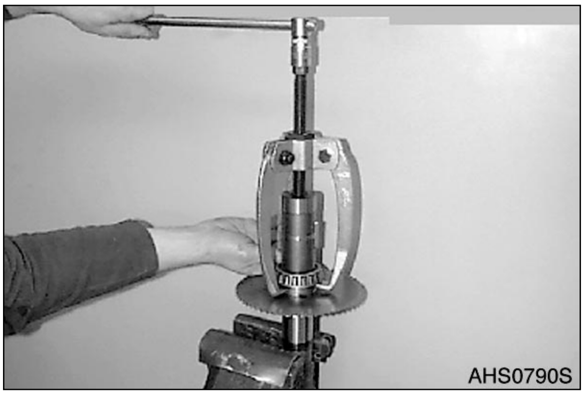

Figure 99

7. Separate inner bearing race from driver.

   NOTE: *Pay attention to released shim.*

8. If necessary, squeeze snap rings (3x) out.

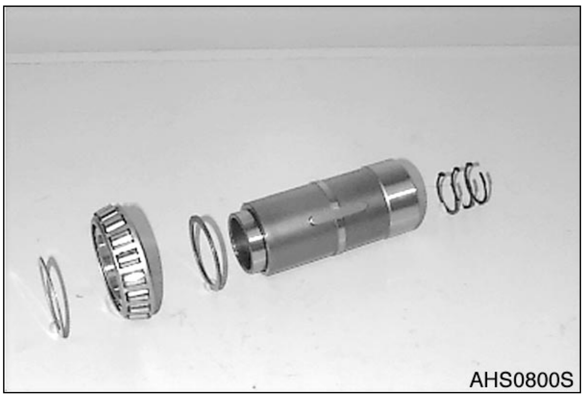

Figure 100

TRANSMISSION PUMP

1. Tilt gearbox housing 180˚.
2. Loosen hex. head screws and remove both pump flanges.

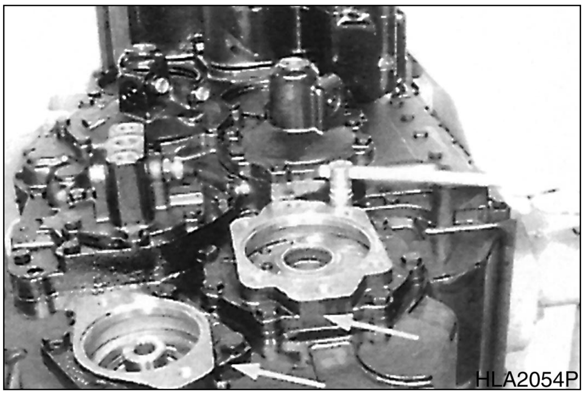

Figure 101

3. Loosen socket head screws (M8) and position Puller device (s).
4. Pull transmission pump out of housing bore

   NOTE: *Tapping housing face is a help during extraction operation.*

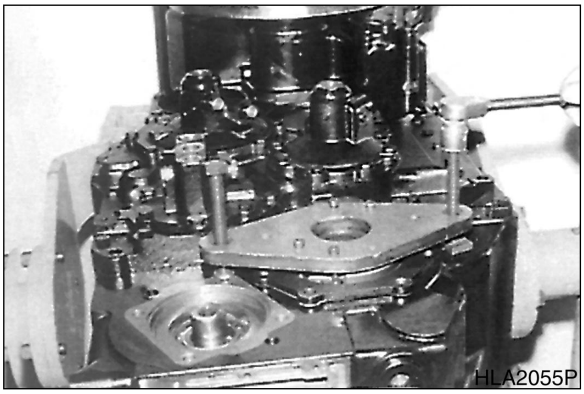

Figure 102

OUTPUT- LAYSHAFT ASSEMBLY

1. Loosen screw connection and remove brake caliper.

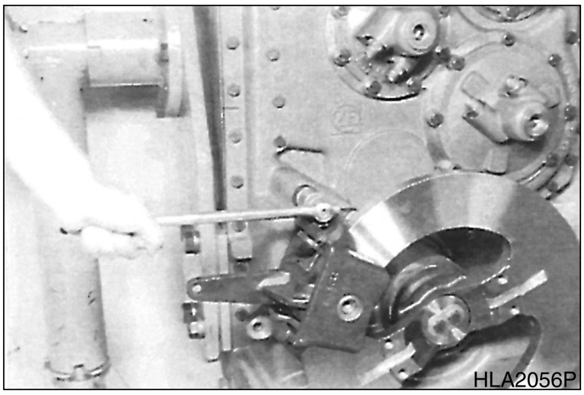

Figure 103

2. Unlock and loosen hex. head screws, tap brake disk loose and separate it from output shaft.

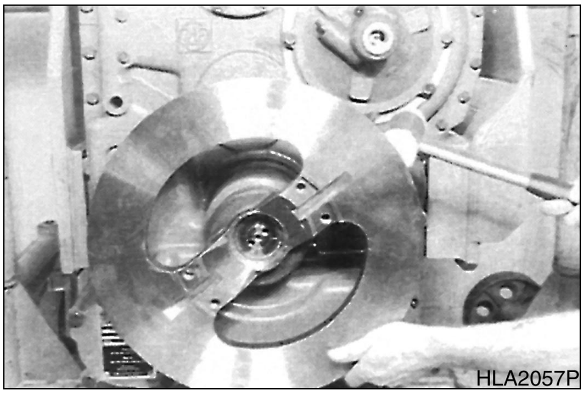

Figure 104

3. Pry shaft seal out of housing bore.

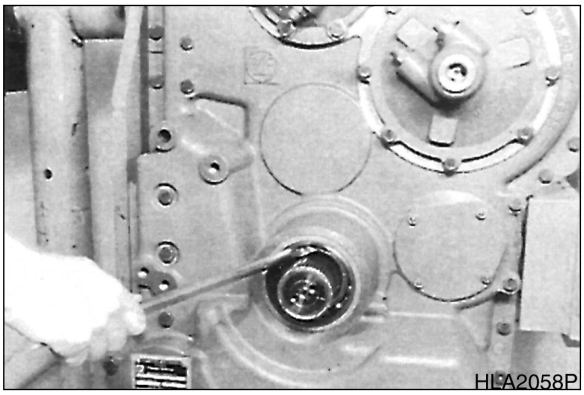

Figure 105

4. Tilt gearbox housing.
5. Remove sealing covers (Figure 106)

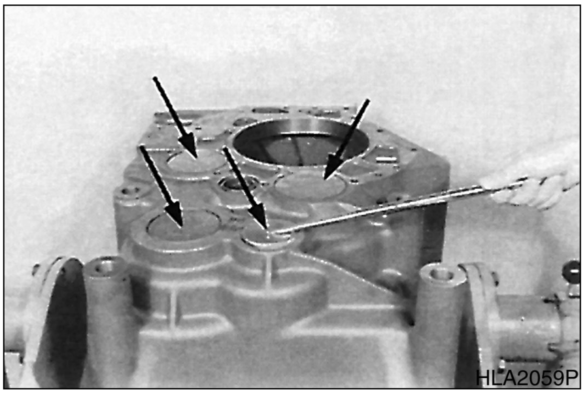

Figure 106

6. Loosen hex. head screws.

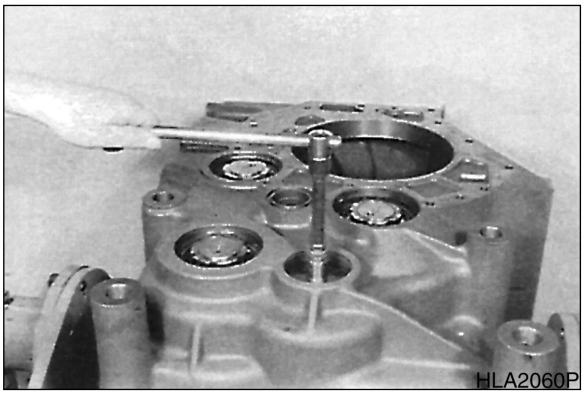

Figure 107

7. Pull idler shaft using puller out of housing bore.

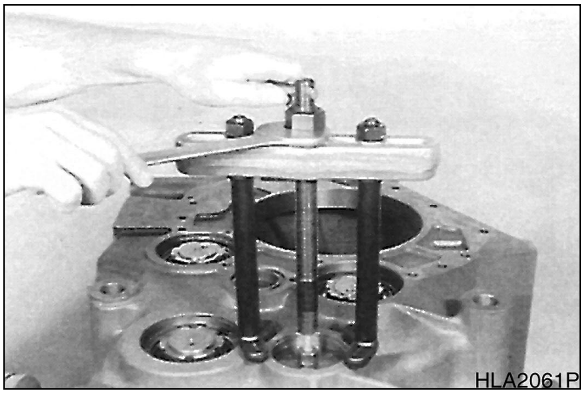

Figure 108

8. Tilt gearbox housing 180˚.
9. Loosen hex. head screws and pull bearing cover -K1/KV out of housing bore.

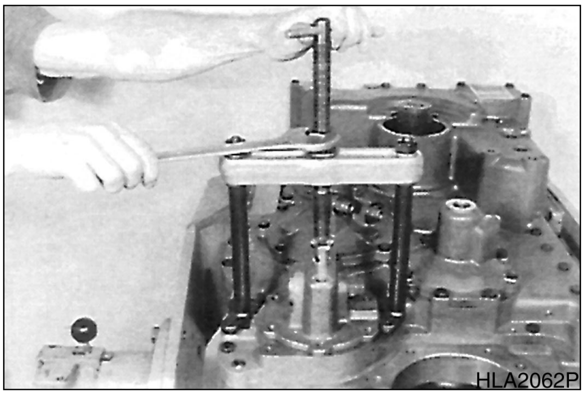

Figure 109

10. Loosen hex. head screws and remove bearing cover KR/K2 and K3/K4.

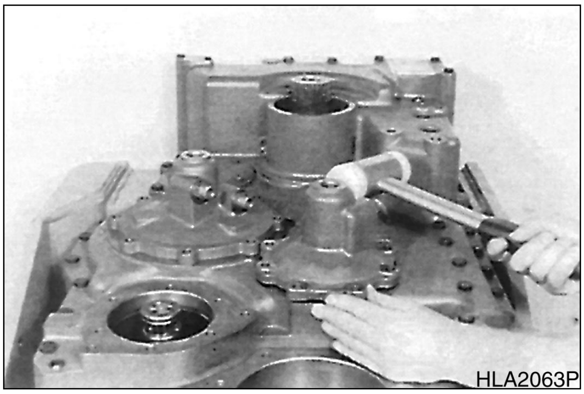

Figure 110

11. Squeeze rectangular rings (3 pieces/axle) out, see Figure 111.

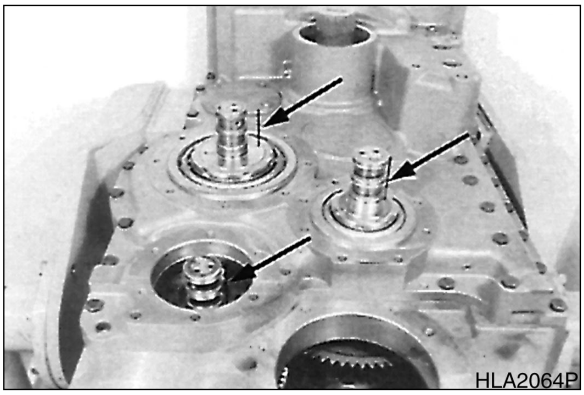

Figure 111

12. Squeeze snap ring and remove released washers.

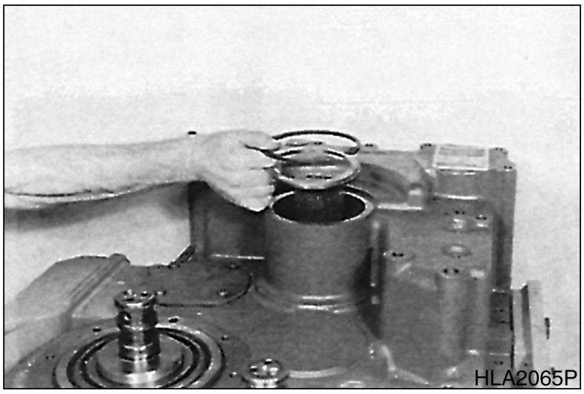

Figure 112

13. Support output flange against gearbox housing, see Figure 113.

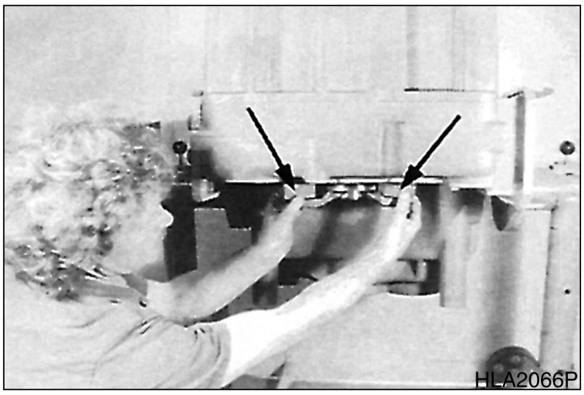

Figure 113

14. Loosen hex. head screws and separate housing cover from gearbox housing, using forcing screws and lifting device.

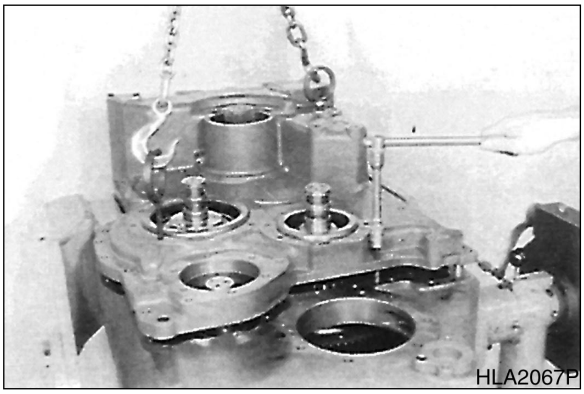

Figure 114

15. Unlock and loosen hex. head screws.
16. Remove output flange and pry shaft seal out of housing.

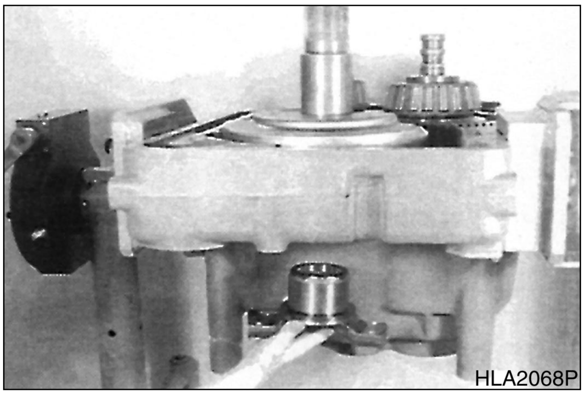

Figure 115

17. Loosen hex. head screws and remove oil baffle.

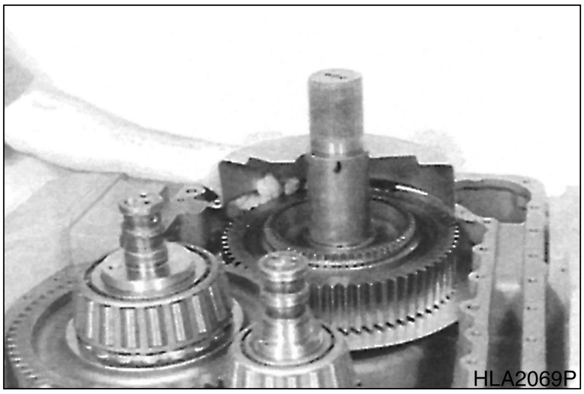

Figure 116

18. Remove output gear along with shaft.

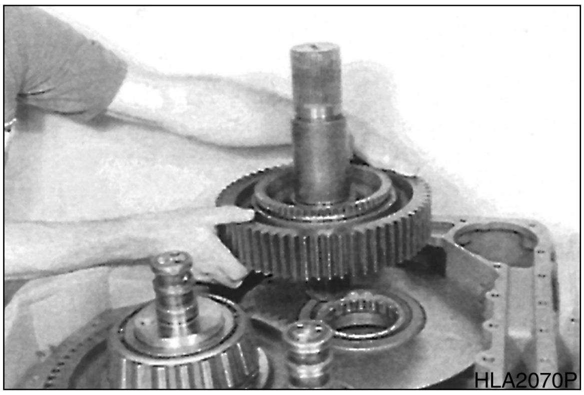

Figure 117

19. Separate output shaft from spur gear.

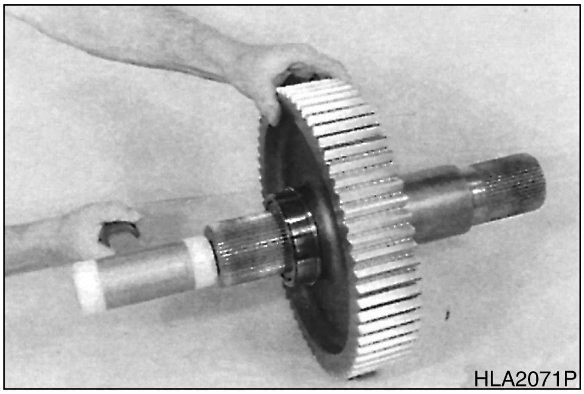

Figure 118

20. Pull inner bearing race from output gear.

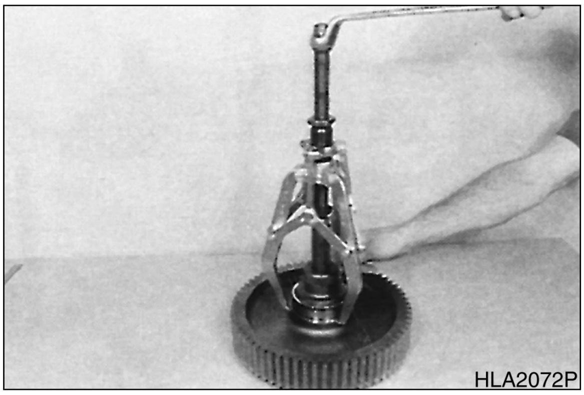

Figure 119

21. Remove plate.

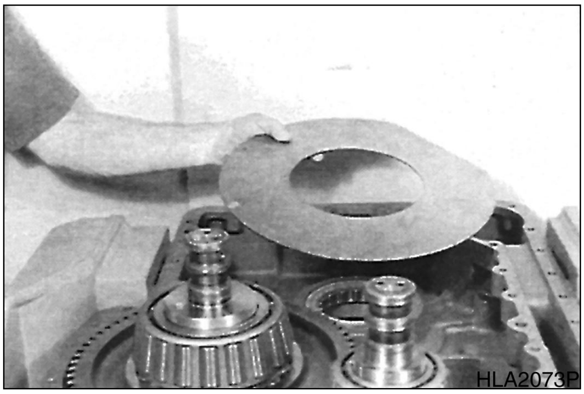

Figure 120

22. Drive roller bearing out of housing bore and remove it.

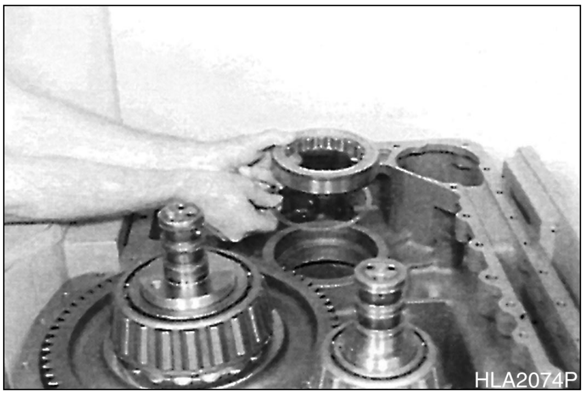

Figure 121

MULTIDISK CLUTCHES

1. Disassemble clutch K4/K3, KR/K2 and KV/K1 using lifting device.

   NOTE: *At the disassembly of the clutch K4/K3, lift clutch KR/K2 slightly and displace it in arrow direction, see Figure 122.*

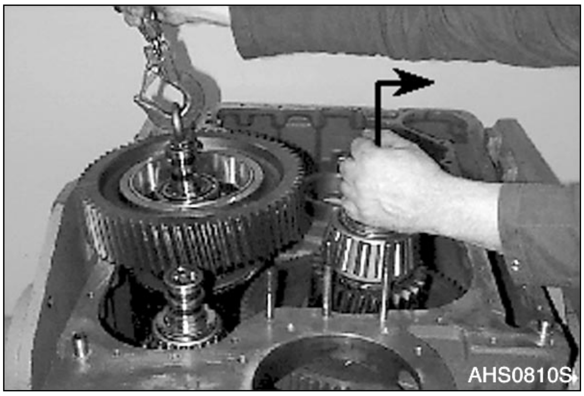

Figure 122

2. Figure 123, shows the clutches in disassembled condition.

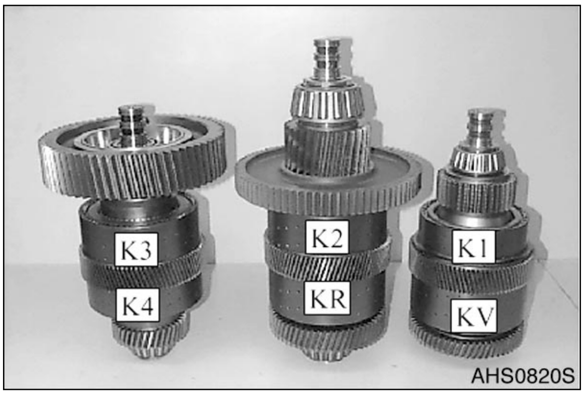

Figure 123

3. Remove countershaft gear.

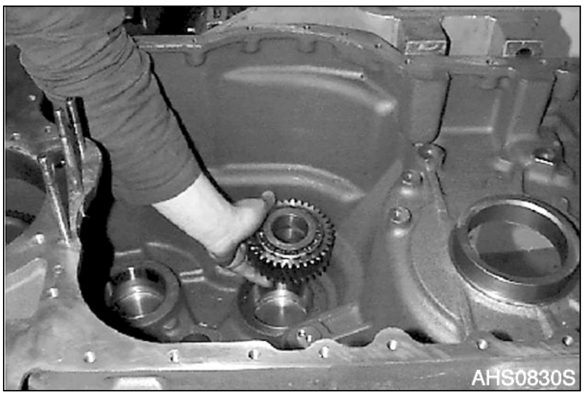

Figure 124

POWER TAKE-OFF

1. Squeeze circlip out and remove shims.

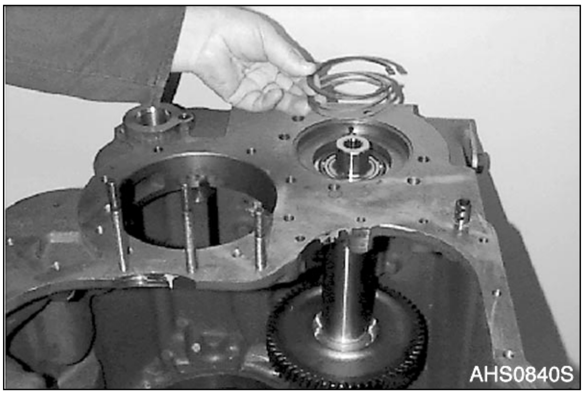

Figure 125

2. Lift output shaft using pry bar until the outer bearing race is free.

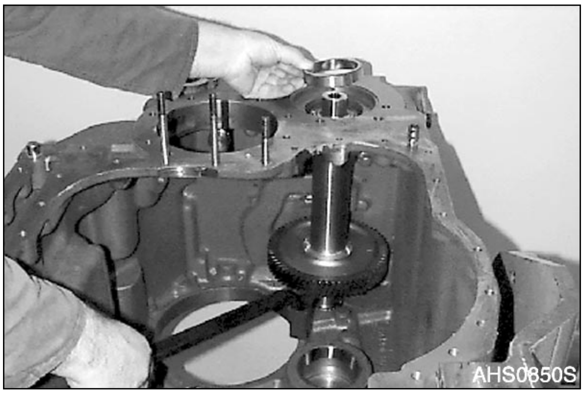

Figure 126

3. Take output shaft out of the housing.

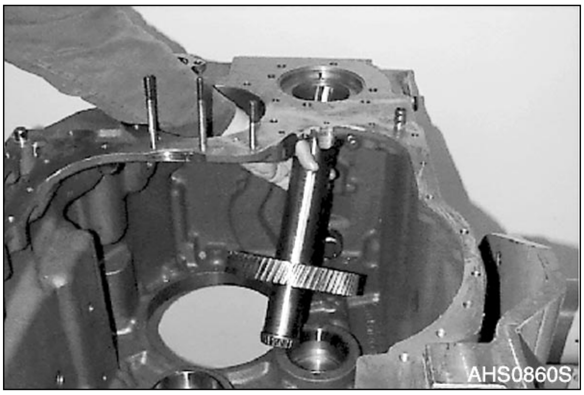

Figure 127

4. Pull outer bearing race out of the housing bore.

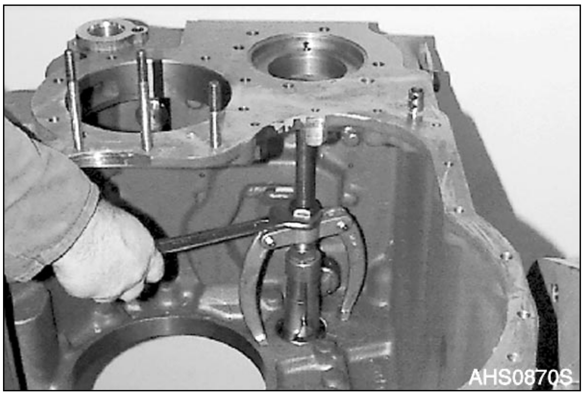

Figure 128

5. Pull inner bearing race from the shaft (Figure 129).
6. Press opposite inner bearing race from the shaft.

   NOTE: *The separation of shaft and gear is not possible (shrink fit).*

Figure 129

MULTIDISK CLUTCH - K3/K4

1. Fasten clutch using clamping ring (S) on the assembly car.

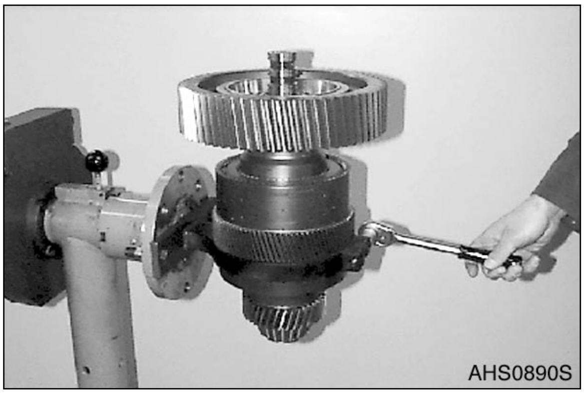

Figure 130

2. Pull roller bearing from plate carrier.

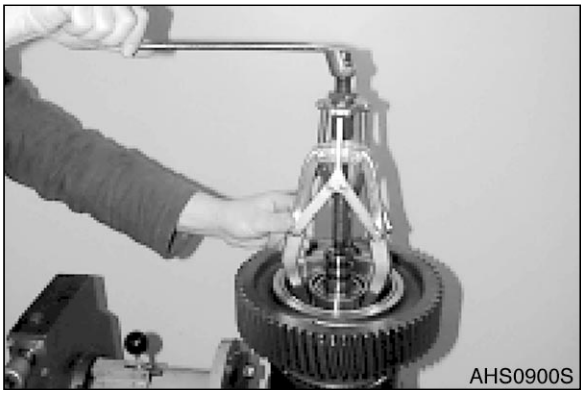

Figure 131

3. Separate spur gear K3 from plate carrier.

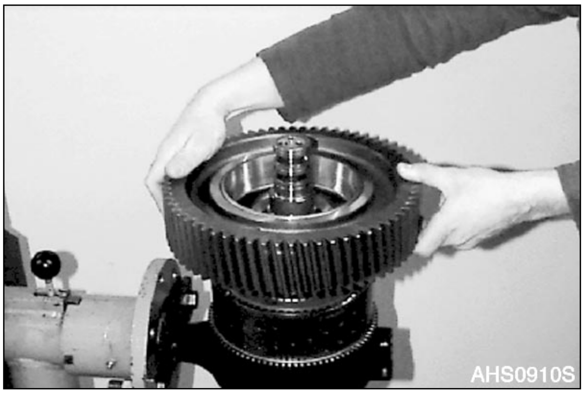

Figure 132

4. Pull inner bearing race from plate carrier.

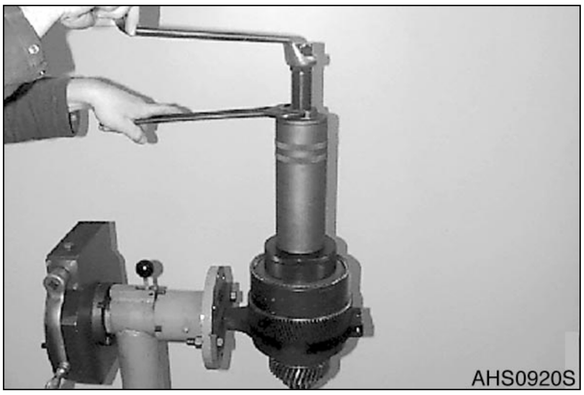

Figure 133

5. Squeeze snap ring out.
6. Disassemble end shim and plate pack K3.

Figure 134

7. Tilt plate carrier 90°.
8. Loosen slotted nut.

> **CAUTION!**
>
> **Slotted nut is secured with Loctite. To prevent a damage of the thread, heat the slotted nut before loosen it (about 120°C (248°F))**

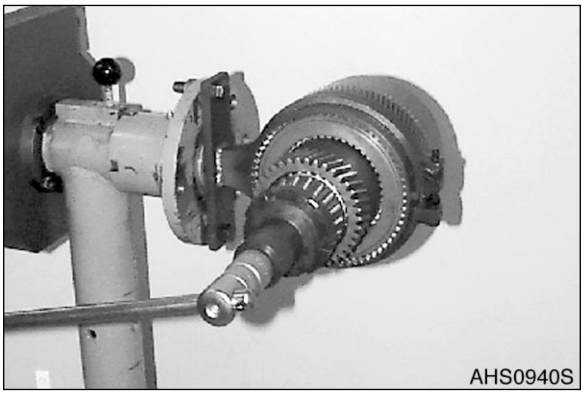

Figure 135

9. Tilt plate carrier 90°.
10. Pull off the tapered roller bearing.

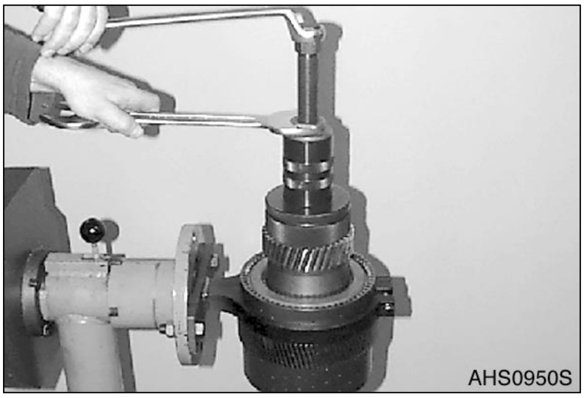

Figure 136

11. Pull spur gear K4 from plate carrier.

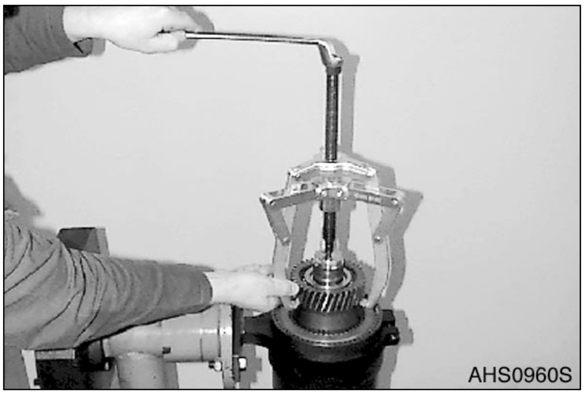

Figure 137

12. Remove adjusting ring.

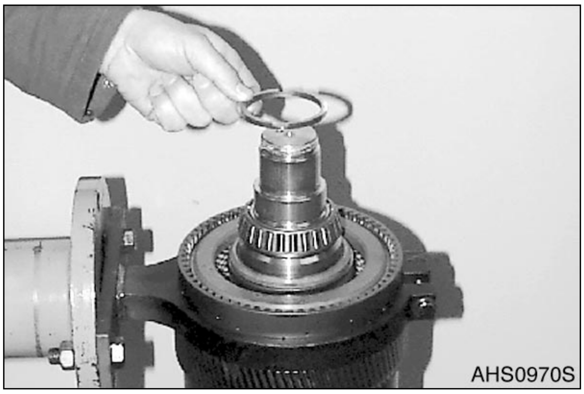

Figure 138

13. Pull off tapered roller bearing.

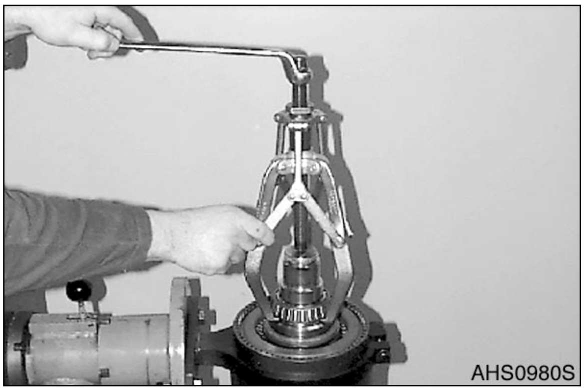

Figure 139

14. Squeeze snap ring out.
15. Disassemble end shim and plate pack K4.

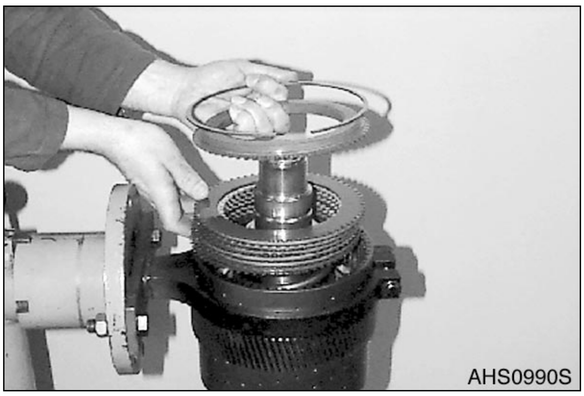

Figure 140

16. Preload compression spring using Special device (S). Squeeze snap ring out and remove the released components.
17. Disassemble opposite components (K3-side) accordingly.

Figure 141

18. Separate both pistons using compressed air from the plate carrier.

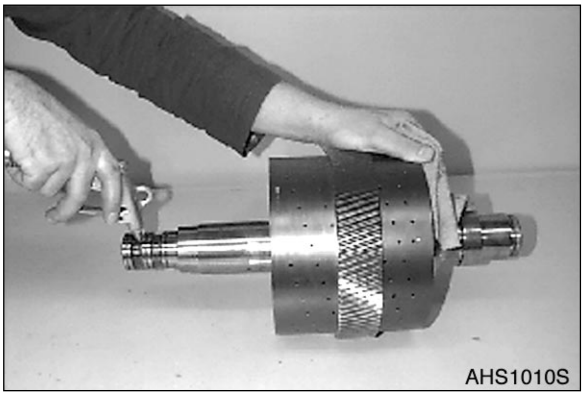

Figure 142

MULTIDISK CLUTCH KR/K2

1. Fasten clutch using clamping ring (Figure 143) on the assembly car.

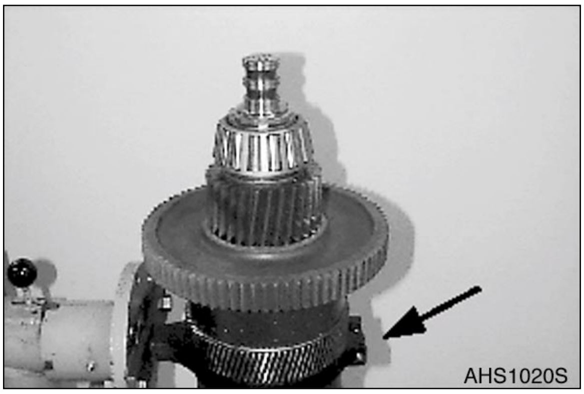

Figure 143

2. Tilt plate carrier 90˚.
3. Loosen slotted nut.

CAUTION!

Slotted nut is secured with Loctite. To prevent a damage of the thread, heat the slotted nut before loosen it (about 120˚C (248˚F)).

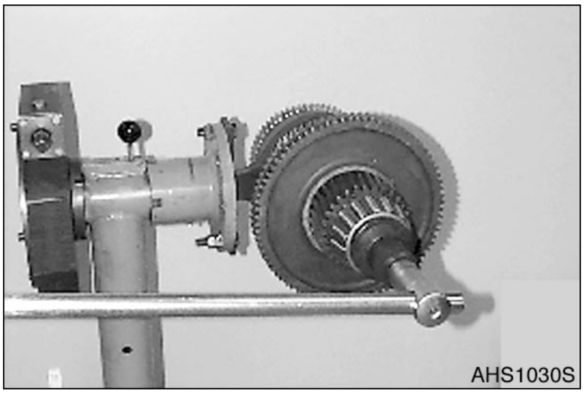

Figure 144

4. Pull tapered roller bearing from plate carrier.

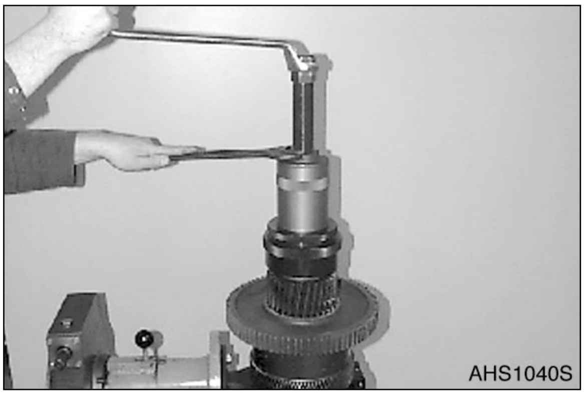

Figure 145

5. Press spur gear K2 from the plate carrier.

CAUTION!
Pay attention to the released plate carrier.

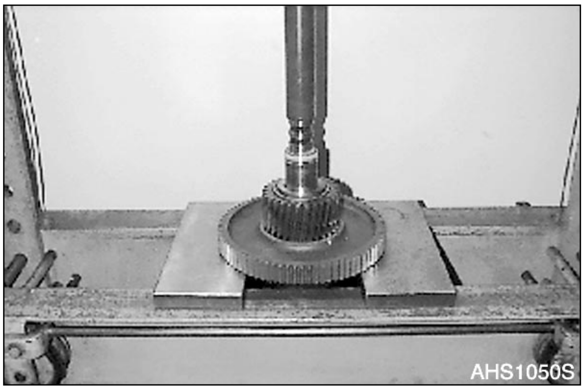

Figure 146

6. Secure plate carrier using clamping ring (S).
7. Remove shim.

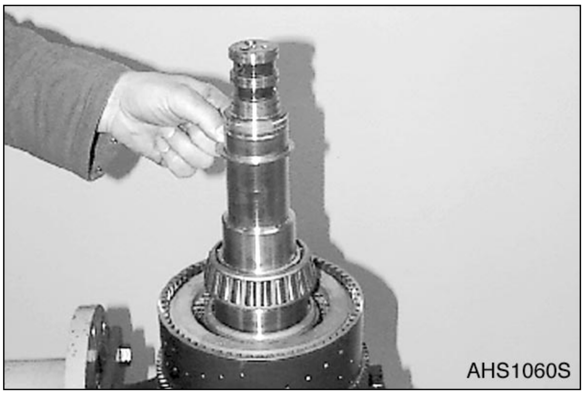

Figure 147

8. Pull tapered roller bearing from plate carrier.

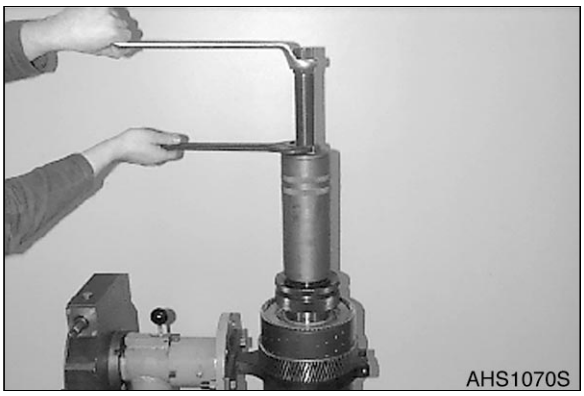

Figure 148

9. Squeeze snap ring out.
10. Disassemble end shim and plate pack K2.

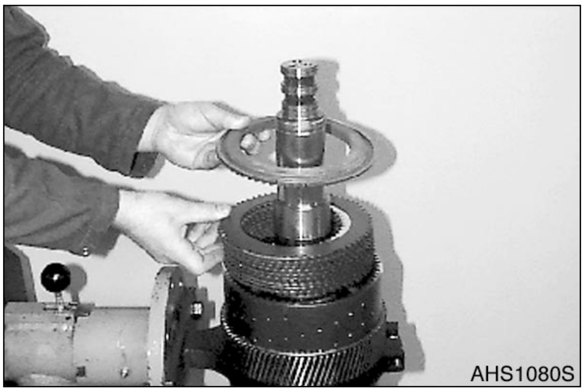

Figure 149

11. Tilt plate carrier 90°.
12. Loosen slotted nut.

> **CAUTION!**
>
> **Slotted nut is secured with Loctite. To prevent a damage of the thread, heat the slotted nut before loosen it (about 120°C (248°F)).**

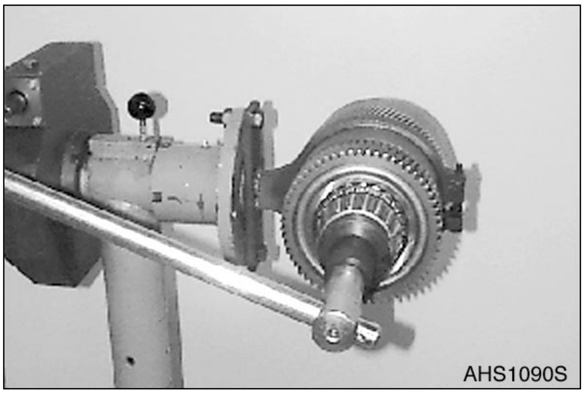

Figure 150

13. Pull tapered roller bearing from plate carrier.

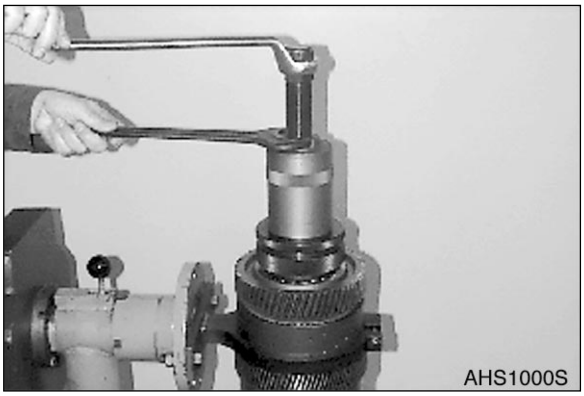

Figure 151

14. Pull tapered roller bearing from plate carrier.

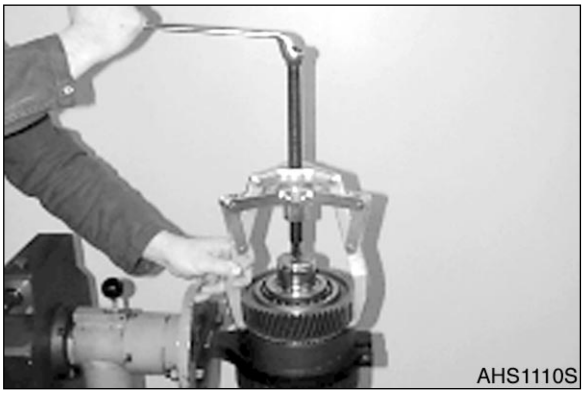

Figure 152

15. Remove adjusting rings.

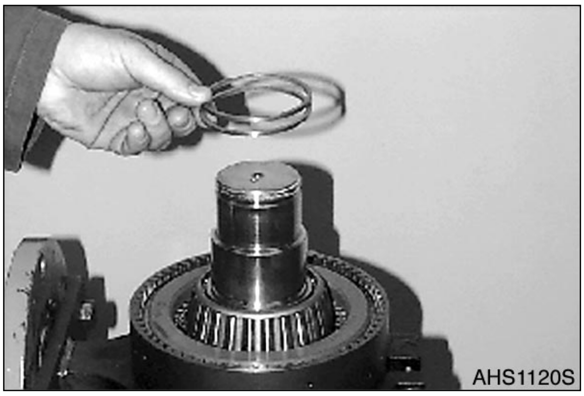

Figure 153

16. Squeeze snap ring out.
17. Disassemble end shim and plate pack KR.

Figure 154

18. Pull tapered roller bearing from plate carrier.
19. Disassemble both pistons, as described at Figure 141and Figure 142.

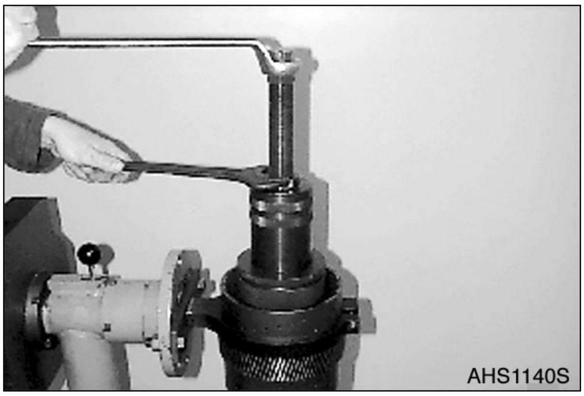

Figure 155

MULTIDISK CLUTCH KV/K1

1. Fasten clutch using clamping ring on the assembly car.
2. Loosen slotted nut (Figure 156).

CAUTION!
Slotted nut is secured with Loctite. To prevent a damage of the thread, heat the slotted nut before loosen it (about 120˚C (248˚F)).

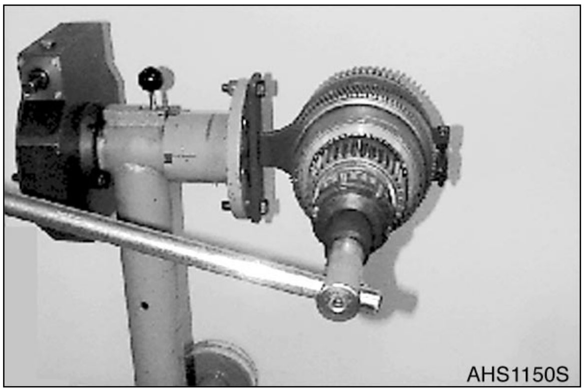

Figure 156

3. Pull tapered roller bearing from plate carrier.

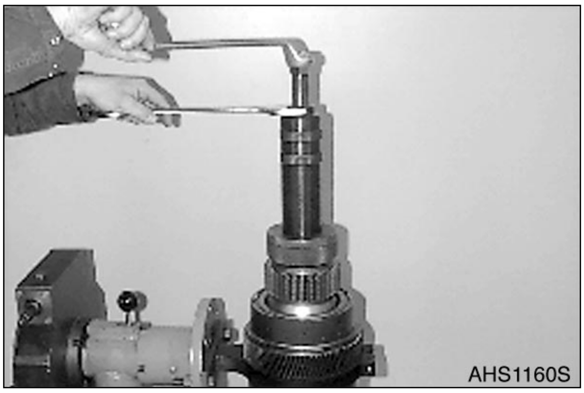

Figure 157

4. Remove disk.

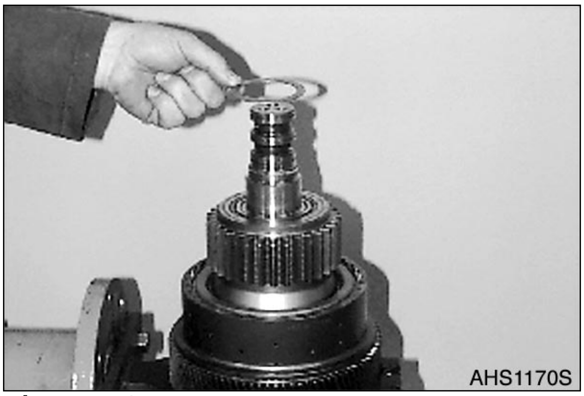

Figure 158

5. Pull spur gear K1 from plate carrier.

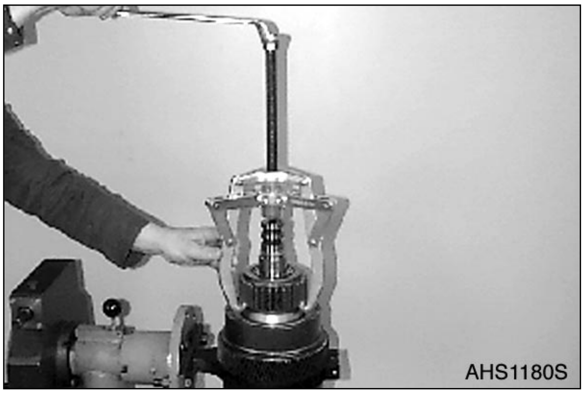

Figure 159

6. Figure 160, shows the spur gear bearing K1.
7. The bearing (1) is only as sub-assembly available.

CAUTION!

If the disassembly of the plate pack-side ball bearing (Arrow, resp. Figure 162 and Figure 163) is necessary, the complete bearing (1) must be replaced.

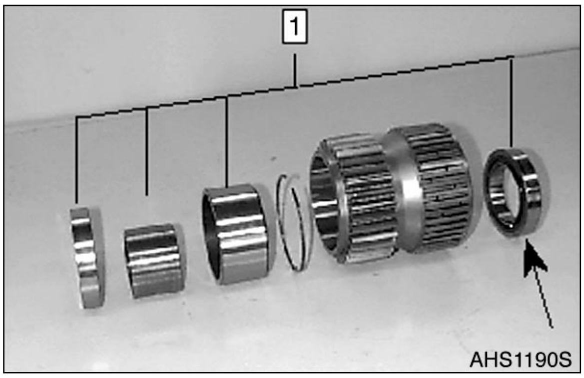

Figure 160

8. Remove bush.

Figure 161

9. Pull ball bearing from plate carrier (Figure 162 and Figure 164).

   NOTE: *Pay attention to the released balls.*

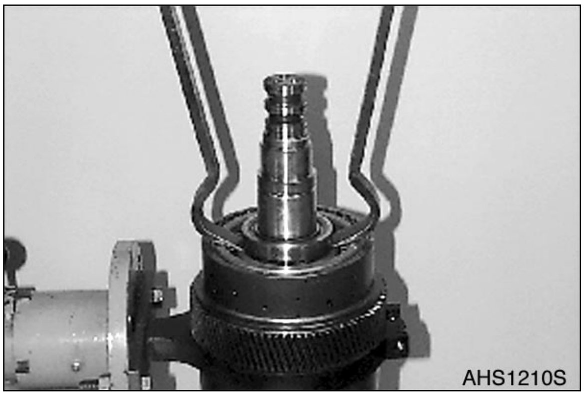

Figure 162

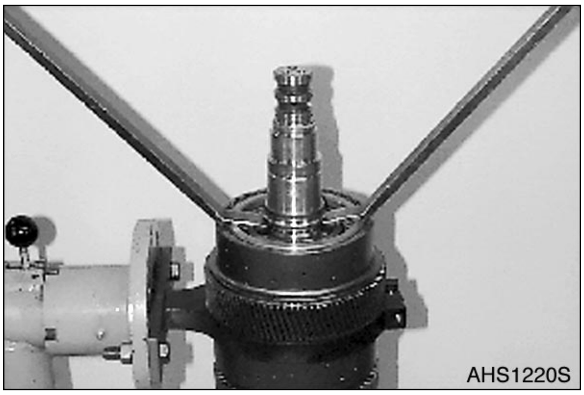

Figure 163

10. Squeeze snap ring out.
11. Disassemble end shim and plate pack K1.

Figure 164

12. Tilt plate carrier 90˚.

13. Loosen slotted nut.

CAUTION!
Slotted nut is secured with Loctite. To prevent a damage of the thread, heat the slotted nut before loosen it (about 120˚C (248˚F)).

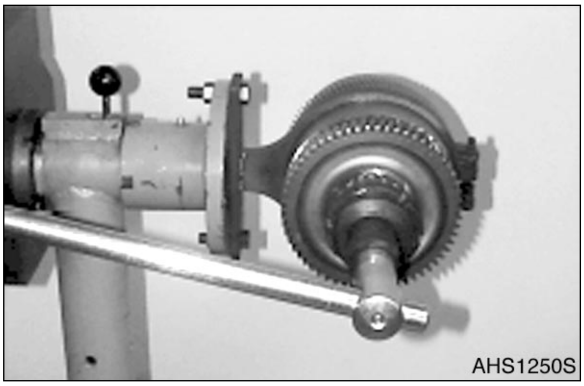

Figure 165

14. Pull tapered roller bearing from plate carrier.

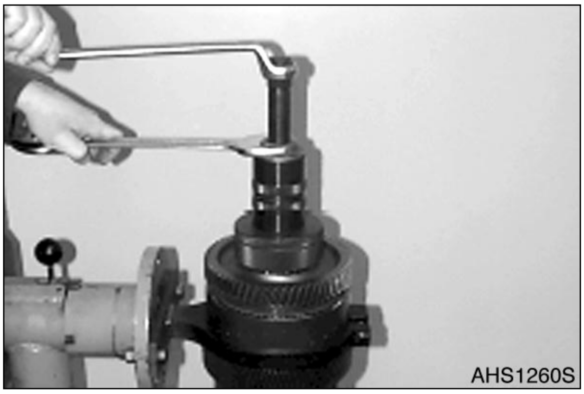

Figure 166

15. Pull spur gear KV from plate carrier.

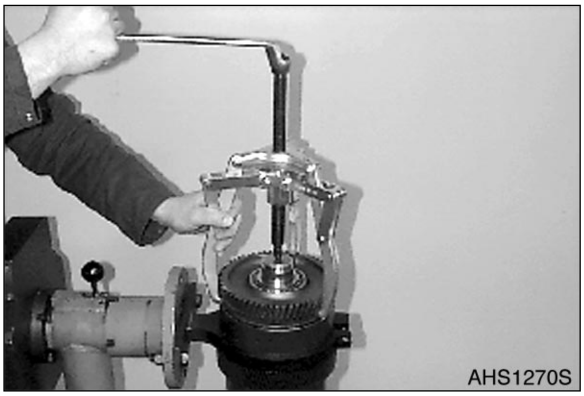

Figure 167

16. Remove shim and ring.

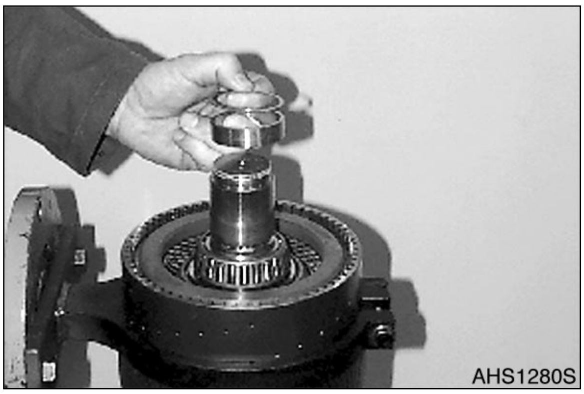

Figure 168

17. Pull tapered roller bearing from plate carrier (Figure 169).
18. Squeeze snap ring out.
19. Disassemble end shim and plate pack KV.
20. Disassemble both pistons (as described at Figure 141 and Figure 142).

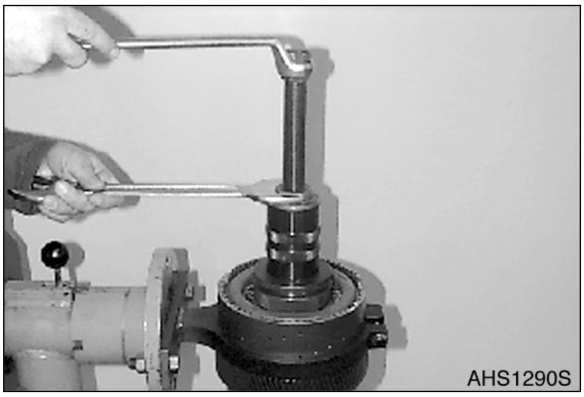

Figure 169

TRANSMISSION REASSEMBLY

1. Install studs (Figure 170).

   NOTE: *Wet thread with Loctite #243*

> **CAUTION!**
>
> **According to the transmission version, differences concerning number and length of the studs are possible. See in this connection the corresponding Spare Parts List.**

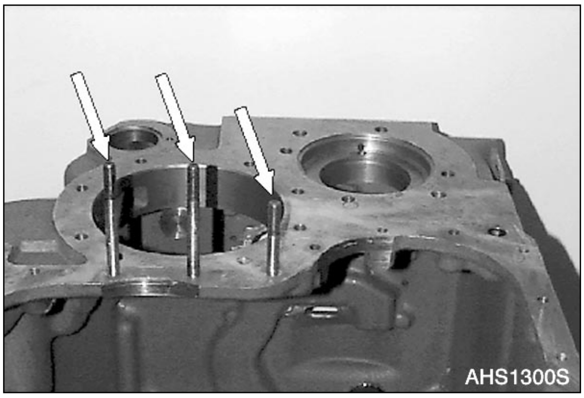

Figure 170

2. Line up O-ring (Figure 171).
3. Insert bush into the housing bore until contact is obtained and fasten it.

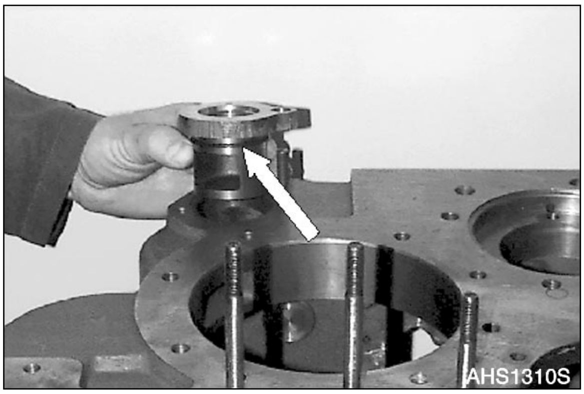

Figure 171

POWER TAKE-OFF

1. Supercool the shaft (about -80˚C (-112˚F)), heat gear (about 120˚C (248˚F)) and line it up, resp. press it against shoulder.

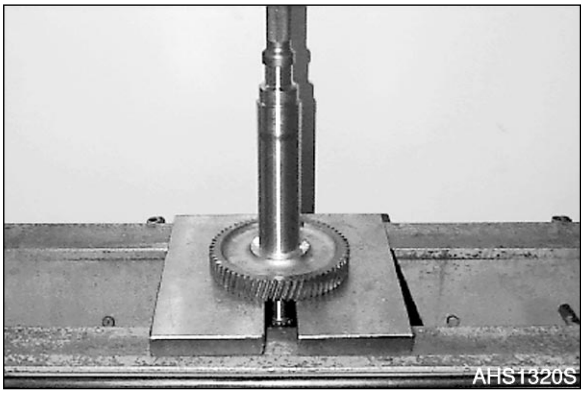

Figure 172

2. Press inner bearing race against shoulder.
3. Press opposite inner bearing race against shoulder.

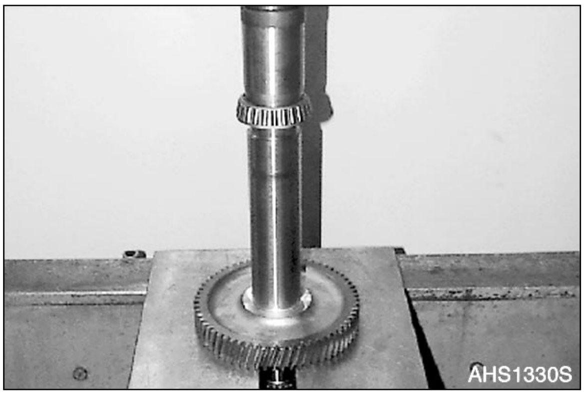

Figure 173

4. Insert outer bearing race (Figure 174) into the housing bore until contact is obtained.

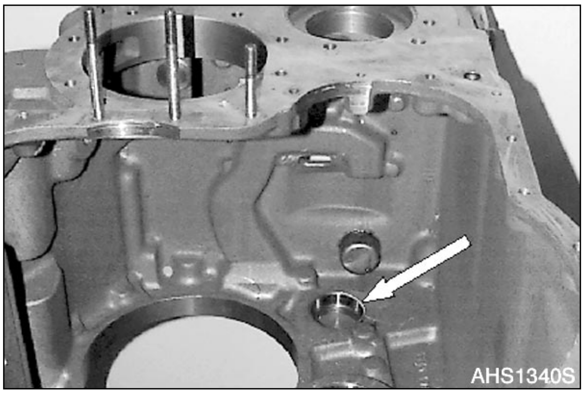

Figure 174

5. Position pre-assembled PTO shaft in the housing, and insert outer bearing race until contact is obtained.

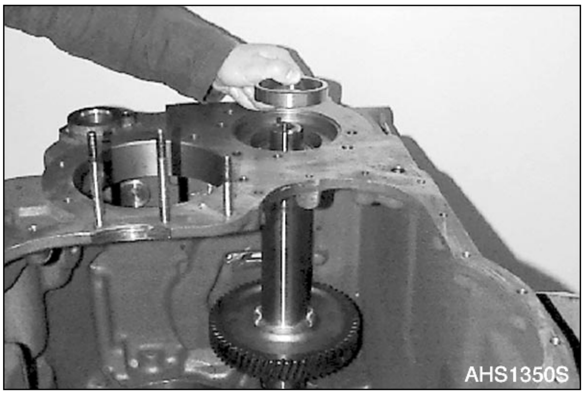

Figure 175

6. Adjust Axial play – Power take-off bearing – max. 0.10 mm (0.0039 in) using shim(s) and circlip.

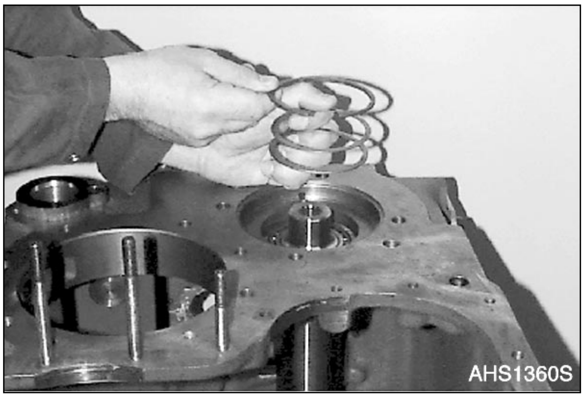

Figure 176

7. Tilt gearbox housing 180˚.
8. Insert sealing disk (Figure 177), with the concave side facing downward, into the housing bore until contact is obtained.

NOTE: *Wet contact face with Loctite #262*

IMPORTANT
Do not damage the centric orifice hole ∅0.8 mm (0.0315 in) during the installation of the sealing disk

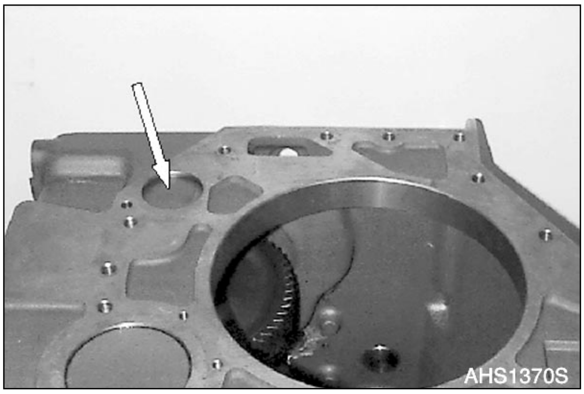

Figure 177

REASSEMBLE MULTIDISK CLUTCH K3/K4

1. Lift plate carrier, with the K4-side facing downward, into the clamping ring (S) and secure it. Now, tilt plate carrier 180˚.
2. Insert both roll pins (6x24 and 3.5x24) flush-mounted into the end face-side bore of the plate carrier, see Arrow in Figure 178.

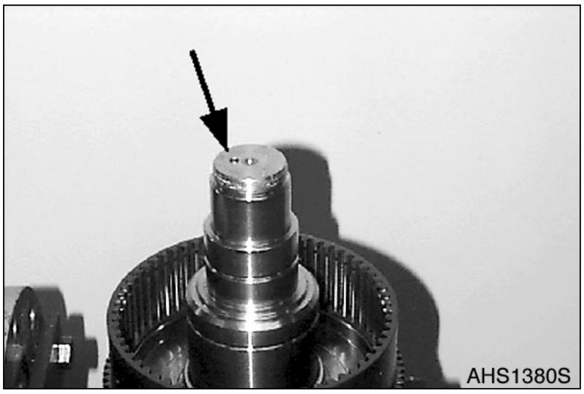

Figure 178

3. Tilt plate carrier 180˚.
4. Wet both roll pins (Figure 179) with Loctite #262 and install them.

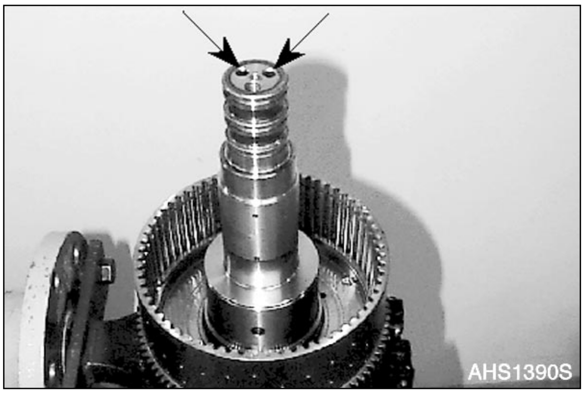

Figure 179

5. Insert purge valve (Figure 180) flush-mounted, with the chamfer facing downward.

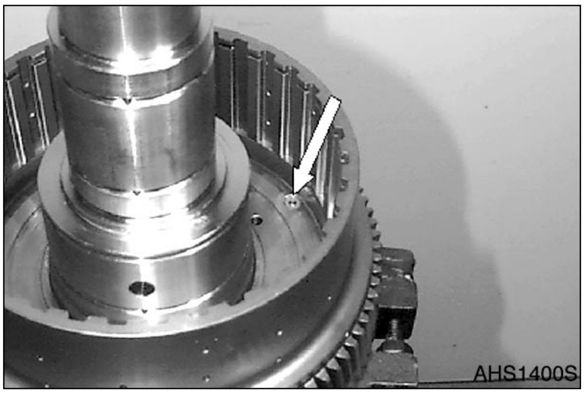

Figure 180

6. Insert both O-rings scrollfree into the ring grooves of the piston, see Figure 181.

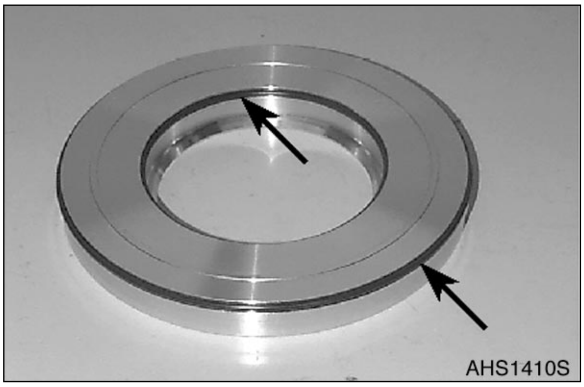

Figure 181

7. Oil O-rings and piston bearing surfaces.
8. Insert piston K3 uniformly until contact is obtained.

   NOTE: *Pay attention to the installation position of the piston, see Figure 182.*

Figure 182

9. Introduce intermediate washer and compression spring.

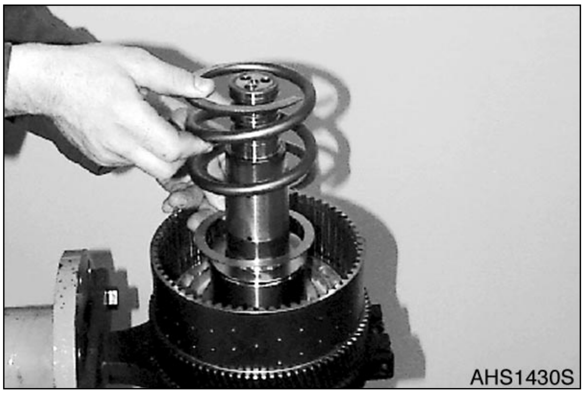

Figure 183

10. Lay guide ring, with the chamfer (Figure 184) facing upward, over the compression spring and line up the snap ring.
11. Lift plate carrier out of the clamping ring.

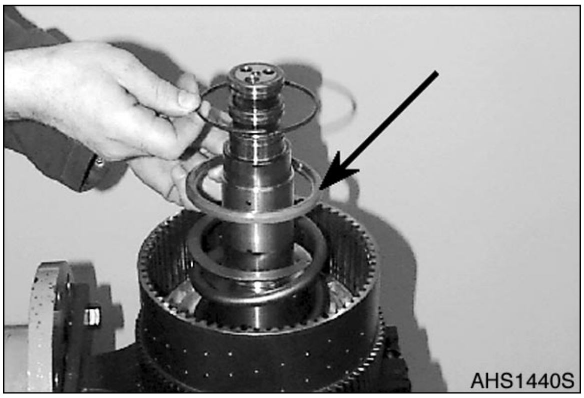

Figure 184

12. Preload compression spring using Special device (S) and squeeze snap ring into the annular groove of the plate carrier, see Figure 186.
13. Install purge valve, spool and compression spring on the opposite side (Clutch K4) accordingly, see Figure 180 - Figure 185.
14. Now, lift plate carrier, with the K4-side facing downward, into the clamping ring and secure it. Tilt plate carrier 180°.

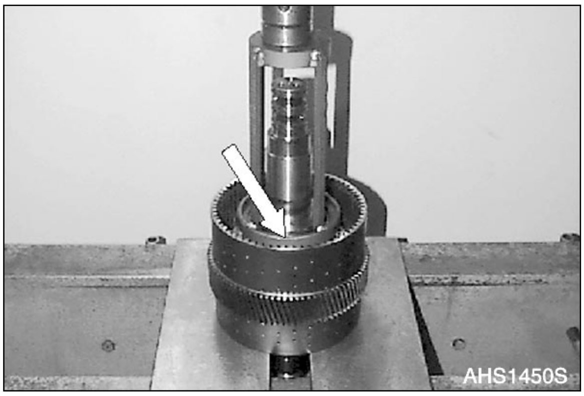

Figure 185

Multidisk Clutch - K4

Figure 186, shows the plate stacking and the installation position of the components.

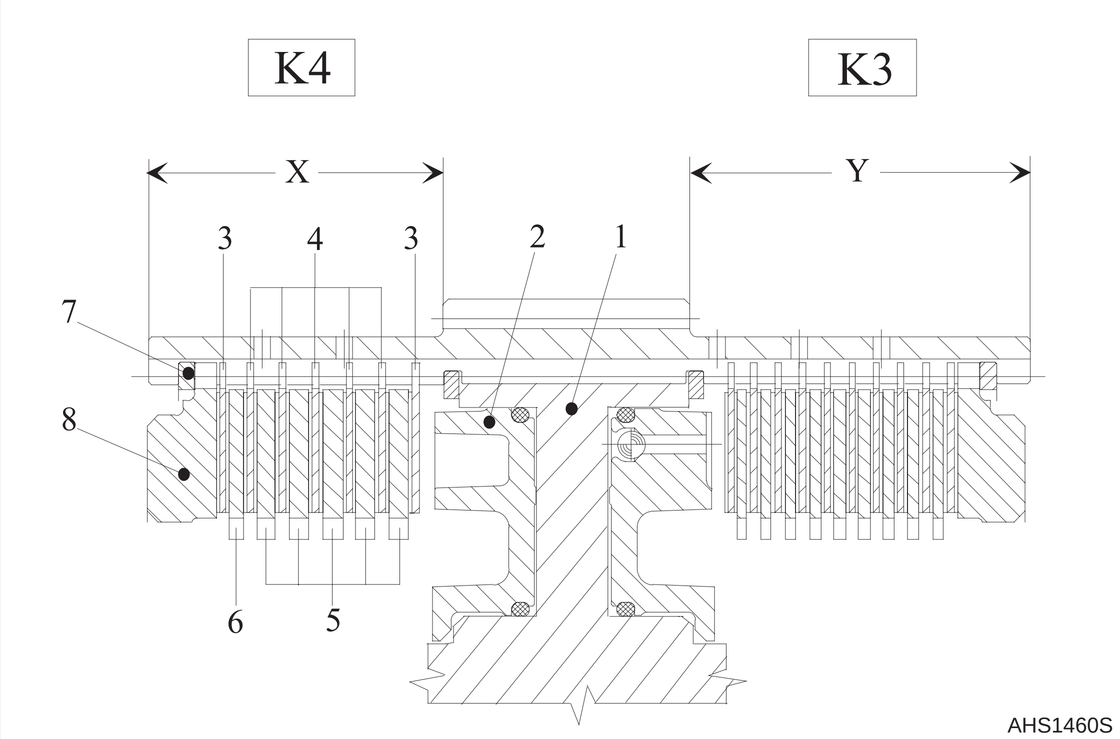

Figure 186

Item	Denomination	Quantity	s (mm)	Comment
1	Plate Carrier	1		
2	Piston	1		
3	Outer Plate	2	1.85 (0.0728 in)	One-side Coated
4	Outer Plate	5	2.5 (0.0984 in)	Coated On Both Sides
5	Inner Plate	5	3.5 (0.1378 in)	
6	Inner Plate	1	2.5 - 4.0 (0.0984 - 0.1575 in)	Optional
7	Snap Ring	1	2.55 - 3.10 (0.1004 - 0.1220 in)	Optional
8	End Shim	1		
Number of friction surfaces: 12				
Plate clearance: 2.2 - 2.4 mm (0.0866 - 0.0945 in)				

NOTE: *Install outer plates Item 3, with the uncoated side facing the piston, resp. the end shim. The respective clutch side can be recognized by the length of the plate carrier, see Figure 186.*

K4 = Dimension X (short plate-carrier side)

K3 = Dimension Y (long plate-carrier side)

1. Check Plate Clearance - K4 (2.2 - 2.4 mm (0.0866 - 0.0945 in)) (Figure 187- Figure 189).

   NOTE: *To ensure a faultless measuring result, install the plate pack for the present without oil*

   A. Install the plate pack according to Figure 186.

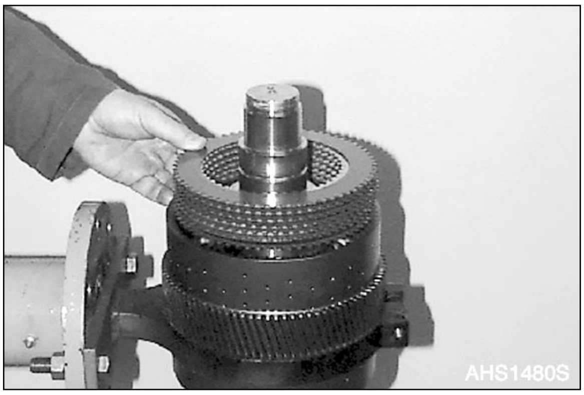

Figure 187

   B. Introduce the end shim and secure it using snap ring.

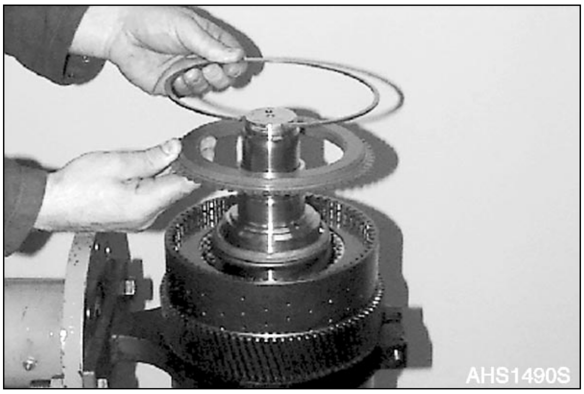

Figure 188

   C. Press end shim on with about 100 N (10 kg) and set dial indicator to "Zero" (Figure 189).

   D. Now, press end shim against the snap ring (upward) and read the plate clearance on the dial indicator.

   E. After the performed adjustment of the plate clearance, disassemble the plate pack, oil the plates according to ZF-List of lubricants TE-ML 03, and install them again.

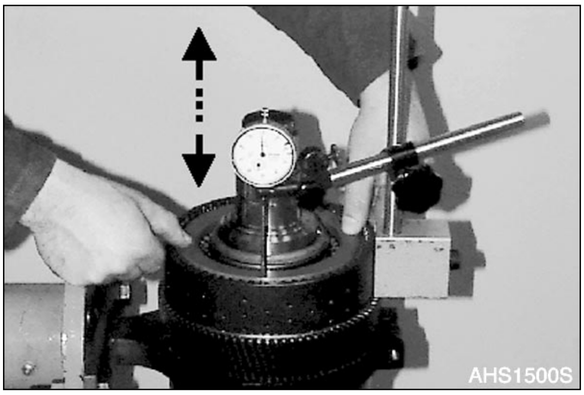

Figure 189

IMPORTANT

In case of a deviation from the required plate clearance (2.2 - 2.4 mm (0.0866 - 0.0945 in)), correct with corresponding inner plate Item 6 (optional s = 2.5 - 4.0 mm (0.0984 - 0.1575 in)) or and snap ring Item 7 (optional).

2. Pre-assemble and install Spur gear K4 (Figure 190 - Figure 196).

   A. Figure 190, shows the components of spur gear K4.

Reference Number	Description
1	Inner Bearing Race
2	Outer Bearing Race
3	Shim (Optional, Empirical Value s=5.4 mm (0.2126 in))
4	Spur Gear

   B. Check Axial play – Spur gear bearing 0.0 - 0.05 mm (0.0 - 0.0020 in).

   C. Install components, according to Figure 190. Preload tapered roller bearing with about 50,000 N (5.5 ton), and determine axial play with dial indicator.

NOTE: *In case of deviations from the required axial play, correct with corresponding shim (Item 3/ Figure 190).*

   D. Heat inner bearing race and line it up until contact is obtained.

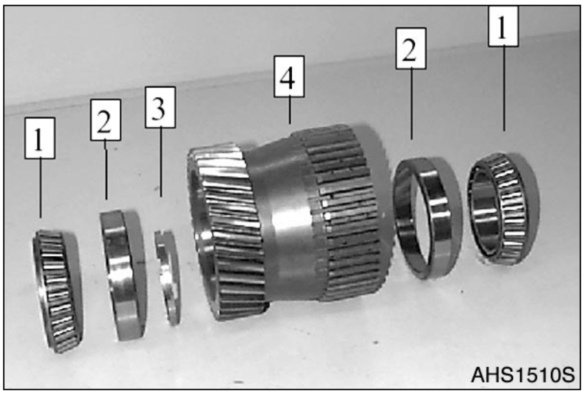

Figure 190

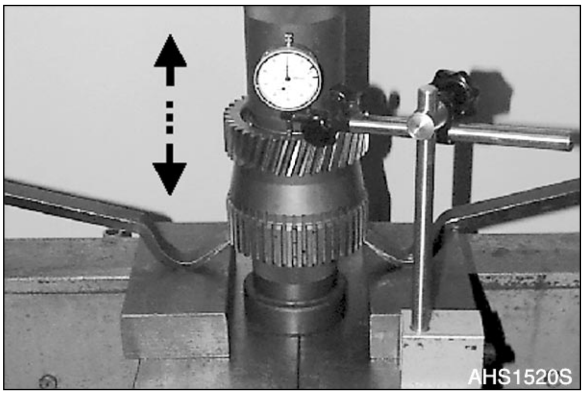

Figure 191

Figure 192

E. Line up the determined shim (see Figure 190 and Figure 191), with the oil groove facing upward.

Figure 193

F. Introduce spur gear until all inner plates are accommodated.

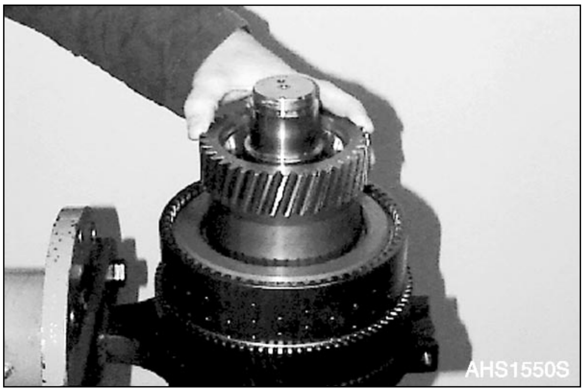

Figure 194

G. Heat inner bearing race (spur gear bearing) and position it against shoulder.

CAUTION!
Use protective gloves.

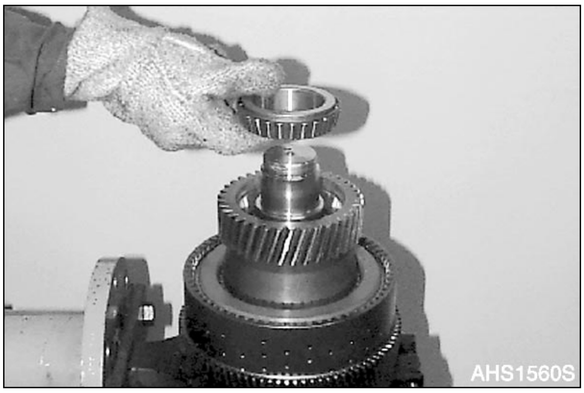

Figure 195

H. Heat inner bearing race (spur gear bearing) and position it against shoulder.

CAUTION!
Use protective gloves.

Figure 196

Multidisk Clutch - K3

Figure 197, shows the plate stacking and the installation position of the components.

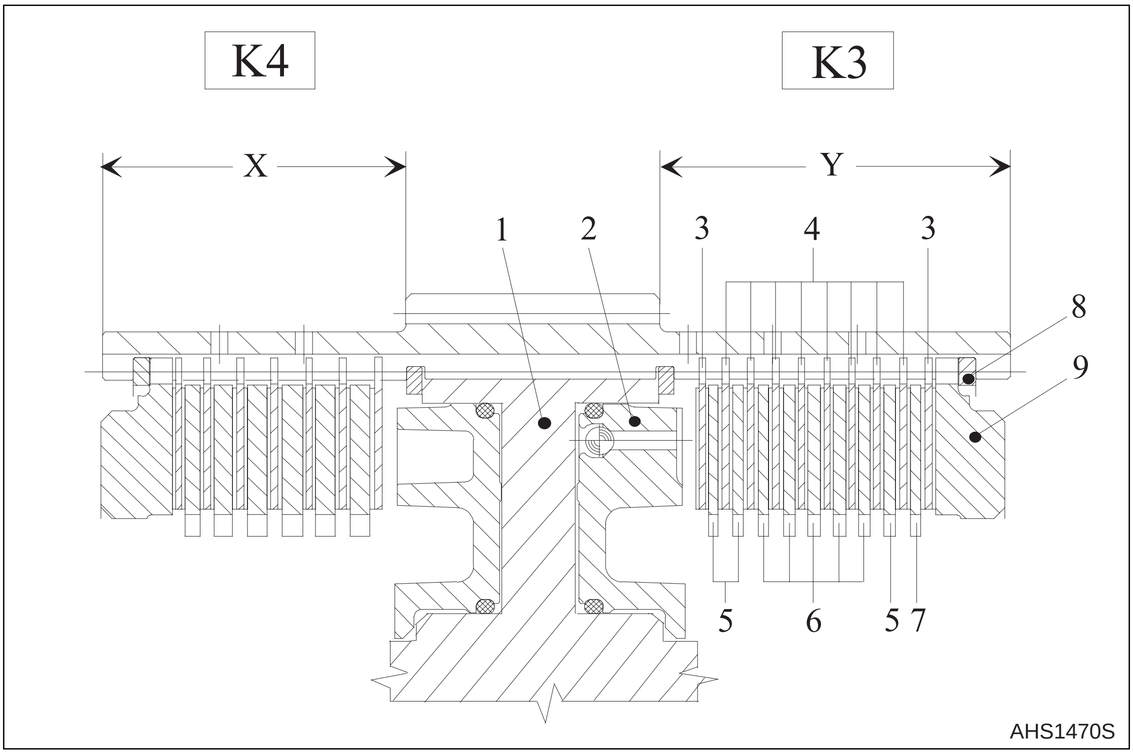

Figure 197

Item	Denomination	Quantity	s (mm)	Comment
1	Plate Carrier	1		
2	Piston	1		
3	Outer Plate	2	1.85 (0.0728 in)	One-side Coated
4	Outer Plate	8	2.5 (0.0984 in)	Coated On Both Sides
5	Inner Plate	3	2.5 (0.0984 in)	
6	Inner Plate	5	3.0 (0.1181 in)	
7	Inner Plate	1	2.5 - 4.0 (0.0984 - 0.1575 in)	Optional
8	Snap Ring	1	2.55 - 3.10 (0.1004 - 0.1220 in)	Optional
9	End Shim	1		
Number of friction surfaces: 18				
Plate clearance: 2.6 - 2.8 mm (0.1024 - 0.1102 in)				

NOTE: *Install outer plates Item 3, with the uncoated side facing the piston, resp. the end shim. The respective clutch side can be recognized by the length of the plate carrier, see Figure 197.*

K4 = Dimension X (short plate-carrier side)

K3 = Dimension Y (long plate-carrier side)

1. Check plate clearance K3 = 2.6 - 2.8 mm (Figure 198 - Figure 200).

   NOTE: *To ensure a faultless measuring result, install the plates for the present without oil.*

   A. Install the plate pack according to Figure 197.

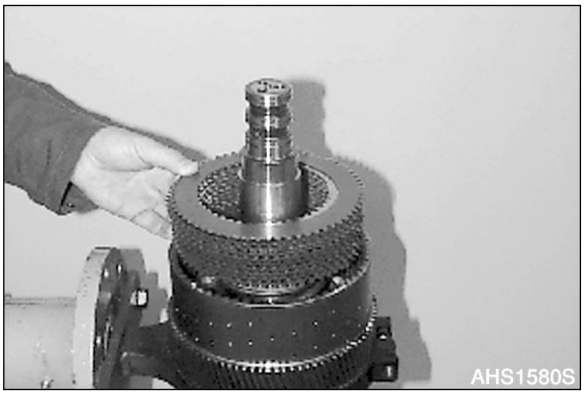

Figure 198

   B. Introduce the end shim and secure it using snap ring.

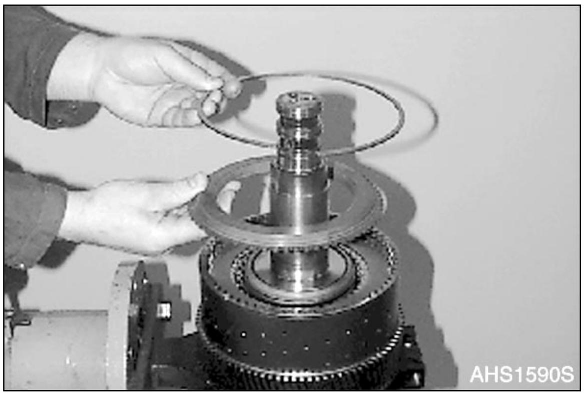

Figure 199

   C. Press the end shim on with about 100 N (10 kg) and set the dial indicator to "Zero" (Figure 200).

   D. Now, press the end shim against the snap ring (upward), and read the plate clearance on the dial indicator.

   E. After the performed adjustment of the plate clearance, disassemble the plate pack, oil plates according to ZF-List of lubricants TE-ML 03 and install them again.

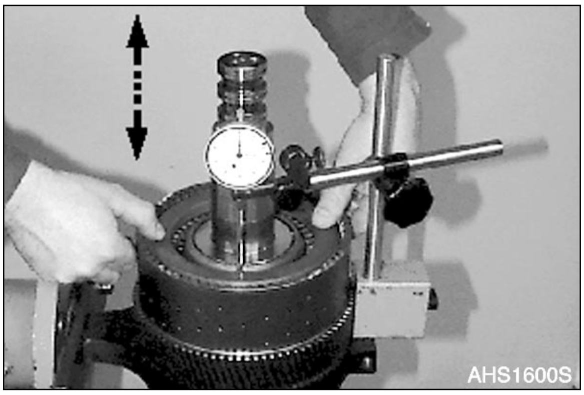

Figure 200

IMPORTANT

In case of a deviation from the required plate clearance (2.2 - 2.4 mm (0.0866 - 0.0945 in)), correct with corresponding inner plate Item 6 (optional s = 2.5 - 4.0 mm (0.0984 - 0.1575 in)) or and snap ring Item 7 (optional).

2. Heat inner bearing race and line it up until contact is obtained.

CAUTION!

Use protective gloves.

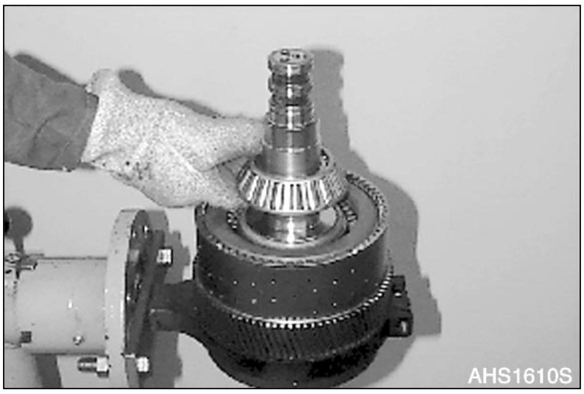

Figure 201

3. Lift plate carrier out of the clamping ring (S).
4. To ensure the exact contact of the components, preload the bearing with 100 000 N (10 ton) (Figure 202).

CAUTION!

Support on the lower and on the upper inner bearing race.

Use pressure pieces (S).

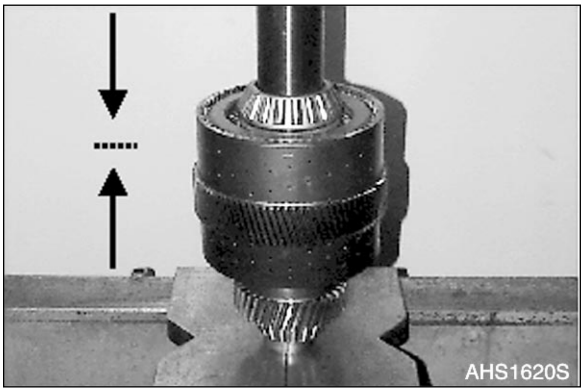

Figure 202

5. Lift plate carrier, with the K4-side facing downward, into the clamping ring (S) and secure it.
6. Tilt plate carrier 90˚.
7. Wet thread of slotted nut with Loctite #262 and install slotted nut (Figure 203).

NOTE: *Install slotted nut, with the collar (∅60 mm (2.3622 in) facing the inner bearing race.*

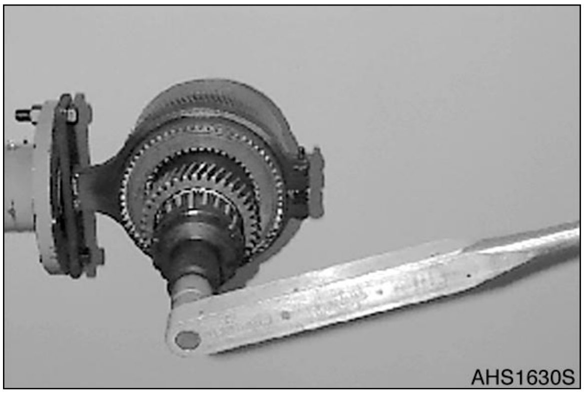

Figure 203

8. Insert outer bearing race into the spur gear K3 until contact is obtained.

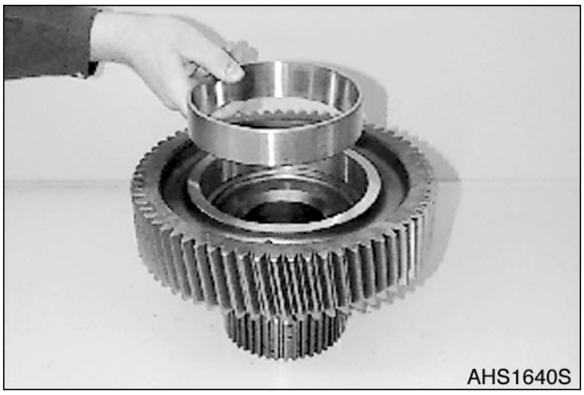

Figure 204

9. Heat roller bearing and position it against shoulder.

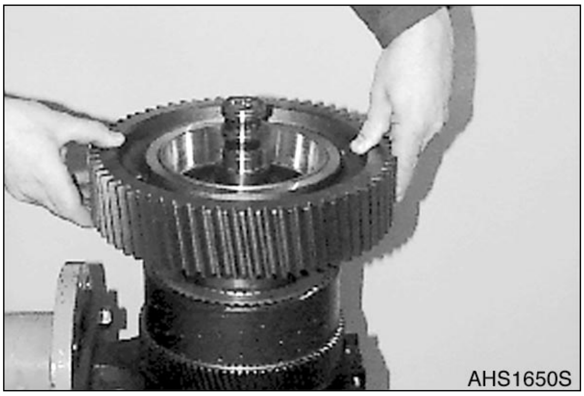

Figure 205

10. Tighten slotted nut.

CAUTION!
Use protective gloves.

Figure 206

11. Introduce inner bearing race.

Figure 207

12. Check function of clutch using compressed air.

    NOTE: *At correctly installed components, the closing resp. opening of the clutches is clearly audible.*

Figure 208

13. Squeeze in and engage rectangular rings (3x, Figure 209).

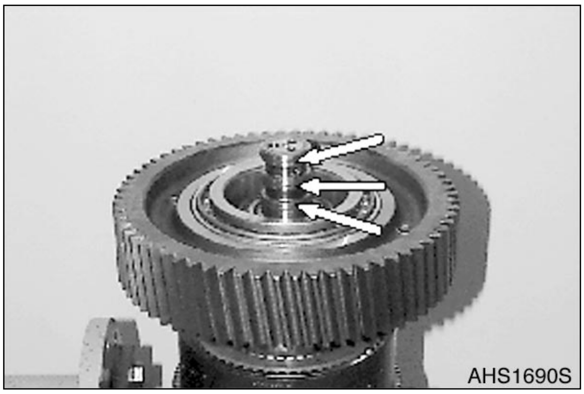

Figure 209

REASSEMBLE MULTIDISK CLUTCH KR/K2

1. Lift plate carrier, with the KR-side facing downward, into the clamping ring and secure it.
2. Tilt plate carrier 180˚.
3. Insert both roll pins (6x24 and 3.5x24) flush-mounted into the spur gear-side bore (Figure 210) of the plate carrier.

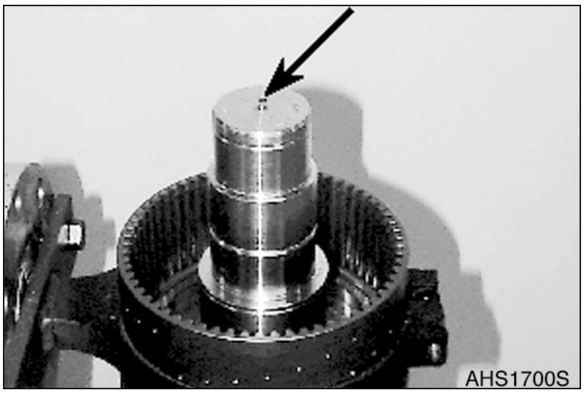

Figure 210

4. Tilt plate carrier 180˚.
5. Wet both set screws (Figure 211) with Loctite #262 and install them.

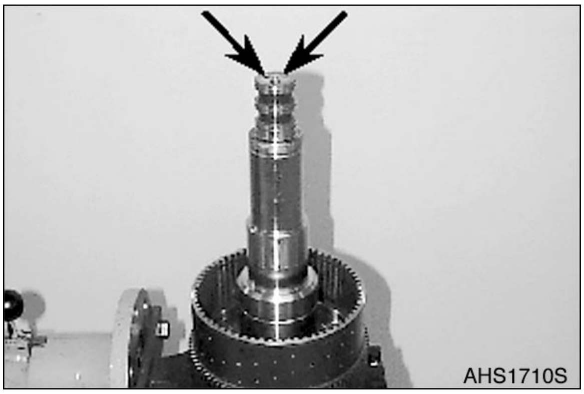

Figure 211

6. Insert purge valve (Figure 212) flush-mounted, with the chamfer facing downward.

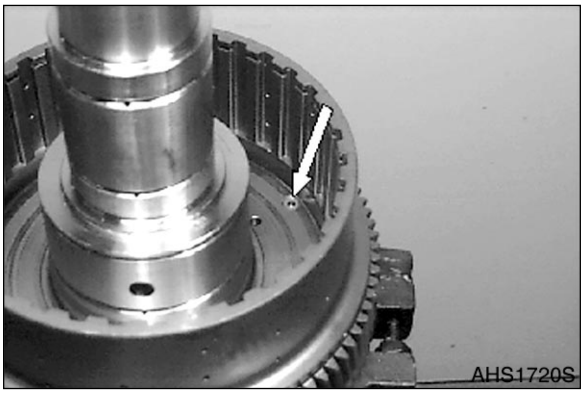

Figure 212

7. Lay both O-rings scrollfree into the ring grooves of the piston, see Arrows.

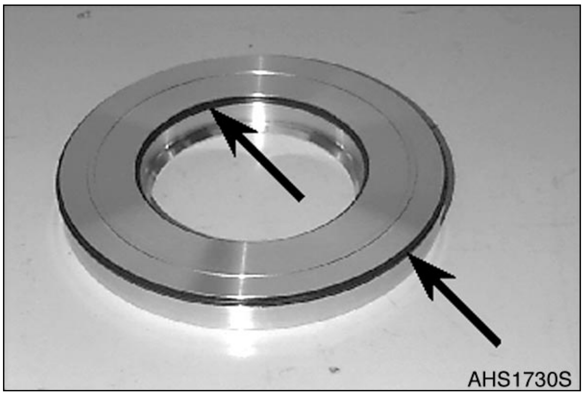

Figure 213

8. Oil O-rings and piston bearing surfaces. Insert K2 piston uniformly until contact is obtained.

   NOTE: *Pay attention to the installation position of the piston, see / Figure 214.*

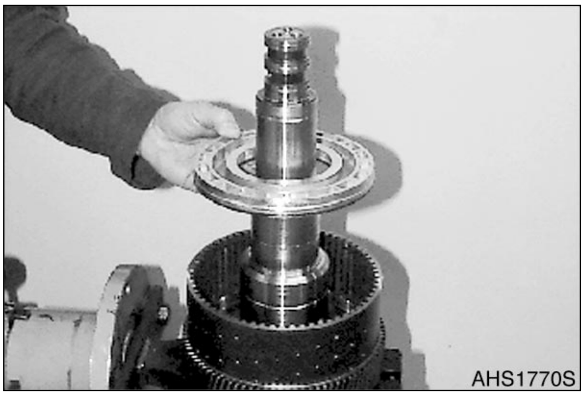

Figure 214

9. Introduce intermediate plate and compression spring.

Figure 215

10. Lay guide ring, with the chamfer (Arrow) facing upward, over the compression spring and line up the snap ring.

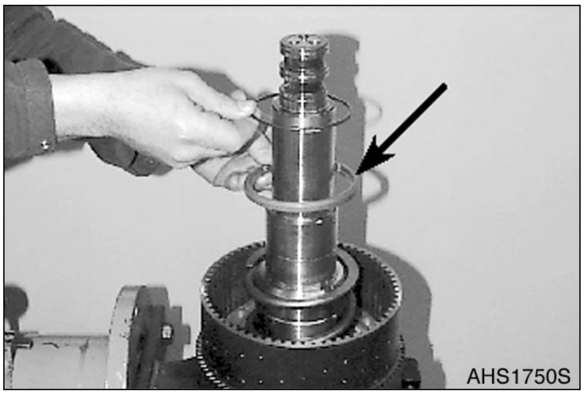

Figure 216

11. Lift plate carrier out of the clamping ring (S). Preload compression spring using Special device (S) and squeeze snap ring into the annular groove of the plate carrier (Arrow), see Figure 217.
12. Install purge valve, spool and compression spring on the opposite side (KR clutch) accordingly as Figure 212 - Figure 217.
13. Now, lift plate carrier, with the KR-side facing downward into the clamping ring (S) and secure it.

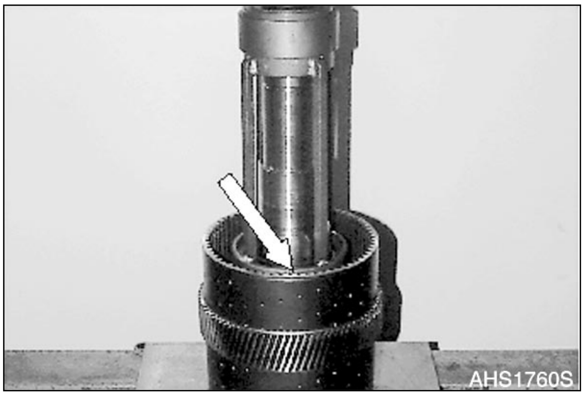

Figure 217

Multidisk Clutch - KR

Figure 218, shows the plate stacking and the installation position of the components.

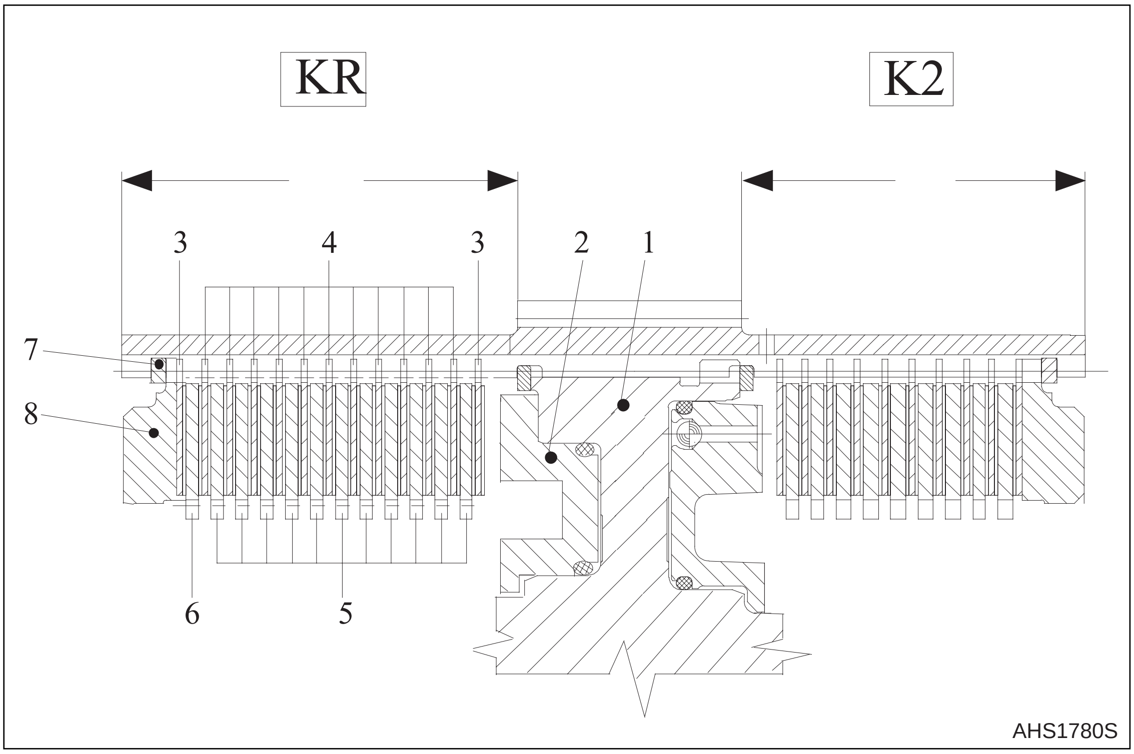

Figure 218

Item	Denomination	Quantity	s (mm)	Comment
1	Plate Carrier	1		
2	Piston	1		
3	Outer Plate	2	1.85 (0.0728 in)	One-side Coated
4	Outer Plate	11	2.5 (0.0984 in)	Coated On Both Sides
5	Inner Plate	11	2.5 (0.0984 in)	
6	Inner Plate	1	3.0 (0.1181 in)	Optional
7	Snap Ring	1	2.5 - 4.0 (0.0984 - 0.1575 in)	Optional
8	End Shim	1		
Number of friction surfaces: 24				
Plate clearance: 2.8 - 3.0 mm (0.1102 - 0.1181 in)				

NOTE: *Install outer plates Item 3, with the uncoated side facing the piston, resp. the end shim. The respective clutch side can be recognized by the length of the plate carrier, see Figure 218.*

KR = Dimension Y (long plate-carrier side)

K2 = Dimension X (short plate-carrier side)

1. Check Plate clearance KR = 2.8 - 3.0 mm (0.1102 - 0.1181 in) (Figure 219 - Figure 221).

   NOTE: *To ensure a faultless measuring result, install the plates for the present without oil.*

   A. Install plate pack according to Figure 218.

Figure 219

   B. Introduce end shim and secure it using snap ring.

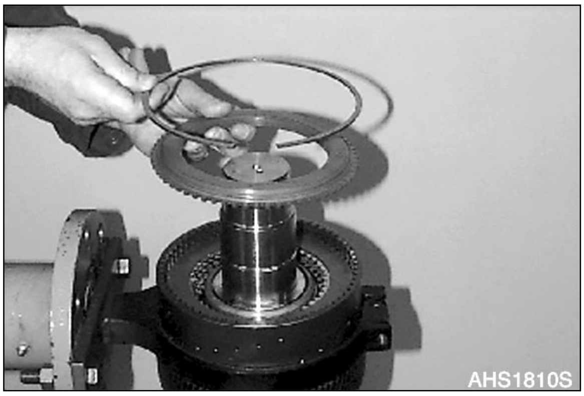

Figure 220

   C. Press the end shim on with about 100 N (10 kg) and set the dial indicator to "Zero." Now, press the end shim against the snap ring (upward) and read the plate clearance on the dial indicator.

   D. After the performed adjustment of the plate clearance, disassemble the plate pack, oil plates according to ZF-List of lubricants TE-ML 03 and install them again.

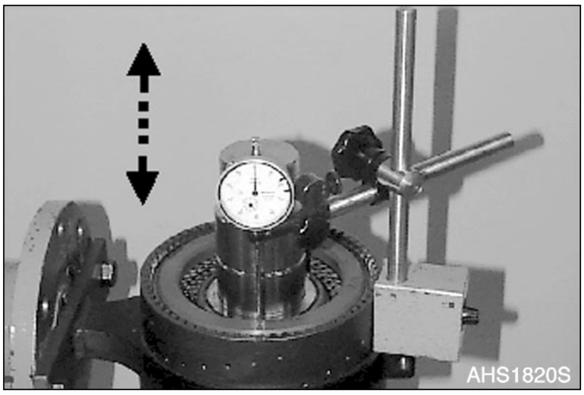

Figure 221

IMPORTANT

In case of deviations from the required plate clearance = 2.8 - 3.0 mm (0.1102 - 0.1181 in), correct with corresponding inner plate Item 6 (optional 2.5 - 4.0 mm (0.0984 - 0.1575 in)) or and snap ring Item 7 (optional).

2. Pre-assemble and install Spur gear KR (Figure 222 - Figure 230)

   A. Figure 222, shows the components of spur gear KR.

Reference Number	Description
1	Inner Bearing Race
2	Shim s=3.0 and s=3.10 mm (∑=6.10 mm / Empirical Value)
3	Spur Gear
4	Inner Bearing Race

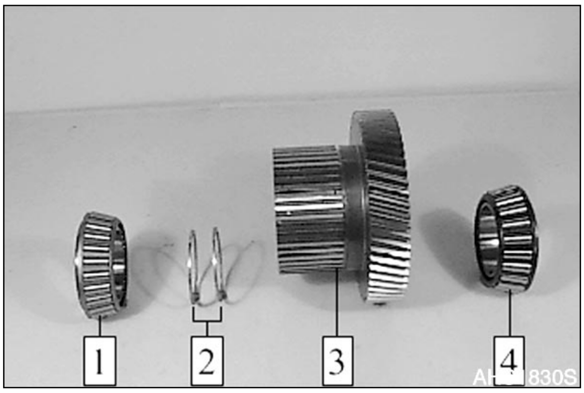

Figure 222

   B. Check Axial play – Spur gear bearing 0.0 - 0.05 mm (0.0 - 0.0020 in).

   C. Place spur gear over the inner bearing race.

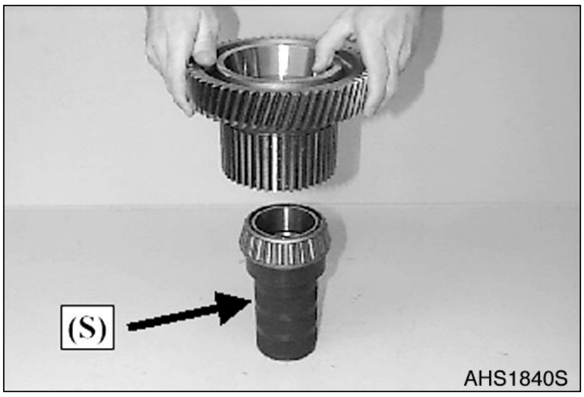

Figure 223

   D. Introduce shims (2 pieces/s = 3.0 (0.1181 in) and s = 3.10 mm (0.1220 in)).

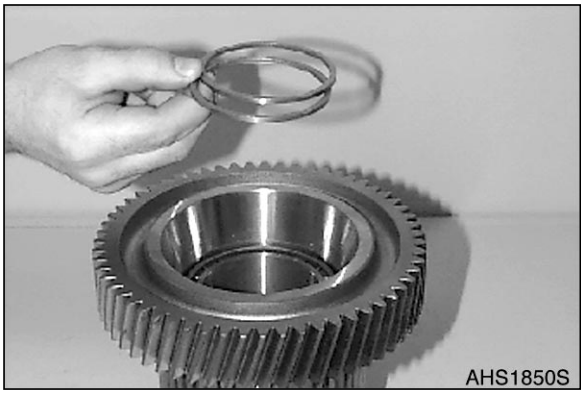

Figure 224

E. Mount inner bearing race.

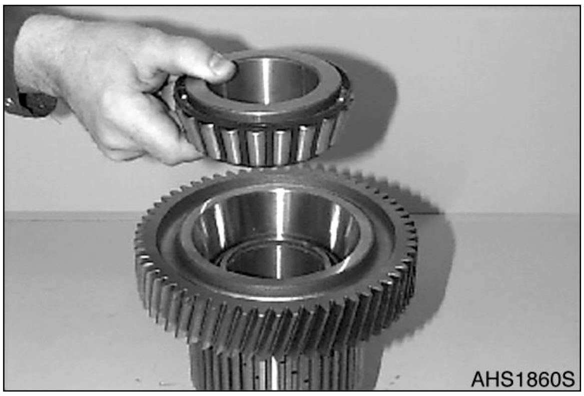

Figure 225

F. Preload the tapered roller bearing with about 50 000 N (5 ton) and determine the axial play with dial indicator.

NOTE: *In case of deviations from the required axial play, correct with corresponding shims (Item 2/ Figure 222).*

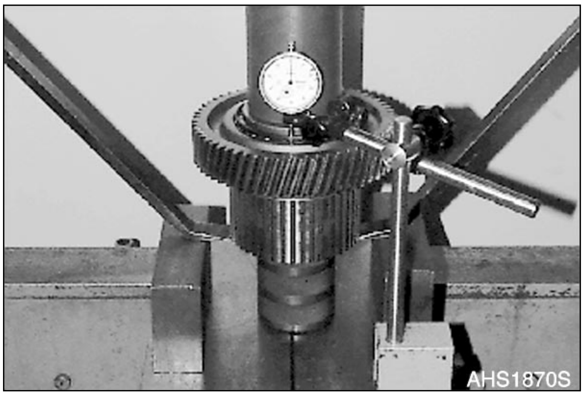

Figure 226

G. Heat inner bearing race and position it against shoulder.

CAUTION!
Use protective gloves.

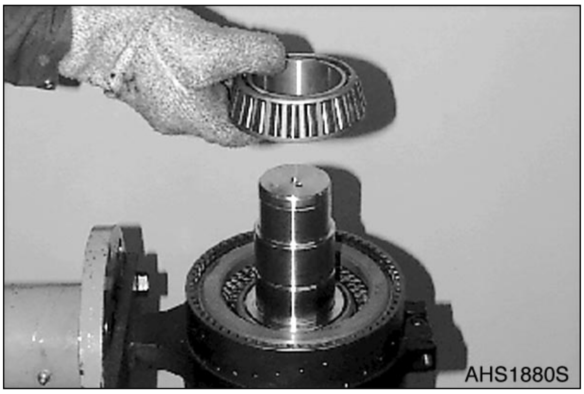

Figure 227

H. Introduce the spur gear until all inner plates are accommodated.

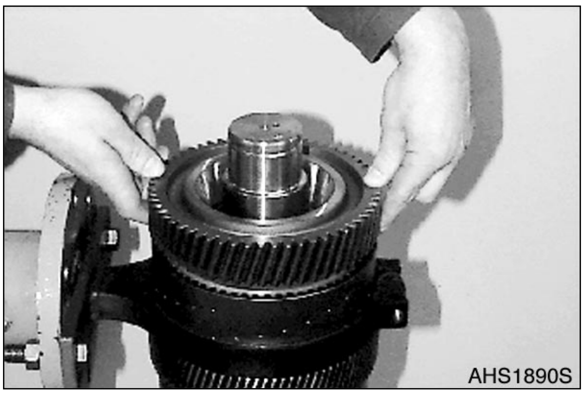

Figure 228

I. Introduce determined shims (see Figure 223 to Figure 226).

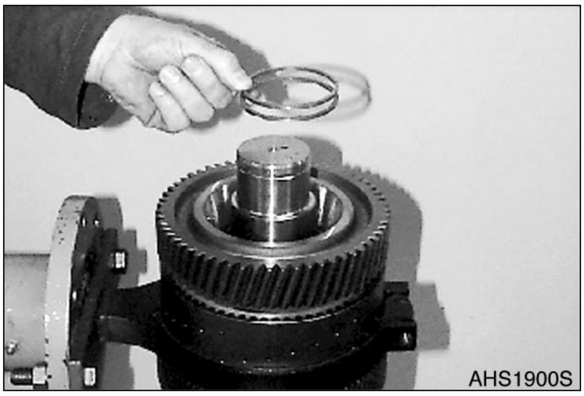

Figure 229

J. Heat inner bearing race (spur gear bearing) and position it against shoulder.

CAUTION!

Use protective gloves.

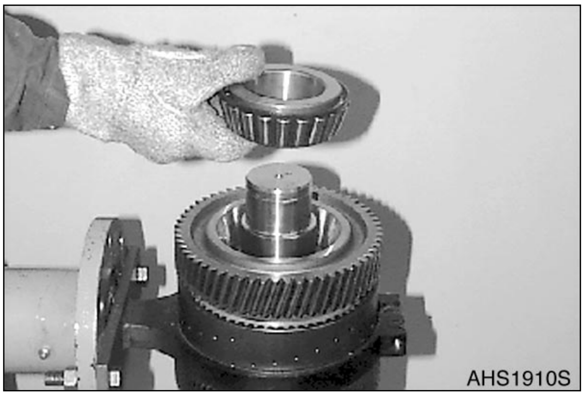

Figure 230

K. Heat inner bearing race (spur gear bearing) and position it against shoulder.

CAUTION!

Use protective gloves.

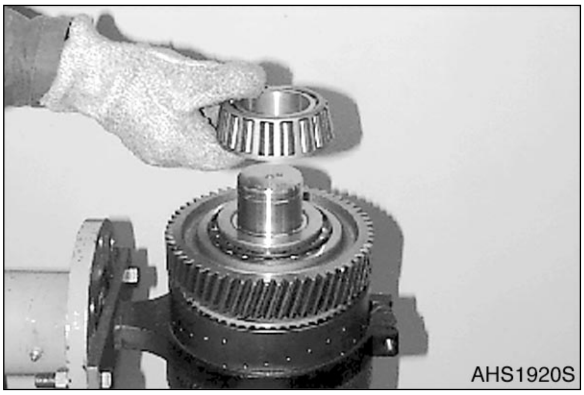

Figure 231

Multidisk Clutch - K2

Figure 232, shows the plate stacking and the installation position of the components.

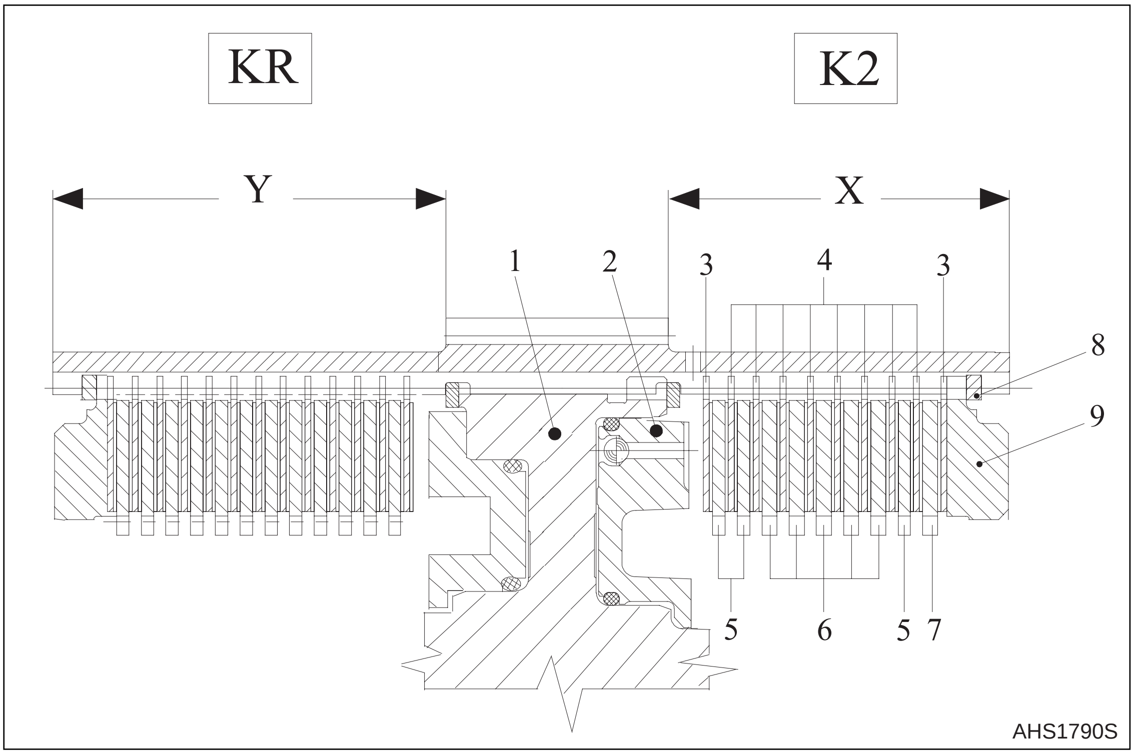

Figure 232

Item	Denomination	Quantity	s (mm)	Comment
1	Plate Carrier	1		
2	Piston	1		
3	Outer Plate	2	1.85 (0.0728 in)	One-side Coated
4	Outer Plate	8	2.5 (0.0984 in)	Coated On Both Sides
5	Inner Plate	3	2.5 (0.0984 in)	
6	Inner Plate	5	3.0 (0.1181 in)	
7	Inner Plate	1	2.5 - 4.0 (0.0984 - 0.1575 in)	Optional
8	Snap Ring	1	2.55 - 3.10 (0.1004 - 0.1220 in)	Optional
9	End Shim	1		
Number of friction surfaces: 18				
Plate clearance: 2.6 - 2.8 mm (0.1024 - 0.1102 in)				

NOTE: *Install outer plates Item 3, with the uncoated side facing the piston, resp. the end shim. The respective clutch side can be recognized by the length of the plate carrier, see Figure 232.*

KR = Dimension Y (long plate-carrier side)

K2 = Dimension X (short plate-carrier side)

1. Check Plate clearanceK2 = 2.6 - 2.8 mm (Figure 233 - Figure 235).

   NOTE: *To ensure a faultless measuring result, install the plates for the present without oil.*

   A. Install the plate pack according to Figure 232.

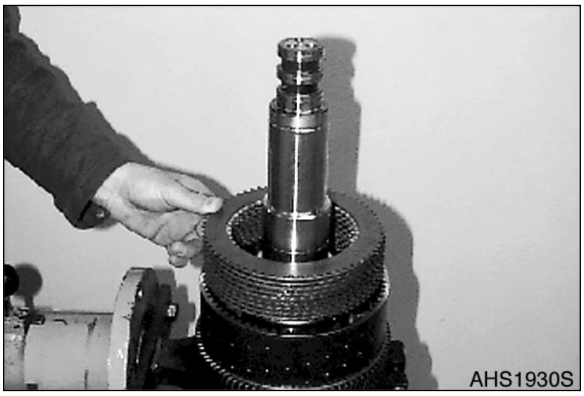

Figure 233

   B. Introduce end shim and secure it using snap ring.

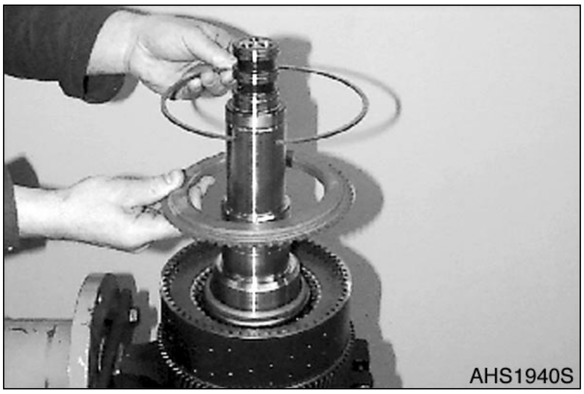

Figure 234

   C. Press the end shim on with about 100 N (10 kg) and set the dial indicator to "Zero."

   D. Now, press the end shim against the snap ring (upward) and read the plate clearance on the dial indicator.

   E. After the performed adjustment of the plate clearance, disassemble the plate pack, oil the plates according to ZF-List of lubricants TE-ML 03 and install them again.

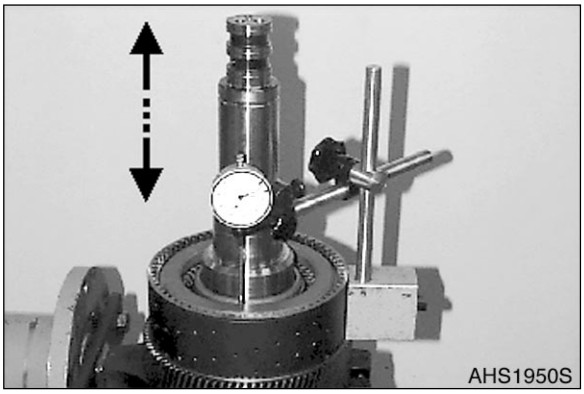

Figure 235

IMPORTANT
In case of deviations from the required plate clearance = 2.6 - 2.8 mm (0.1024 - 0.1102 in), correct with corresponding inner plate Item 7 (optional s = 2.5 - 4.0 mm (0.0984 - 0.1575 in)) or and snap ring Item 8 (optional).

2. Pre-assemble and install Spur gear K2 (Figure 236 - Figure 245)

   A. Supercool gear wheel 1 (about -80˚C (-112˚F)) and heat gear wheel 2 (about 120˚C (248˚F)). Squeeze snap ring in (Arrow), preload, and join both parts together using hydraulic press until the snap ring snaps into the annular groove of the gear wheel 2.

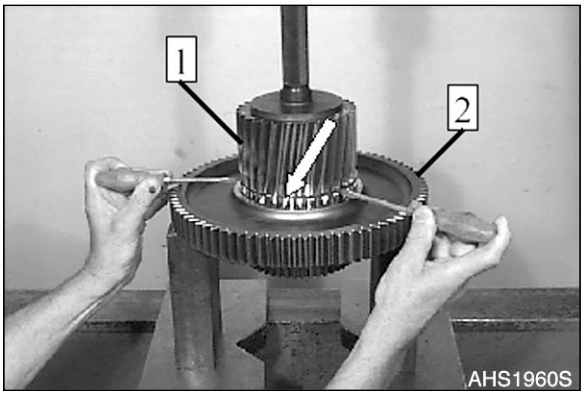

Figure 236

   B. Adjust Axial play – Spur gear bearing 0.05 - 0.15 mm (0.0020 - 0.0059 in) (Figure 237 - Example C).

   C. Figure 237, shows the components of the spur gear bearing.

Reference Number	Description
1	Bearings Inner Race
2	Shim (Optional)
3	Spur Gear Compl.
4	Inner Bearing Race

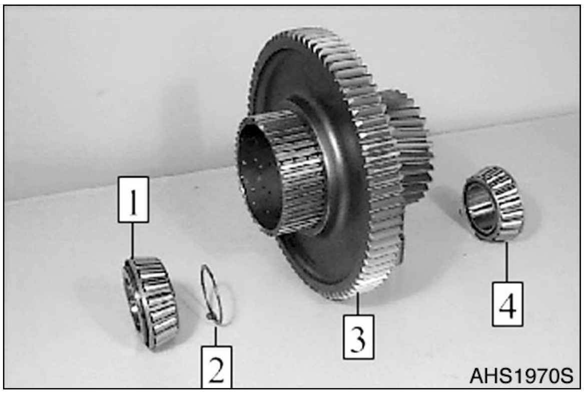

Figure 237

   D. Place spur gear over the inner bearing race.

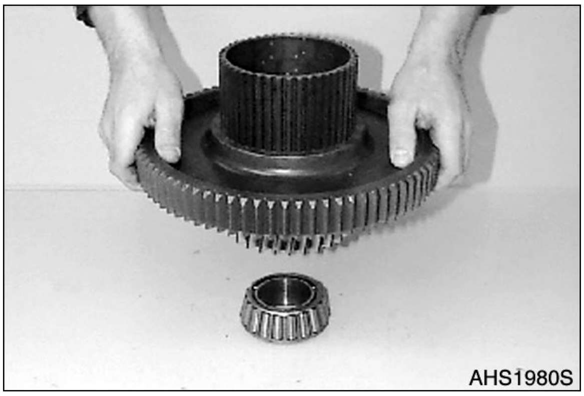

Figure 238

E. Introduce inner bearing race.

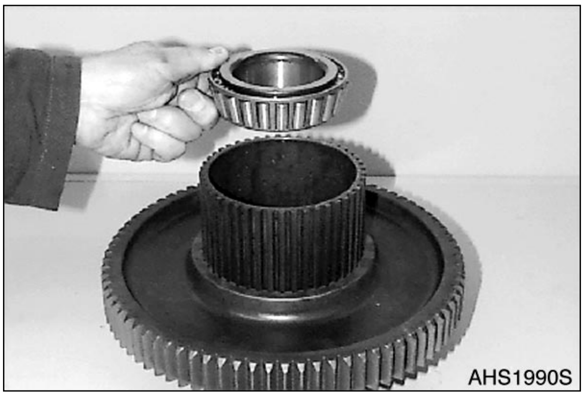

Figure 239

F. Determine Dimension I (bearing dimension).

NOTE: *Dimension I e.g. 76.270 mm (3.0028 in)*

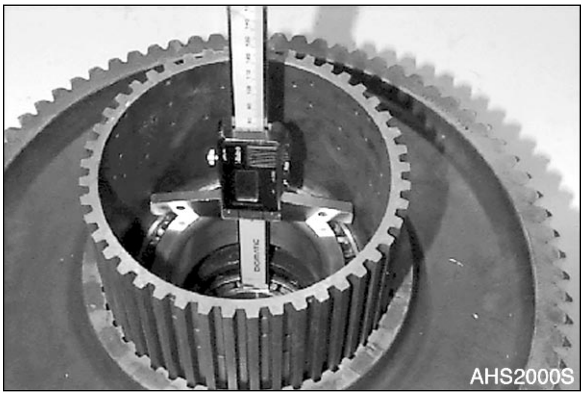

Figure 240

G. Determine Dimension II (shaft dimension).

NOTE: *Dimension II e.g. 74.14 mm (3.0028 in)*

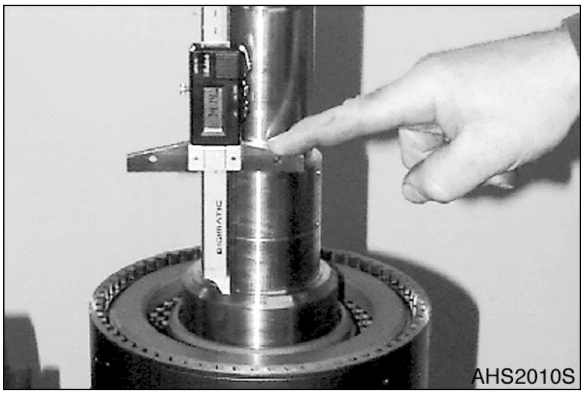

Figure 241

EXAMPLE C:

Dimension I e.g.	76.27 mm (3.0028 in)
Dimension II e.g.	- 74.14 mm (2.9189 in)
Difference	= 2.13 mm (0.0839 in)
Axial Play e.g.	+ 0.07 mm (0.0028 in)
Gives Shim	= 2.20 mm (0.0866 in)

3. Heat inner bearing race and line it up until contact is obtained.

CAUTION!
Use protective gloves.

Figure 242

4. Introduce spur gear until all inner plates are accommodated.

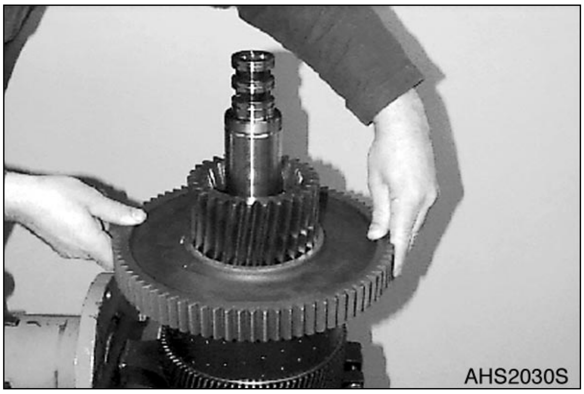

Figure 243

5. Line up shim (e.g. s = 2.20 mm (0.0866 in), see Example/page 106).

Figure 244

6. Heat inner bearing race (spur gear bearing) and line it up until contact is obtained.

CAUTION!
Use protective gloves.

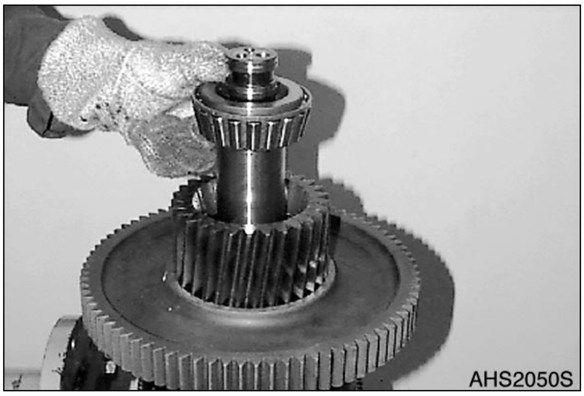

Figure 245

7. Heat inner bearing race (clutch bearing) and position it against shoulder.

⚠ CAUTION!
Use protective gloves.

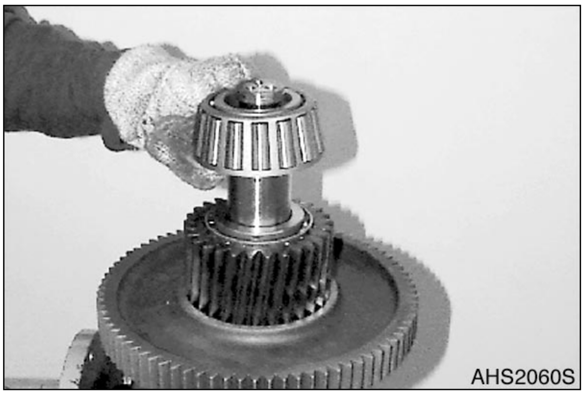

Figure 246

8. Lift plate carrier out of the clamping ring (S).
9. To ensure the exact contact of the components, preload bearing with 100 000 N (10 ton) (Figure 247).

⚠ CAUTION!
Support on the lower and on the upper bearing race. Use pressure pieces (S).

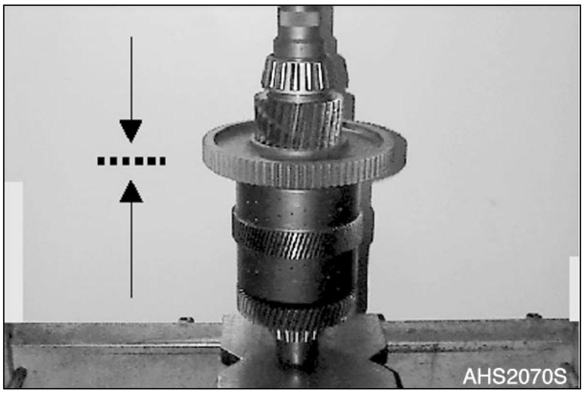

Figure 247

10. Lift plate carrier into the clamping ring (S) and secure it.
    A. Tilt clutch 90˚.
    B. K2-Side: Wet thread of slotted nut with Loctite #262 and install it (Figure 317).

NOTE: *Install slotted nut with the chamfer facing the inner bearing race.*

NOTE: *Torque limit 800 Nm (590 ft lb).*

    C. KR-Side: Wet thread of slotted nut with Loctite #262 and install it.

NOTE: *Install slotted nut, with the collar (∅ 70 mm (2.7560 in)) facing the inner bearing race.*

NOTE: *Torque limit 800 Nm (590 ft lb).*

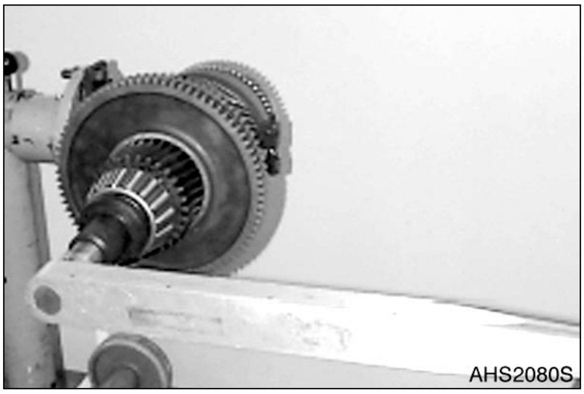

Figure 248

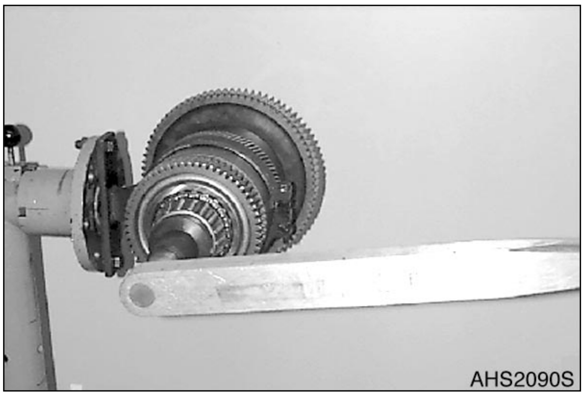

Figure 249

D. D. Check function of clutches K3 and K4 using compressed air (Figure 250).

NOTE: *At correctly installed components, the closing, resp. opening of the clutches is clearly audible.*

E. Squeeze in and engage rectangular ring (3x – see Arrows).

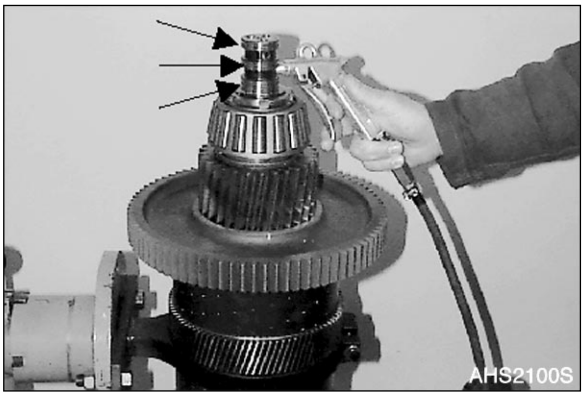

Figure 250

REASSEMBLE MULTIDISK CLUTCH KV / K1

1. Lift plate carrier, with the KV-side facing downward, into the clamping ring (S) and secure it.
2. Tilt plate carrier 180˚.
3. Insert both roll pins (6x24 and 3.5x24) flush-mounted into the end face-side bore of the plate carrier (Figure 251).

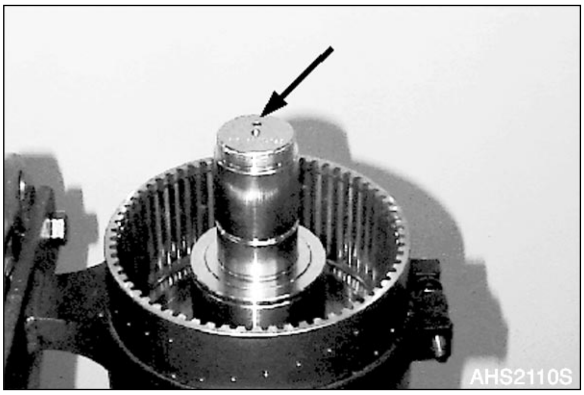

Figure 251

4. Tilt plate carrier 180˚.
5. Wet both set screws (Figure 252) with Loctite #262 and install them.

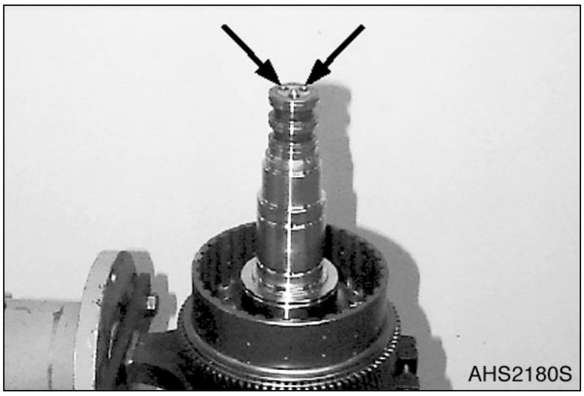

Figure 252

6. Drive purge valve (Arrow) flush-mounted in, with the chamfer facing downward.

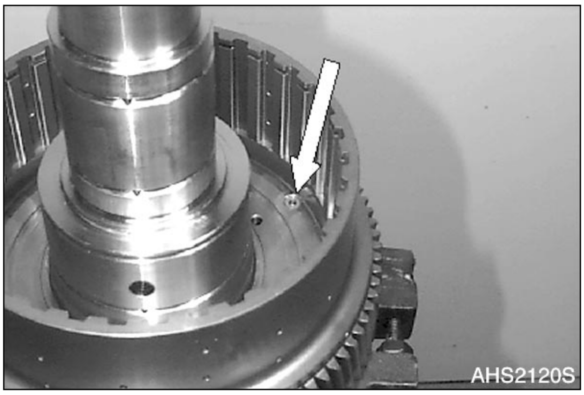

Figure 253

7. Lay both O-rings scrollfree into the ring grooves of the piston, see Figure 254.

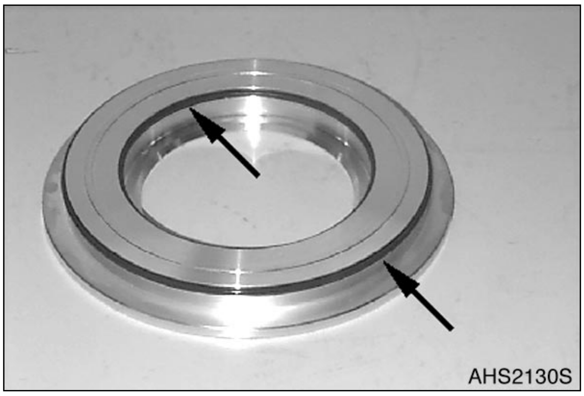

Figure 254

8. Oil O-rings and piston bearing surfaces.
9. Insert K1-piston uniformly against shoulder.

   NOTE: *Pay attention to the installation position of the piston, see Figure 255.*

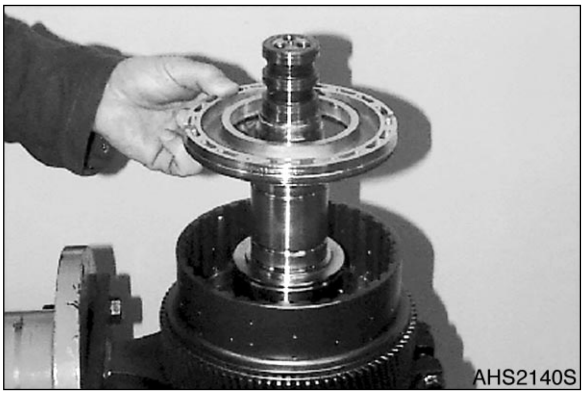

Figure 255

10. Introduce intermediate washer and compression spring.

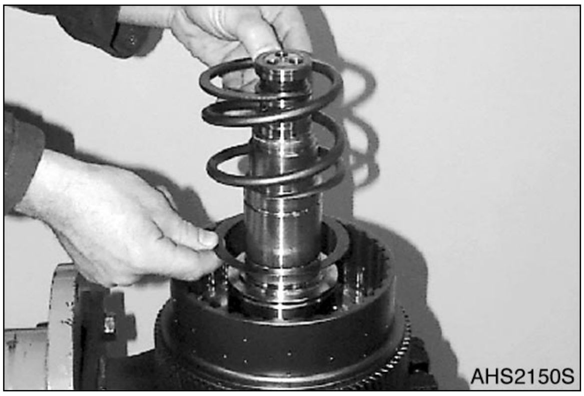

Figure 256

11. Lay guide ring, with the chamfer (Figure 257) facing upward, over the compression spring and line up the snap ring.

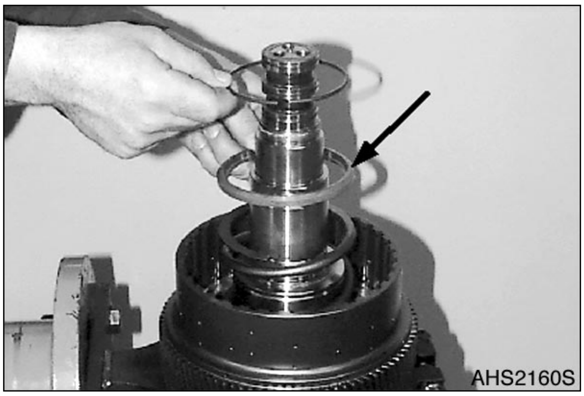

Figure 257

12. Lift the plate carrier out of the clamping ring. Preload compression spring using Special device (S) and squeeze snap ring into the annular groove of the plate carrier (Arrow) – seeFigure 258.
13. Install purge valve, spool and compression spring on the opposite side (KV-clutch) accordingly.
14. Now, lift the plate carrier, with the KV-side facing downward, into the clamping ring (S) and secure it. Tilt plate carrier 180˚.

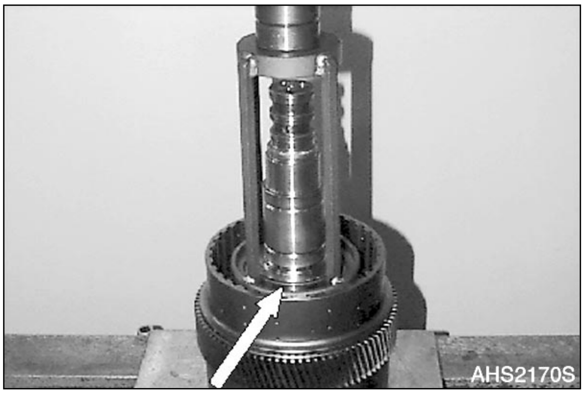

Figure 258

Multidisk Clutch - KV

Figure 259, shows the plate stacking and the installation position of the components.

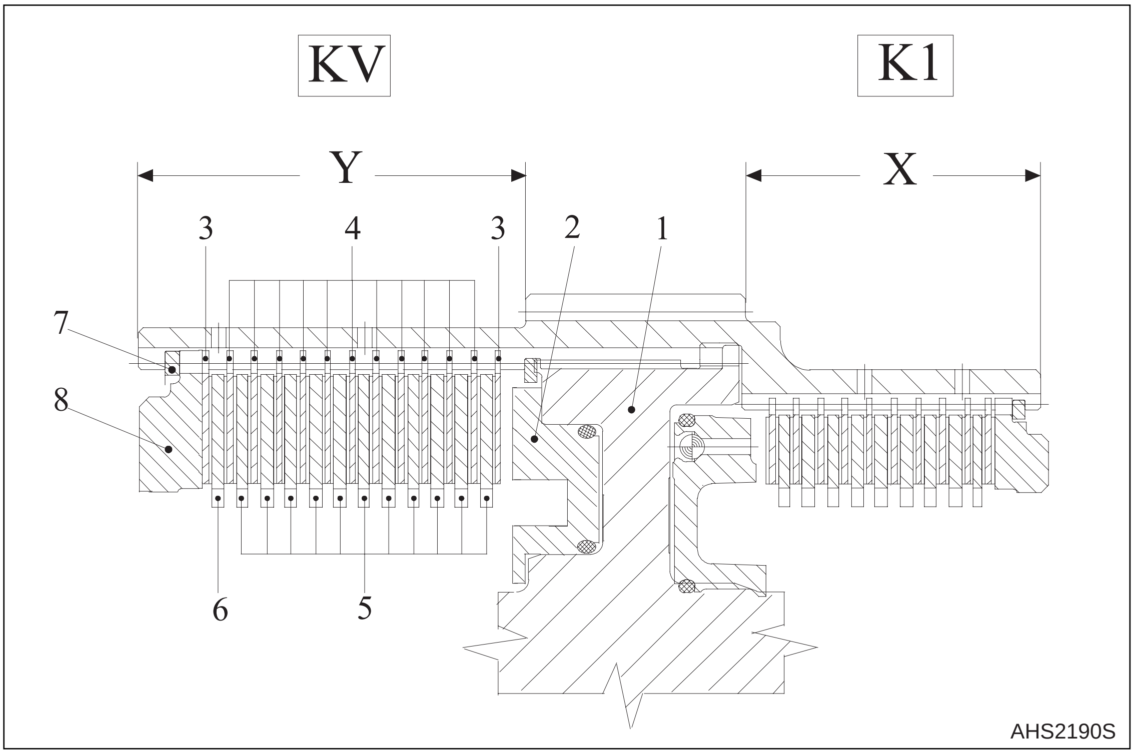

Figure 259

Item	Denomination	Quantity	s (mm)	Comment
1	Plate Carrier	1		
2	Piston	1		
3	Outer Plate	2	1.85 (0.0728 in)	One-side Coated
4	Outer Plate	11	2.5 (0.0984 in)	Coated On Both Sides
5	Inner Plate	11	2.5 (0.0984 in)	
6	Inner Plate	1	3.0 (0.1181 in)	Optional
7	Snap Ring	1	2.5 - 4.0 (0.0984 - 0.1575 in)	Optional
8	End Shim	1		
Number of friction surfaces: 24				
Plate clearance: 2.8 - 3.0 mm (0.1102 - 0.1181 in)				

NOTE: *Install outer plates Item 3, with the uncoated side facing the piston, resp. the end shim. The respective clutch side can be recognized by the length, resp. ∅ of the plate carrier, see Figure 259.*

KV = Dimension Y (long plate-carrier side, resp. great ∅)

K1 = Dimension X (short plate-carrier side, resp. small ∅)

1. Check plate clearance KV = 2.8 - 3.0 mm (0.1102 - 0.1181 in) (Figure 260 - Figure 262).

   NOTE: *To ensure a faultless measuring result, install the plates for the present without oil.*

   A. Install the plate pack according to Figure 259.

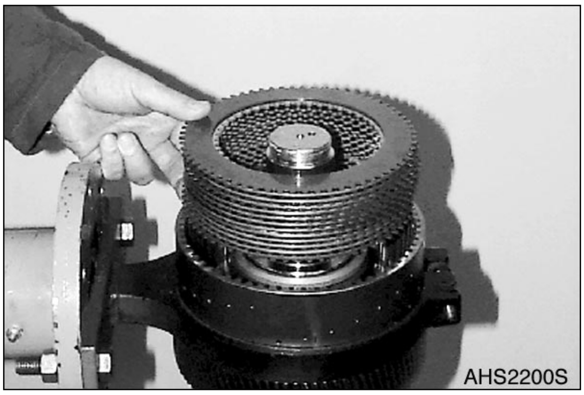

Figure 260

   B. Introduce the end shim and secure it using snap ring.

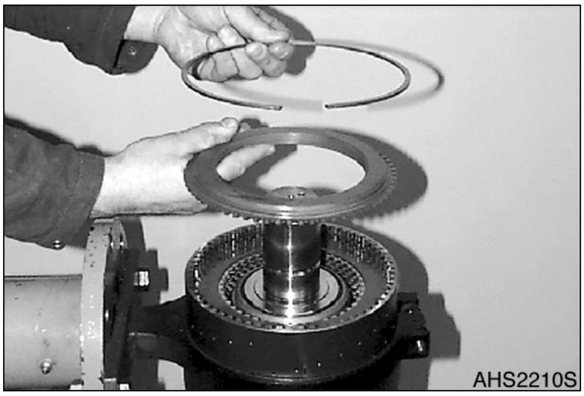

Figure 261

   C. Press the end shim on with about 100 N (10 kg) and set the dial indicator to "Zero."

   D. Now, press the end shim against the snap ring (upward), and read the plate clearance on the dial indicator.

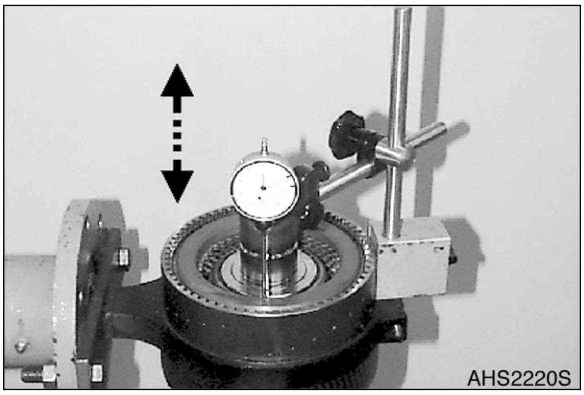

Figure 262

IMPORTANT

In case of deviations from the required plate clearance = 2.8 - 3.0 mm (0.1102 - 0.1181 in), correct with corresponding inner plate Item 6 (optional s = 2.5 - 4.0 (0.0984 - 0.1575 in)) or and snap ring (optional).

After the performed adjustment of the plate clearance disassemble the plate pack, oil plates according to ZF-List of lubricants TE-ML 03 and install them again.

2. Pre-assemble and install Spur gear KV (Figure 263 - Figure 271):

   A. Figure 263, shows the components of spur gear KV.

Reference Number	Description
1	Inner Bearing Race
2	Outer Bearing Race
3	Ring
4	Shim(s) Optional, Empirical Value s = 1.70 mm (0.0669 in)
5	Spur Gear

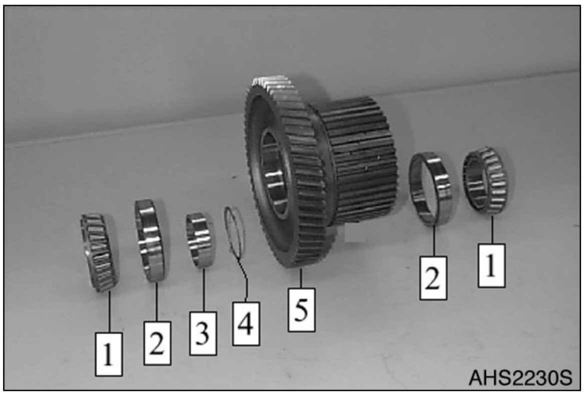

Figure 263

   B. Check Axial play – Spur gear bearing 0.0 - 0.05 mm (0.0 - 0.0020 in).

   C. Install both outer bearing races (2) and place spur gear over the inner bearing race.

Figure 264

   D. Introduce shim(s) 4 and ring 3.

Figure 265

Figure 266

E. Preload the tapered roller bearing with about 50,000 N (5.5 ton) and determine axial play using dial indicator.

NOTE: *In case of deviations from the required axial play, correct with corresponding shim (Item 4/ Figure 263).*

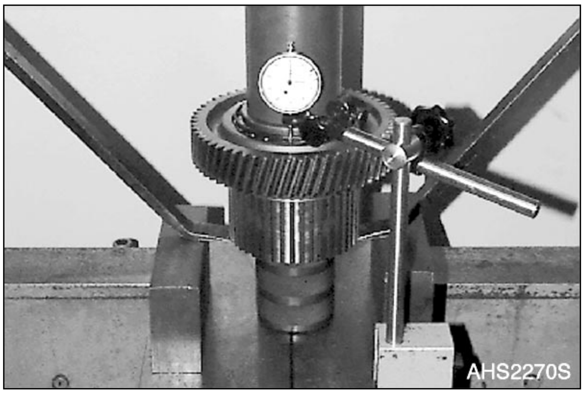

Figure 267

F. Heat inner bearing race and position it against shoulder.

CAUTION!
Use protective gloves.

Figure 268

G. Line up shim (see Figure 263 -Figure 267) and ring.

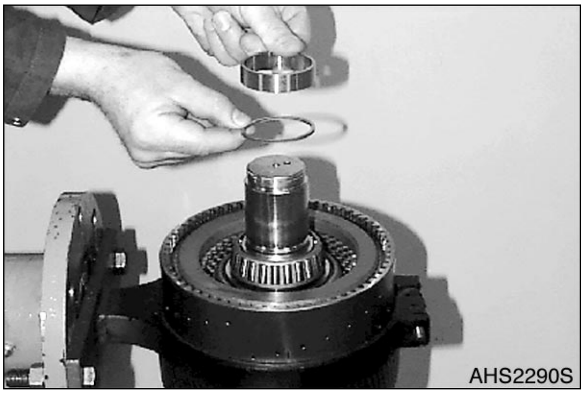

Figure 269

H. Introduce spur gear until all inner plates are accommodated.

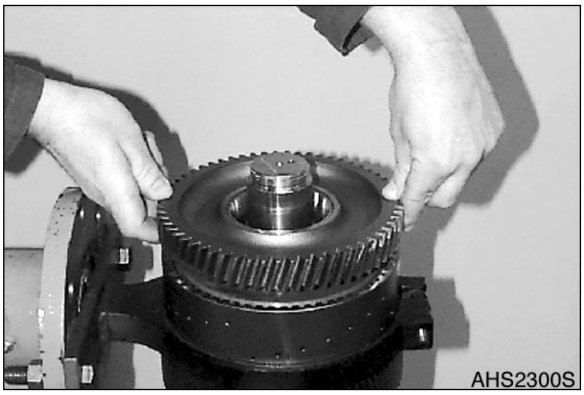

Figure 270

I. Heat inner bearing race (spur gear bearing) and position it against shoulder.

CAUTION!
Use protective gloves.

Figure 271

J. Heat inner bearing race (clutch bearing) and position it against shoulder.

CAUTION!
Use protective gloves.

K. Tilt plate carrier 180˚.

Figure 272

Multidisk Clutch - K4

Figure 273, shows the plate stacking and the installation position of the components.

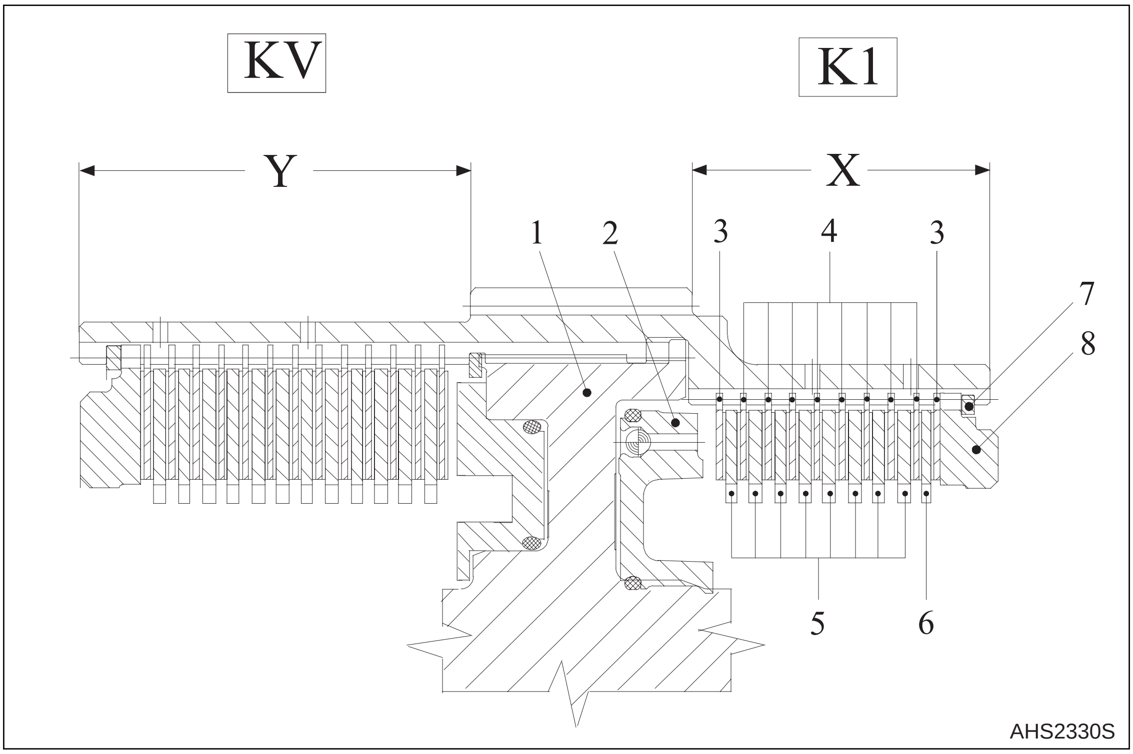

Figure 273

Item	Denomination	Quantity	s (mm)	Comment
1	Plate Carrier	1		
2	Piston	1		
3	Outer Plate	2	1.85 (0.0728 in)	One-side Coated
4	Outer Plate	8	2.5 (0.0984 in)	Coated On Both Sides
5	Inner Plate	8	3.5 (0.1378 in)	
6	Inner Plate	1	2.5 - 3.5 (0.0984 - 0.1378 in)	Optional
7	Snap Ring	1	2.1 - 2.5 (0.0827 - 0.0984 in)	Optional
8	End Shim	1		
Number of friction surfaces: 18				
Plate clearance: 2.6 - 2.8 mm (0.1024 - 0.1102 in)				

NOTE: *Install outer plates Item 3, with the uncoated side facing the piston, resp. the end shim. The respective clutch side can be recognized by the length, resp. ∅ of the plate carrier, see Figure 273.*

KV = Dimension Y (long plate-carrier side, resp. great ∅)

K1 = Dimension X (short plate-carrier side, resp. small ∅)

1. Check plate clearance K1 = 2.6 - 2.8 mm (0.1024 - 0.1102 in) (Figure 274 - Figure 276).

   NOTE: *To ensure a faultless measuring result, install the plates for the present without oil.*

   A. Install plate pack according to Figure 273.

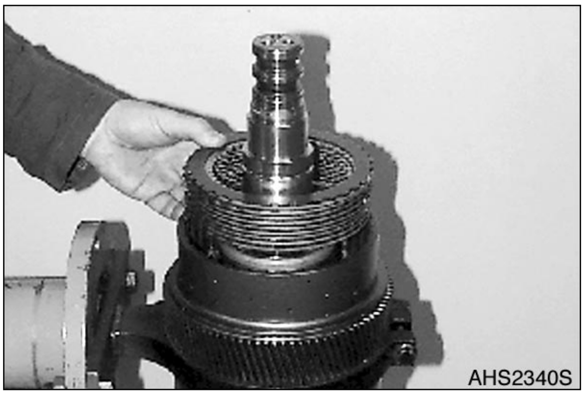

Figure 274

   B. Introduce the end shim and secure it using snap ring.

Figure 275

   C. Press the end shim on with about 100 N (10 kg) and set the dial indicator to "Zero."

   D. Now, press the end shim against the snap ring (upward), and read the plate clearance on the dial indicator.

   E. After the performed adjustment of the plate clearance, disassemble the plate pack, oil plates according to ZF-List of lubricants TE-ML 03 and install them again.

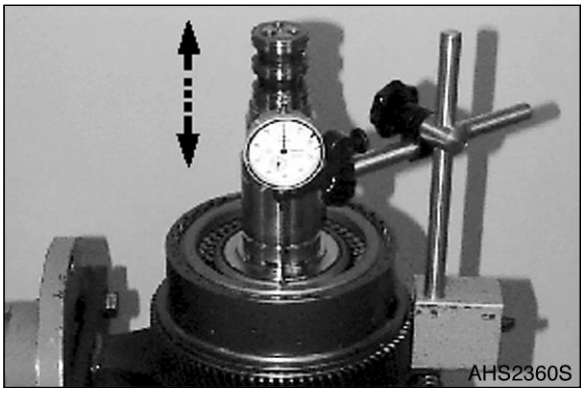

Figure 276

IMPORTANT
In case of deviations from the required plate clearance = 2.6 - 2.8 mm (0.1024 - 0.1102 in), correct with corresponding inner plate Item 6 (optional 2.5 - 3.5 mm (0.0984 - 0.1378 in)) or and snap ring Item 7 (optional).

2. Pre-assemble and install Spur gear K1 (Figure 277 - Figure 284).

   A. Figure 277, shows the components of spur gear K1.

Reference Number	Description
1	Ball Bearing (Compl.)
2	Snap Ring
3	Spur Gear

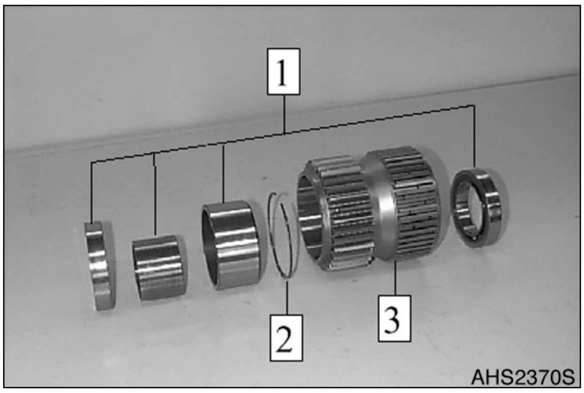

Figure 277

NOTE: *Prior to assemble the components, align plate pack using the spur gear radially and center it, see Figure 278.*

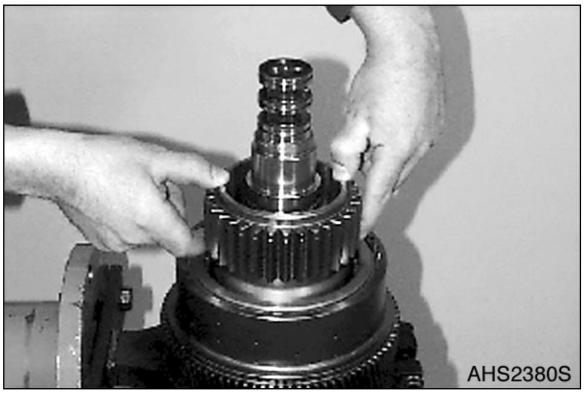

Figure 278

   B. Install snap ring.

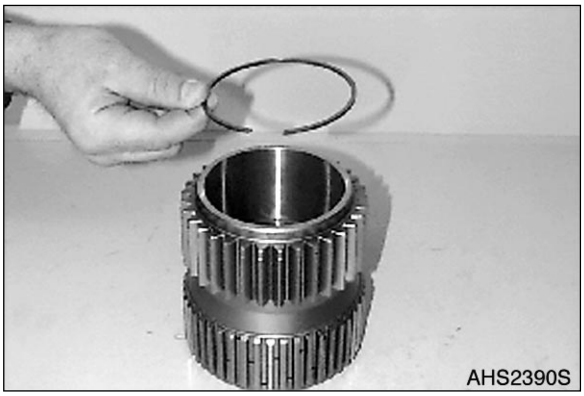

Figure 279

   C. Introduce bush, with the end face-side collar (Arrow) facing the snap ring.

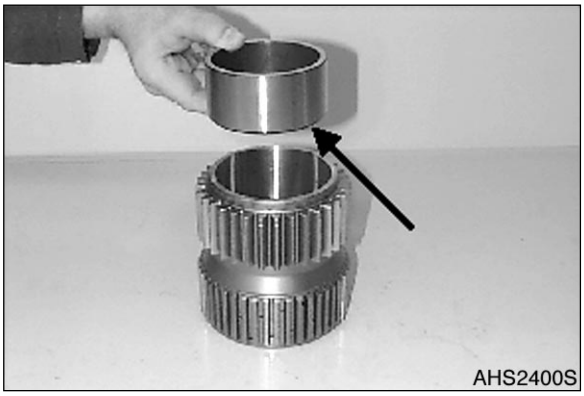

Figure 280

D. Press ball bearing in until contact is obtained.

NOTE: *Install ball bearing, with the lubricating groove (Arrow) facing downward. Apply the pressing-in tool only on the outer bearing race.*

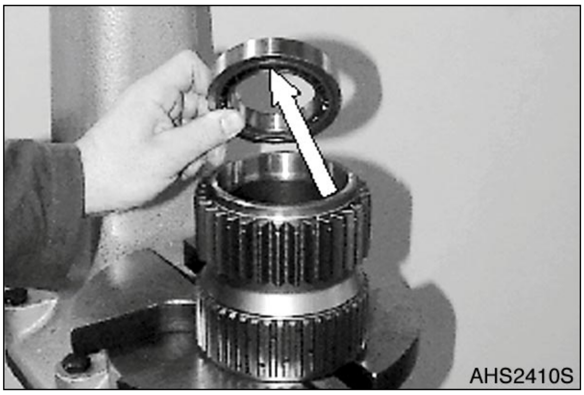

Figure 281

E. Heat ball bearing and line it up until contact is obtained.

NOTE: *Lubricating groove (Arrow) must face upward.*

CAUTION!
Use protective gloves.

Figure 282

F. Line up the bush.

Figure 283

G. Heat spur gear about 120˚C (248˚F) and introduce it until all inner plates are accommodated.

CAUTION!
Use protective gloves.

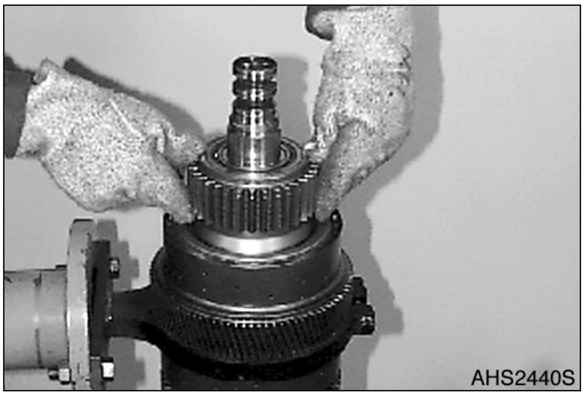

Figure 284

NOTE: *Line up shim = 1.2 mm (0.0472 in).*

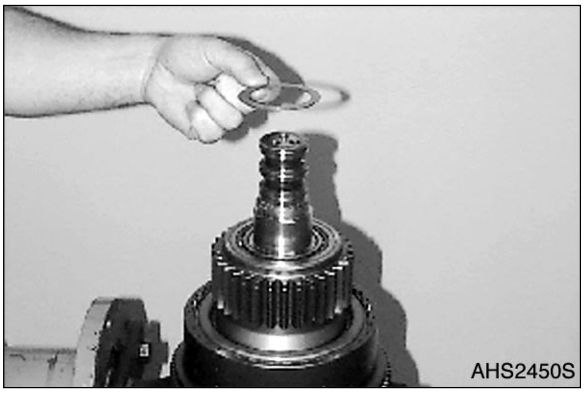

Figure 285

3. Heat inner bearing race and line it up until contact is obtained.

CAUTION!
Use protective gloves.

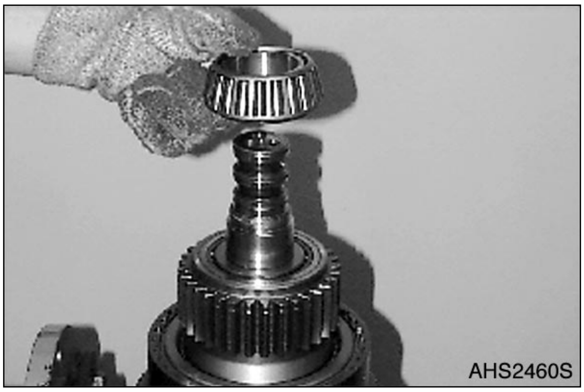

Figure 286

4. Lift plate carrier out of the clamping ring (S). To ensure the exact contact of the components, preload bearing with 100 000 N (10 ton) (Figure 287).

CAUTION!
Support on the lower and on the upper inner bearing race. Use pressure pieces (S).

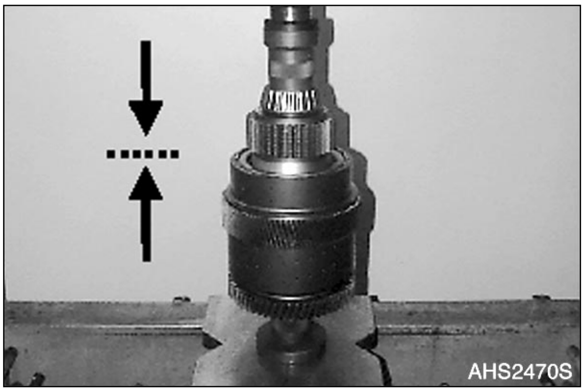

Figure 287

5. Lift plate carrier into the clamping ring (S), secure and tilt it 90°. Wet thread of slotted nut with Loctite #262 and install slotted nut.

   NOTE: *Install slotted nut, with the collar facing the inner bearing race.*

   NOTE: *Torque limit 550 Nm (405 ft lb).*

6. Install opposite slotted nut (KV-side) accordingly.

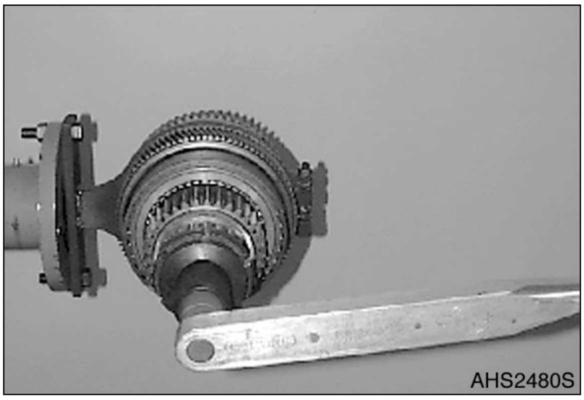

Figure 288

7. Check function of the clutches KV and K1 using compressed air.

NOTE: *At correctly installed components, the closing, resp. opening of the clutches is clearly audible.*

Figure 289

8. Squeeze in and engage rectangular rings (3x, see Arrows).

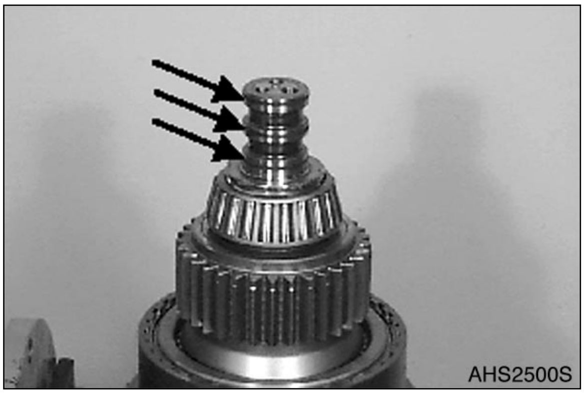

Figure 290

INSTALL COUNTERSHAFT GEAR AND MULTIDISK CLUTCHES

1. Adjust axial play of the countershaft gear bearing 0.0 - 0.05 mm (0.0 - 0.0020 in) (Figure 291 - Example D2).
2. Determine Dimension I (shaft dimension).

   NOTE: *Dimension I e.g. 61.57 mm (2.4240 in).*

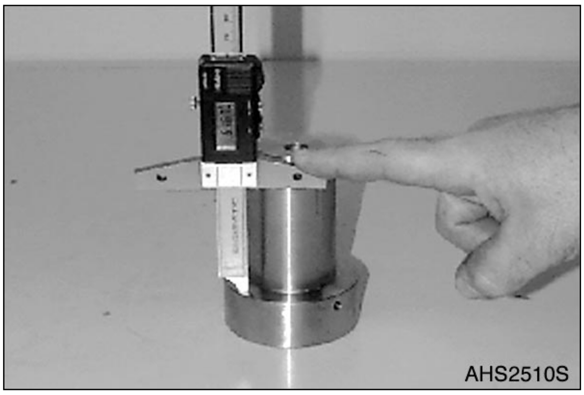

Figure 291

3. Measure Dimension II (housing dimension) from the locating face of the inner bearing race to the locating face of the axle.

   NOTE: *Dimension II e.g. 0.52 mm (0.0205 in).*

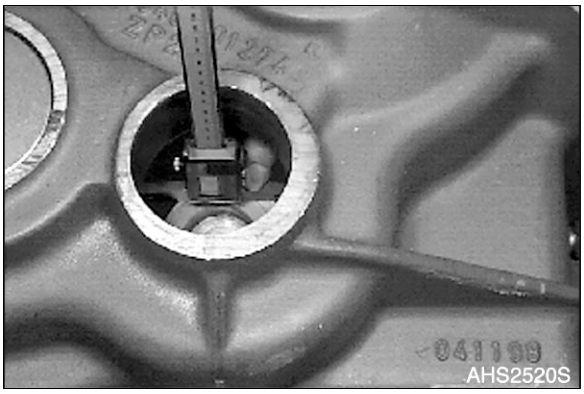

Figure 292

EXAMPLE D1:

Dimension I e.g.	61.57 mm (2.4240 in)
Dimension II e.g.	- 0.52 mm (0.0205 in)
Gives Dimension X	61.05 mm (2.4035 in)
Required Axial Play e.g.	- 0.03 mm (0.0012 in)
Gives Installation Dimension Y e.g.	= 61.02 mm (2.4024 in)

4. Install both inner bearing races. Lay pre-assembled countershaft gear upon the surface plate and determine Dimension III (bearing dimension).

   NOTE: *Dimension III e.g. 59.52 mm (2.3433 in).*

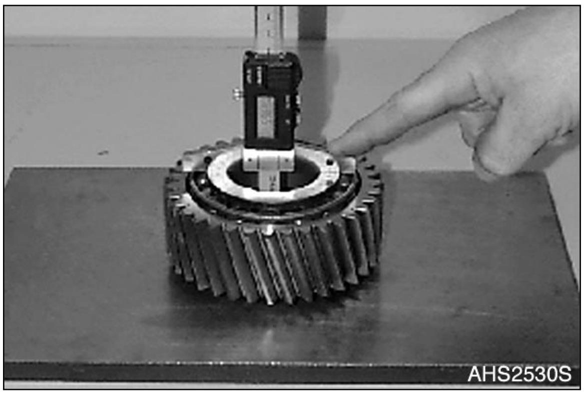

Figure 293

EXAMPLE D2:

Dimension Y (installation dimension)	61.02 mm (2.4024 in)
Dimension III (bearing dimension)	- 59.52 mm (2.3433 in)
Gives Shim e.g.	s = 1.50 mm (0.0591 in)

NOTE: *The assembly of the shim and of the countershaft axle can be performed only after the installation of the clutches (page 139).*

5. Position countershaft gear (along with inner bearing races), see Figure 294.

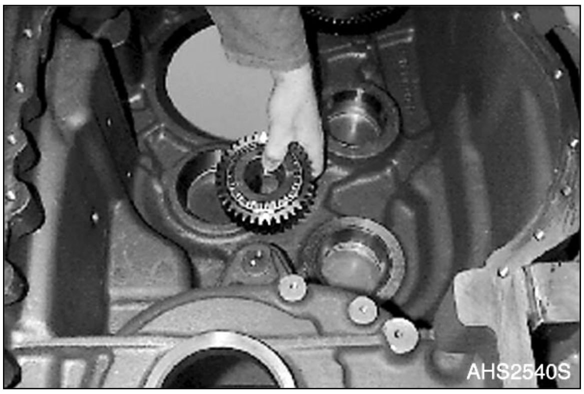

Figure 294

6. Insert outer bearing races KV/K1, KR/K2 and K3/K4 into the housing bores until contact is obtained, see Arrows.

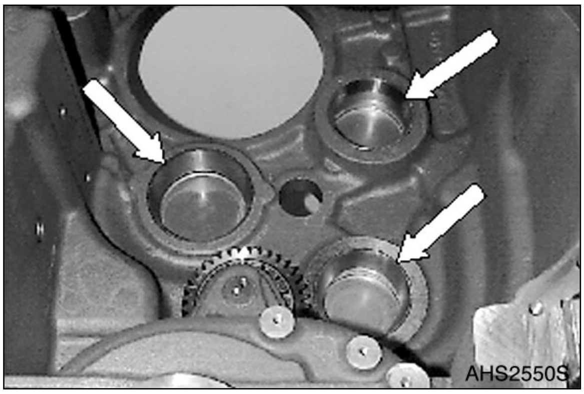

Figure 295

7. Position clutch KV/K1, using lifting device.

Figure 296

8. Position clutch KR/K2.

Figure 297

9. Check installation position of the countershaft gear (Arrow) once more and correct if necessary.

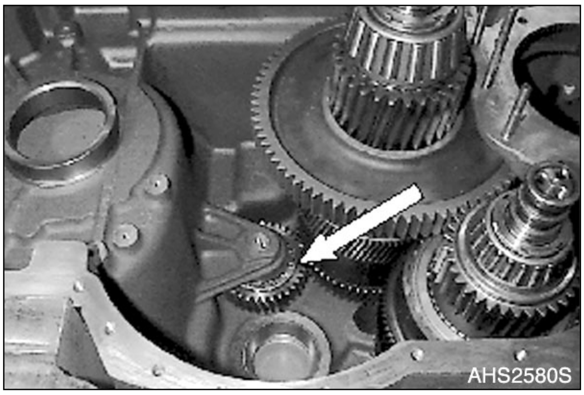

Figure 298

10. Locate the spur gear K3 using Special device and eye bolt (Arrow) axially.

    NOTE: *The securing of spur gear prevents the slipping out of the plates during the lifting into position of the clutch.*

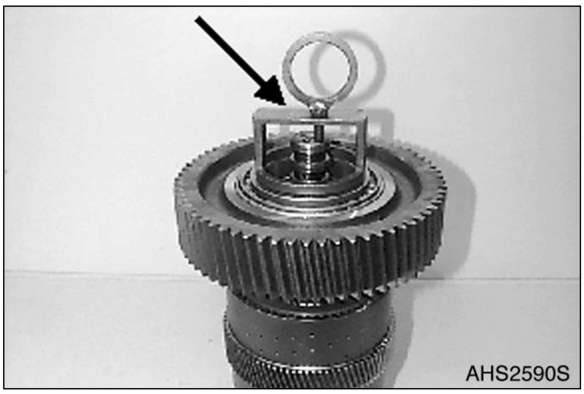

Figure 299

11. Lift clutch KR/K2 slightly, displace it in direction of arrow, and position clutch K3/K4.
12. Now, remove the Special device again.

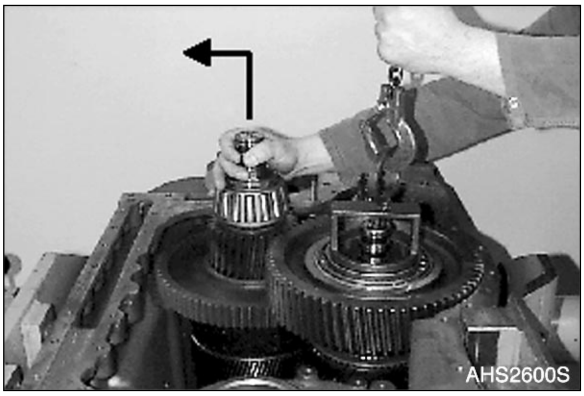

Figure 300

13. Cool down outer bearing race and insert in into housing bore until contact is obtained.

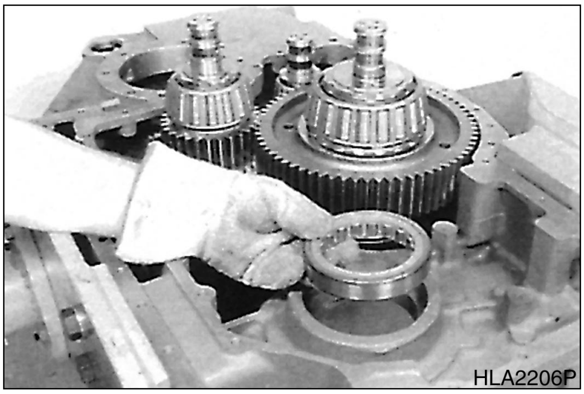

Figure 301

14. Heat inner bearing race and assemble it until contact is obtained.

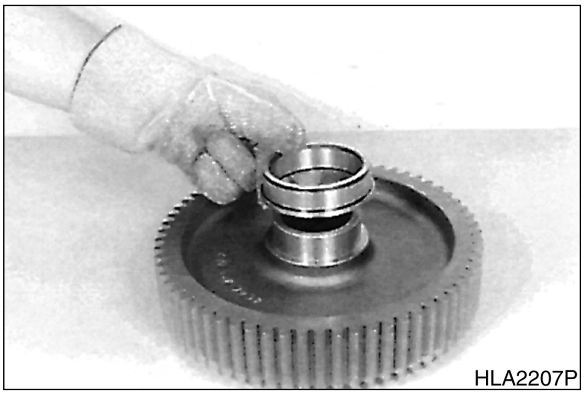

Figure 302

15. Position oil baffle.

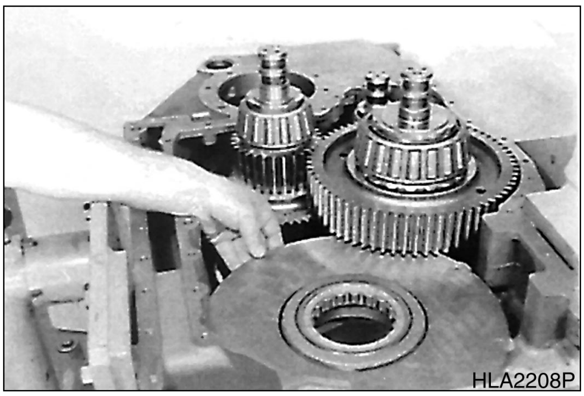

Figure 303

16. Install output gear.

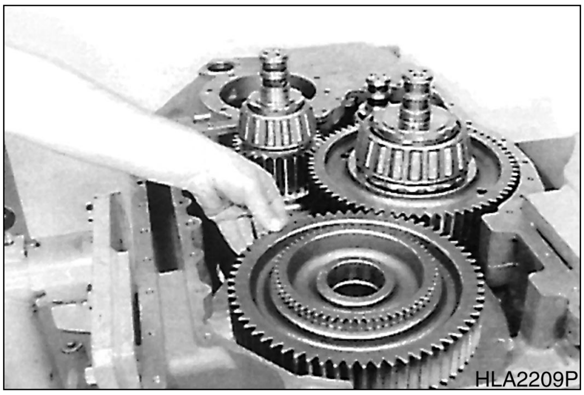

Figure 304

17. Insert second oil baffle and fasten both plates using hex. head screws (mount plain washer).

NOTE: *Torque limit (M8/8.8) 2.35 kg•m (16.96 ft lb).*

NOTE: *Secure hex. head screws with Loctite #262.*

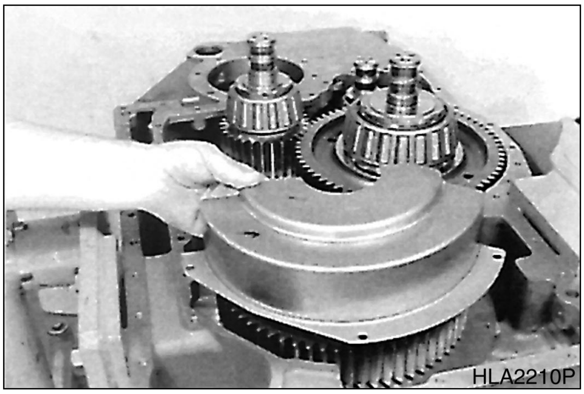

Figure 305

18. Cool down output shaft and install it until contact is obtained.

NOTE: *Pay attention to installation position, see Figure 306.*

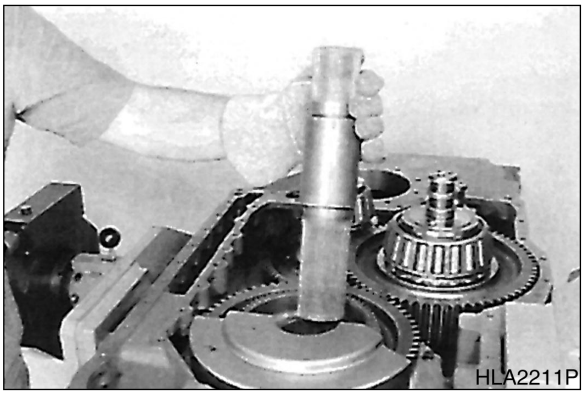

Figure 306

PRE-ASSEMBLE AND MOUNT HOUSING COVER

1. Mount components.

Reference Number	Description
1	Sealing Cover (Use Loctite #262)
2	Connecting Piece (Install New Sealing Ring)
3	Cover Plate (Install New Gasket)
4	Sealing Cover (Use Loctite #262)

NOTE: *According to the transmission version, differences concerning components and their installation positions are possible. In this connection, see the respective Spare Parts List.*

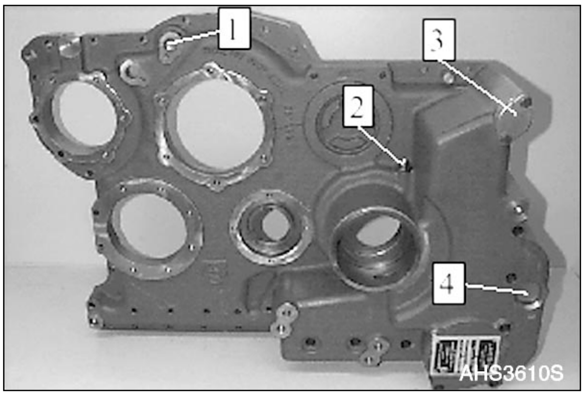

Figure 307

2. Drive the roll pin (2x8 mm (0.0787 x 0.3150 in) flush-mounted in (1, Figure 308).
3. Equip screw plug with new O-ring and install it (2, Figure 308).

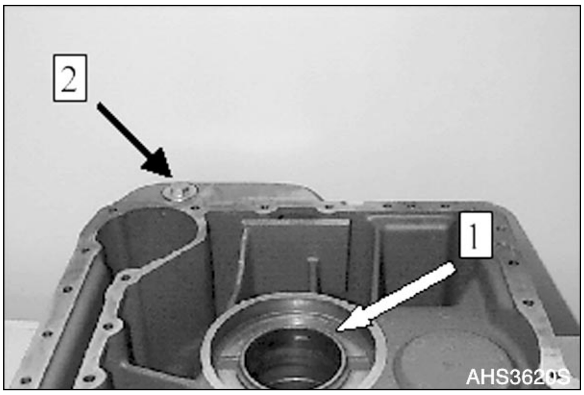

Figure 308

4. Squeeze both snap rings (Arrow) into the recess.

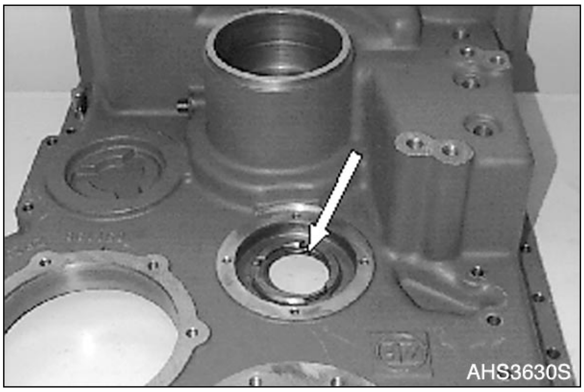

Figure 309

5. Expand the two snap rings. Introduce ball bearing, with the annular groove facing upward, until the upper snap ring snaps into the groove of the ball bearing.

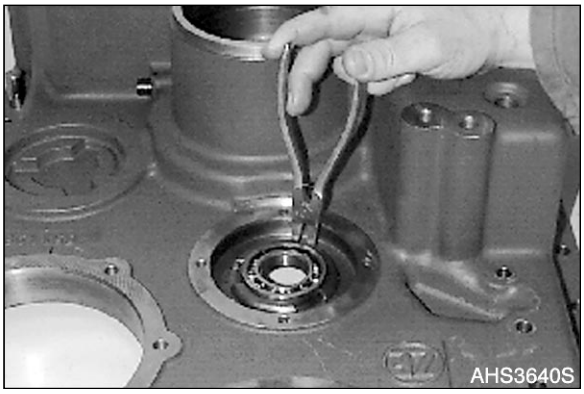

Figure 310

6. Insert gear wheel until contact is obtained.

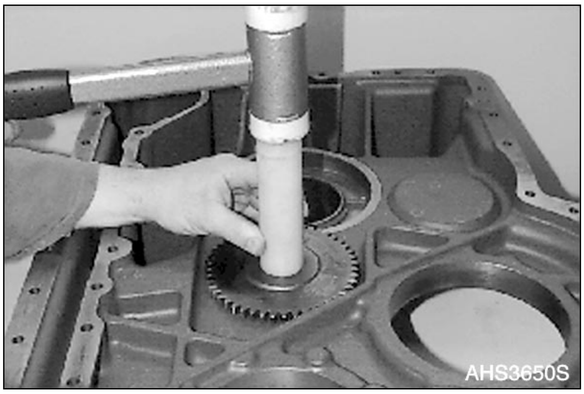

Figure 311

7. Secure gear wheel using circlip.

Figure 312

8. Cover mounting face with sealing compound Loctite #574).
9. Install two adjusting screws and position the housing cover on the gearbox housing until contact is obtained, using lifting device.

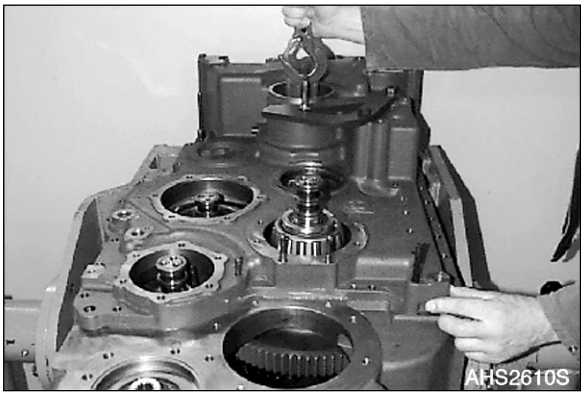

Figure 313

10. Insert both cylindrical pins (1 and 2, Figure 314) until contact is obtained.
11. Fasten housing cover using screw connection.
12. Drive roll pin (3, Figure 314) flush-mounted in.

    NOTE: *Torque limit (M10/8.8) 46 Nm (34 ft lb).*

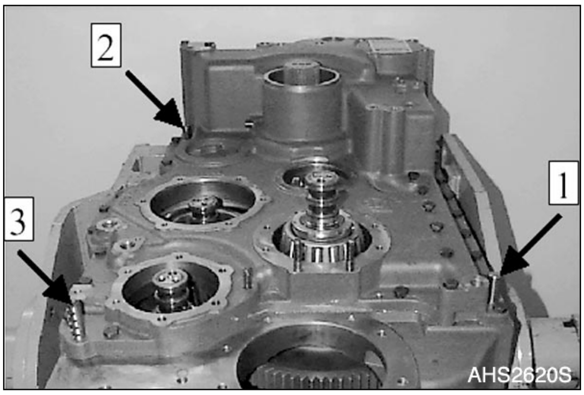

Figure 314

13. Insert ball bearing until contact is obtained.

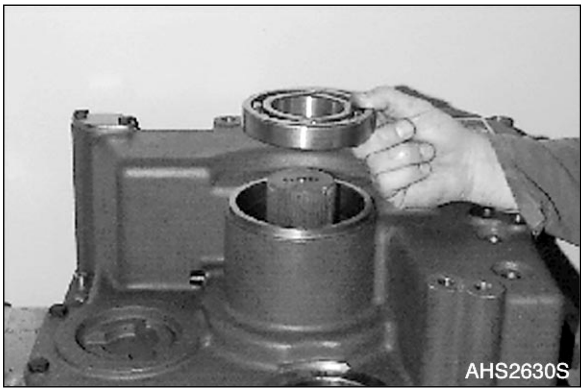

Figure 315

NOTE: *Introduce shim s = 4.0 mm (0.1575 in).*

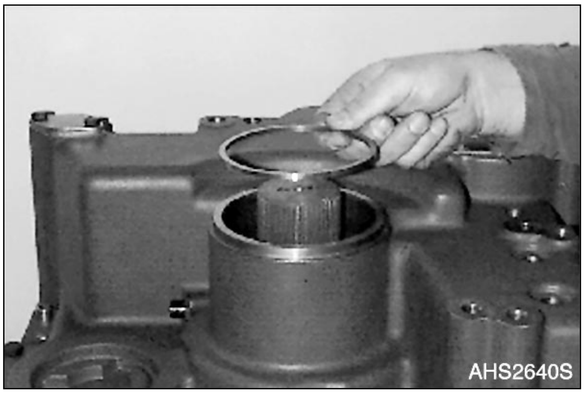

Figure 316

14. Secure ball bearing free play, using shim and circlip.

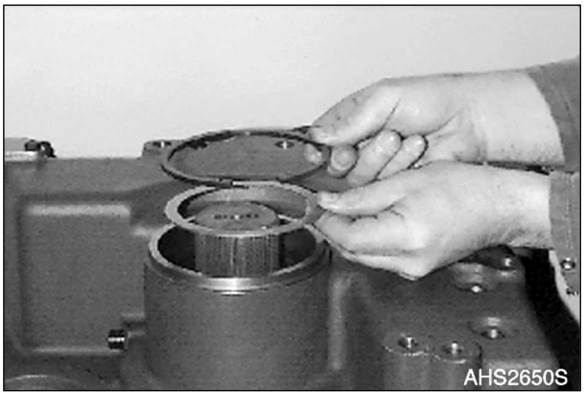

Figure 317

15. Install shaft seal, with the sealing lip facing the oil chamber.

NOTE: *At application of the prescribed driver (S), the exact installation position is obtained. Grease sealing lip.*

CAUTION!

According to the version, different shaft seals can have been applied. Outer diameter rubber-coated – wet with mineral spirits.

Outer diameter metallic - wet with sealing compound (Loctite #574).

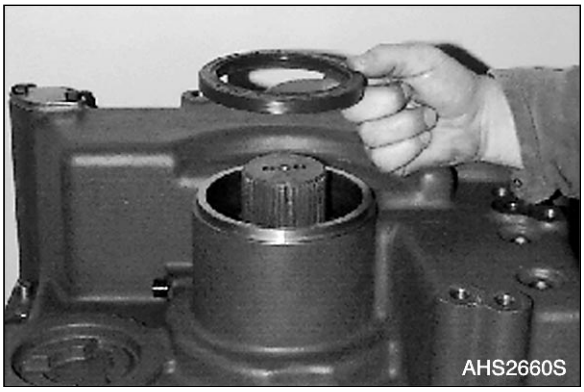

Figure 318

16. Press screening plate against shoulder.

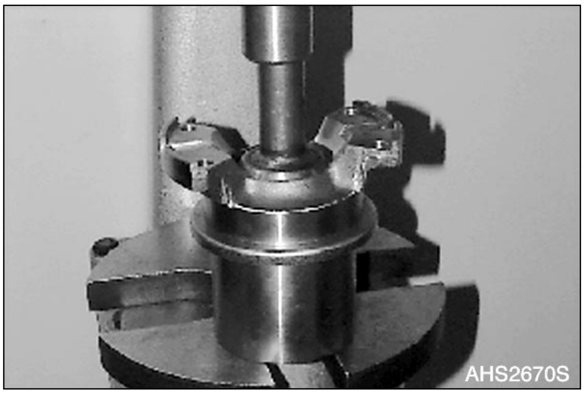

Figure 319

17. Line up output flange.
18. Wet contact face of the shim with sealing compound Loctite #574 and fasten output flange with hex head screws.

NOTE: *Torque limit (M10/8.8) 46 Nm (34 ft lb).*

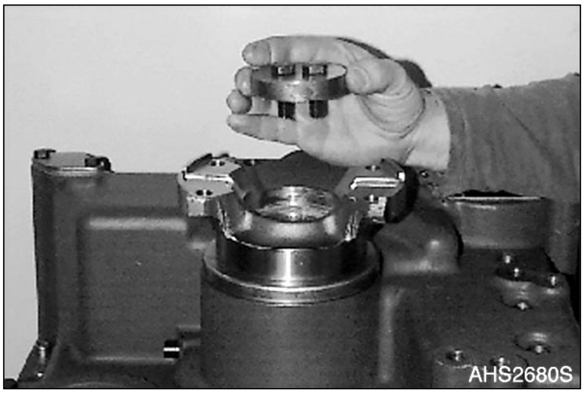

Figure 320

19. Secure hex. head screws using lock plate.

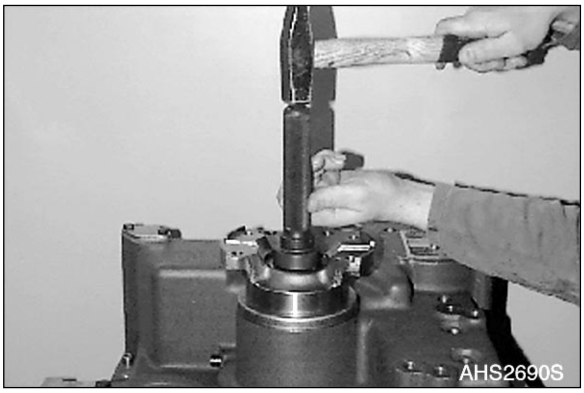

Figure 321

20. Adjust bearing preload – Clutch K3/K4 = 0.00 - 0.15 mm (0.00 - 0.0059 in) (Figure 322 - Figure 324).

    A. Insert inner bearing race into the outer race.

       Housing dimension: Press the inner bearing race uniformly on, and determine Dimension I from the mounting face to the inner bearing race.

NOTE: *Dimension I e.g. 43.85 mm (1.7264 in).*

NOTE: *Apply several measuring points and determine the average value.*

Cover dimension: Determine Dimension II from the mounting face to the con-tact / inner bearing race.

NOTE: *Dimension II e.g. 42.15 mm (1.6594 in).*

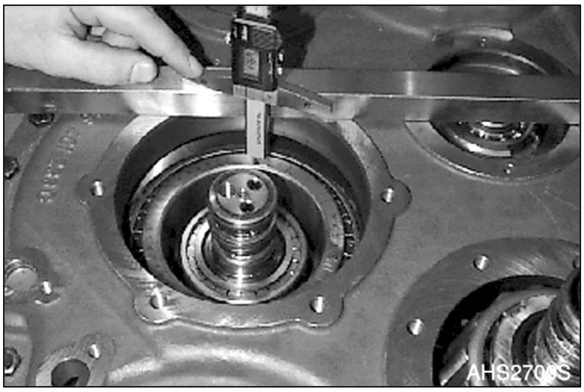

Figure 322

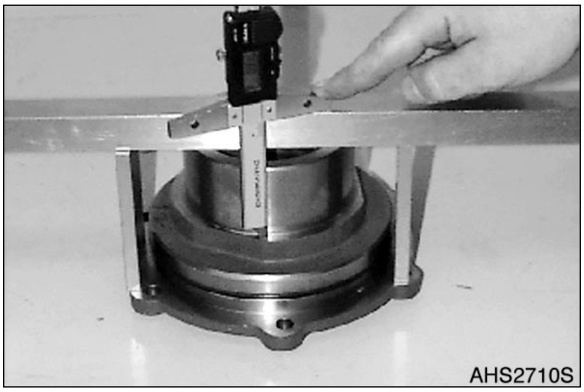

Figure 323

B. Line up the shim.

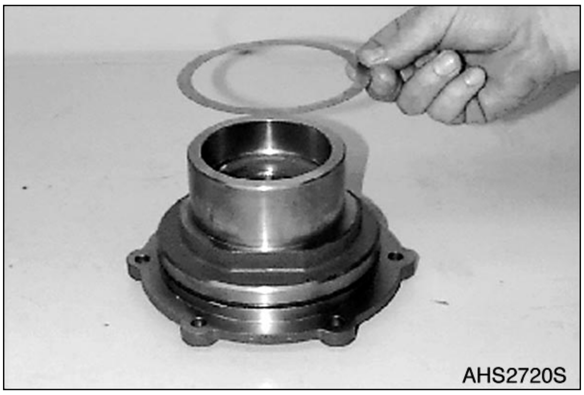

Figure 324

EXAMPLE F:

Dimension I e.g.	43.85 mm (1.7264 in)
Dimension II e.g.	- 42.15 mm (1.6594 in)
Difference	= 1.70 mm (0.0669 in)
Bearing Preload e.g.	+ 0.10 mm (0.0039 in)
Gives Shim (s)	s = 1.80 mm (0.0709 in)

21. Heat inner bearing race and position it against shoulder.

CAUTION!

Use protective gloves.

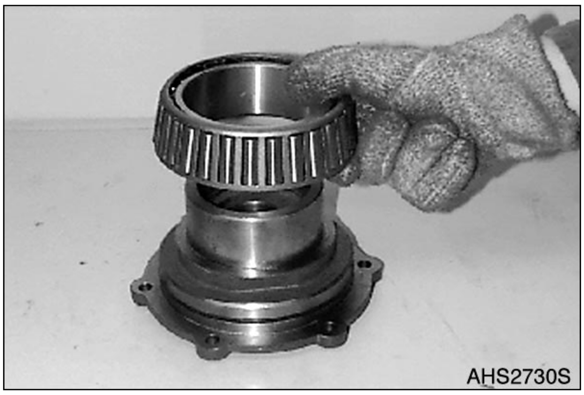

Figure 325

22. Install and grease O-ring (Figure 326).
23. Heat inner diameter of the bearing cover (bearing seat).

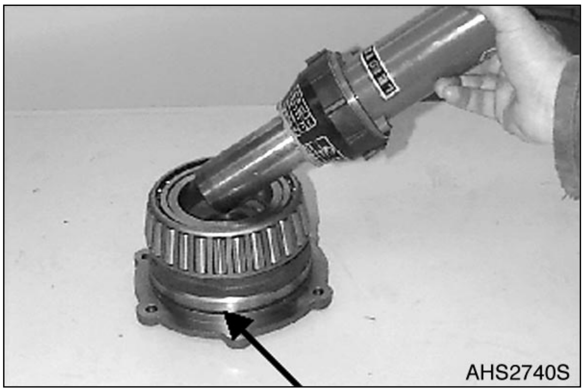

Figure 326

24. Grease and align rectangular rings (3x, Figure 327) and align them centrically.

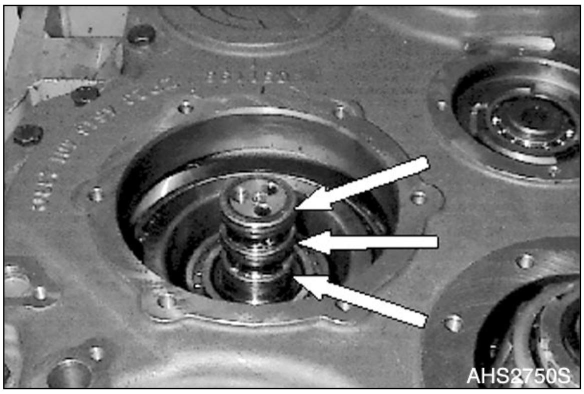

Figure 327

25. Install two adjusting screws. Line up the bearing cover using hex. head screws and pull it uniformly against shoulder.

NOTE: *Torque limit (M10/8.8) 46 Nm (34 ft lb).*

NOTE: *Pay attention to the radial installation position, see markings (Arrows).*

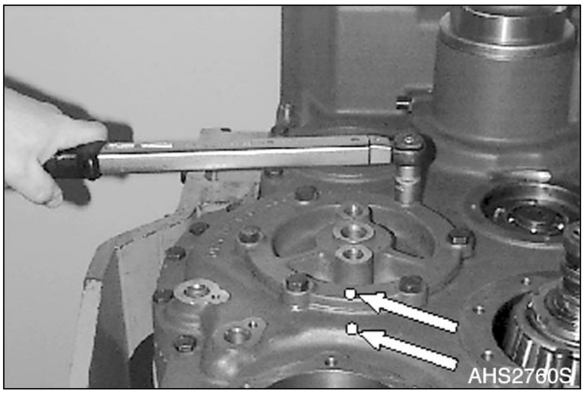

Figure 328

26. Adjust bearing preload of Clutch KR/K2 = 0.20 - 0.25 mm (0.0079 - 0.0098 in) (Figure 329 - Figure 332).

    A. Insert outer bearing race until contact is obtained.

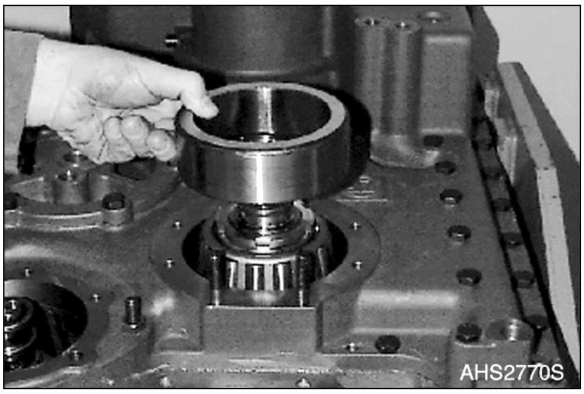

Figure 329

Housing dimension: Determine Dimension I from outer bearing race to mounting face.

NOTE: *Dimension I e.g. 15.68 mm (0.6173 in).*

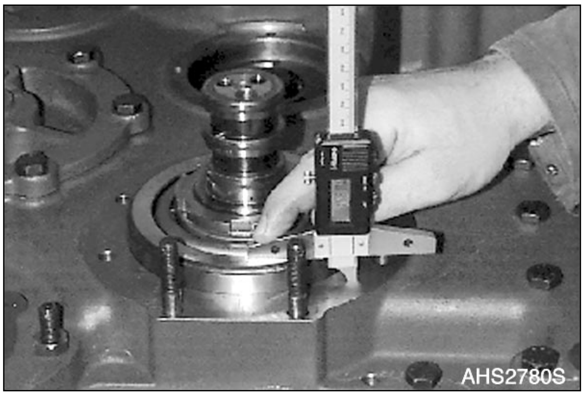

Figure 330

Cover dimension: Determine Dimension II from the contact/outer bearing race to the mounting face.

NOTE: *Dimension II e.g. 17.46 mm (0.6874 in).*

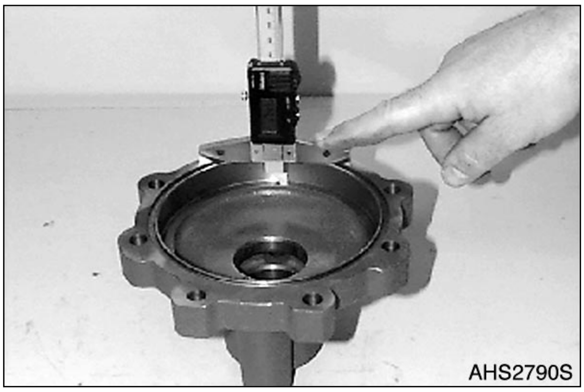

Figure 331

B. Make shim adhere with assembly grease in the cover. Install O-ring (Arrow).

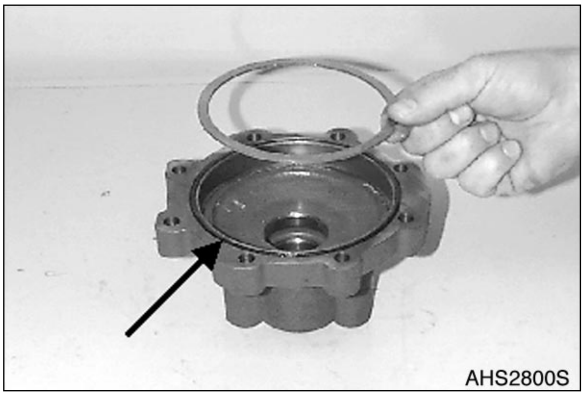

Figure 332

EXAMPLE G:

Dimension I e.g.	17.46 mm (0.6874 in)
Dimension II e.g.	- 15.68 mm (0.6173 in)
Difference	= 1.78 mm (0.0701 in)
Bearing Preload e.g.	+ 0.22 mm (0.0079 in)
Gives Shim (s)	s = 2.00 mm (0.0787 in)

27. Grease and align rectangular rings (Figure 333) centrically.

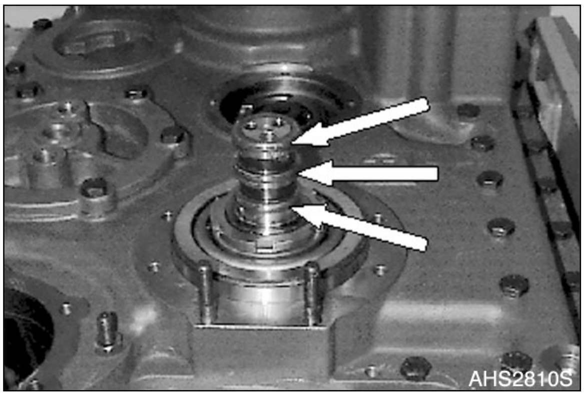

Figure 333

28. Pull bearing cover uniformly against shoulder.

NOTE: *Torque limit (M10/8.8) 46 Nm (34 ft lb).*

NOTE: *Pay attention to the radial installation position, see markings (Figure 334).*

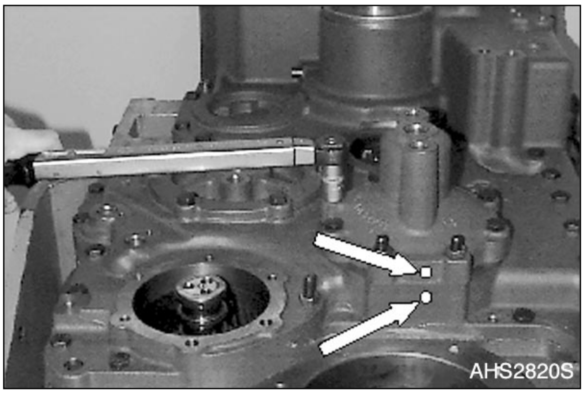

Figure 334

29. Adjust Bearing preload of the Clutch KV/K1= 0.15 - 0.20 mm (0.0059 - 0.0079 in) (Figure 335 - Figure 338).

    A. Lay outer bearing race over the inner bearing race.

    Housing dimension: Press the outer bearing race uniformly on, and determine Dimension I from the mounting face to the outer bearing race.

    NOTE: *Dimension I e.g. 52.67 mm (2.0736 in).*

    NOTE: *Apply several measuring points and determine the average value.*

    B. Insert ring, with the chamfer facing downward, into the bearing cover.

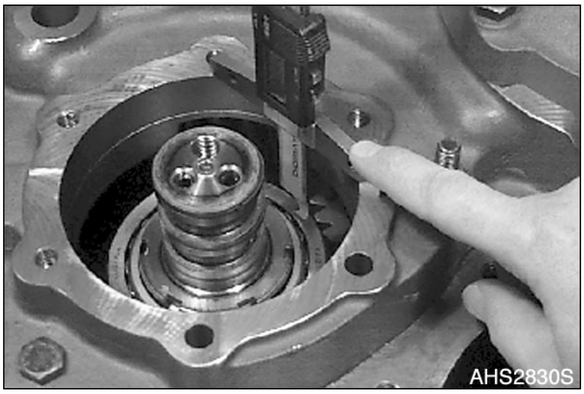

Figure 335

Figure 336

Cover dimension: Determine Dimension II from the mounting face to the ring.

NOTE: *Dimension II e.g. 50.75 mm (1.9980 in).*

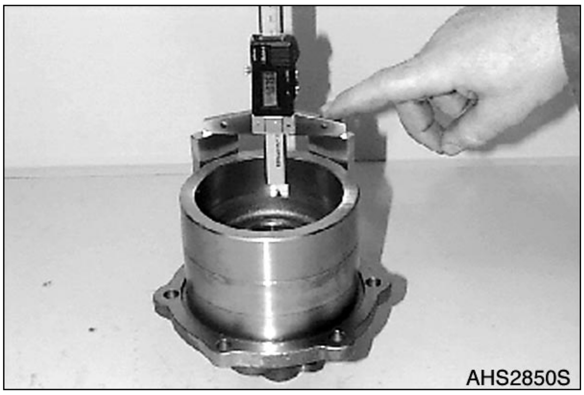

Figure 337

C. Insert shim.

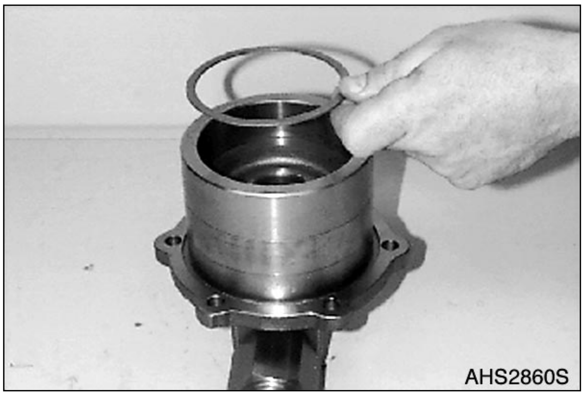

Figure 338

EXAMPLE H:

Dimension I	52.67 mm (2.0736 in)
Dimension II	- 50.75 mm (1.9980 in)
Difference	1.92 mm (0.0076 in)
Bearing Preload e.g.	+ 0.18 mm (0.0071 in)
Gives Shim (s)	s = 2.10 mm (0.0827 in)

30. Insert outer bearing race until contact is obtained.
31. Line up O-ring (Figure 339).

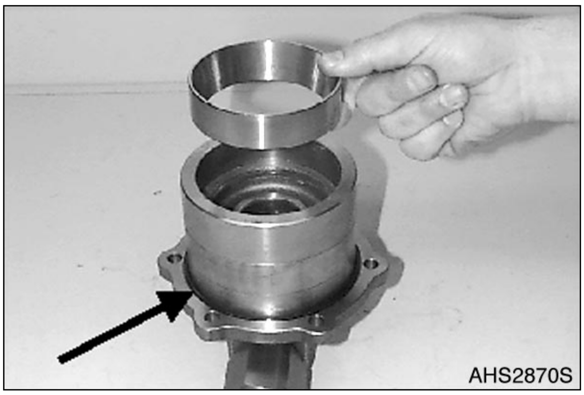

Figure 339

32. Grease and align the rectangular rings (Figure 340) centrically.

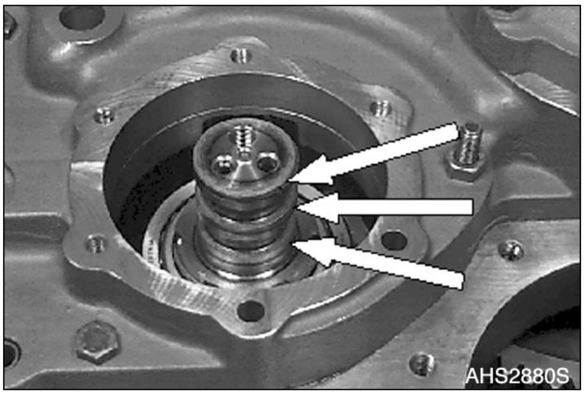

Figure 340

33. Insert the bearing cover until contact is obtained and fasten using hex. head screws.

    NOTE: *Torque limit (M10/8.8) 46 Nm (34 ft lb).*

    NOTE: *Pay attention to the radial installation position, see markings (Arrows).*

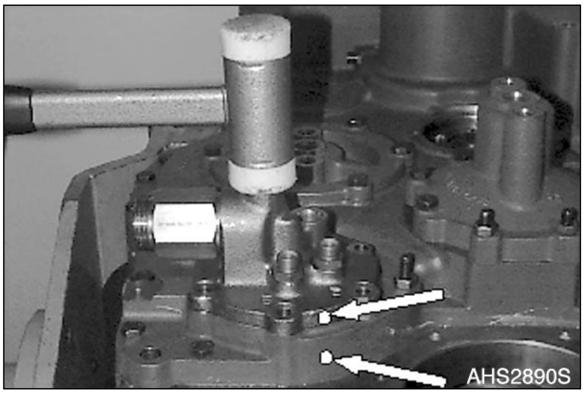

Figure 341

INSTALL COUNTERSHAFT AXLE

1. Tilt gearbox housing 180˚.
2. Align countershaft gear centrically.
3. Install adjusting screw (Figure 342).

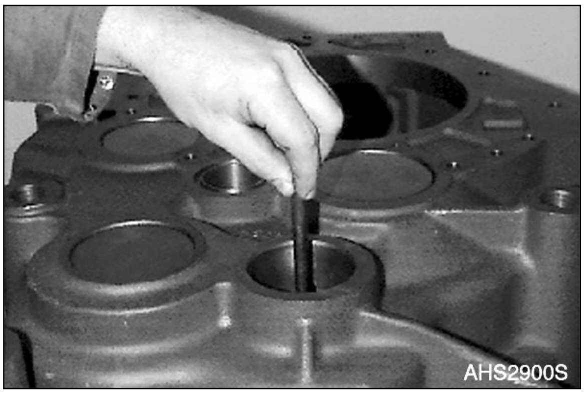

Figure 342

4. Supercool pin.
5. Make determined shim (see also page 123) adhere with grease.

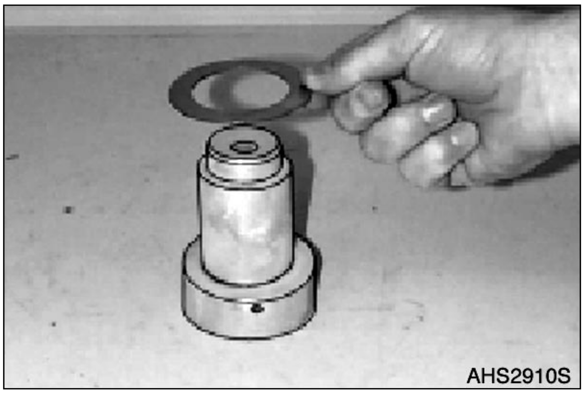

Figure 343

6. Insert pin until contact is obtained.

CAUTION!
Use protective gloves.

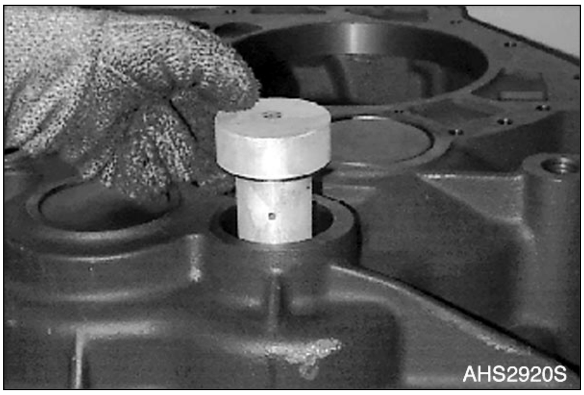

Figure 344

7. Remove adjusting screw and secure bolt using hex. head screw.

   NOTE: *Torque limit (M10/8.8) 46 Nm (34 ft lb).*

   NOTE: *Wet thread of hex. head screw with Loctite #243.*

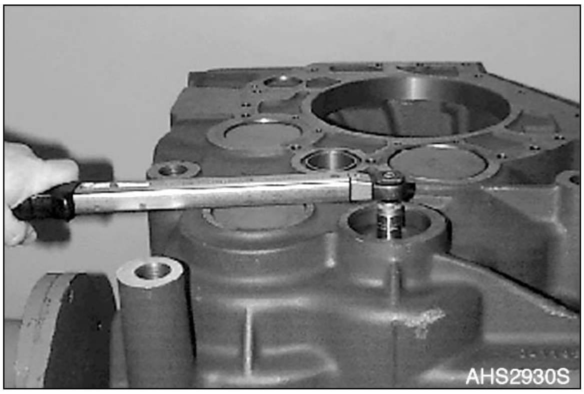

Figure 345

8. Drive the sealing covers (Figure 346) in, with the concave side showing downward, flush-mounted to the housing face.

   NOTE: *Wet contact face with Loctite #262.*

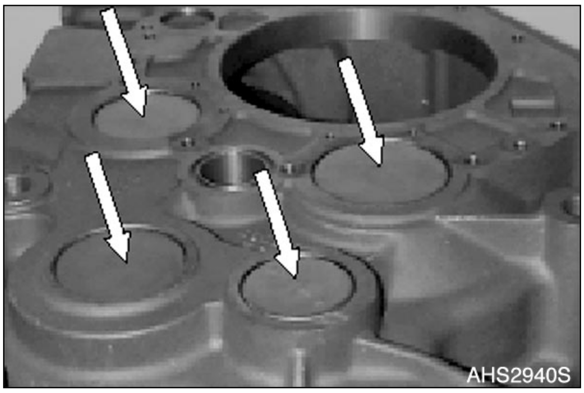

Figure 346

HYDRAULIC PUMP

1. Press needle sleeve (Figure 347) against shoulder, with the reinforced shell facing the pressing-in tool.

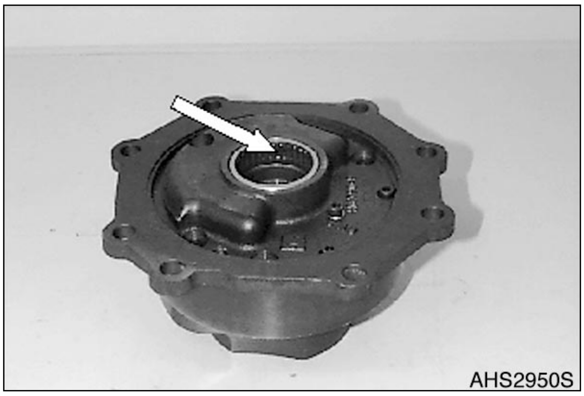

Figure 347

2. Insert disk s = 1.3 mm (0.0512 in) and position outer bearing race against shoulder.

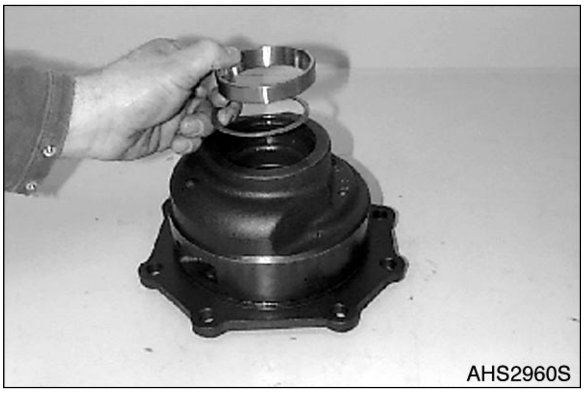

Figure 348

3. Install and grease O-ring (Figure 349).

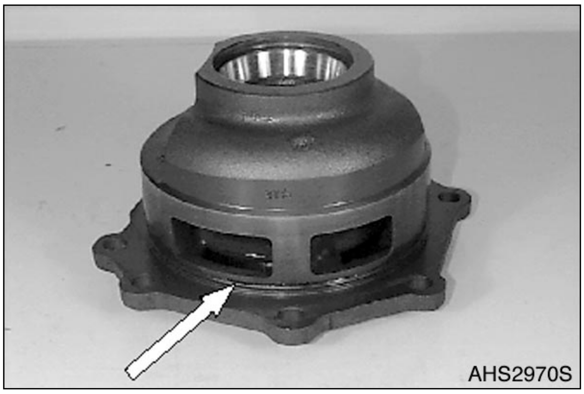

Figure 349

4. Supercool the pump to about -80˚C (-112˚F).

5. Install two adjusting screws and introduce pump until contact is obtained.

NOTE: *Pay attention to the radial installation position.*

CAUTION!
Use protective gloves.

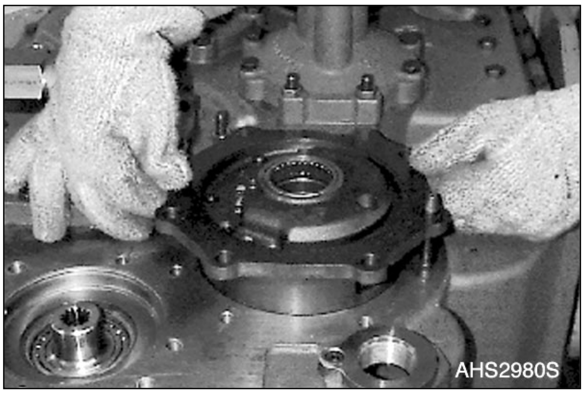

Figure 350

6. Install O-ring (Figure 351) and mount pump flange.

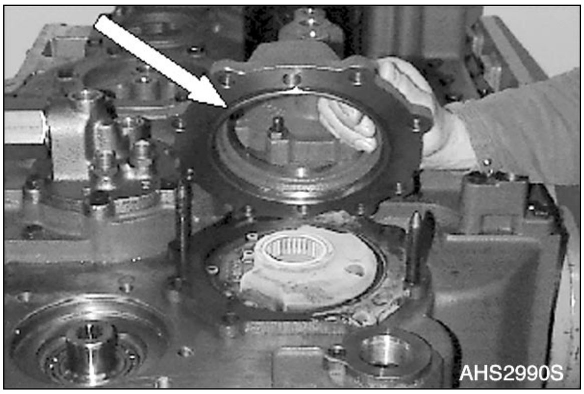

Figure 351

7. Fasten pump flange, resp. the pump using hex. head screws.

NOTE: *Torque limit (M12/8.8) 79 Nm (58 ft lb).*

NOTE: *Wet thread of the two hex. head screws, (Position, see Arrows) with Loctite #243 (through holes).*

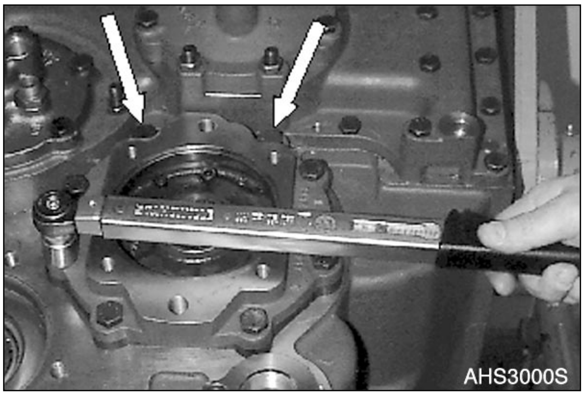

Figure 352

8. Insert O-ring (Figure 353) into the annular groove and grease it. Fasten pump flange (power take-off) with hex. head screws.

NOTE: *Torque limit (M14/8.8) 125 Nm (92 ft lb).*

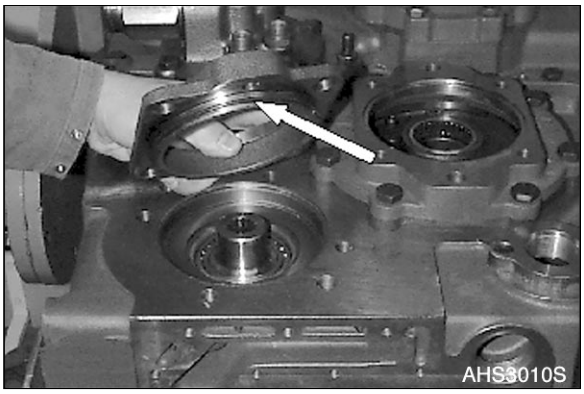

Figure 353

AXLE DISCONNECTION

1. Install shaft seal (Arrow), with the sealing lip facing the oil chamber.

   NOTE: *At application of the prescribed driver (S), the exact installation position is obtained. Grease sealing lip.*

   CAUTION!

   According to the version, different shaft seals may be applied: Outer diameter rubber-coated – wet with mineral spirits.

   Outer diameter metallic - wet with sealing compound Loctite #574.

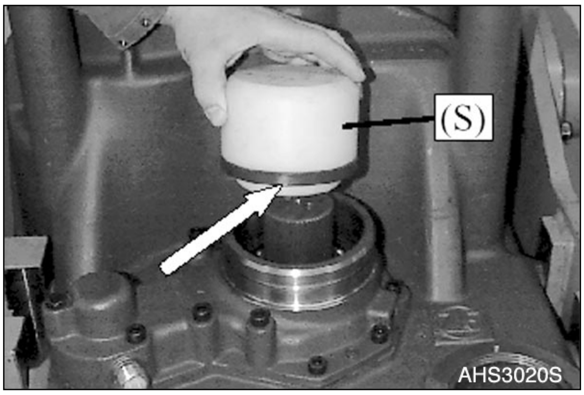

Figure 354

2. Press screening plate (Figure 355) against shoulder.

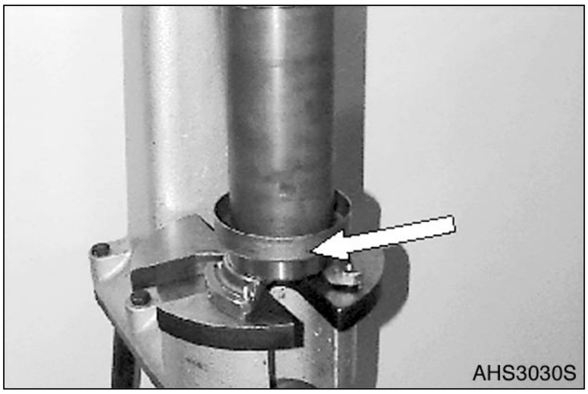

Figure 355

3. Line up output flange.
4. Wet contact face of the disk with sealing compound Loctite #574 and fasten output flange with hex. head screws.

   NOTE: *Torque limit (M10/8.8) 46 Nm (34 ft lb).*

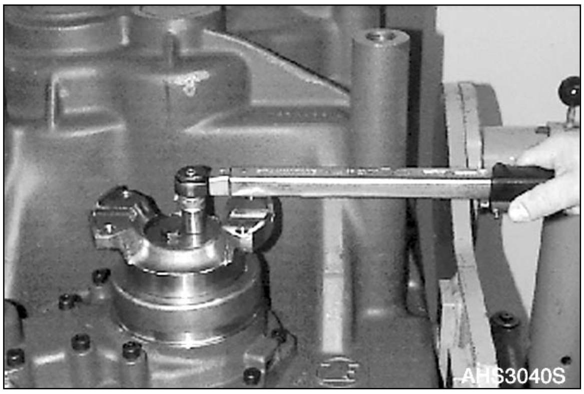

Figure 356

5. Secure hex. head screws using lock plate.

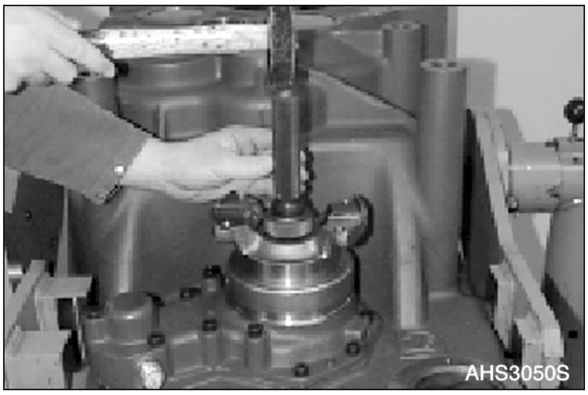

Figure 357

FILTER

1. Introduce filter (compl.) into the housing bore.

   NOTE: *Oil sealing ring (Arrow).*

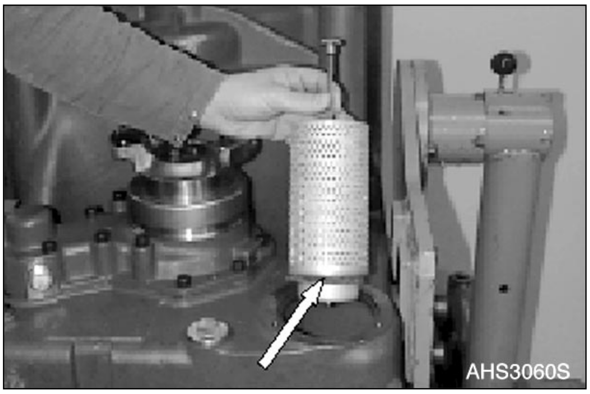

Figure 358

2. Fasten cover using hex. head screws (mount flat washers).
3. Install new O-ring (Arrow).

   NOTE: *Torque limit (M8/8.8) 23 Nm (17 ft lb).*

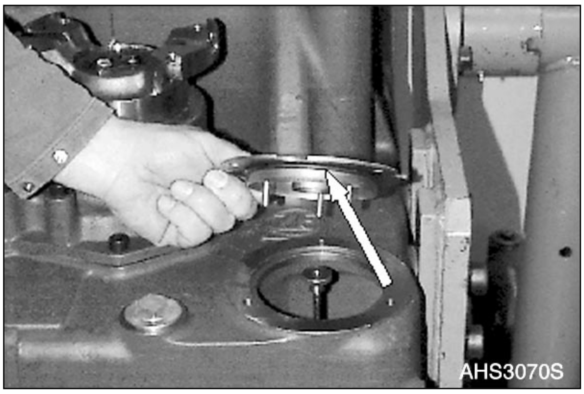

Figure 359

4. Equip screw plugs (1 and 2, Figure 360) with new O-ring and install them.
5. Mount gasket and fasten cover plate (3, Figure 360) using hex. head screws.

   NOTE: *Torque limit (screw plugs) 140 Nm (103 ft lb).*

   NOTE: *Torque limit (M8/8.8) 23 Nm (17 ft lb).*

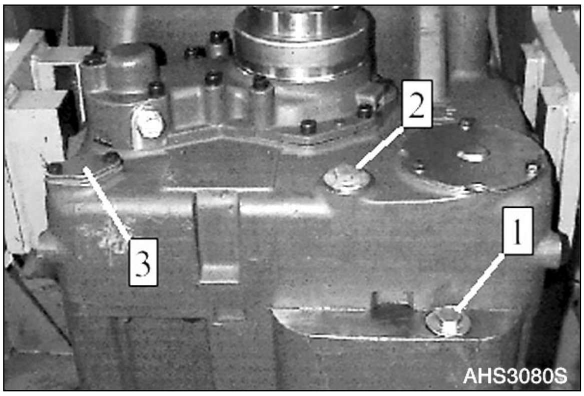

Figure 360

INPUT SHAFT (POWER TAKE-OFF PUMP)

1. Tilt gearbox housing 180˚.
2. Squeeze V-rings (3x) into the recess of the driver (internal splines). Install fitting key (Figure 361).

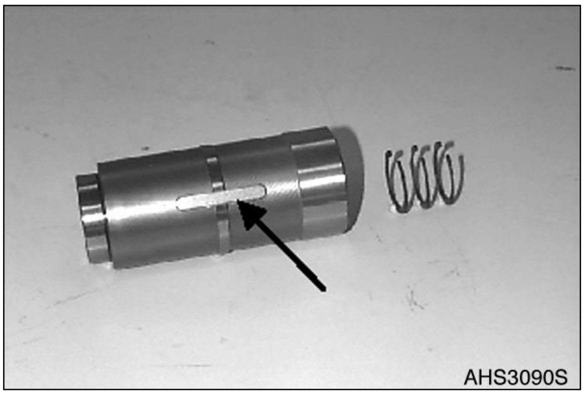

Figure 361

3. Adjust Gap Dimension = 0.50 mm (0.0197 in) (Driver/ Input shaft) (Figure 362 - Figure 366).

Reference Number	Description
1	Driver
2	Input Shaft

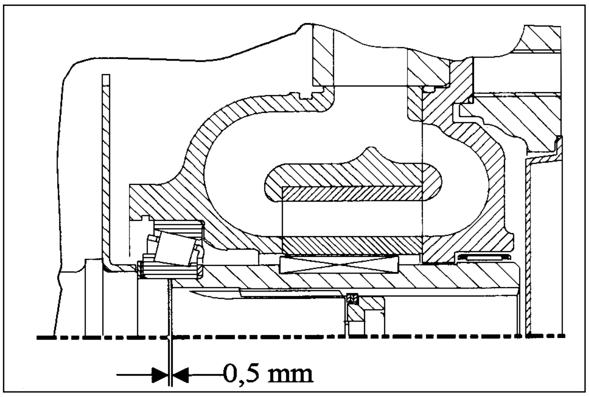

Figure 362

A. Line up the disk s = 1.90 mm (0.0748 in) and position inner bearing race against shoulder.

Figure 363

B. Determine Dimension I from the inner bearing race to the end face/ driver.

NOTE: *Dimension I e.g. 9.64 mm (0.3795 in).*

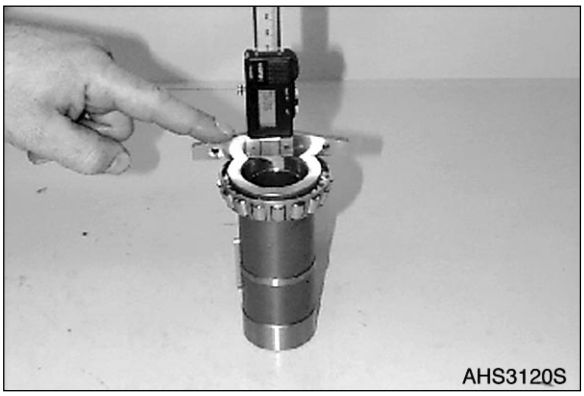

Figure 364

C. Determine Dimension II (A – B).

NOTE: *Dimension II e.g. 10.64 mm (0.4189 in).*

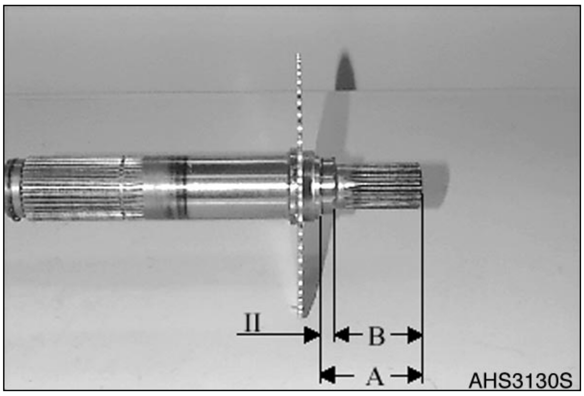

Figure 365

EXAMPLE J:

Dimension II	10.64 mm (0.4189 in)
Dimension I	- 9.64 mm (0.3795 in)
Difference	= 1.00 mm (0.0394 in)
Required Gap Dimension	+ 0.50 mm (0.0197 in)
Gives Shim (s)	= 1.50 mm (0.0591 in)

D. Line up shim(s).

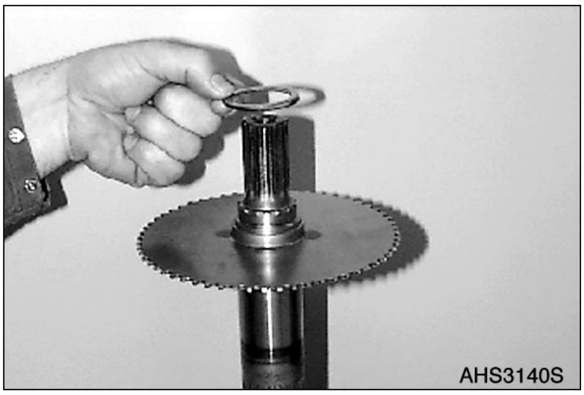

Figure 366

4. Position driver against shoulder and secure it using clamping disk and socket head screw.

NOTE: *Torque limit (M10/8.8, DIN 6912) 32 Nm (24 ft lb).*

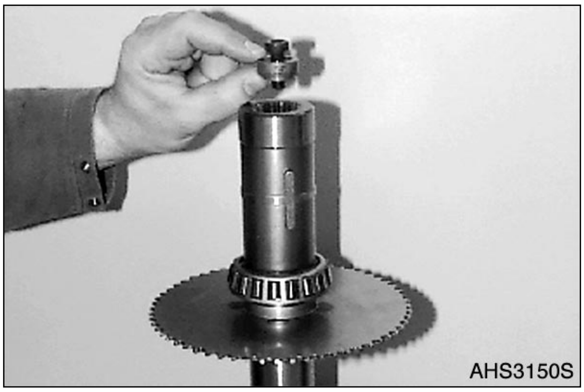

Figure 367

5. Press inner bearing race against shoulder.

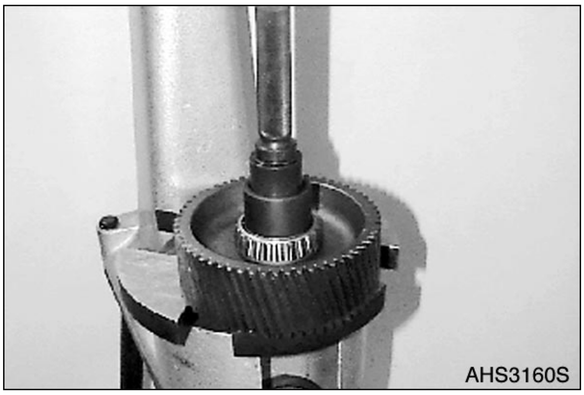

Figure 368

6. Squeeze circlip in (Figure 369) and line up the drive gear.

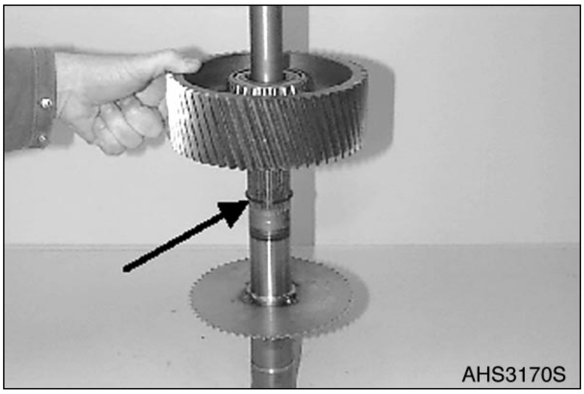

Figure 369

7. Squeeze circlip in (Figure 370) and engage it.

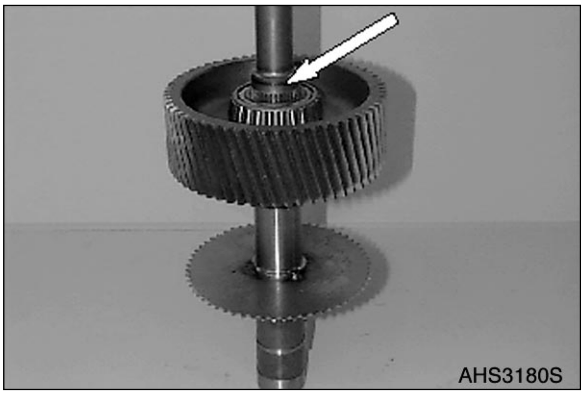

Figure 370

8. Introduce pre-assembled input shaft until contact is obtained.

   NOTE: *Pay attention to the overlapping of the fitting key with the fitting key groove.*

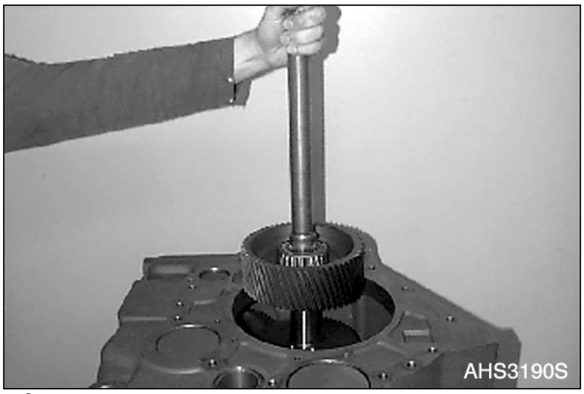

Figure 371

9. Adjust Axial Play of the Input Shaft Bearing = 0.0 - 0.05 mm (0.0000 - 0.0020 in) (Figure 372 - Figure 374).

   A. Mount flat gasket. Mount outer bearing race, press it uniformly on and determine Dimension I from the mounting face (gasket) to the outer bearing race.

NOTE: *Dimension I e.g. 128.50 mm (5.0591 in).*

NOTE: *Apply several measuring points and determine the average value.*

   B. Measure Dimension II from the mounting face/converter bell to the locating face/outer bearing race.

NOTE: *Dimension II e.g. 127.46 mm (5.0181 in).*

   C. Insert shim and position outer bearing race until contact is obtained.

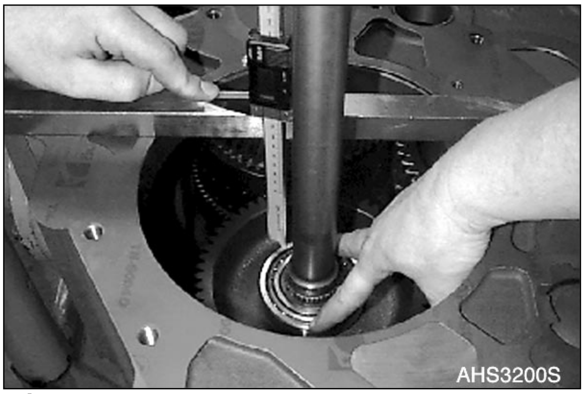

Figure 372

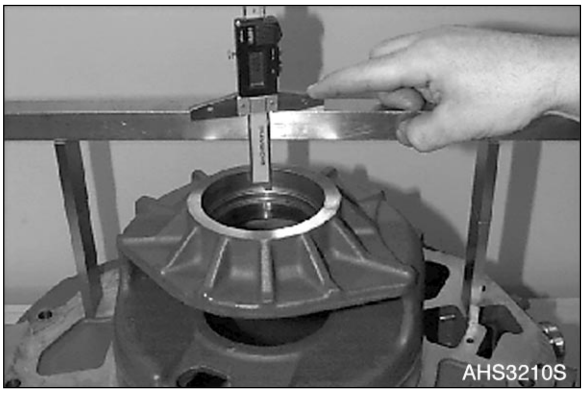

Figure 373

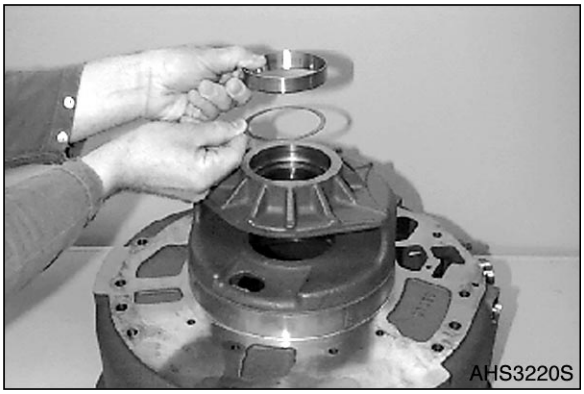

Figure 374

EXAMPLE K:

Dimension I	128.50 mm (5.0591 in)
Dimension II	- 127.46 mm (5.0181 in)
Difference	1.04 mm (0.0409 in)
Axial Play e.g.	- 0.04 mm (0.0016 in)
Gives Shim (s)	= 1.00 mm (0.0394 in)

INPUT – CONVERTER BELL

1. Insert outer bearing race into the housing bore until contact is obtained and install inner bearing race, see Figure 375.

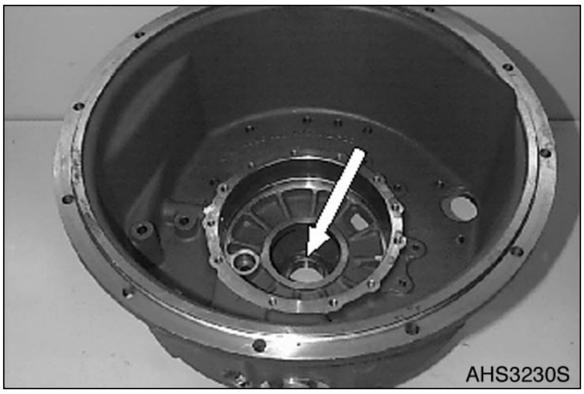

Figure 375

2. Introduce spur gear (Figure 376). starting from the side, with the long collar facing upward, and bring it in position.

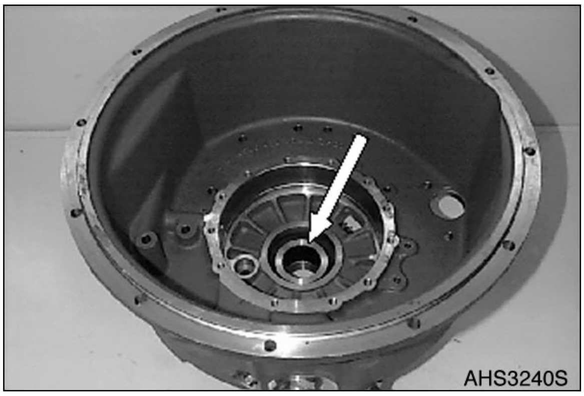

Figure 376

3. Insert both roll pins (ø 2.5 mm (10.0984 in) and ø 1.5 mm (0.0591 in)) flush-mounted into the bore (Arrow) of the input shaft.

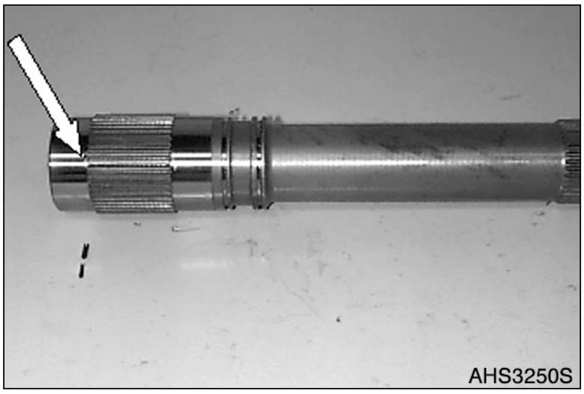

Figure 377

4. Supercool the input shaft and introduce it until contact is obtained.

CAUTION!
Use protective gloves.

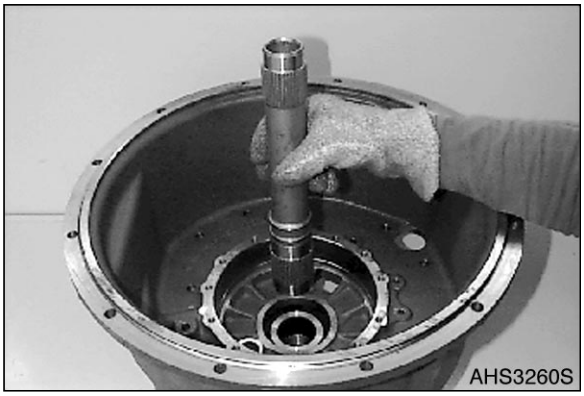

Figure 378

5. Heat inner bearing race and line it up until contact is obtained.

⚠ CAUTION!
Use protective gloves.

Figure 379

6. Position outer bearing race against shoulder.

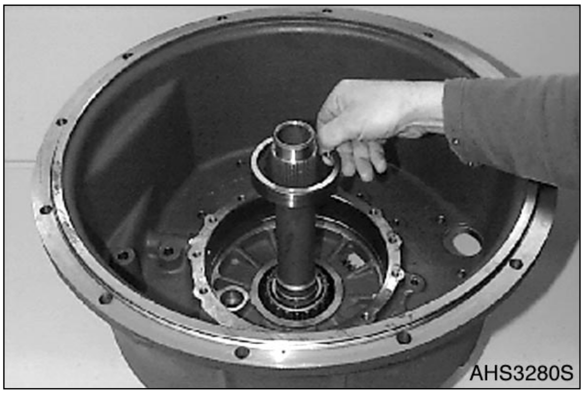

Figure 380

7. Adjust Axial play of the Drive gear bearing = 0.03 - 0.07 mm (0.0012 - 0.0028 in) (Figure 381 - EXAMPLE L).

   A. Measure Dimension I from the mounting face to the outer bearing race.

NOTE: *Dimension I e.g. 59.60 mm (2.3465 in).*

   B. Mount gasket (Arrow) and determine Dimension II from the mounting face to the locating face of the outer bearing race.

NOTE: *Dimension II e.g. 58.50 mm (2.3031 in).*

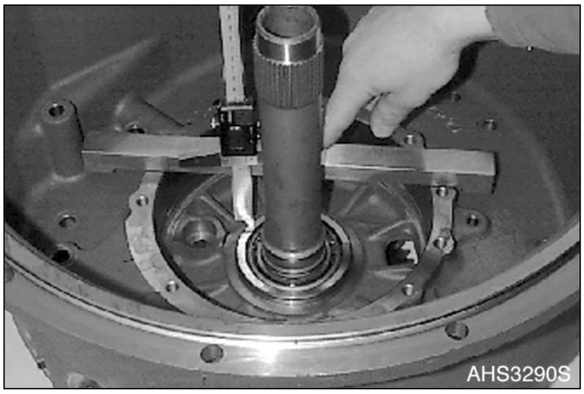

Figure 381

EXAMPLE L:

Dimension I	59.60 mm (2.3465 in)
Dimension II	- 58.50 mm (2.3031 in)
Difference	= 1.10 mm (0.0433 in)
Axial Play (0.03 - 0.07) e.g.	- 0.05 mm (0.0020 in)
Gives Shim (s)	= 1.05 mm (0.0413 in)

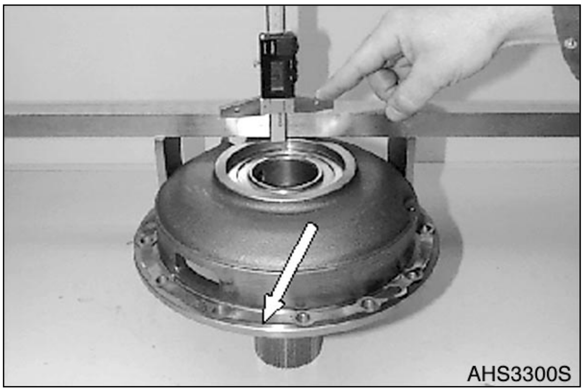

Figure 382

8. Insert needle sleeve (Figure 383), with the reinforced shell facing the pressing-in tool until contact is obtained.

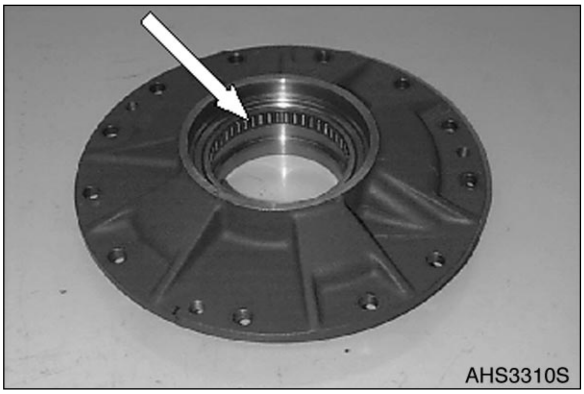

Figure 383

9. Install two adjusting screws and mount gasket (1, Figure 384).
10. Install converter safety valve (disk, compression spring and ball), see (2, Figure 384). Squeeze both rectangular rings into the annular grooves of the input shaft and engage them (3, Figure 384).
11. Now, grease rectangular rings and align them centrically.

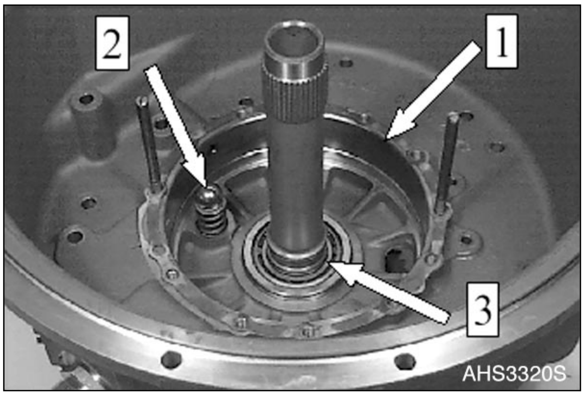

Figure 384

12. Supercool oil feed flange, (about -80˚C (-112˚F)) and make shim s = 1.05 mm (0.0413 in) (see Example, page 149) adhere with assembly grease in the bearing bore.

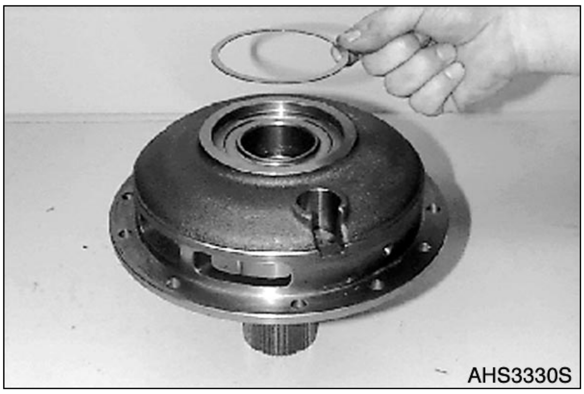

Figure 385

13. Introduce supercooled oil feed flange until contact is obtained.

NOTE: *Pay attention to the radial installation position.*

CAUTION!
Use protective gloves.

Figure 386

14. Mount flat gasket (Arrow) and install bearing cover.

NOTE: *Pay attention to the radial installation position.*

NOTE: *Torque limit (M10/8.8) 46 Nm (34 ft lb).*

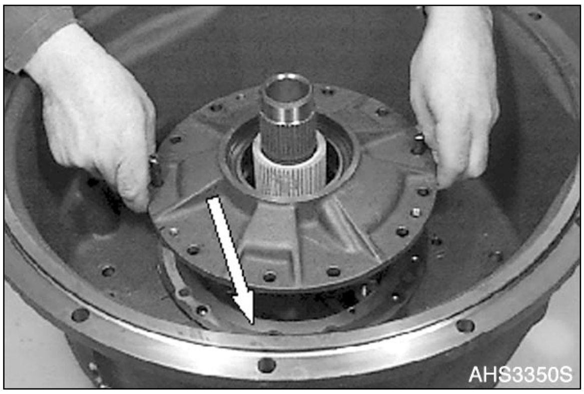

Figure 387

15. Wet thread of the screw-in sleeves (1 and 2, Figure 388) with Loctite #262 and install the two screw-in sleeves.

16. Equip screw plugs (3 and 4, Figure 388) with new O-rings and install them.

NOTE: *Torque limit (10x1) 25 Nm (18 ft lb).*

NOTE: *Torque limit (M14x1,5) 35 Nm (26 ft lb).*

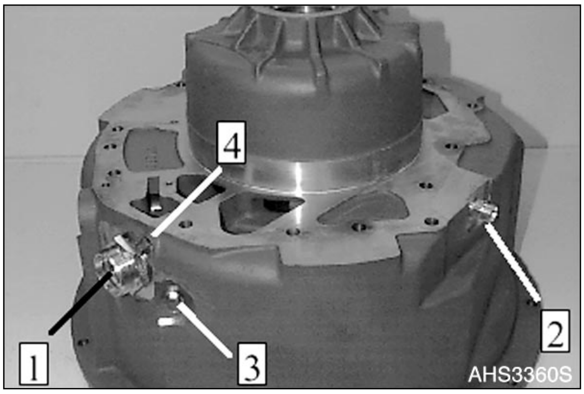

Figure 388

17. Converter Pressure Backup Valve (Figure 389 and Figure 390).

    A. Drive roll pin (6 x 50 mm) (0.2362 x 1.9685 in) into the bore until contact is obtained.

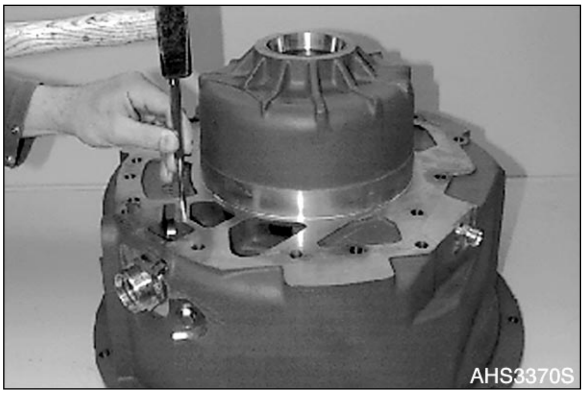

Figure 389

B. Introduce spool and compression spring.

C. Equip screw plug with new O-ring and install it.

NOTE: *Torque limit 130 Nm (96 ft lb).*

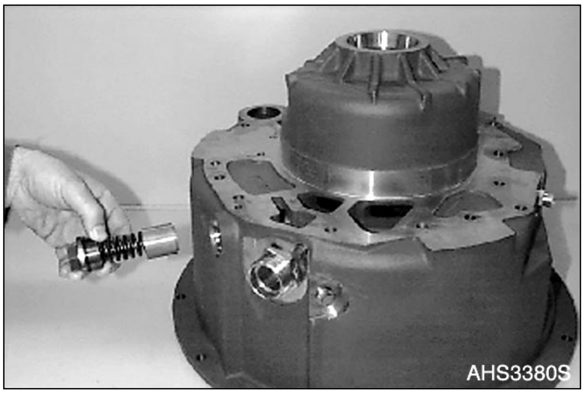

Figure 390

18. Remove input shaft and heat housing bore (about 120˚C (248˚F)).

NOTE: *Carry out the following steps (Figure 392 - Figure 394) in immediate chronological order.*

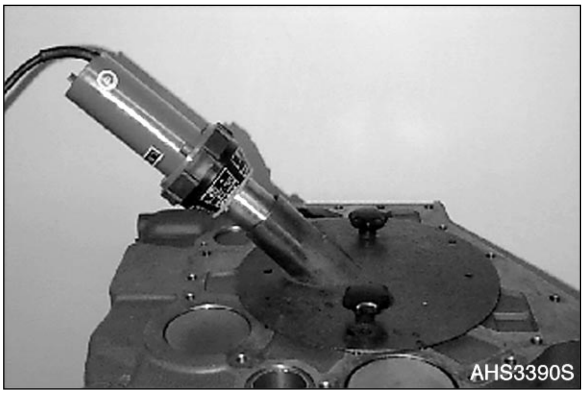

Figure 391

19. Grease rectangular ring (Arrow) and align it centrically. Introduce input shaft until contact is obtained.

NOTE: *Pay attention to the overlapping of the fitting key with the fitting key groove.*

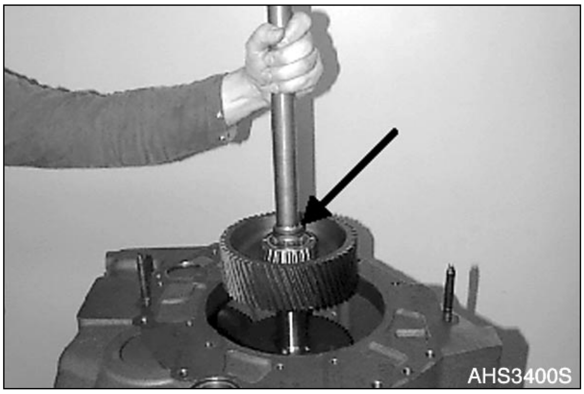

Figure 392

20. Install two adjusting screws and mount flat gasket (1, Figure 393).

21. Lay O-ring (2, Figure 393) into the annular groove.

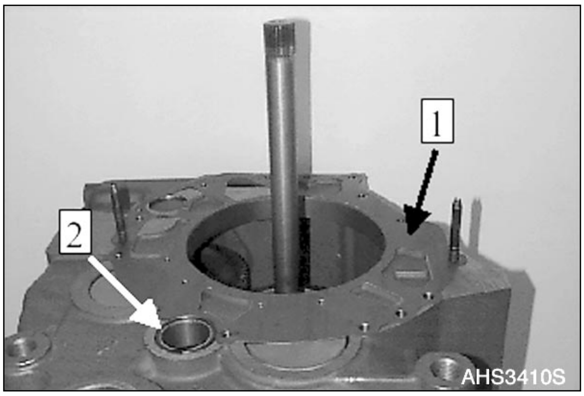

Figure 393

22. Introduce converter bell using lifting device until contact is obtained.

    NOTE: *Slight rotary motions of the input shaft will facilitate the sliding in. Protect the splines from damage. Pay attention to the radial installation position.*

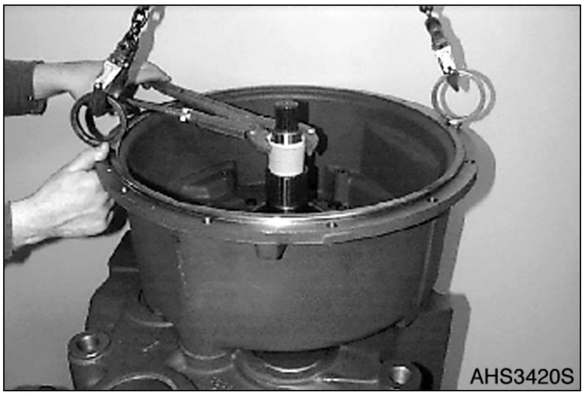

Figure 394

CONVERTER

1. Fasten diaphragms (3x) on converter, using hex. head screws (mount plain washer).

    NOTE: *Insert hex. head screws with Loctite #243.*

    NOTE: *Torque limit (M10/8.8) 4.69 kg•m (33.93 ft lb).*

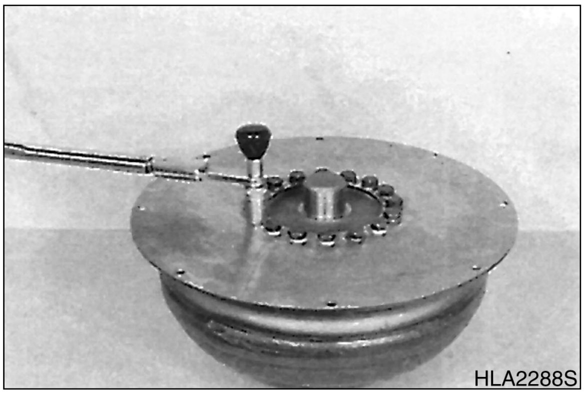

Figure 395

2. Squeeze in and engage rectangular ring (Figure 396). Now, grease rectangular and align it centrically.

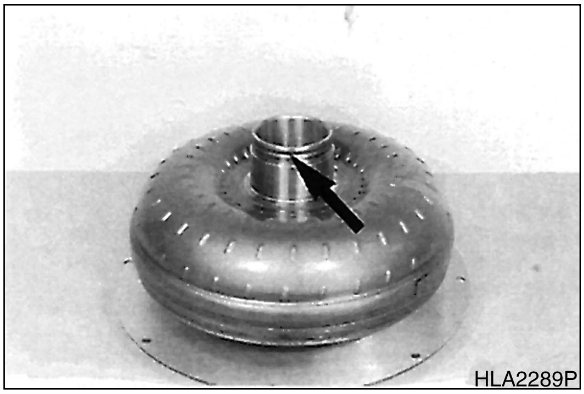

Figure 396

3. Install converter using lifting drive until contact is obtained.

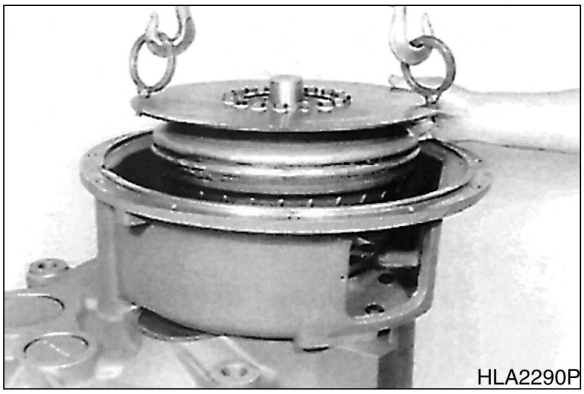

Figure 397

4. Tilt transmission 90°.
5. Insert pot flush-mounted to the housing face.

   NOTE: *Wet sealing surface with Loctite #262.*

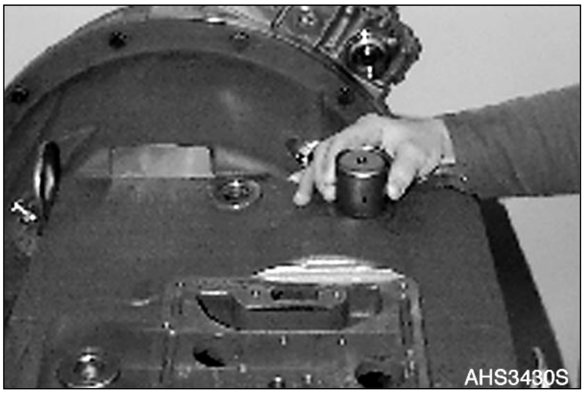

Figure 398

6. Install breather (Figure 399).

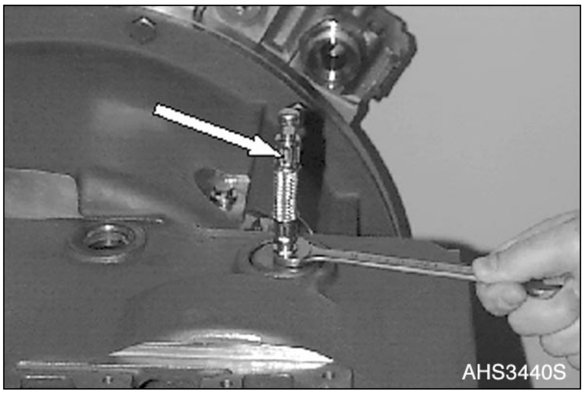

Figure 399

7. Equip screw plug (1, Figure 400) with new O-ring and install it. Install the two retaining plates (2, Figure 400).
8. Mount hydraulic control unit (HSG-94), see page 56 - page 58.
9. Install all oil lines.

CAUTION!
The line routing is different according to the design. In this connection, pay attention to the Perspective Illustrations of the corresponding Spare Parts List.

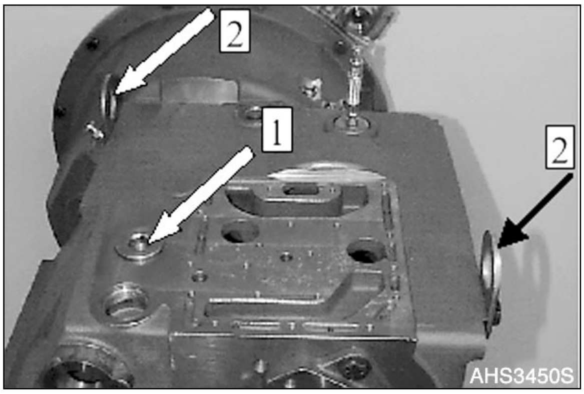

Figure 400

INDUCTIVE TRANSMITTERS AND SPEED SENSOR

1. The figures show the installation position of the single inductive transmitters and the speed sensor.

Reference Number	Description
6	Inductive Transmitter N – Turbine
14	Inductive Transmitter N – Engine
39	Inductive Transmitter N – Central Gear Train 6
31	Speed Sensor N – Output And Speedometer 39

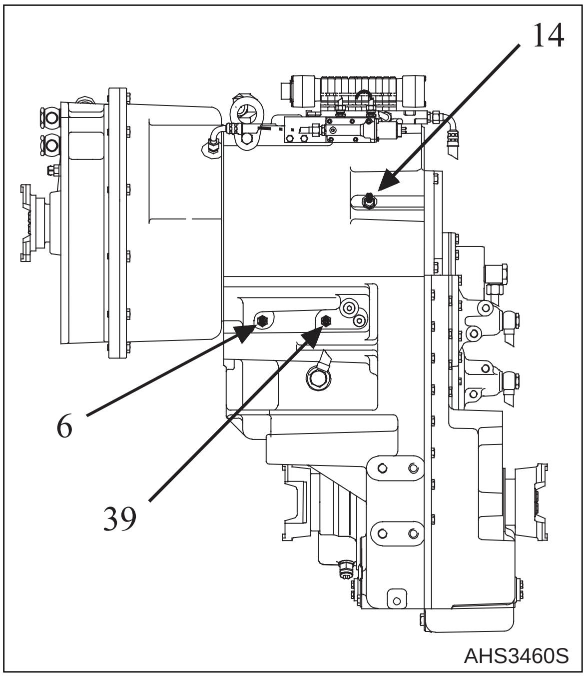

Figure 401

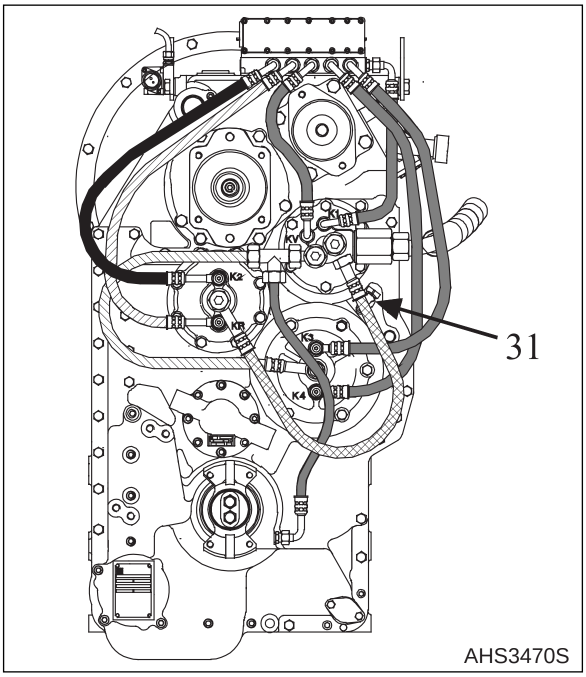

Figure 402

2. The following illustrations describe the reassembly, resp. the setting of the Inductive transmitter N engine (14, Figure 401). The reassembly of the Inductive transmitter N turbine (6, Figure 401) and N central gear train (39, Figure 401) has to be carried out accordingly.

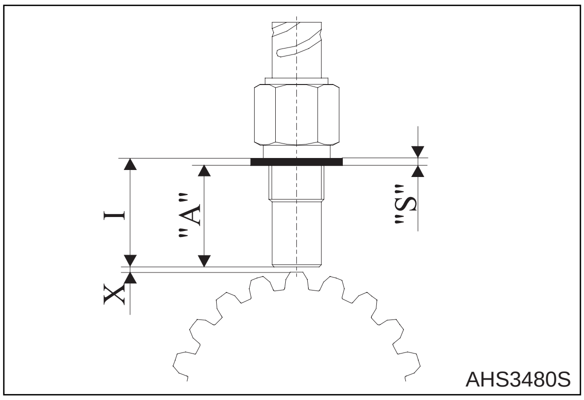

Figure 403

IMPORTANT

Pay attention to the different Setting dimensions "X."

Inductive transmitter N-Engine (14) X = 0.5 $^{+0.3}$ mm (0.0197 $^{+0.0118}$ in)

Inductive transmitter N-Turbine (6) X = 0.5 $^{+0.3}$ mm (0.0197 $^{+0.0118}$ in)

Inductive transmitter N-Central gear train (39) X = 0.3 ±0.1 mm (0.0118 $^{+0.0039}$ in)

3. Set Dimension X using adjusting disk(s) (Figure 404 - Figure 410).

   A. Measure Dimension I from the contact face to the screw-in face on the inductive transmitter.

   NOTE: *Dimension I e.g. 30.00 mm (1.1811 in).*

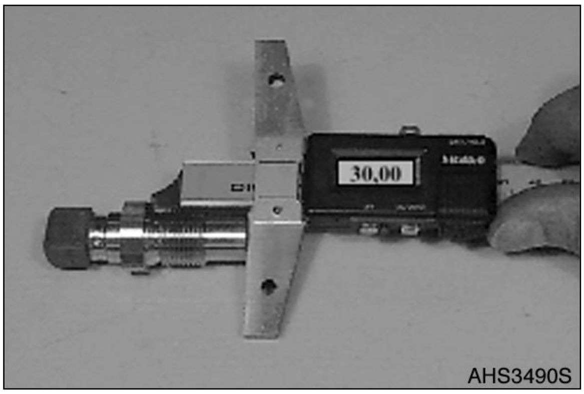

Figure 404

   B. Rotate counting disk radially until one tooth tip is central to the inductive transmitter bore.

   C. Screw the plug gauge in until contact is obtained. Position anvil on the tooth tip until contact is obtained and lock it using set screw (Figure 405and Figure 406).

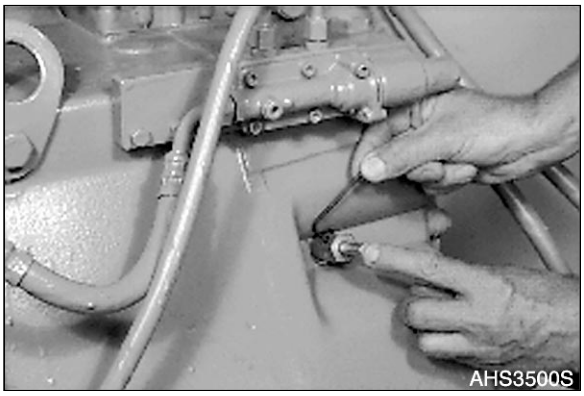

Figure 405

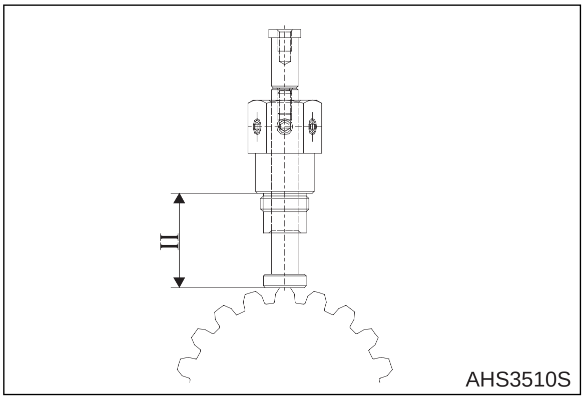

Figure 406

D. Screw the plug gauge out and determine Dimension II (see also Figure 405).

NOTE: *Dimension II e.g. 30.10 mm (1.1850 in).*

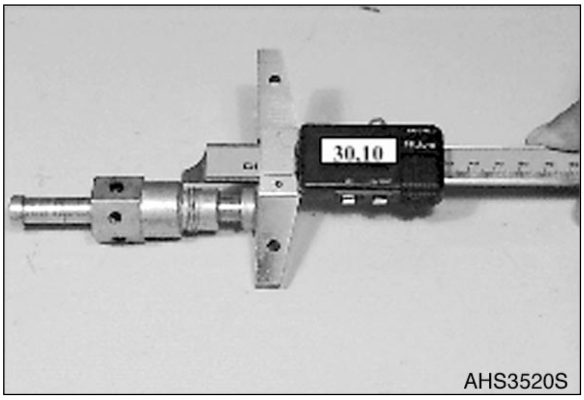

Figure 407

EXAMPLE M1:

Dimension II e.g.	30.10 mm (1.1850 in)
Dimension X (0.5 $^{+0.3}$ mm (0.0197$^{+0.0118}$ in)) e.g.	- 0.60 mm (0.0236 in)
Gives Installation Dimension A	= 29.50 mm (1.1614 in)

EXAMPLE M2:

Dimension I e.g.	30.10 mm (1.1850 in)
Installation Dimension A e.g.	- 29.50 mm (1.1614 in)
Gives Adjusting Disk (s)	= 0.50 mm (0.0197 in)

E. Line up the corresponding adjusting disk(s) and wet thread (Arrow) with Loctite #574.

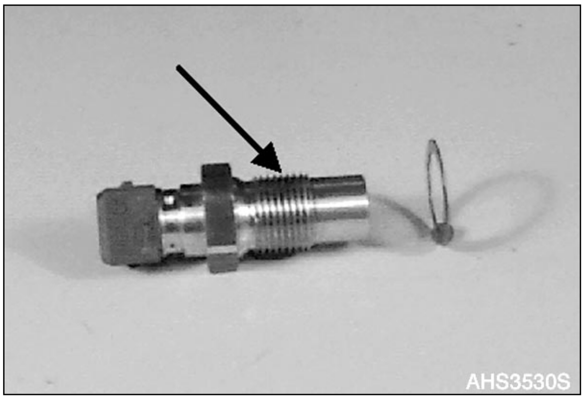

Figure 408

F. Install inductive transmitter N-Engine (14), see Figure 409.

NOTE: *Torque limit 30 Nm (22 ft lb).*

NOTE: *Set and install the inductive transmitter n-Turbine (6) and n-Central gear train (39) accordingly.*

NOTE: *Pay attention to the different setting dimensions. Installation position of the single inductive transmitters, see also page 160.*

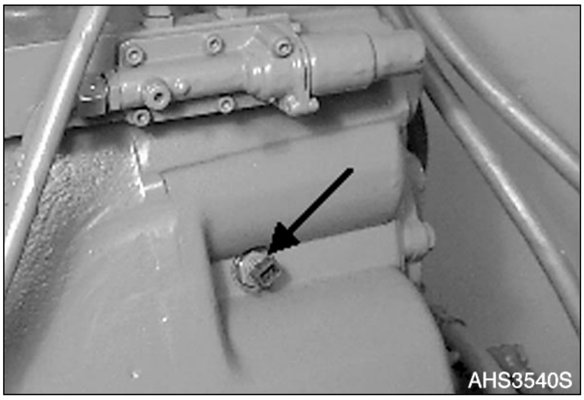

Figure 409

4. Install Speed sensor N-Output/ Speedometer (31) (Figure 410 - Figure 415).

NOTE: *Setting dimension X = 1.0 $^{+0.5}$ mm (0.0394 $^{+0.0197}$ in).*

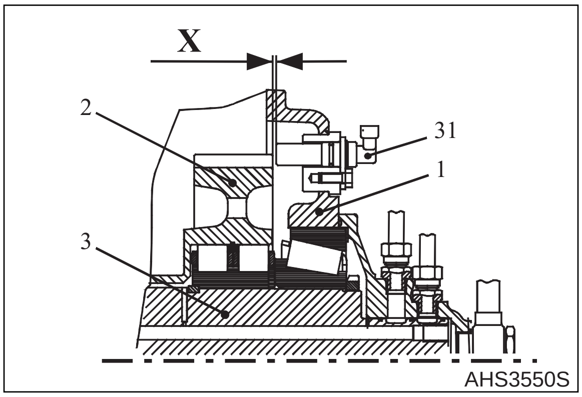

Figure 410

A. Figure 411, shows the speed sensor (Hall sensor).

Reference Number	Description
1	Speed Sensor
2	O-ring
3	Setting Plate(s)

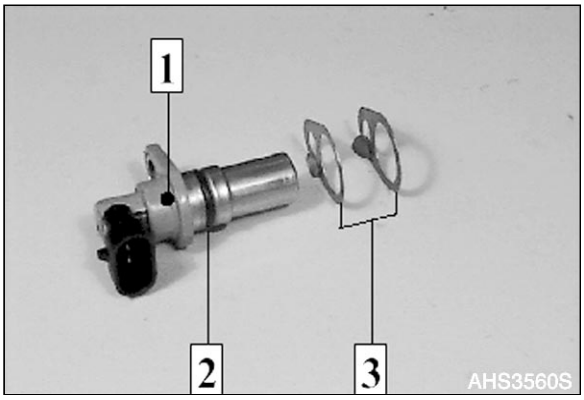

Figure 411

B. Determine Dimension I from the housing face to the spur gear K3.

NOTE: *Dimension I e.g. 39.20 mm (1.5433 in).*

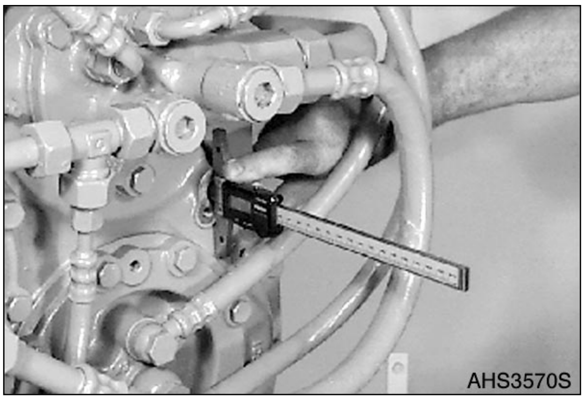

Figure 412

C. Measure Dimension II from the contact face to the mounting face.

NOTE: *Dimension II e.g. 39.00 mm (1.5354 in).*

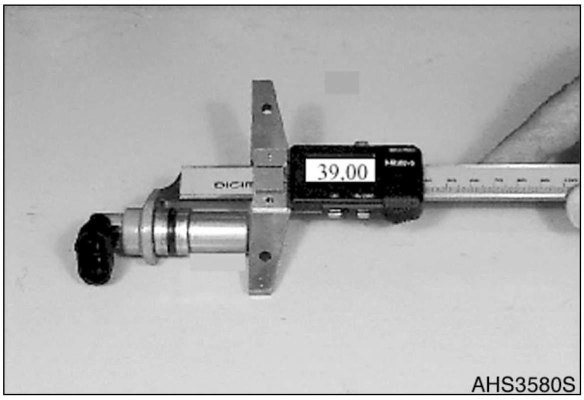

Figure 413

D. Line up setting plates (2x, s = 0.5 mm (0.0197 in)) and grease O-ring.

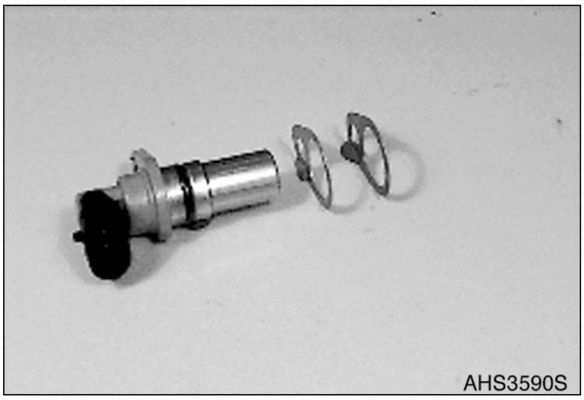

Figure 414

EXAMPLE N1:

Dimension I e.g.	39.20 mm (1.5433 in)
Dimension X (1.0 $^{+0.3}$ mm (0.0394 $^{+0.0118}$ in) e.g.	- 1.20 mm (0.0472 in)
Gives Adjusting Disk (s)	= 38.00 mm (1.4961 in)

EXAMPLE N2:

Dimension I e.g.	39.00 mm (1.5354 in)
Installation Dimension A e.g.	- 38.00 mm (1.4961 in)
Gives Setting Plate (s)	= 1.00 mm (0.0394 in)

5. Fasten speed sensor using socket head screw.

NOTE: *Torque limit (M8/8.8) 23 Nm (17 ft lb).*

NOTE: *Installation position of the speed sensor, see also page 155.*

CAUTION!

Prior to the commissioning of the Transmission, carry out the oil filling according to the Operating Instructions.

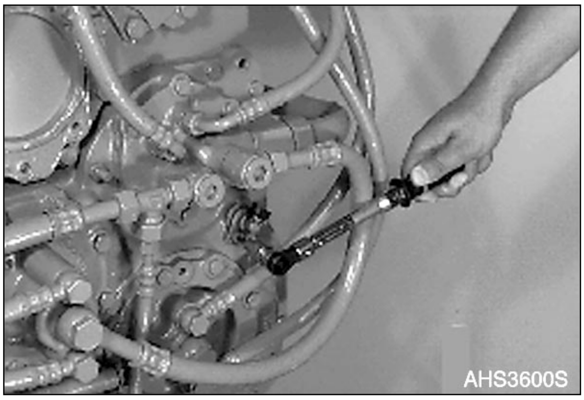

Figure 415

S0607900C
R2

TRANSMISSION ERROR CODES (ZF)

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Mega 130	1003 and Up
Mega 160	1021 and Up
Mega 200-V	1001 and Up
Mega 250-V	1001 and Up
Mega 300-V	1001 and Up
Mega 400-III PLUS	1001 and Up
Mega 400-V	1001 and Up
Mega 500-V	1001 and Up

November 2001

TABLE OF CONTENTS

INTRODUCTION

The "WG" series of ZF Transmissions use an electronic control system called "ZF-Ergopower."

The Ergo System (for short) allows the transmission to function either in a manual powershift mode, or in a fully automatic mode.

An LCD display (Figure 1) is in the cab. This display gives the machine operator a continuos status of the operating condition of the system. It displays normal operational codes, and fault codes.

ABBREVIATIONS

Throughout this section the following abbreviations are used to indicate various conditions.

Abbreviations	
ABS	Anti Blocking System
ADM (1 - 8)	??????
AEB	??????
ASR	Anti Slipping Regulation
CAN	Controller Area Network
CCO	Clutch Cut Off
DCO	??????
DCT1	??????
DNS1	??????
EAM1	??????
EAMODUL1	??????
EEC (1, 3)	Electronic Engine Controller
FMR (1 and 2)	??????
LIS (1 and 2)	Load Isolation System (Solenoids 1 and 2)
MDU1	??????
O.C.	Open Circuit
OMRON	??????
OP-Mode	OPeration Mode
PTO	Power Take Off
S.C.	Short Circuit
SCT1	??????
TCU	Transmission Control Unit
VPS (1 and 2)	??????

DISPLAY

If a fault is detected, the display shows a spanner symbol (g) for a fault. The display shows the fault code, if the gear selector is in neutral position.

If more than one fault is detected, each fault code is shown for about 1 second.

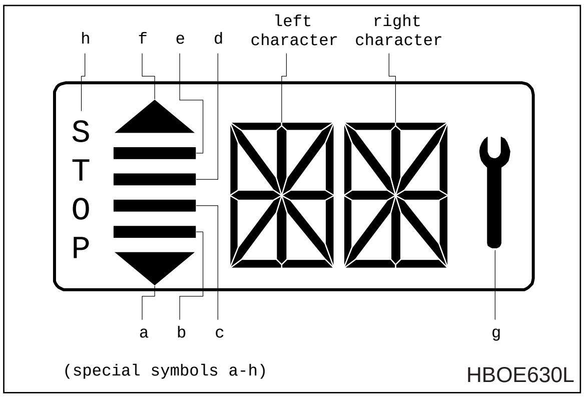

Figure 1

DESCRIPTION OF FAULT CODES

The first number of the error code is the category that it is grouped into. They are as follows for the first number.

First Number	Meaning of Number
1 Hex	Digital Input Signal
2 Hex	Analog Input Signal
3 Hex	Speed Signal
4 Hex	CAN Signal Error
5 Hex	CAN Signal Error
6 Hex	CAN Signal Error
7 Hex	Analog Current Output Signal
8 Hex	Analog Current Output Signal
9 Hex	Digital Output Signal
A Hex	Digital Output Signal
B Hex	Transmission Fault, Clutch Error
C Hex	Logical Fault
D Hex	Power Supply
E Hex	High Speed Signal
F Hex	General Fault

DISPLAY DURING OPERATION

Symbol	Meaning	Remarks
1F, 1R 2F, 2R 3F, 3R 4F 5F 6F LF, LR	Actual gear and direction. Left digit shows actual gear. Right digit shows actual direction. Limp home gear.	---------------
F or R, no gear	Clutch Cut Off.	---------------
F or R flashing	Only 6WG. Direction F or R selected while turbine speed is too high. **CAUTION:** Gear will engage if turbine speed drops.	---------------
NN	Not neutral, waiting for neutral after power up or a severe fault.	Go engage a gear, first move shift selector to neutral position and again to F or R position.
**	Oil temperature too low, no gear available.	Warm up engine / transmission.
*N	Oil temperature low, only one gear available.	Warm up engine / transmission.
1 bar (special symbol)	Manual mode 1. gear.	---------------
2 bars	Manual mode 2. gear.	---------------
3 bars	Manual mode 3. gear.	---------------
4 bars	Manual mode 4. gear.	---------------
4 bars and 2 arrows	Automatic mode.	---------------
Bars flashing	6 WG: converter lockup clutch open. 4 WG: Downshift mode active.	Difference of engine and turbine speed above a certain limit and lockup clutch not activated.
Spanner	At least one fault active.	Select neutral to get fault code displayed.
Fault code	See fault code list (See page 10).	---------------
WS	Warning sump temperature.	Changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner).
WR	Warning retarder temperature.	Changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner).
WE	Warning high engine speed.	Changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner).
PN	Direction F or R selected while parking brake engaged.	Transmission in neutral until parking brake is released. **CAUTION**: Vehicle starts to move after release of parking brake.

Symbol	Meaning	Remarks
F or R flashing	Direction F or R selected while turbine speed is to high. **CAUTION:** Gear will engage if turbine speed drops.	---------------
EE flashing	No communication with display.	Checked wiring from TCU to display.

DEFINITION OF OPERATING MODES

NORMAL

There is no failure detected in transmission system or failure has no or slight effects on transmission control. TCU will work without or in special cases with little limitations. (See “Table of Fault Codes” on page 10.)

SUBSTITUTE CLUTCH CONTROL

TCU cannot change gears or direction under control of normal clutch modulation. TCU uses substitute strategy for clutch control. All modulations are only time controlled. (Comparable with EST 25.)

LIMP-HOME

The detected failure in the system has strong limitations to transmission control. TCU can engage only one gear in each direction. In some cases only one direction will be possible.

TCU will shift the transmission into neutral at the first occurrence of the failure. First, the operator must shift the gear selector into neutral position.

If output speed is less than a threshold for neutral to gear and the operator shifts the gear selector into forward or reverse, the TCU will select the limp-home gear.

If output speed is less than a threshold for reversal speed and TCU has changed into the limp-home gear and the operator selects a shuttle shift, TCU will shift immediately into the limp-home gear of the selected direction.

If output speed is greater than the threshold, TCU will shift the transmission into neutral. The operator has to slow down the vehicle and must shift the gear selector into neutral position.

TRANSMISSION SHUT DOWN

TCU has detected a severe failure that disables control of the transmission.

TCU will shut off the solenoid valves for the clutches and also the common power supply (VPS1).

Transmission shifts to Neutral. The park brake will operate normally, also the other functions which use ADM 1 to ADM 6.

The operator has to slow down the vehicle. The transmission will stay in neutral.

TCU SHUT DOWN

TCU has detected a severe failure that disables control of system.

TCU will shut off all solenoid valves and also both common power supplies (VPS1, VPS2). The park brake will engage, also all functions are disabled which use ADM 1 to ADM 6.

The transmission will stay in neutral.

NOTE: *VPS2: is the LIS (option power supply).*

CLUTCH PACK AND SOLENOID VALVE CROSS-REFERENCE TABLE

Throughout the fault codes, references are made to various clutch packs within the transmission. These clutch pack references are indicated as K1, K2, etc.

Clutch pack charge pressure is controlled by proportional valves that contain a solenoid valve.

The following chart identifies which solenoid valve corresponds to each clutch pack.

Clutch Pack	Solenoid Valve (Proportioning Valve) Number						
	Mega 130 4WG-100	Mega 160 4WG-130	Mega 250-V 4WG-190	Mega 300-V 4WG-210	Mega 400-III PLUS 4WG-260	Mega 400-V 4WG-260	Mega 500-V 4WG-310
K1	Y3	Y3	Y3	Y3	Y3	Y3	Y3
K2	Y6	Y6	Y6	Y6	Y6	Y6	Y6
K3	Y4	Y4	Y4	Y4	Y4	Y4	Y4
K4	Y1	Y1	Y1	Y1	Y2	Y2	Y2
KR	Y2	Y2	Y2	Y2	Y1	Y1	Y1
KV	Y5	Y5	Y5	Y5	Y5	Y5	Y5

TABLE OF FAULT CODES

The fault codes shown in this table are a complete list of codes that are common to more than one version of the transmission. Some of the versions are 4WG (four speed) and 6WG (six speed).

NOTE: *This fault code list is valid for the ZF Software Versions V 53.x to V58.0*

Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
11	Logical error at gear range signal. TCU detected a wrong signal combination for gear range. • Cable from shift lever to TCU is broken. • Cable is defective and is contacted to battery voltage or vehicle ground. • Shift lever is defective.	TCU shifts transmission to neutral. OP-Mode: transmission shut down.	Check cables from TCU to shift lever. Check signal combinations of shift lever positions for gear range.	Failure cannot be detected in systems with DW2/DW3 shift lever. Fault is taken back if TCU detects a valid signal for position.
12	Logical error at direction select signal. TCU detected a wrong signal combination for direction. • Cable from shift lever to TCU is broken. • Cable is defective and is contacted to battery voltage or vehicle ground. • Shift lever is defective.	TCU shifts transmission to neutral. OP-Mode: transmission shut down.	Check cables from TCU to shift lever. Check signal combinations of shift lever positions F-N-R.	Fault is taken back if TCU detects a valid signal for direction at shift lever.
17 **	S.C. to ground at Solenoid LIS1 (Function No. 1). TCU detected a wrong voltage at output pin, that looks like a S.C. to vehicle ground. • Cable is defective and is contacted to vehicle ground. • Solenoid LIS1 (Function No. 1) device has an internal defect. • Connector pin is contacted to vehicle ground.	Customer specific.	Check cable from TCU to Solenoid LIS1 (Function No. 1) device. Check connectors from Solenoid LIS1 (Function No. 1) to TCU. Check resistance of Solenoid LIS1 (Function No. 1) device.	[1] See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
* Only Mega 400-III PLUS ** Only Series "V" Gray shaded boxes are error codes for other applications. They are only given for general reference purposes.				

Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
18 **	S.C. to battery voltage at Solenoid LIS1 (Function No. 1). TCU detected a wrong voltage at output pin, that looks like a S.C. to battery voltage. • Cable is defective and is contacted to battery voltage. • Solenoid LIS1 (Function No. 1) device has an internal defect. • Connector pin is contacted to battery voltage.	Customer specific.	Check cable from TCU to Solenoid LIS1 (Function No. 1) device. Check connectors from Solenoid LIS1 (Function No. 1) to TCU. Check resistance of Solenoid LIS1 (Function No. 1) device.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
19 **	O.C. at Solenoid LIS1 (Function No. 1). TCU detected a wrong voltage at output pin, that looks like a O.C. for this output pin. • Cable is defective and has no connection to TCU. • Solenoid LIS1 (Function No. 1) device has an internal defect. • Connector has no connection to TCU.	Customer specific.	Check cable from TCU to Solenoid LIS1 (Function No. 1) device. Check connectors from Solenoid LIS1 (Function No. 1) device to TCU. Check resistance of Solenoid LIS1 (Function No. 1) device.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
1A **	S.C. to ground at Solenoid LIS2 (Function No. 2). TCU detected a wrong voltage at output pin, that looks like a S.C. to vehicle ground. • Cable is defective and is contacted to vehicle ground. • Solenoid LIS2 (Function No. 2) device has an internal defect. • Connector pin is contacted to vehicle ground.	Customer specific.	Check cable from TCU to Solenoid LIS2 (Function No. 2) device. Check connectors from Solenoid LIS2 (Function No. 2) device to TCU. Check resistance of Solenoid LIS2 (Function No. 2) device.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
* Only Mega 400-III PLUS ** Only Series "V" Gray shaded boxes are error codes for other applications. They are only given for general reference purposes.				

Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
1B **	S.C. to battery voltage at Solenoid LIS2 (Function No. 2). TCU detected a wrong voltage at output pin, that looks like a S.C. to battery voltage. • Cable is defective and is contacted to battery voltage. • Solenoid LIS2 (Function No. 2) device has an internal defect. • Connector pin is contacted to battery voltage.	Customer specific.	Check cable from TCU to Solenoid LIS2 (Function No. 2) device. Check connectors from Solenoid LIS2 (Function No. 2) device to TCU. Check resistance of Solenoid LIS2 (Function No. 2) device.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
1C **	O.C. at Solenoid LIS2 (Function No. 2). TCU detected a wrong voltage at output pin, that looks like a O.C. for this output pin. • Cable is defective and has no connection to TCU. • Solenoid LIS2 (Function No. 2) device has an internal defect. • Connector has no connection to TCU.	Customer specific.	Check cable from TCU to Solenoid LIS2 (Function No. 2) device. Check connectors from Solenoid LIS2 (Function No. 2) device to TCU. Check resistance of Solenoid LIS2 (Function No. 2) device.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
25	S.C. to battery voltage or O.C. at transmission sump temperature sensor input. The measured voltage is too high: • Cable is defective and is contacted to battery voltage. • Cable has no connection to TCU. • Temperature sensor has an internal defect. • Connector pin is contacted to battery voltage or is broken.	No reaction, TCU uses default temperature. OP-Mode: normal.	Check cable from TCU to sensor. Check connectors. Check temperature sensor.	---------------

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Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
26	S.C. to ground at transmission sump temperature sensor input. The measured voltage is too low: • Cable is defective and is contacted to vehicle ground. • Temperature sensor has an internal defect. • Connector pin is contacted to vehicle ground.	No reaction, TCU uses default temperature. OP-Mode: normal.	Check cable from TCU to sensor. Check connectors. Check temperature sensor.	---------------
31	S.C. to battery voltage or O.C. at engine speed input. TCU measures a voltage higher than 7.00 V at speed input pin. • Cable is defective and is contacted to battery voltage. • Cable has no connection to TCU. • Speed sensor has an internal defect. • Connector pin is contacted to battery voltage or has no contact.	OP-Mode: substitute clutch control.	Check cable from TCU to sensor. Check connectors. Check speed sensor.	---------------
32	S.C. to ground at engine speed input. TCU measures a voltage less than 0.45V at speed input pin. • Cable / connector is defective and is contacted to vehicle ground. • Speed sensor has an internal defect.	OP-Mode: substitute clutch control.	Check cable from TCU to sensor. Check connectors. Check speed sensor.	---------------
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Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
33	Logical error at engine speed input. TCU measures a engine speed over a threshold and the next moment the measured speed is zero. • Cable / connector is defective and has bad contact. • Speed sensor has an internal defect. • Sensor gap is incorrect.	OP-Mode: substitute clutch control.	Check cable from TCU to sensor. Check connectors. Check speed sensor. Check sensor gap.	This fault is reset after power up of TCU.
34	S.C. to battery voltage or O.C. at turbine speed input. TCU measures a voltage higher than 7.00 V at speed input pin. • Cable is defective and is contacted to battery voltage. • Cable has no connection to TCU. • Speed sensor has an internal defect. • Connector pin is contacted to battery voltage or has no contact.	OP-Mode: substitute clutch control. If a failure is existing at output speed, TCU shifts to neutral. OP-Mode: limp home.	Check cable from TCU to sensor. Check connectors. Check speed sensor.	---------------
35	S.C. to ground at turbine speed input. TCU measures a voltage less than 0.45V at speed input pin. • Cable / connector is defective and is contacted to vehicle ground. • Speed sensor has an internal defect.	OP-Mode: substitute clutch control. If a failure is existing at output speed, TCU shifts to neutral. OP-Mode: limp home.	Check cable from TCU to sensor. Check connectors. Check speed sensor.	---------------
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Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
36	Logical error at turbine speed input. TCU measures a turbine speed over a threshold and at the next moment the measured speed is zero. • Cable / connector is defective and has bad contact. • Speed sensor has an internal defect. • Sensor gap is incorrect.	OP-Mode: substitute clutch control. If a failure is existing at output speed, TCU shifts to neutral. OP-Mode: limp home.	Check cable from TCU to sensor. Check connectors. Check speed sensor. Check sensor gap.	This fault is reset after power up of TCU.
37	S.C. to battery voltage or O.C. at internal speed input. TCU measures a voltage higher than 7.00 V at speed input pin. • Cable is defective and is contacted to battery voltage. • Cable has no connection to TCU. • Speed sensor has an internal defect. • Connector pin is contacted to battery voltage or has no contact.	OP-Mode: substitute clutch control.	Check cable from TCU to sensor. Check connectors. Check speed sensor.	---------------
38	S.C. to ground at internal speed input. TCU measures a voltage less than 0.45V at speed input pin. • Cable / connector is defective and is contacted to vehicle ground. • Speed sensor has an internal defect.	OP-Mode: substitute clutch control.	Check cable from TCU to sensor. Check connectors. Check speed sensor.	---------------

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Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
39	Logical error at internal speed input. TCU measures a internal speed over a threshold and at the next moment the measured speed is zero. • Cable / connector is defective and has bad contact. • Speed sensor has an internal defect. • Sensor gap is incorrect.	OP-Mode: substitute clutch control.	Check cable from TCU to sensor. Check connectors. Check speed sensor. Check sensor gap.	This fault is reset after power up of TCU.
3A	S.C. to battery voltage or O.C. at output speed input. TCU measures a voltage higher than 12.5 V at speed input pin. • Cable is defective and is contacted to battery voltage. • Cable has no connection to TCU. • Speed sensor has an internal defect. • Connector pin is contacted to battery voltage or has no contact.	Special mode for gear selection; OP-Mode: substitute clutch control. If a failure is existing at turbine speed, TCU shifts to neutral. OP-Mode: limp home.	Check cable from TCU to sensor. Check connectors. Check speed sensor.	---------------
3B	S.C. to ground at output speed input. TCU measures a voltage less than 1.00V at speed input pin. • Cable / connector is defective and is contacted to vehicle ground. • Speed sensor has an internal defect.	Special mode for gear selection. OP-Mode: substitute clutch control. If a failure is existing at turbine speed, TCU shifts to neutral. OP-Mode: limp home.	Check cable from TCU to sensor. Check connectors. Check speed sensor.	---------------

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Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
3C	Logical error at output speed input. TCU measures a output speed over a threshold and at the next moment the measured speed is zero. • Cable / connector is defective and has bad contact. • Speed sensor has an internal defect. • Sensor gap is incorrect.	Special mode for gear selection. OP-Mode: substitute clutch control. If a failure is existing at turbine speed, TCU shifts to neutral. OP-Mode: limp home.	Check cable from TCU to sensor. Check connectors. Check speed sensor. Check sensor gap.	This fault is reset after power up of TCU.
3E	Output speed zero doesn't fit to other speed signals. If transmission is not neutral and the shifting has finished, TCU measures output speed zero and turbine speed or internal speed not equal to zero. • Speed sensor has an internal defect. • Sensor gap is incorrect.	Special mode for gear selection. OP-Mode: substitute clutch control. If a failure is existing at turbine speed, TCU shifts to neutral. OP-Mode: limp home.	Check sensor signal of output speed sensor. Check sensor gap of output speed sensor. Check cable from TCU to sensor.	This fault is reset after power up of TCU.
71	S.C. to battery voltage at clutch K1. The measured resistance value of valve is out of limit, voltage at K1 valve is too high. • Cable / connector is defective and has contact to battery voltage. • Cable / connector is defective and has contact to another regulator output of TCU. • Regulator has an internal defect.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check cable from TCU to gearbox. Check connectors from TCU to gearbox. Check regulator resistance. 1) Check internal wire harness of gearbox.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.

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Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
72	S.C. to ground at clutch K1. The measured resistance value of valve is out of limit, voltage at K1 valve is too low. • Cable / connector is defective and has contact to vehicle ground. • Regulator has an internal defect.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check cable from TCU to gearbox. Check connectors from gearbox to TCU. Check regulator resistance. 1) Check internal wire harness of gearbox.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
73	O.C. at clutch K1. The measured resistance value of valve is out of limit. • Cable / connector is defective and has no contact to TCU. • Regulator has an internal defect.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check cable from TCU to gearbox. Check connectors from gearbox to TCU. Check regulator resistance. 1) Check internal wire harness of gearbox.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
74	S.C. to battery voltage at clutch K2. The measured resistance value of valve is out of limit, voltage at K2 valve is too high. • Cable / connector is defective and has contact to battery voltage. • Cable / connector is defective and has contact to another regulator output of TCU. • Regulator has an internal defect.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check cable from TCU to gearbox. Check connectors from gearbox to TCU. Check regulator resistance. 1) Check internal wire harness of gearbox.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
75	S.C. to ground at clutch K2. The measured resistance value of valve is out of limit, voltage at K2 valve is too low. • Cable / connector is defective and has contact to vehicle ground. • Regulator has an internal defect.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check cable from TCU to gearbox. Check connectors from gearbox to TCU. Check regulator resistance. 1) Check internal wire harness of gearbox.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.

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Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
76	O.C. at clutch K2. The measured resistance value of valve is out of limit. • Cable / connector is defective and has no contact to TCU. • Regulator has an internal defect.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check cable from TCU to gearbox. Check connectors from gearbox to TCU. Check regulator resistance. 1) Check internal wire harness of gearbox.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
77	S.C. to battery voltage at clutch K3. The measured resistance value of valve is out of limit, voltage at K3 valve is too high. • Cable / connector is defective and has contact to battery voltage. • Cable / connector is defective and has contact to another regulator output of TCU. • Regulator has an internal defect.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check cable from TCU to gearbox. Check connectors from gearbox to TCU. Check regulator resistance. 1) Check internal wire harness of gearbox.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
78	S.C. to ground at clutch K3. The measured resistance value of valve is out of limit, voltage at K3 valve is too low. • Cable / connector is defective and has contact to vehicle ground. • Regulator has an internal defect.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check cable from TCU to gearbox. Check connectors from gearbox to TCU. Check regulator resistance. 1) Check internal wire harness of gearbox.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
79	O.C. at clutch K3. The measured resistance value of valve is out of limit. • Cable / connector is defective and has no contact to TCU. • Regulator has an internal defect.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check cable from TCU to gearbox. Check connectors from gearbox to TCU. Check regulator resistance. 1) Check internal wire harness of gearbox.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.

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Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
7D	S.C. to ground at engine derating device. • Cable is defective and is contacted to vehicle ground. • Engine derating device has an internal defect. • Connector pin is contacted to vehicle ground.	Engine derating will be on until TCU power down even if fault vanishes (loose connection). OP-Mode: normal.	Check cable from TCU to engine derating device. Check connectors from engine derating device to TCU. Check resistance [1] of engine derating device.	[1] See "Measurement of Resistance at Actuator/sensors and Cable" on page 35. (Only Mega 500-V)
7E	S.C. to battery voltage at engine derating device. • Cable / connector is defective and is contacted to battery voltage. • Engine derating device has an internal defect.	No reaction. OP-Mode: normal.	Check cable from TCU to engine derating device. Check connectors from backup alarm device to TCU. Check resistance [1] of backup alarm device.	Only Mega 500-V
7F	O.C. at engine derating device. TCU detected a wrong voltage at output pin, that looks like a O.C. for this output pin. • Cable is defective and has no connection to TCU. • Engine derating device has an internal defect. • Connector has no connection to TCU.	No reaction. OP-Mode: normal.	Check cable from TCU to engine derating device. Check connectors from engine derating device to TCU. Check resistance [1] of engine derating device.	[1] See "Measurement of Resistance at Actuator/sensors and Cable" on page 35. (Only Mega 500-V)
81	S.C. to battery voltage at clutch K4. The measured resistance value of valve is out of limit, voltage at K4 valve is too high. • Cable / connector is defective and has contact to battery voltage. • Cable / connector is defective and has contact to another regulator output of TCU. • Regulator has an internal defect.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check cable from TCU to gearbox. Check connectors from gearbox to TCU. Check regulator resistance. [1] Check internal wire harness of gearbox.	[1] See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.

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Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
82	S.C. to ground at clutch K4. The measured resistance value of valve is out of limit, voltage at K4 valve is too low. • Cable / connector is defective and has contact to vehicle ground. • Regulator has an internal defect.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check cable from TCU to gearbox. Check connectors from gearbox to TCU. Check regulator resistance. 1) Check internal wire harness of gearbox.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
83	O.C. at clutch K4. The measured resistance value of valve is out of limit. • Cable / connector is defective and has no contact to TCU. • Regulator has an internal defect.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check cable from TCU to gearbox. Check connectors from gearbox to TCU. Check regulator resistance. 1) Check internal wire harness of gearbox.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
84	S.C. to battery voltage at clutch KV. The measured resistance value of valve is out of limit, voltage at KV valve is too high. • Cable / connector is defective and has contact to battery voltage. • Cable / connector is defective and has contact to another regulator output of TCU. • Regulator has an internal defect.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check cable from TCU to gearbox. Check connectors from gearbox to TCU. Check regulator resistance. 1) Check internal wire harness of gearbox.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
85	S.C. to ground at clutch KV. The measured resistance value of valve is out of limit, voltage at KV valve is too low. • Cable / connector is defective and has contact to vehicle ground. • Regulator has an internal defect.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check cable from TCU to gearbox. Check connectors from gearbox to TCU. Check regulator resistance. 1) Check internal wire harness of gearbox.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.

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Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
86	O.C. at clutch KV. The measured resistance value of valve is out of limit. • Cable / connector is defective and has no contact to TCU. • Regulator has an internal defect.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check cable from TCU to gearbox. Check connectors from gearbox to TCU. Check regulator resistance. 1) Check internal wire harness of gearbox.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
87	S.C. to battery voltage at clutch KR. The measured resistance value of valve is out of limit, voltage at KR valve is too high. • Cable / connector is defective and has contact to battery voltage. • Cable / connector is defective and has contact to another regulator output of TCU. • Regulator has an internal defect.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check cable from TCU to gearbox. Check connectors from gearbox to TCU. Check regulator resistance. 1) Check internal wire harness of gearbox.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
88	S.C. to ground at clutch KR. The measured resistance value of valve is out of limit, voltage at KR valve is too low. • Cable / connector is defective and has contact to vehicle ground. • Regulator has an internal defect.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check cable from TCU to gearbox. Check connectors from gearbox to TCU. Check regulator resistance. 1) Check internal wire harness of gearbox.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
89	O.C. at clutch KR. The measured resistance value of valve is out of limit. • Cable / connector is defective and has no contact to TCU. • Regulator has an internal defect.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check cable from TCU to gearbox. Check connectors from gearbox to TCU. Check regulator resistance. 1) Check internal wire harness of gearbox.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.

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Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
91 **	S.C. to ground at relay reverse warning alarm. TCU detected a wrong voltage at output pin, that looks like a S.C. to vehicle ground. • Cable is defective and is contacted to vehicle ground. • Backup alarm device has an internal defect. • Connector pin is contacted to vehicle ground.	Backup alarm will be on until TCU power down even if fault vanishes (loose connection). OP-Mode: normal.	Check cable from TCU to backup alarm device. Check connectors from backup alarm device to TCU. Check resistance 1) of backup alarm device.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
92 **	S.C. to battery voltage at relay reverse warning alarm. TCU detected a wrong voltage at output pin, that looks like a S.C. to battery voltage. • Cable is defective and is contacted to battery voltage. • Backup alarm device has an internal defect. • Connector pin is contacted to battery voltage.	No reaction. OP-Mode: normal.	Check cable from TCU to backup alarm device. Check connectors from backup alarm device to TCU. Check resistance 1) of backup alarm device.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
93 **	O.C. at relay reverse warning alarm. TCU detected a wrong voltage at output pin, that looks like a O.C. for this output pin. • Cable is defective and has no connection to TCU. • Backup alarm device has an internal defect. • Connector has no connection to TCU.	No reaction. OP-Mode: normal.	Check cable from TCU to backup alarm device. Check connectors from backup alarm device to TCU. Check resistance 1) of backup alarm device.	1) See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
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Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
94 **	S.C. to ground at relay starter interlock. TCU detected a wrong voltage at output pin, that looks like a S.C. to vehicle ground. • Cable is defective and is contacted to vehicle ground. • Starter interlock relay has an internal defect. • Connector pin is contacted to vehicle ground.	No reaction. OP-Mode: normal.	Check cable from TCU to starter interlock relay. Check connectors from starter interlock relay to TCU. Check resistance 1) of starter interlock relay.	1) See “Measurement of Resistance at Actuator/sensors and Cable” on page 35.
95 *	O.C. at LIS1 solenoid valve. The measured resistance value of the valve is out of limit. • Cable/connector is defective and has no contact to TCU. • Valve has an internal defect.	No reaction. OP-Mode: normal.	Check the cable from TCU to the valve. Check the connectors from valve to TCU. Check the valve resistance.	If fault code 95 and 98 are both being displayed for about one second each, see combined fault code.
95 **	S.C. to battery voltage at relay starter interlock. TCU detected a wrong voltage at output pin, that looks like a S.C. to battery voltage. • Cable is defective and is contacted to battery voltage. • Starter interlock relay has an internal defect. • Connector pin is contacted to battery voltage.	No reaction. OP-Mode: normal.	Check cable from TCU to starter interlock relay. Check connectors from starter interlock relay to TCU. Check resistance 1) of starter interlock relay.	1) See “Measurement of Resistance at Actuator/sensors and Cable” on page 35.
95 * 98 * Each fault code shown for about one second.	S.C. battery voltage or ground at LIS1 solenoid valve or LIS2 solenoid valve. • Cable is defective and is contacted to vehicle ground or vehicle ground. • Cable has no connection to TCU. • Valve has an internal defect. • Connector pin is contacted to battery voltage or is broken. • Connector pin is contacted to vehicle ground.	No reaction. OP-Mode: normal.	Check the cable from TCU to the valve. Check the connector. Check the valve.	---------------

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Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
96 **	O.C. at relay starter interlock. TCU detected a wrong voltage at output pin, that looks like a O.C. for this output pin. • Cable is defective and has no connection to TCU. • Starter interlock relay has an internal defect. • Connector has no connection to TCU.	No reaction. OP-Mode: normal.	Check cable from TCU to starter interlock relay. Check connectors from starter interlock relay to TCU. Check resistance [1] of starter interlock relay.	[1] See "Measurement of Resistance at Actuator/sensors and Cable" on page 35.
98 *	O.C. at LIS2 solenoid valve. The measured resistance value of the valve is out of limit. • Cable/connector resistance and has no contact to TCU. • Valve has an internal defect.	No reaction. OP-Mode: normal.	Check the cable from TCU to the valve. Check the connectors from valve to TCU. Check the valve resistance.	If fault code 95 and 98 are both being displayed for about one second each, see combined fault code.
B1	Slippage at clutch K1. TCU calculates a differential speed at closed clutch K1. If this calculated value is out of range, TCU interprets this as slipping clutch. • Low pressure at clutch K1. • Low main pressure. • Wrong signal at internal speed sensor. • Wrong signal at output speed sensor. • Sensor gap is incorrect. • Clutch is defective.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check pressure at clutch K1. Check main pressure in system. Check sensor gap at internal speed sensor. Check sensor gap at output speed sensor. Check signal at internal speed sensor. Check signal at output speed sensor. Replace clutch.	---------------
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Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
B2	Slippage at clutch K2. TCU calculates a differential speed at closed clutch K2. If this calculated value is out of range, TCU interprets this as slipping clutch. • Low pressure at clutch K2. • Low main pressure. • Wrong signal at internal speed sensor. • Wrong signal at output speed sensor. • Sensor gap is incorrect. • Clutch is defective.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check pressure at clutch K2. Check main pressure in system. Check sensor gap at internal speed sensor. Check sensor gap at output speed sensor. Check signal at internal speed sensor. Check signal at output speed sensor. Replace clutch.	---------------
B3	Slippage at clutch K3. TCU calculates a differential speed at closed clutch K3. If this calculated value is out of range, TCU interprets this as slipping clutch. • Low pressure at clutch K3. • Low main pressure. • Wrong signal at internal speed sensor. • Wrong signal at output speed sensor. • Sensor gap is incorrect. • Clutch is defective.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check pressure at clutch K3. Check main pressure in system. Check sensor gap at internal speed sensor. Check sensor gap at output speed sensor. Check signal at internal speed sensor. Check signal at output speed sensor. Replace clutch.	---------------
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Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
B4	Slippage at clutch K4. TCU calculates a differential speed at closed clutch K4. If this calculated value is out of range, TCU interprets this as slipping clutch. • Low pressure at clutch K4. • Low main pressure. • Wrong signal at internal speed sensor. • Wrong signal at turbine speed sensor. • Sensor gap is incorrect. • Clutch is defective.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check pressure at clutch K4. Check main pressure in system. Check sensor gap at internal speed sensor. Check sensor gap at turbine speed sensor. Check signal at internal speed sensor. Check signal at turbine speed sensor. Replace clutch.	---------------
B5	Slippage at clutch KV. TCU calculates a differential speed at closed clutch KV. If this calculated value is out of range, TCU interprets this as slipping clutch. • Low pressure at clutch KV. • Low main pressure. • Wrong signal at internal speed sensor. • Wrong signal at turbine speed sensor. • Sensor gap is incorrect. • Clutch is defective.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check pressure at clutch KV. Check main pressure in system. Check sensor gap at internal speed sensor. Check sensor gap at turbine speed sensor. Check signal at internal speed sensor. Check signal at turbine speed sensor. Replace clutch.	---------------

* Only Mega 400-III PLUS
** Only Series "V"
Gray shaded boxes are error codes for other applications. They are only given for general reference purposes.

Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
B6	Slippage at clutch KR. TCU calculates a differential speed at closed clutch KR. If this calculated value is out of range, TCU interprets this as slipping clutch. • Low pressure at clutch KR. • Low main pressure. • Wrong signal at internal speed sensor. • Wrong signal at turbine speed sensor. • Sensor gap is incorrect. • Clutch is defective.	TCU shifts to neutral. OP-Mode: limp home. If failure at another clutch is pending. TCU shifts to neutral. OP-Mode: TCU shut down.	Check pressure at clutch KR. Check main pressure in system. Check sensor gap at internal speed sensor. Check sensor gap at turbine speed sensor. Check signal at internal speed sensor. Check signal at turbine speed sensor. Replace clutch.	---------------
B7	Overtemp sump. TCU measured a temperature in oil sump that is over allowed threshold.	No reaction. OP-Mode: normal.	Cool down machine. Check oil level. Check temperature sensor.	---------------
D1	S.C. to battery voltage at power supply for sensors. TCU measures more than 6V at the pin AU1 (5V sensor supply).	See fault codes No. 21 - 2C.	Check cables and connectors to sensors, which are supplied from AU1. Check the power supply at the pin AU1 (should be approximately 5V).	Fault codes No. 21 to No. 2C may be a reaction of this fault.
D2	S.C. to ground at power supply for sensors. TCU measures less than 4V at the pin AU1 (5V sensor supply).	See fault codes No. 21 - 2C.	Check cables and connectors to sensors, which are supplied from AU1. Check the power supply at the pin AU1 (should be approximately 5V).	Fault codes No. 21 to No. 2C may be a reaction of this fault.
D3	Low power at battery. Measured voltage at power supply is lower than 18 V.	Shift to neutral. OP-Mode: TCU shut down.	Check power supply battery. Check cables from batteries to TCU. Check connectors from batteries to TCU.	---------------

* Only Mega 400-III PLUS
** Only Series "V"
Gray shaded boxes are error codes for other applications. They are only given for general reference purposes.

Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
D4	High power at battery. Measured voltage at power supply is higher than 32 V.	Shift to neutral. OP-Mode: TCU shut down.	Check power supply battery. Check cables from batteries to TCU. Check connectors from batteries to TCU.	---------------
D5	Error at switch 1 for valve power supply VPS1. TCU switched on VPS1 and measured VPS1 is off or TCU switched off VPS1 and measured VPS1 is still on. • Cable or connectors are defect and are contacted to battery voltage. • Cable or connectors are defect and are contacted to vehicle ground. • Permanent power supply KL30 missing. • TCU has an internal defect.	Shift to neutral. OP-Mode: TCU shut down.	Check fuse. Check cables from gearbox to TCU. Check connectors from gearbox to TCU. Replace TCU.	---------------
D6	Error at switch 2 for valve power supply VPS2. TCU switched on VPS2 and measured VPS2 is off or TCU switched off VPS2 and measured VPS2 is still on. • Cable or connectors are defect and are contacted to battery voltage. • Cable or connectors are defect and are contacted to vehicle ground. • Permanent power supply KL30 missing. • TCU has an internal defect.	Shift to neutral. OP-Mode: TCU shut down.	Check fuse. Check cables from gearbox to TCU. Check connectors from gearbox to TCU. Replace TCU.	---------------
* Only Mega 400-III PLUS ** Only Series "V" Gray shaded boxes are error codes for other applications. They are only given for general reference purposes.				

Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
E3	S.C. to battery voltage at display output. TCU sends data to the display and measures always a high voltage level on the connector. • Cable or connectors are defective and are contacted to battery voltage. • Display has an internal defect.	No reaction. OP-Mode: normal.	Check the cable from TCU to the display. Check the connectors at the display. Change display.	---------------
E4	S.C. to ground at display output. TCU sends data to the display and measures always a high voltage level on the connector. • Cable or connectors are defective and are contacted to vehicle ground. • Display has an internal defect.	No reaction. OP-Mode: normal.	Check the cable from TCU to the display. Check the connectors at the display. Change display.	---------------
F1	General EEPROM fault. TCU cannot read non volatile memory. • TCU is defective.	Transmission stay neutral. OP-Mode: TCU shut down.	Replace TCU.	Often shown together with fault code F2.
F2	Configuration lost. TCU has lost the correct configuration and can't control the transmission. • Interference during saving data on non volatile memory. • TCU is brand new or from another vehicle.	Transmission stay neutral. OP-Mode: TCU shut down.	Reprogram the correct configuration for the vehicle (e.g. with cluster controller,...).	---------------
F3	Application error. Something of this application is wrong.	Transmission stay neutral. OP-Mode: TCU shut down.	Replace TCU!	This fault occurs only if an test engineer did something wrong in the application of the vehicle.
F5 **	Clutch failure. AEB was not able to adjust clutch filling parameters. • One of the AEB-Values is out of limit.	Transmission stay neutral. OP-Mode: TCU shut down.	Check clutch.	TCU shows also the affected clutch on the Display.

*   Only Mega 400-III PLUS
** Only Series "V"
Gray shaded boxes are error codes for other applications. They are only given for general reference purposes.

Fault Code (hex)	Meaning of the Fault Code (Possible reason for fault detection.)	Reaction of the TCU	Possible Steps to Repair	Remarks
F6 **	Clutch Adjustment Data lost. TCU was not able to read correct clutch adjustment parameters. • Interference during saving data on non volatile memory. • TCU is brand new.	No reaction, Default values = 0 for AEB offsets used. OP-Mode: normal.	Execute AEB.	---------------

* Only Mega 400-III PLUS
** Only Series "V"
Gray shaded boxes are error codes for other applications. They are only given for general reference purposes.

TABLE OF FAULT CODES - ERGO-CONTROL

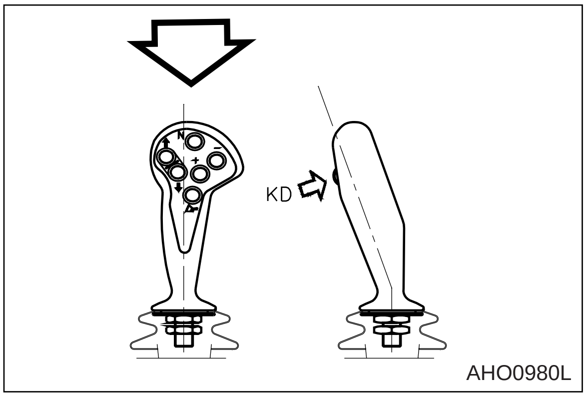

Figure 2

Error Code Number	Meaning of Error Code	Remarks
11	Logical error at gear range signal.	
12	Logical error at direction select signal.	
21	Short circuit to battery voltage at clutch cutoff input.	
22	Short circuit to ground or open circuit at clutch cutoff input.	
23	Short circuit to battery voltage at load sensor input.	Not used.
24	Short circuit to ground or open circuit at load sensor input.	Not used.
25	Short circuit to battery voltage or open circuit at temperature sensor input.	
26	Short circuit to ground at temperature sensor input.	
31	Short circuit to battery voltage at engine speed input.	
32	Short circuit to ground or open circuit at engine speed input.	
33	Logical error at engine speed input.	
34	Short circuit to battery voltage at turbine speed input.	
35	Short circuit to ground or open circuit at turbine speed input.	
36	Logical error at turbine speed input.	
37	Short circuit to battery voltage at internal speed input.	
38	Short circuit to ground or open circuit at internal speed input.	
39	Logical error at internal speed input.	

Error Code Number	Meaning of Error Code	Remarks
3A	Short circuit to battery voltage at output speed input.	
3B	Short circuit to ground or open circuit at output speed input.	
3C	Logical error at output speed input.	
71	Short circuit to battery voltage at clutch K1.	
72	Short circuit to ground at clutch K1.	
73	Open circuit at clutch K1.	
74	Short circuit to battery voltage at clutch K2.	
75	Short circuit to ground at clutch K2.	
76	Open circuit at clutch K2.	
77	Short circuit to battery voltage at clutch K3.	
78	Short circuit to ground at clutch K3.	
79	Open circuit at clutch K3.	
7A	Short circuit to battery voltage at converter clutch.	Not used.
7B	Short circuit to ground at converter clutch.	Not used.
7C	Open circuit at converter clutch.	Not used
81	Short circuit battery voltage at clutch K4.	
82	Short circuit to ground at clutch K4.	
83	Open circuit at clutch K4.	
84	Short circuit to battery voltage at clutch KV.	
85	Short circuit to ground at clutch KV.	
86	Open circuit at clutch KV.	
87	Short circuit to battery voltage at clutch KR.	
88	Short circuit to ground at clutch KR.	
89	Open circuit at clutch KR.	
91	Short circuit battery voltage at relay reverse warning alarm.	
92	Short circuit to ground at relay reverse warning alarm.	
93	Open circuit at relay reverse warning alarm.	
94	Short circuit to battery voltage at relay starter interlock.	

Error Code Number	Meaning of Error Code	Remarks
95	Short circuit to ground at relay starter interlock.	
96	Open circuit at relay starter interlock.	
97	Short circuit to battery voltage at park brake solenoid.	
98	Short circuit ground at park brake solenoid.	
99	Open circuit at park brake solenoid.	
B1	Slippage at clutch K1.	
B2	Slippage at clutch K2.	
B3	Slippage at clutch K3.	
B4	Slippage at clutch K4.	
B5	Slippage at clutch KV.	
B6	Slippage at clutch KR.	
D1	Short circuit to battery voltage at power supply for sensors.	
D2	Short circuit to ground at power supply for sensors.	
D3	Low power at battery.	
D4	High power at battery.	
D5	Error at switch 1 for valve power supply.	
D6	Error at switch 2 for valve power supply.	
E1	Short circuit to battery at speedometer output.	Not used.
E2	Short circuit to ground or open circuit at speedometer output.	Not used.
E3	Short circuit to battery voltage at display output.	Not used.
E4	Short circuit to ground or open circuit at display output.	Not used.
E5	Error at communication on CAN.	
F1	General EEPROM fault.	
F2	Configuration lost.	
F3	Application error.	

MEASUREMENT OF RESISTANCE AT ACTUATOR/ SENSORS AND CABLE

ACTUATOR

Open circuit: $R_{12} \approx R_{1G} \approx R_{2G} \approx \infty$

Short cut to ground: $R_{12} \approx R; R_{1G} \approx 0$, $R_{2G} \approx R$ or $R_{1G} \approx R$, $R_{2G} \approx 0$ (for S.C. to ground, G is connected to vehicle ground)

Short cut to battery: $R_{12} \approx R; R_{1G} \approx 0$, $R_{2G} \approx R$ or $R_{1G} \approx R$, $R_{2G} \approx 0$ (for S.C. to battery, G is connected to battery voltage.

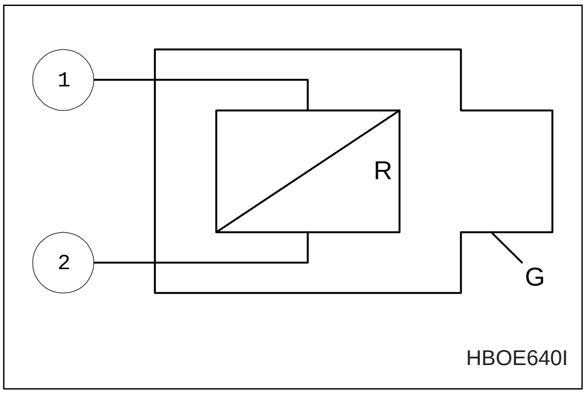

Figure 3

CABLE

open circuit:

$R_{12} \approx R_{1P} \approx R_{1C} \approx R_{2P} \approx R_{2C} \approx \infty$

short cut to ground:

$R_{12} \approx 0; R_{1C} \approx R_{2C} \approx 0, R_{1P} \approx R_{2P} \approx \infty$

short cut to battery:

$R_{12} \approx 0, R_{1C} \approx R_{2C} \approx \infty, R_{1P} \approx R_{2P} \approx 0$

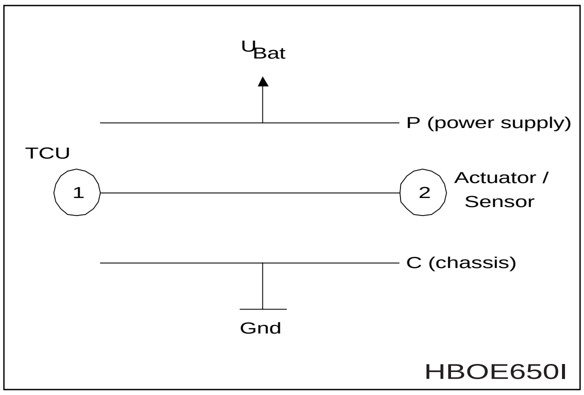

Figure 4

HYDRAULICS

ACCUMULATOR

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Mega 130	0001 and Up
Mega 160	0001 and Up
Mega 200-III	1001 and Up
Mega 200-V	1001 and Up
Mega 250-III	1001 and Up
Mega 250-V	1001 and Up
Mega 300-V	1001 and Up
Mega 400-III PLUS	1001 and Up
Mega 400-V	1001 and Up
Mega 500-V	1001 and Up
Solar 130LC-V	0001 and Up
Solar 130W-V	0001 and Up
Solar 170LC-V	1001 and Up
Solar 170W-V	1001 and Up
Solar 200W-V	0001 and Up
Solar 220LC-V	0001 and Up
Solar 220LL	1001 and Up
Solar 220N-V	1001 and Up
Solar 250LC-V	1001 and Up

Models continued on back of cover.

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MODEL	SERIAL NUMBER RANGE
Solar 290LC-V	0001 and Up
Solar 290LL	1001 and Up
Solar 330LC-V	1001 and Up
Solar 400LC-V	1001 and Up
Solar 450LC-V	1001 and Up

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GENERAL DESCRIPTION

The accumulator is a gas-charged storage device designed to hold a reserve quantity of hydraulic fluid under pressure. Accumulators are used in hydraulic circuits in much the same way that condensers (or capacitors) are used to collect, store and maintain electrical charge in a circuit.

In a hydraulic circuit, minor variations or lags in pump output that might otherwise cause unsteady or irregular operation are made up from the supply of pressurized oil in the accumulator.

Reference Number	Description
1	Screw Plug
2	Sealing Ring
3	Diaphragm
4	Fluid Valve
5	Steel Pressure Vessel

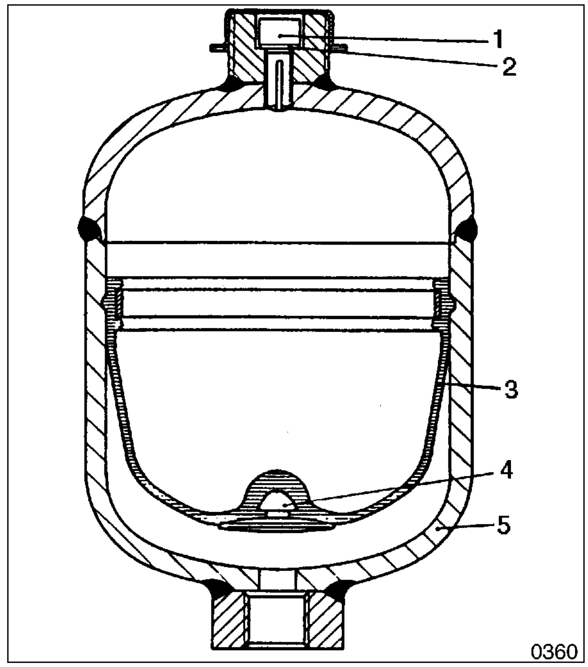

Figure 1

Accumulators are solidly constructed to resist the high operating pressures of the fluids they contain. There are only three main moving parts: a valve assembly at the top allows adding or expelling gas from the compressible, pre-charged upper chamber; a valve assembly at the bottom of the accumulator for passing hydraulic fluid in and out, and an elastic diaphragm to separate the two chambers. The flexible diaphragm changes shape to conform to the changing pressures and volumes of the two fluids in the upper and lower chambers.

There are six possible positions the diaphragm can be in and they are as follows:

1. With no gas charge in the upper chamber 0 bar (0 psi, empty) and no oil in the bottom 0 bar (0 psi, dry) the elastic diaphragm hangs loosely.
2. When the pre-pressure charge of gas (usually nitrogen) is introduced through the valve at the top of the accumulator, the diaphragm expands to maximum size. The valve button in the center of the diaphragm pushes into the fluid opening in the bottom chamber, sealing off the lower valve. If the pressure of the gas charge exceeds system oil pressure, no fluid enters the accumulator. The button also keeps the diaphragm from protruding into the lower valve opening.

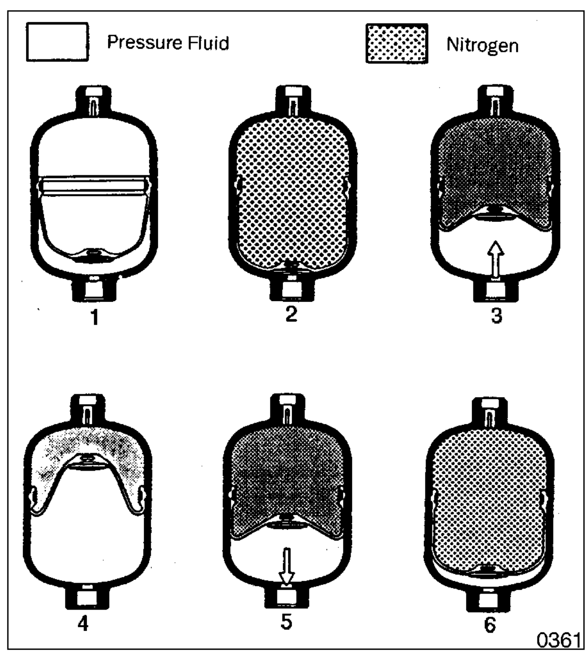

Figure 2

NOTE: *Pre-charge pressure is referred to as the "P1" pressure. The accumulator manufacturer's "P1" rated pressure should be stamped or marked on the accumulator's rating plate. Annual checks of actual pre-charge pressure should be made by tapping a hydraulic pressure gauge (and 3-way adapter coupling) into the valve on the bottom of the accumulator. When hydraulic fluid is pushed out the lower valve opening by the pressure of the gas charge on the other side of the diaphragm - and there is no counter-pressure from system oil - the valve button on the bottom of the diaphragm eventually seals off the lower oil passage. Just after the needle on the gauge reaches its highest point (when there is 0 bar (0 psi) resistance from hydraulic system pressure) pressure on the gauge will drop sharply to zero, as the accumulator is completely emptied of oil and the diaphragm button closes.*

Record the highest gauge reading and compare to the "P1" rated pre-charge pressure on the accumulator manufacturer's data label. Repeat this test at least once a year to verify proper functioning of the accumulator.

3. As hydraulic system pressure overcomes accumulator pre-charge pressure, the flexible diaphragm begins to retract upward.
4. When system oil is at highest working pressure and the accumulator fills to maximum reserve capacity, the flexible diaphragm is pushed up into the top of the upper chamber.

   The highest working pressure is sometimes referred to as the "P3" pressure and can also be referenced on the manufacturer's data label on the exterior of the accumulator.
5. If system oil pressure begins to fall off or is momentarily checked or interrupted, the energy stored on the other side of the diaphragm, in the form of compressed gas, pushes oil back out of the lower chamber, maintaining oil pressure of the circuit.
6. With minimal system pressure, an equilibrium point may be reached in which accumulator pre-charge pressure and hydraulic system oil pressure achieve a rough balance. In this condition a minimal amount of oil is stored in the accumulator.

SPECIFICATIONS

Model	Serial Number	System	Charge Pressure	Volume
Mega 130	S/N 0001 - 1003	Pilot	15 kg/cm^2 (210 psi)	320 cc (19.53 in^3)
Mega 130	S/N 0001 and Up	Brake System	9 kg/cm^2 (130 psi)	500 cc (30.51 in^3)
Mega 160	S/N 0001 - 1020	Brake System	8 kg/cm^2 (115 psi)	500 cc (30.51 in^3)
Mega 160	S/N 0001 - 1020	Pilot	15 kg/cm^2 (210 psi)	320 cc (19.53 in^3)
Mega 160	S/N 1021 and Up	Brake System	30 kg/cm^2 (430 psi)	750 cc (45.77 in^3)
Mega 200-III	S/N 1001 - 1386	Brake System	15 kg/cm^2 (210 psi)	320 cc (19.53 in^3)
Mega 200-III	S/N 1001 - 1386	Pilot	15 kg/cm^2 (210 psi)	320 cc (19.53 in^3)

Model	Serial Number	System	Charge Pressure	Volume
Mega 200-III	S/N 1387 and Up	Brake System	40 kg/cm^2 (570 psi)	750 cc (45.77 in^3)
Mega 200-V	S/N 1001 and Up	Brake System	15 kg/cm^2 (210 psi)	320 cc (19.53 in^3)
Mega 250-III	S/N 1001 and Up	Brake / Pilot System	30 kg/cm^2 (430 psi)	750 cc (45.77 in^3)
Mega 250-V	S/N 1001 and Up	Brake / Pilot System	15 kg/cm^2 (210 psi)	320 cc (19.53 in^3)
Mega 300-V	S/N 1001 and Up	Brake System	30 kg/cm^2 (430 psi)	750 cc (45.77 in^3)
Mega 300-V	S/N 1001 and Up	Pilot	15 kg/cm^2 (210 psi)	320 cc (19.53 in^3)
Mega 400-III	S/N 1001 and Up	Brake System		
Mega 400-III	S/N 1001 and Up	Pilot		
Mega 400-III PLUS	S/N 1001 and Up	Brake / Pilot System	30 kg/cm^2 (430 psi)	750 cc (45.77 in^3)
Mega 400-V	S/N 1001 and Up	Brake System	30 kg/cm^2 (430 psi)	750 cc (45.77 in^3)
Mega 400-V	S/N 1001 and Up	Pilot	15 kg/cm^2 (210 psi)	320 cc (19.53 in^3)
Mega 500-V	S/N 1001 and Up	Brake System	30 kg/cm^2 (430 psi)	750 cc (45.77 in^3)
Mega 500-V	S/N 1001 and Up	Pilot	15 kg/cm^2 (210 psi)	320 cc (19.53 in^3)
Solar 130LC-V	S/N 0001 and Up	Pilot / Travel	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
Solar 130W-V	S/N 0001 and Up	Brake System	30 kg/cm^2 (430 psi)	750 cc (45.77 in^3)
Solar 130W-V	S/N 0001 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
Solar 130W-V	S/N 0001 and Up	Transmission	8 kg/cm^2 (115 psi)	750 cc (45.77 in^3)
Solar 170LC-V	S/N 1001 and Up	Pilot / Travel	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
Solar 170W-V	S/N 1001 and Up	Brake System	30 kg/cm^2 (430 psi)	750 cc (45.77 in^3)
Solar 170W-V	S/N 1001 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)

Model	Serial Number	System	Charge Pressure	Volume
Solar 170W-V	S/N 1001 and Up	Transmission	8 kg/cm^2 (115 psi)	750 cc (45.77 in^3)
Solar 200W-V	S/N 0001 and Up	Brake System	30 kg/cm^2 (430 psi)	750 cc (45.77 in^3)
Solar 200W-V	S/N 0001 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
Solar 200W-V	S/N 0001 and Up	Transmission	8 kg/cm^2 (115 psi)	750 cc (45.77 in^3)
Solar 220LC-V	S/N 0001 and Up	Pilot / Travel	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
Solar 220LL	S/N 1001 and Up	Pilot / Travel	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
Solar 220N-V	S/N 1001 and Up		10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
Solar 250LC-V	S/N 1001 and Up	Pilot / Travel	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
Solar 290LC-V	S/N 0001 and Up	Pilot / Travel	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
Solar 290LL	S/N 1001 and Up	Pilot / Travel	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
Solar 330LC-V	S/N 1001 and Up	Pilot / Travel	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
Solar 400LC-V	S/N 1001 and Up	Pilot / Travel	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
Solar 450-V	S/N 1001 and Up	Pilot / Travel	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)

ACCUMULATOR CHARGING

WARNING!

In the event of a diaphragm or upper valve failure, or any type of accident or handling fault, the upper chamber of the accumulator could at some point require re-pressurization. Depending upon the specific procedures and safety precautions recommended for the type and model accumulator that has been installed on your machine, a specialized adapter and/or filling tool may be required to perform the procedure. Consult your dealer or Daewoo After Sales Service for more information and follow recommended procedures carefully. All accumulators may contain gas held under high pressure. Careless handling or improper disassembly could release explosive stored energy, resulting in an accident or injury.

NOTE: *Some machines use 320 cc (19.53 in^3) Bosch Accumulators with a nitrogen precharge (P1) pressure of 15 kg/cm^2 (213 psi). Always verify pre-charge pressure by checking the manufacturer's data label on the exterior of the accumulator.*

CHARGING THE ACCUMULATOR WITH NITROGEN

1. Remove the protective cap (10, Figure 3) and the protective plug (11) from the accumulator (6).

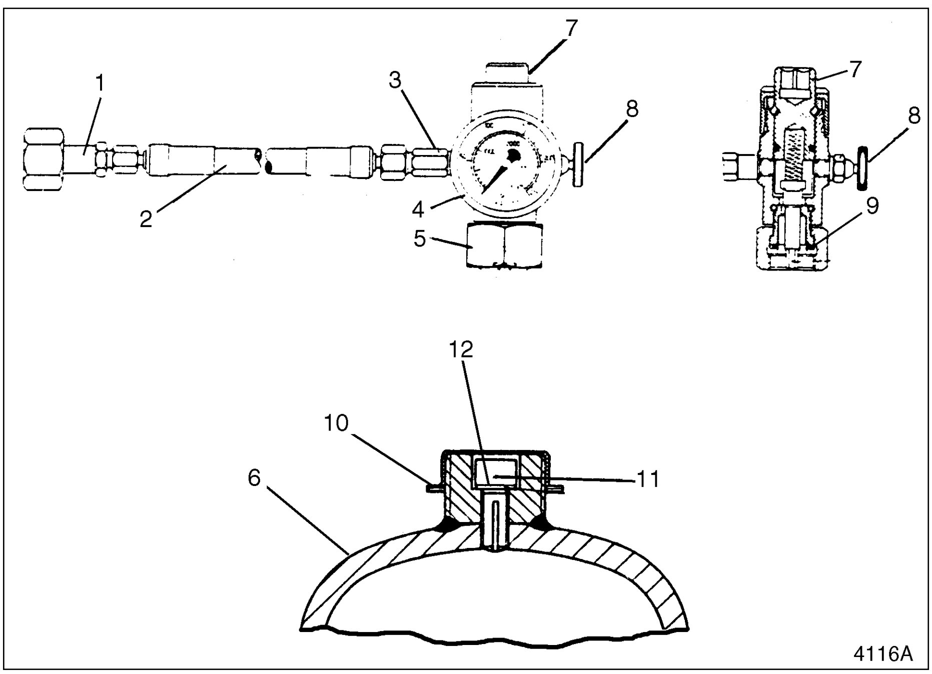

Figure 3

Reference Number	Description
1	Nitrogen Cylinder Fitting
2	Hose, 3 Meters (10 ft) Long
3	Check Valve
4	Pressure Gauge
5	Sealing Nut
6	Accumulator

Reference Number	Description
7	Cylinder to Accumulator Adapter
8	Nitrogen Bleeder Valve
9	Nut O-ring
10	Protective Cap
11	Protective Plug
12	Sealing Ring

2. Clean area around seal ring (12).
3. Thread the sealing nut (5, Figure 3) of adapter (7) onto accumulator. Tighten adapter securely. Close nitrogen bleeder vale (8).
4. Thread nitrogen cylinder fittings (1, Figure 3) onto nitrogen cylinder.
5. Open valve on nitrogen cylinder and charge accumulator to a appropriate pressure (P1). Close valve on nitrogen cylinder.

   NOTE: *Wait 2 or 3 minutes for nitrogen to warm to ambient temperature. This will stabilize pressure.*

6. Slowly open nitrogen bleeder valve (8). Open valve (8) until gauge (4) reading is equal to primary pressure. Close bleeder valve.
7. Unscrew adapter (7, Figure 3) from accumulator (6).
8. Thread protective plug (11, Figure 3) into accumulator. Tighten to 3 kg•m (22 ft lb).
9. Check for nitrogen leaks around protective plug (11, Figure 3). Coat area around protective plug (11) with soapy water. If soap bubbles form, retighten protective plug (11).
10. Install protective cap (10, Figure 3) on accumulator.

WARNING!

Accumulator store nitrogen under high pressure. Before replacing an accumulator, install an adapter (7) with a bleeder valve (8) on the accumulator. Slowly and carefully bleed off all nitrogen before removing the accumulator from the hydraulic system.

NOTE: *After an accumulator has been installed, or after an accumulator has been recharged with (P1) after the first week of operation. Check for a pressure drop due to leaks. If no pressure drop is found after the first week, check again after 3 more weeks. If no pressure drop is found after 3 weeks, check after one year.*

CYLINDERS

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Mega 130	0001 and Up
Mega 160	0001 and Up
Mega 200-III	1001 and Up
Mega 200-V	1001 and Up
Mega 250-III	1001 and Up
Mega 250-V	1001 and Up
Mega 300-V	1001 and Up
Mega 400-III PLUS	1001 and Up
Mega 400-V	1001 and Up
Mega 500-V	1001 and Up

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GENERAL DESCRIPTION

The machine contains boom cylinders, buckets cylinders and steering cylinders. Each cylinder contains a cylinder tube, piston rod, piston, and cylinder head. See Figure 1. The piston is held to piston rod by a nut. A dust seal protects the U-ring and oil seal from dirt and also prevents oil from leaking out of the cylinder.

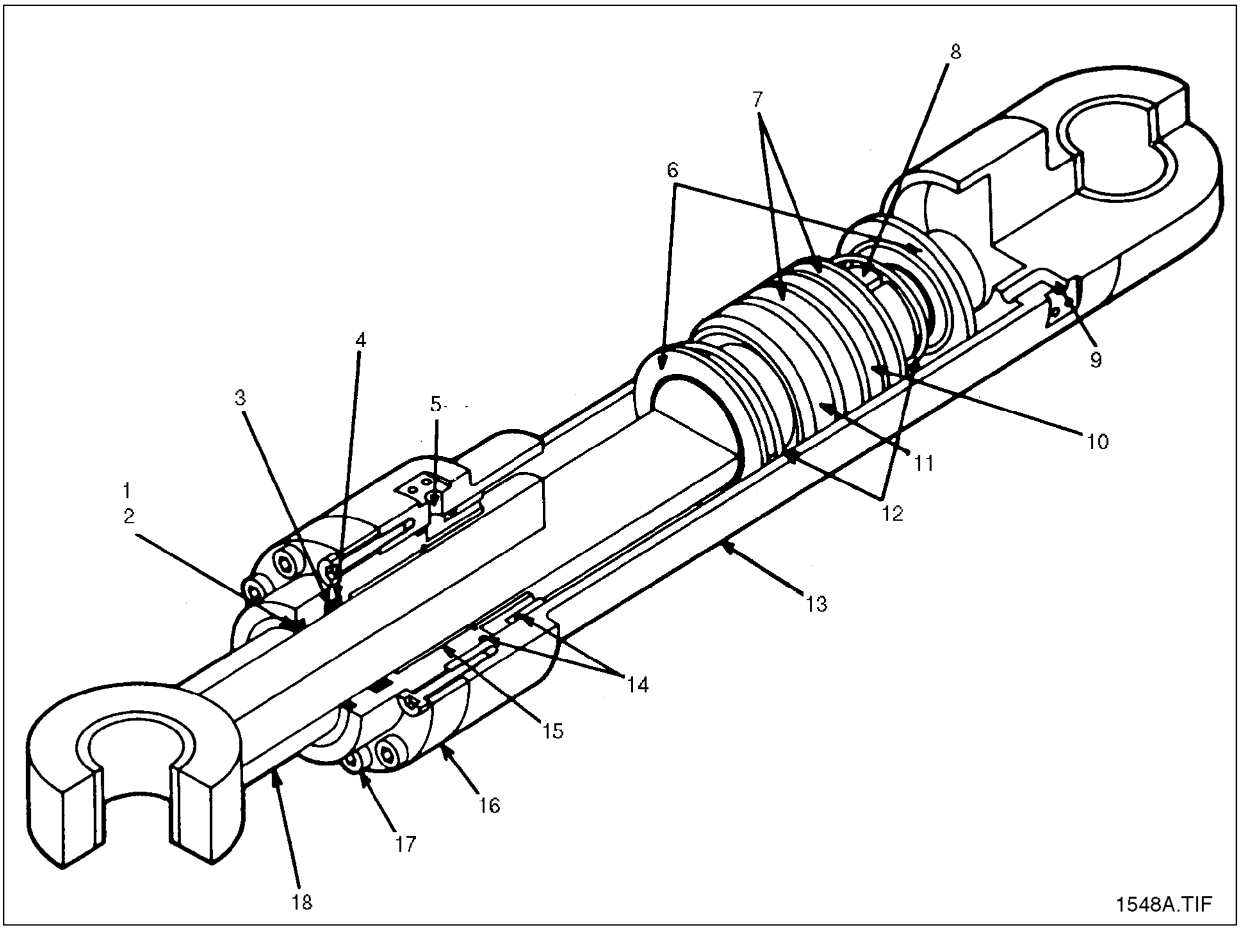

Figure 1

Reference Number	Description
1	Retaining Ring
2	Dust Seal
3	U-Ring
4	Seat O-ring
5	Port (A)
6	Cushion Plate
7	Wear Ring
8	Piston Nut
9	Port (B)

Reference Number	Description
10	Seal O-ring
11	Piston
12	Spring
13	Cylinder Tube
14	O-ring, Backup Ring
15	Bushing
16	Cylinder Head
17	Bolt
18	Piston Rod

THEORY OF OPERATION

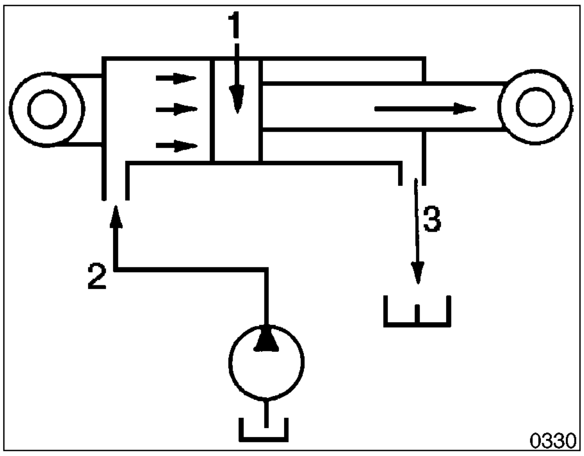

Figure 2

Reference Number	Description
1	Piston
2	Oil Path A
3	Oil Path B

Cylinder piston rods are extended or retracted by oil flow to back side of cylinder (shown as "oil path A") or to front of cylinder ("oil path B").

The cylinder rod is extended as oil flow is pumped through the circuit to the back side of the piston. The force (F1) of the piston stroke can be expressed by the formula below, where P = circuit oil pressure and the inside diameter of the cylinder is expressed by B (Figure 2).

$$F_1 = P \times \frac{\pi B^2}{4}$$

(P: Pressure, π = 3.14, B: Cylinder Inside Diameter)

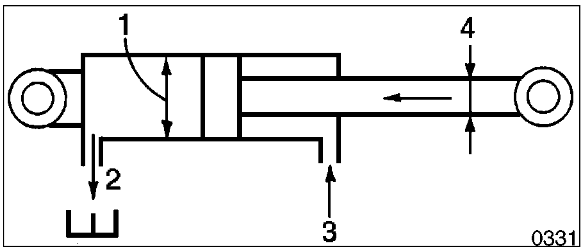

Figure 3

Reference Number	Description
1	Cylinder Inside Diameter - B
2	Oil Path A
3	Oil Path B
4	Rod Diameter

When the cylinder rod is retracted, oil flow through the circuit from the pump to the front side of the cylinder generates a force (F2) that can be expressed by the formula in which the diameter of the piston rod is expressed by R, and the other two terms are the same as in the preceding expression.

$$F_2 = P \times \frac{\pi(B^2-R^2)}{4}$$

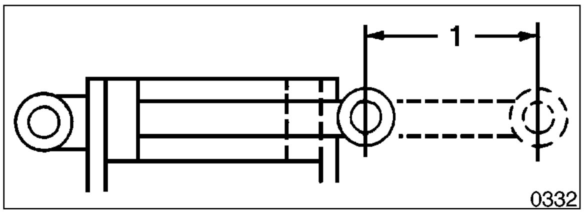

Figure 4

Because the volume of oil needed to lengthen the cylinder rod (Q1) is greater than the volume of oil required to retract the cylinder rod, it takes more time to decrease cylinder stroke length than it does to lengthen it.

$$Q_1 = S \times \frac{\pi(B^2)}{4}$$

$$Q_2 = S \times \frac{\pi(B^2-R^2)}{4}$$

$Q_1 > Q_2$

PARTS LIST

Boom Hydraulic Cylinder

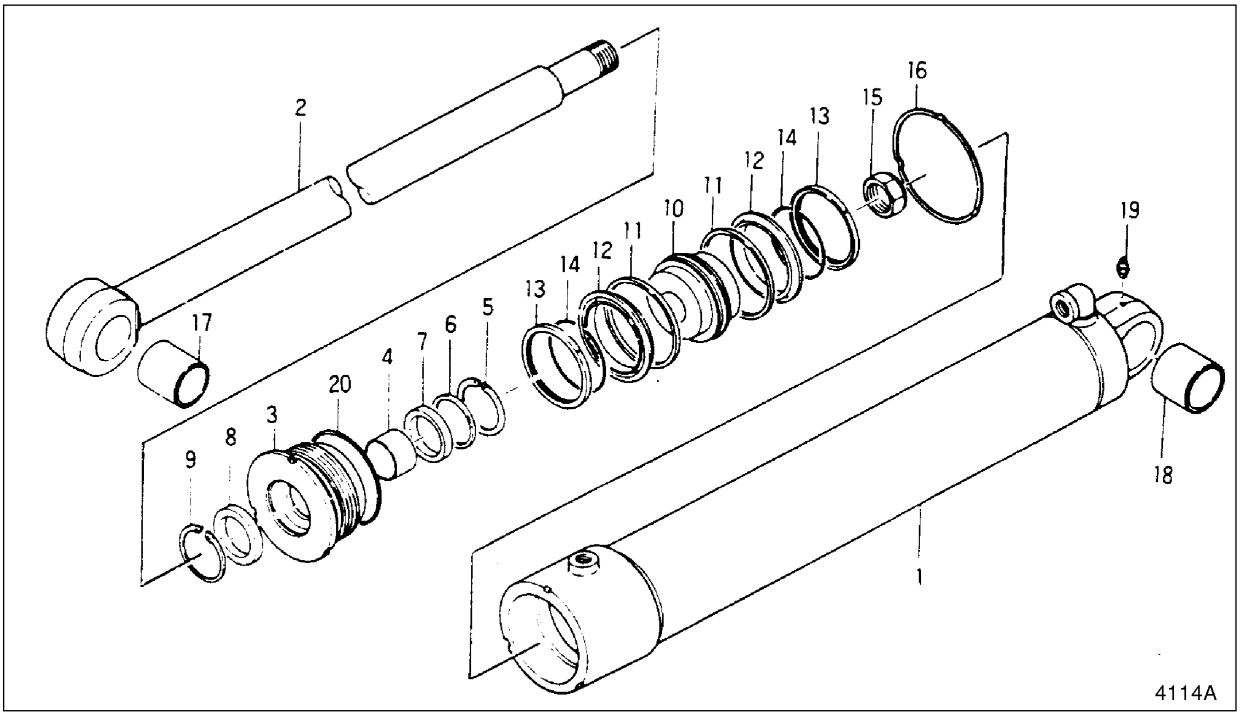

Figure 5

Reference Number	Description
1	Cylinder Tube
2	Cylinder Rod
3	Cylinder Head
4	Bushing
5	Snap Ring
6	Packing Header
7	U-Ring
8	Wiper Ring
9	Snap Ring
10	Piston

Reference Number	Description
11	Piston Ring
12	U-Ring
13	U-Ring Holder
14	Stopper
15	U-nut
16	Lock Washer
17	Pin Bushing
18	Pin Bushing
19	Grease Flitting
20	O-ring

Bucket Hydraulic Cylinder

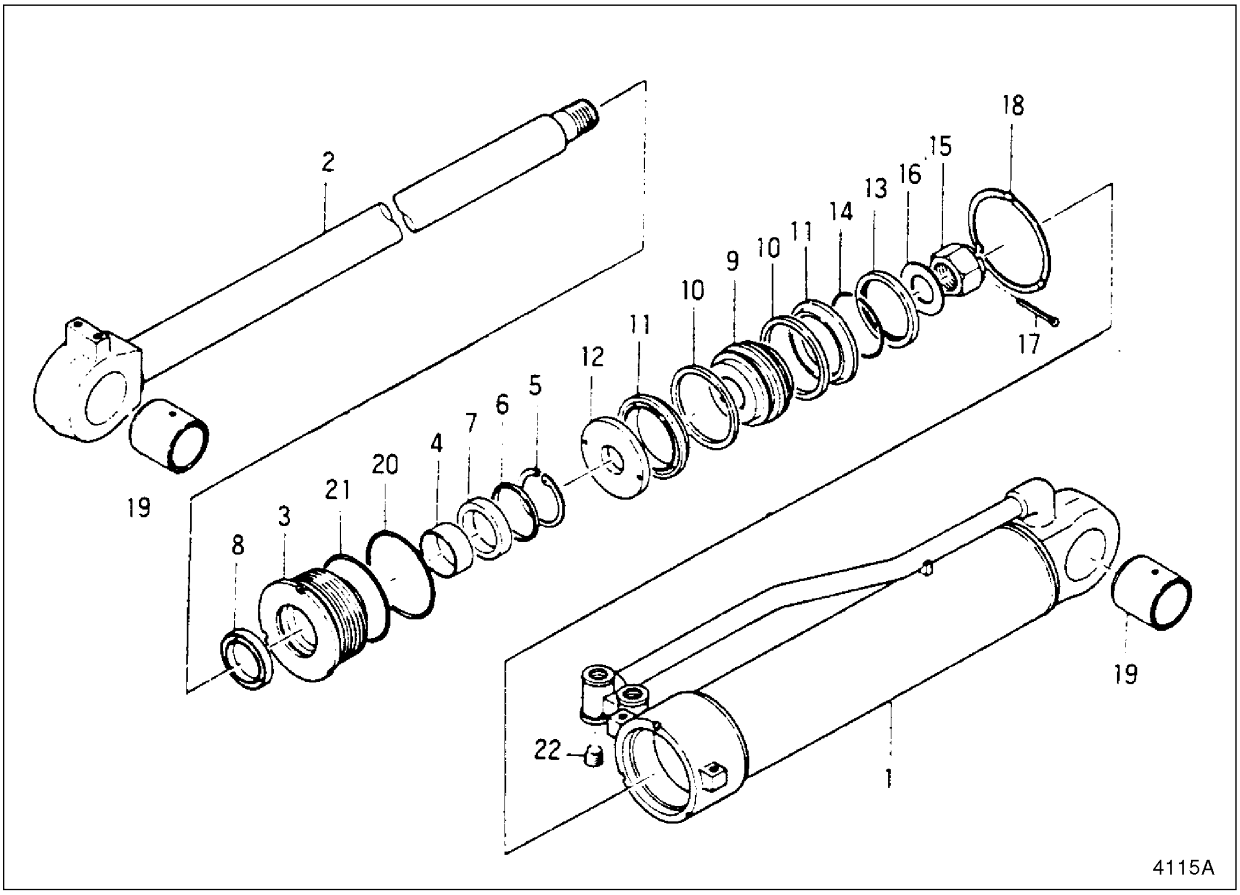

Figure 6

Reference Number	Description
1	Cylinder Tube
2	Cylinder Rod
3	Cylinder Head
4	Bushing
5	Snap Ring
6	Packing Header
7	U-ring
8	Wiper Ring
9	Piston
10	Piston Ring
11	U-ring

Reference Number	Description
12	U-ring Holder
13	U-ring Holder
14	Stopper
15	Castle Nut
16	Shim
17	Dividing Pin
18	Lock Washer
19	Pin Bushing
20	O-ring
21	O-ring
22	Plug

TROUBLESHOOTING, TESTING AND ADJUSTMENT

Problem	Possible Cause	Remedy
Oil leaking between cylinder head (16) and piston rod (18). (Index nos. refer to Figure 1)	Foreign material in U-ring (3).	Remove foreign material.
	Scratches in U-ring (3).	Replace U-ring (3).
	Damage to U-ring (3).	Replace U-ring (3).
	Foreign material in dust seal (2).	Remove foreign material.
	Scratches to dust seal (2).	Replace dust seal.
	Damage to dust seal (2).	Replace dust seal.
	Foreign material in seal O-ring (4).	Remove foreign material.
	Scratches in seal O-ring (4).	Replace O-ring (4).
	Damage to seal O-ring (4).	Replace O-ring (4).
	Scratches on sealing surface of piston rod (18).	If scratches are not deep, hone with an oil stone and lubricate. If scratches are deep, replace piston rod (18).
	Deep scratches on inner surface of bushing (15).	Replace Bushing.
Oil leaking between cylinder head (16) and cylinder tube (13).	Damage to O-rings (14).	Replace O-rings (14).
Oil leaking from welded area of cylinder tube (13).	Damage to welded area.	Replace cylinder tube (13).

Problem	Cause	Remedy
Oil leaking between cylinder head (16) and piston rod (18). (Index nos. refer to Figure 1).	Foreign material in U-ring (3, Figure 1)	Remove foreign material.
	Scratches in U-ring (3, Figure 1).	Replace U-ring (3).
	Damage to U-ring (3, Figure 1).	Replace U-ring (3).
	Foreign material in dust seal (2, Figure 1).	Remove foreign material.
	Scratches in dust seal (2, Figure 1).	Replace dust seal (2).
	Damage to dust seal (2, Figure 1).	Replace dust seal (2).
	Foreign material in seal O-ring (4, Figure 1).	Remove foreign material.
	Scratches in seal O-ring (4, Figure 1).	Replace O-ring (4).
	Damage to seal O-ring (4, Figure 1).	Replace O-ring (4).
	Scratch on sealing surface of piston rod (18, Figure 1).	If scratches are not deep, hone with an oil stone and lubricate. If scratches are deep, replace piston rod (18).
	Deep scratches on inner surface of bushing (15, Figure 1).	Replace bushing.
Oil leaking between cylinder head (16) and cylinder tube (13).	Damage to O-rings (14, Figure 1).	Replace O-rings (14).
Oil leaking from welded area of cylinder tube (13).	Damage to welded area.	Replace cylinder tube (13).
Cylinder drops from pull of gravity.	Light scratches on sealing surface of cylinder tube (13, Figure 1).	Hone out scratches with oil stone.
	Deep scratches on sealing surface of cylinder tube (13, Figure 1).	Replace cylinder tube (13).
	Deep scratches on sealing surface of piston O-rings (10, Figure 1).	Replace O-rings (10).
	Foreign material in U-ring (3, Figure 1).	Remove foreign material.
	Scratches in U-ring (3, Figure 1).	Replace U-ring (3).
	Damage to U-ring (3, Figure 1).	Replace U-ring (3).
	Nylon wear rings (7, Figure 1) twisted.	Replace nylon wear rings (7).
	Nylon wear rings (7, Figure 1) scratched.	Replace nylon wear rings (7).
	Nylon wear rings (7, Figure 1) have other damage.	Replace nylon wear rings (7).

Problem	Cause	Remedy
Slow bucket and boom movements.	Reduced oil flow due to dirty filter or dirty intake line.	Disassemble and clean parts.
	Air drawn into circuit through loose connections.	Tighten intake connections.
	Reservoir oil level too low.	Fill reservoir to correct level.
	Relief valve pressure setting incorrect.	Adjust relief valve pressure.
	Damaged pump shaft or pump drive sleeve.	Replace damaged parts.
	Pump worn or damaged internally.	Replace worn or damaged parts.
	Relief valve sticking.	Disassemble and inspect cartridge. Clean or replace cartridge.
	Air in pressure line.	Perform cylinder bleeding procedure to remove air. Tighten or replace pressure line.
	Damaged pipe or hose.	Replace pipe or hose.
	Worn cylinder seals.	Replace worn parts.
Low pressure, shown by weak upward movement of boom and bucket.	Reduced oil flow due to dirty filter or dirty intake line.	Disassemble and clean parts.
	Reservoir oil level too low.	Fill reservoir to correct level.
	Relief valve pressure setting incorrect.	Adjust relief valve pressure.
	Pump worn or damaged internally.	Replace worn or damaged parts.
	Relief valve sticking.	Disassemble and inspect cartridge. Clean or replace cartridge.
	Worn cylinder seals.	Replace worn parts.
	Low pump output due to dirty discharge pipes.	Remove and clean pump discharge pipes.
	Relief valve spring is weak. Relief valve poppet worn.	Replace worn parts.
Cylinder drops when control valve is in neutral.	Worn plunger in control valve.	Replace plunger.
	Stuck overload relief valve due to worn seat surface.	Replace worn parts.
	Loose pipes or joints.	Tighten parts.
	Worn piston seal on hydraulic cylinder.	Replace seal.
Vibration or excessive noise.	Excessive resistance in pump intake line.	Inspect intake line and clean or replace as necessary.
	Air being drawn into intake line.	Inspect pipe joints and tighten.
	Chattering relief valve.	Change oil, replace valve.

Problem	Cause	Remedy
Air bubbles in oil.	Wrong type of operating oil.	Drain and fill with proper type of oil.
	Oil level too low.	Raise to proper level.
	Air trapped in system.	Perform cylinder bleeding procedure to remove air.
Frequent rubber hose damage.	System pressure too high.	Adjust relief valve pressure.
	Hoses breaking due to contact with another machine parts.	Restrain hoses to prevent contact.

DISASSEMBLY

NOTE: *Keep on hand a container large enough to hold all of the oil in cylinder being repaired. When cylinder rod and head are removed, oil will run out of cylinder.*

1. Use an allen wrench to remove bolts that hold cylinder head to cylinder tube. See Figure 7.

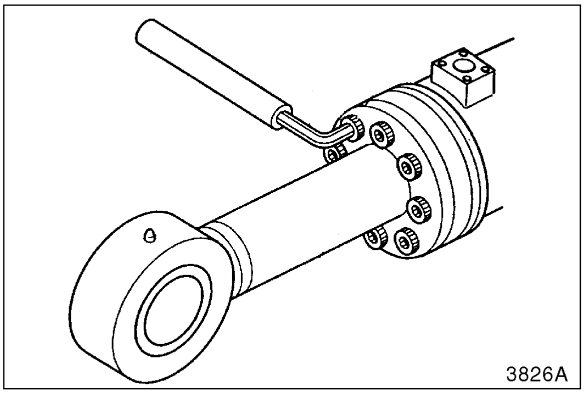

Figure 7

2. Support cylinder rod with a lifting sling. See Figure 8. Slide cylinder rod out of cylinder tube. Rotate cylinder rod slightly as it is being pulled from cylinder tube. This will make it easier to pull rod out of tube.

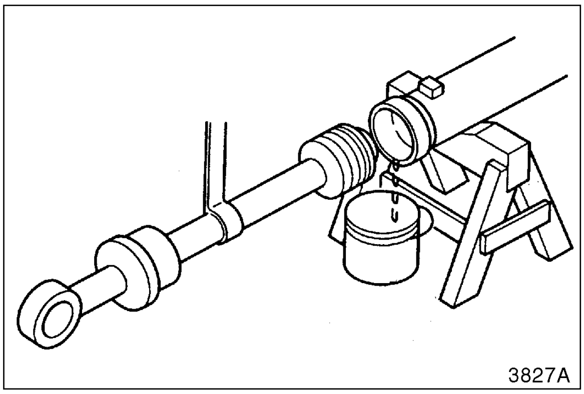

Figure 8

3. Set cylinder rod assembly in a repair fixture and secure rod in place. See Figure 9. Use a power wrench and socket to remove nut that holds piston on rod.

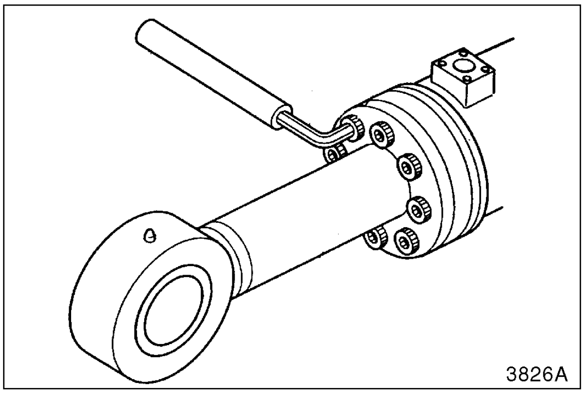

Figure 9

4. Remove piston nut (1, Figure 10), piston assembly (2), cushion flange (3), and cylinder head assembly (4).

Reference Number	Description
1	Piston Nut
2	Piston Assembly
3	Cushion Flange
4	Cylinder Head Assembly

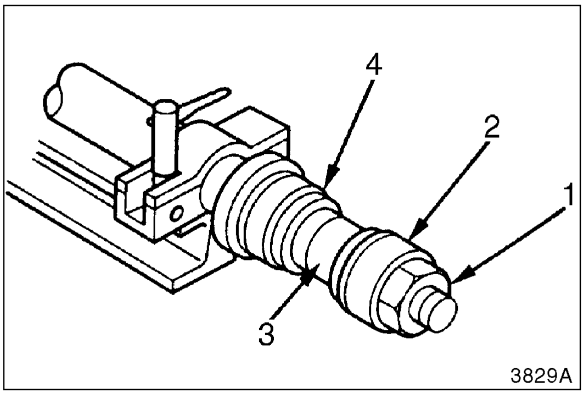

Figure 10

5. Do not remove slipper seal, backup ring, and back ring from piston. If these three items are not scratched or damaged. See Figure 11. Once these 3 items are removed from piston, they must be replaced. They cannot be reused. Exercise caution when removing slipper seal to prevent damage to piston O-ring groove. Remove wear rings from piston.

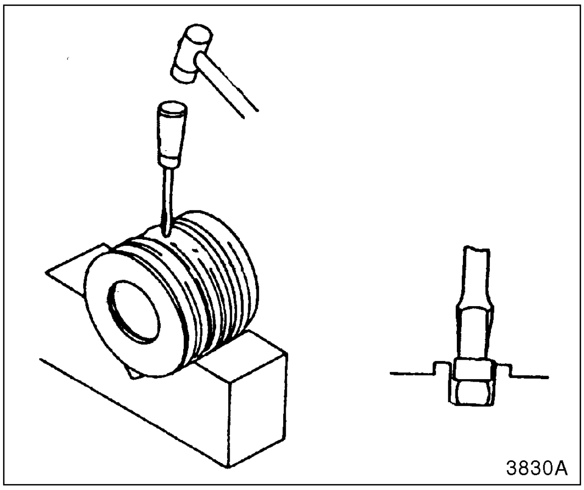

Figure 11

6. When disassembling cylinder head do not remove slipper seal, backup ring, back ring, or dust seal unless items are scratched or damaged. If seals are removed from head, they must be replaced. They cannot be reused. Remove snap ring, (1, Figure 12). Use a screwdriver to remove dust seal (2) from head.

Reference Number	Description
1	Snap Ring
2	Dust Seal

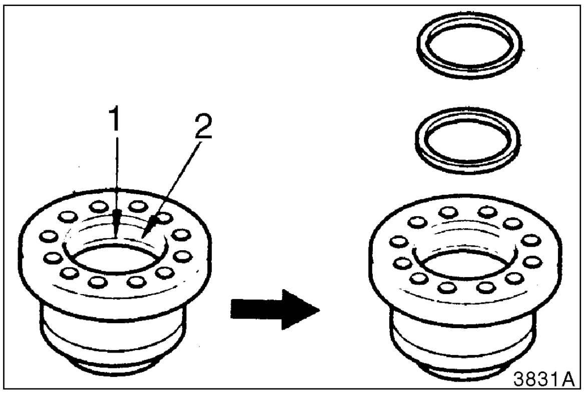

Figure 12

7. Use caution to prevent damage to any parts of U-packing (1, Figure 13). Remove U-packing (1). Remove O-ring (2), and ring (3).

Reference Number	Description
1	U-Packing
2	O-Ring
3	Ring

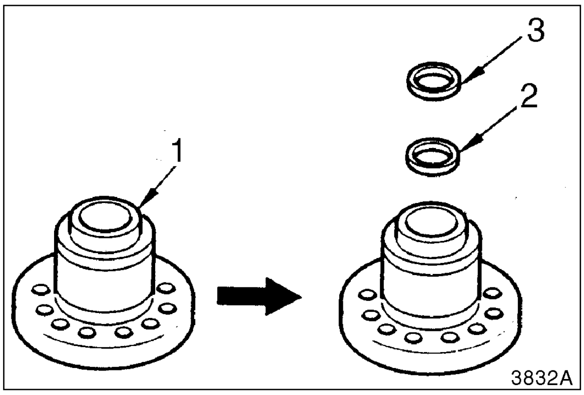

Figure 13

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

For general cleaning and inspection procedures, refer to "General Maintenance Procedures" section.

REASSEMBLY

NOTE: *Check cylinder head grooves for U-packing and dust seal. If edges of grooves are sharp or have burns, use an oil stone to smooth surface. See Figure 14.*

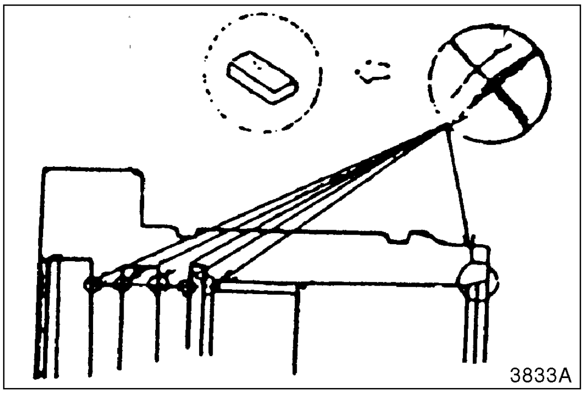

Figure 14

1. Apply grease to inner part of cylinder head and to U-packing groove. See Figure 15.

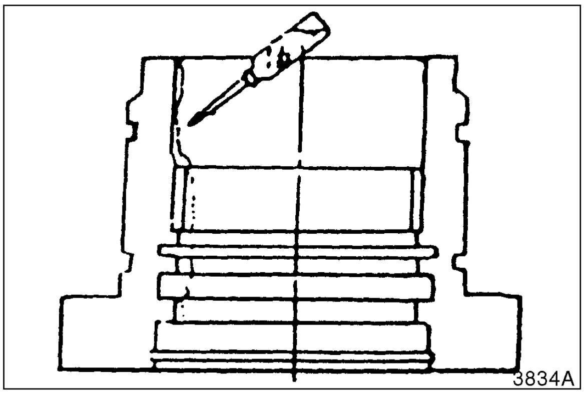

Figure 15

2. Install split backup ring into its groove by compressing ring. See Figure 16. Make sure that ends of ring do not overlap.

   NOTE: *The U-packing can be installed by hand or by using a seal installing jig. The jig should be made of copper, aluminum, or plastic. If a jig is used, be sure that jig does not have sharp edges that could damage U-packing.*

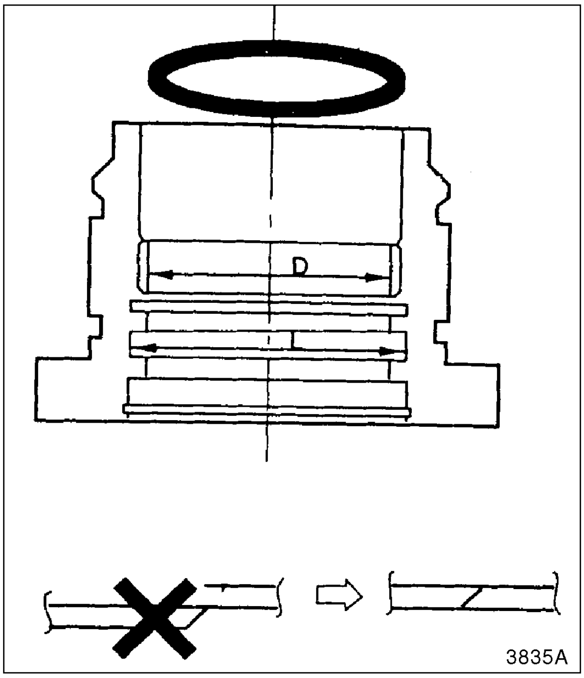

Figure 16

3. Insert one side of U-packing in its groove. See Figure 17.

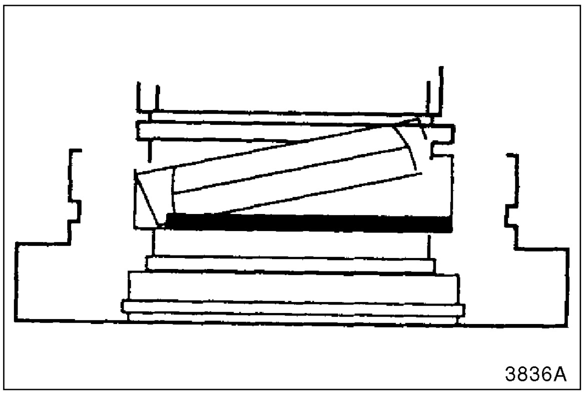

Figure 17

4. Carefully push down on other side of U-packing until entire U-packing is seated in its groove. See Figure 18.

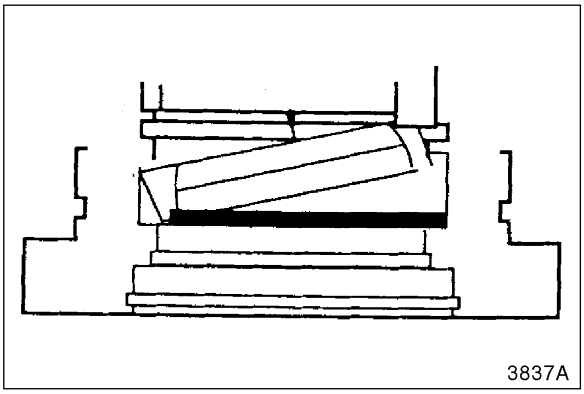

Figure 18

5. Check to be sure that U-packing and backup ring are correctly installed by pushing with your hand on inner diameter of U-packing. See Figure 19.

   NOTE: *There are 2 backup rings used on outside of cylinder head. One backup ring is continuous. The other backup ring is open, split by an angled cut.*

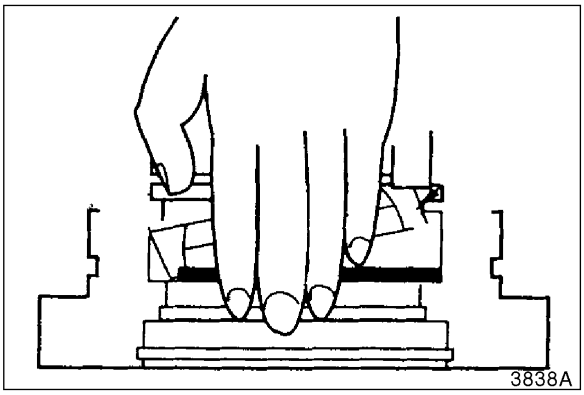

Figure 19

6. Use grease or an adhesive to hold split backup ring (1, Figure 20) in place. Install split backup ring (1) in groove closets to flange on cylinder head.

Reference Number	Description
1	Split Backup Ring
2	Continuous Backup Ring

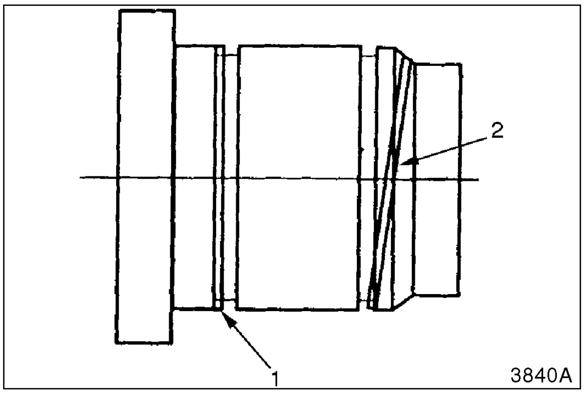

Figure 20

7. Place continuous backup ring in warm water. See Figure 21. Water temperature should be 30 - 50˚C (86 - 122˚F). Leave ring in water for 2 - 3 minutes. Slide continuous backup ring (2, Figure 20) over cylinder head and into its groove.

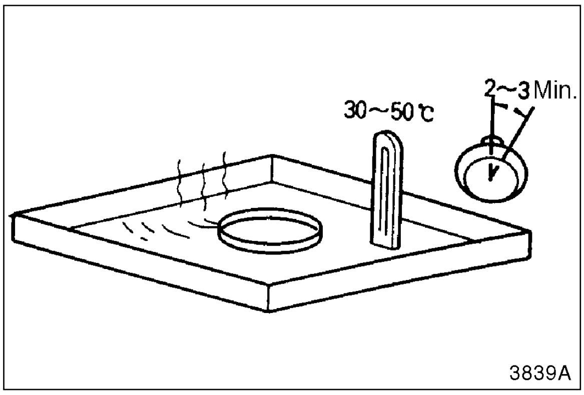

Figure 21

8. Install an O-ring over each of backup rings. See Figure 22.

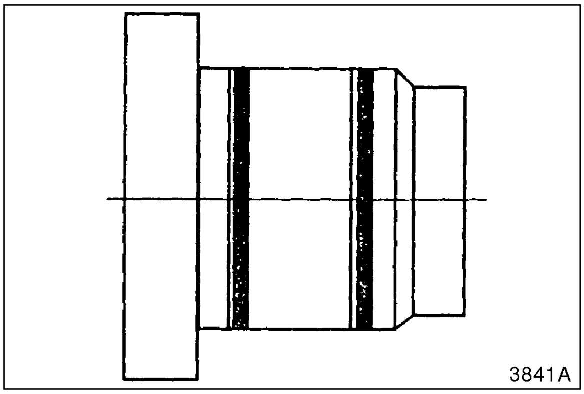

Figure 22

9. Use a seal installing jig to install dust seal into cylinder head. See Figure 23. Install snap ring.

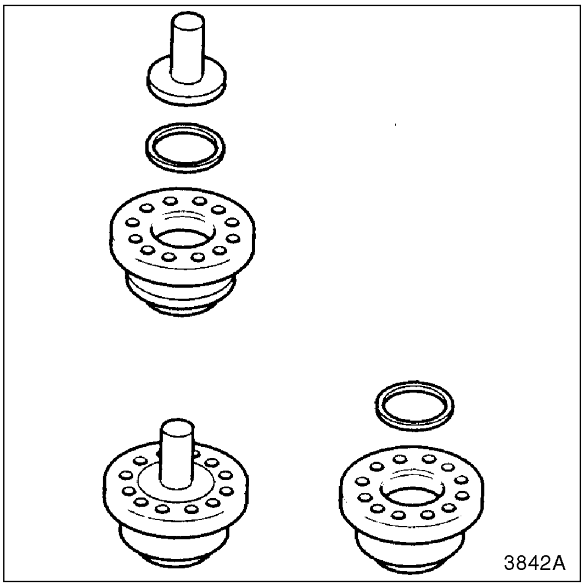

Figure 23

10. On piston, check corners of grooves that piston rings will be mounted in. See Figure 24. If any burrs, roughness, or sharp edges (1) are present, use an oil stone to smooth roughened areas and dull sharp edges.

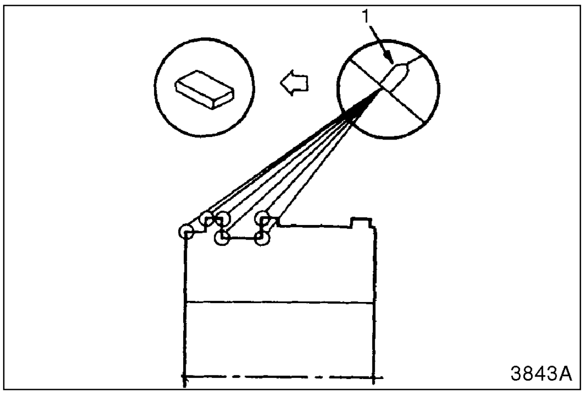

Figure 24

11. Apply grease or hydraulic oil to corner of piston at position A. See Figure 25.

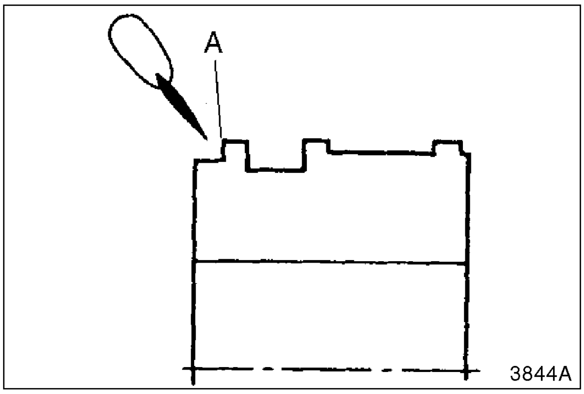

Figure 25

12. Insert one end of backup ring into its groove. See Figure 26. Use your hand to slide other end of ring into groove.

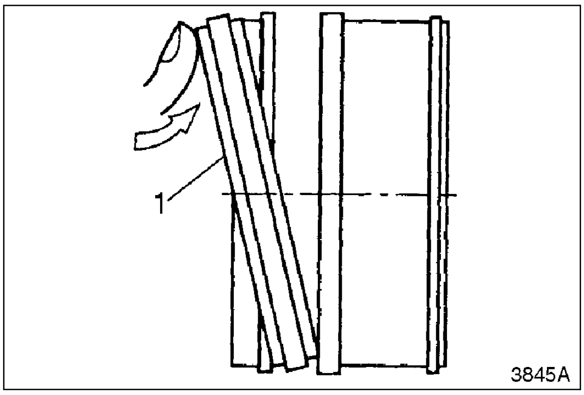

Figure 26

13. Use warm water to expand slipper seal. See Figure 27. This will make seal easier to install. Set slipper seal in 60 -100 degree C (140 - 212 degree F) water for 5 minutes or longer.

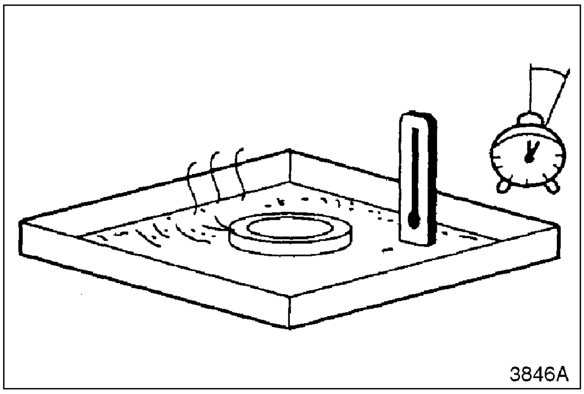

Figure 27

14. Insert one end of slipper seal, (1, Figure 28) into its groove. Use your hand to slide other end of slipper seal into groove.

WARNING!
Before piston is inserted into cylinder tube, make sure that slipper seal is no longer expanded. If seal is still expanded, it could catch on threaded portion of cylinder tube. An expanded seal could also jam inside cylinder tube.

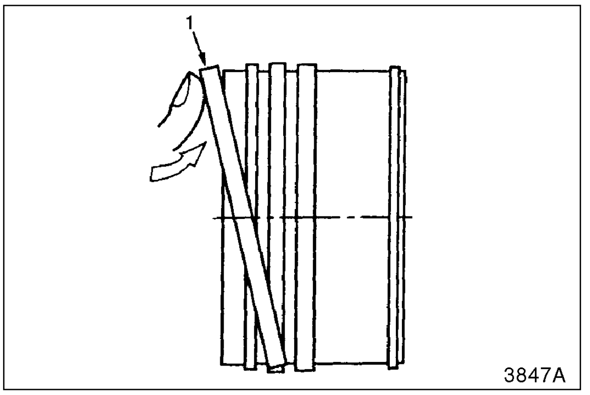

Figure 28

15. Install two backup rings, (1, Figure 29). One ring fits on either side of slipper seal (2).

Reference Number	Description
1	Backup Ring
2	Slipper Seal

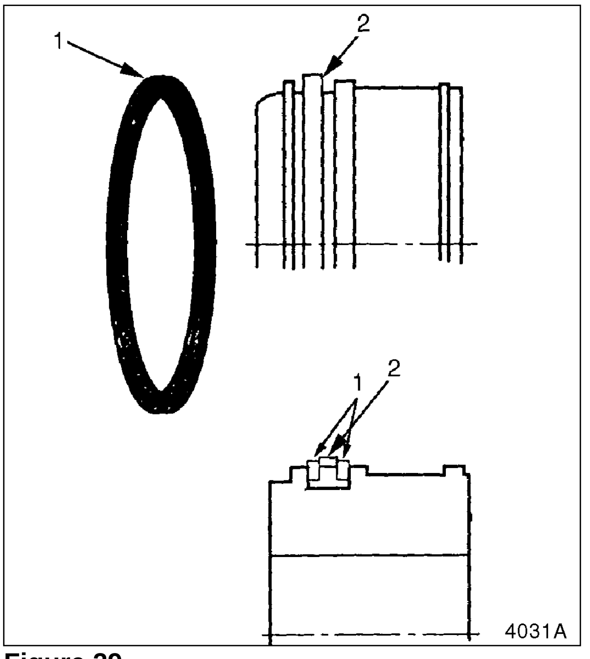

Figure 29

16. Install wear ring (1, Figure 30) on piston.

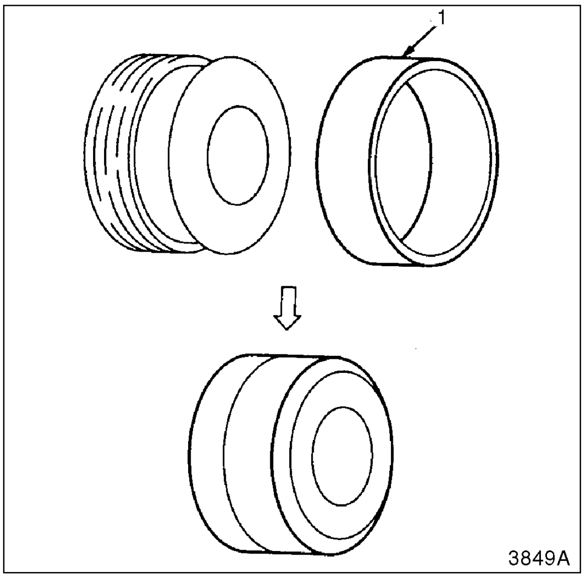

Figure 30

17. Set cylinder rod (1, Figure 31) into a repair fixture (2). Securely clamp rod to fixture. Exercise caution to prevent nicks or scratches to chrome plated areas of rod. chrome plated area is oil sealing surface of rod.

Reference Number	Description
1	Cylinder Rod
2	Repair Fixture

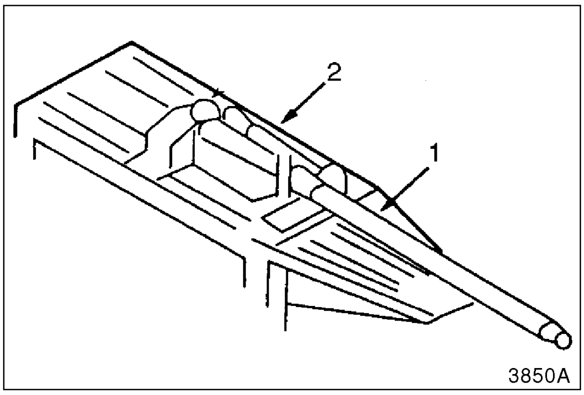

Figure 31

18. Slide cylinder head assembly (1, Figure 32) onto cylinder rod (2). Use caution to prevent threads on rod from damaging seal inside cylinder head.

Reference Number	Description
1	Cylinder Head
2	Cylinder Rod

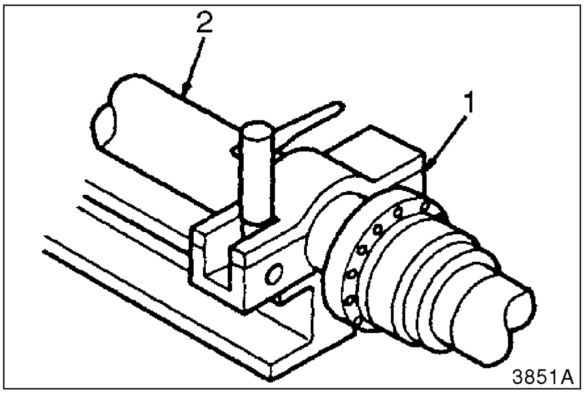

Figure 32

19. Install cushion flange (1, Figure 33) on cylinder rod (2). Slide piston assembly (3) onto cylinder rod (2).

Reference Number	Description
1	Cushion Flange
2	Cylinder Rod
3	Piston Assembly

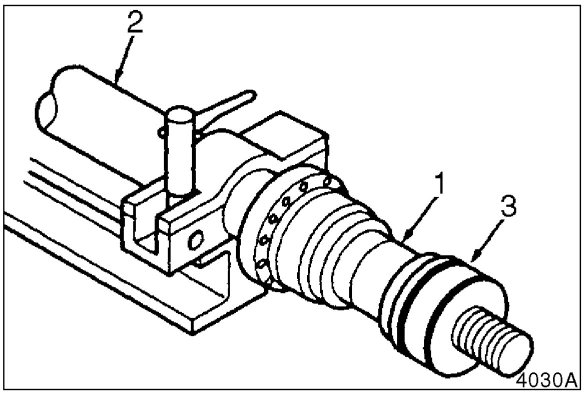

Figure 33

20. Install piston nut (1, Figure 34) and tighten it with an impact wrench. Then use a torque wrench to tighten nut (1) to specified torque.

    After nut has been tightened, check to see that cushion flange moves.

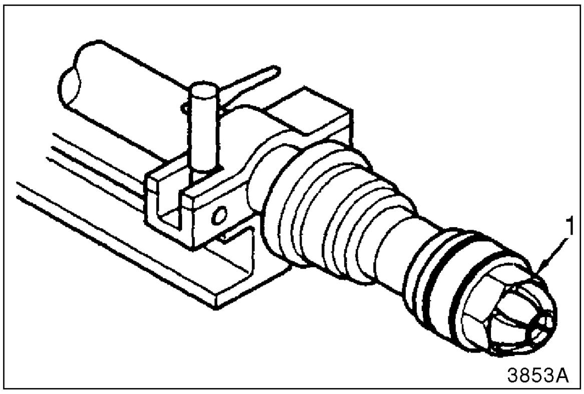

Figure 34

21. Slide rod assembly into cylinder tube. Align punch mark (1, Figure 35) with port (2) in cylinder tube. This will align hole (3) in cylinder head with port (2).

Reference Number	Description
1	Punch Mark
2	Port
3	Hole

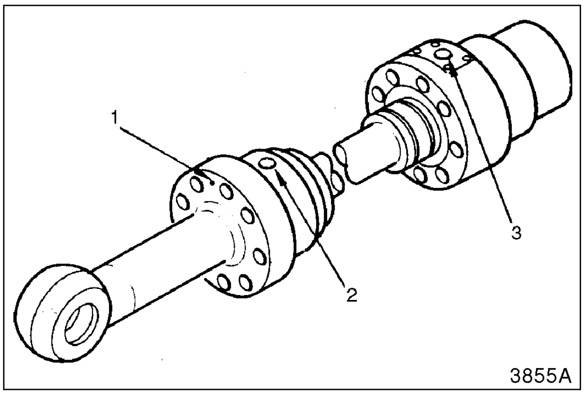

Figure 35

22. Install bolts in cylinder head and tighten them to torque specified in bolt torque chart. See Figure 36. Double check to make sure that hole in cylinder head is align with port in cylinder tube.

    NOTE: *After rebuilding a cylinder, or after loosening a cylinder hydraulic line, air must be bled from hydraulic system. To bleed air from system, first extend and retract a cylinder (or pair of cylinders) about 5 times at low engine rpm. Stop cylinder about 100 mm (4 in) short of full extension and full retraction. Then fully extend and retract cylinder about 5 times, also at low engine rpm.*

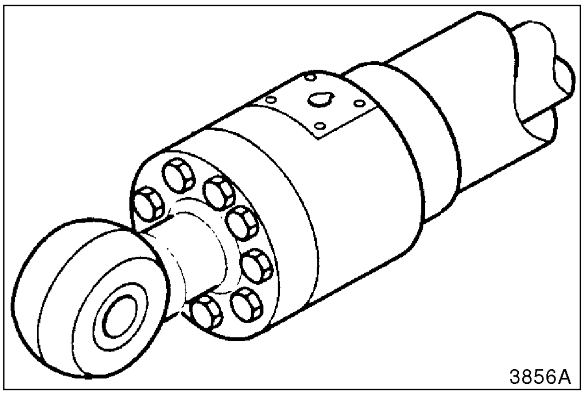

Figure 36

DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

S0708460K

MAIN PUMP (DENISON T6DMY SERIES)

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Mega 400-V	1001 and Up
Mega 500-V	1001 and Up

December 2000

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GENERAL DESCRIPTION

This section describes the servicing of "T6DMY" series pumps. Some additional information is provided with regards to shaft seals and bolt torques for other models in the series. The T6DMY information in indicated with an asterisk (*) or shading when appropriate.

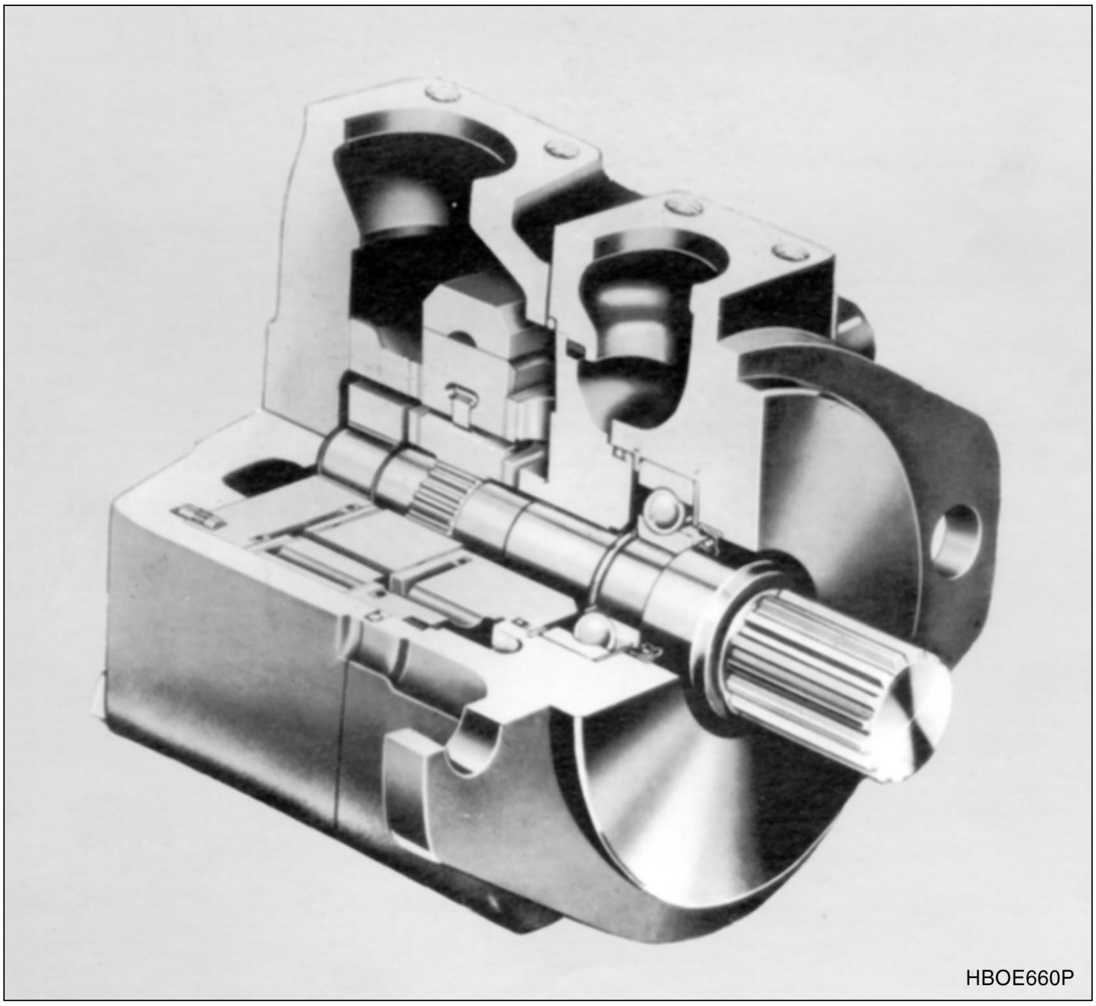

Figure 1

CONSTRUCTION

General

Pumps in this series are used to develop hydraulic fluid flow for operation of industrial and mobile equipment. The positive displacement pumping cartridges are of the rotary vane type with shaft side loads hydraulically balanced. Flow rate depends on pump size and speed at which it is driven.

All units are designed so that direction of rotation, pumping capacity and port positions can be readily changed to suit particular applications.

Assembly and Construction

The pump illustrated in Figure 2 is representative of all single pumps in this series. The unit consist principally of an inlet cover, outlet body, drive shaft and pumping cartridge. The principle components of the cartridge are an elliptical cam ring, a slotted rotor splined to the drive shaft, an inlet and outlet support plate fitted with four special seal packs, two flex side plates, and ten vanes and inserts fitted to the rotor slots. Fluid enters the cartridge through the inlet port in the cover and is discharged through the outlet flex side plate and support plate to the outlet port in the body.

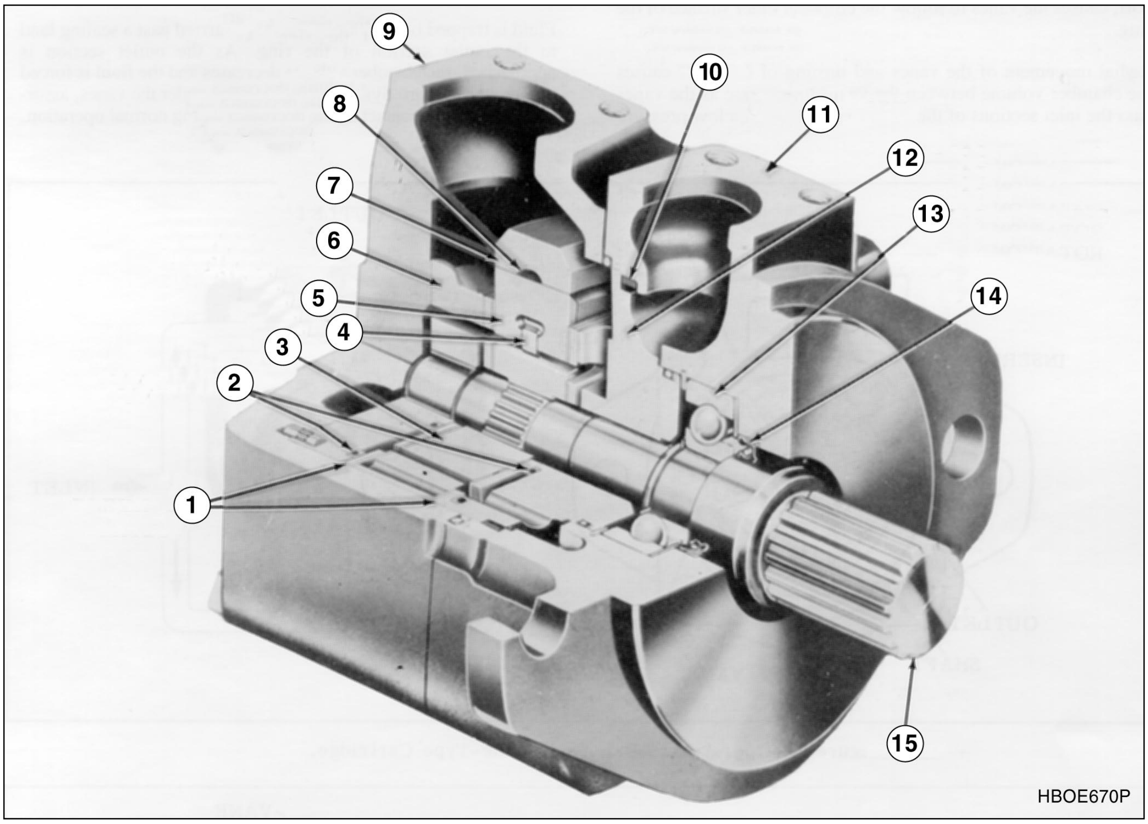

Figure 2

Reference Number	Description
1	Flex Side Plates
2	Seal Packs
3	Rotor
4	Insert
5	Vane
6	Inlet Support Plate
7	Ring
8	Inlet Hole Thru Ring

Reference Number	Description
9	Outlet Cover
10	Square Seal Ring
11	Outlet Body
12	Outlet Support Plate
13	Shaft Bearing
14	Primary Seal
15	Shaft

PRINCIPLES OF OPERATION

Pumping Cartridge

As mentioned in "Construction," fluid flow is developed in the pumping cartridge. The action of the cartridge is illustrated in Figure 3. The rotor is driven within the ring by the drive shaft, which is coupled to a power source. As the rotor turns, centrifugal force on the vanes, aided by under-vane pressure fed from the outlet port, causes the vanes to follow the elliptical inner surface of the ring.

Radial movement of the vanes and turning of the rotor causes the chamber volume between the vanes to increase as the vanes pass the inlet sections of the ring. This results in a low pressure condition which allows atmospheric pressure to force fluid into the chambers.

An additional inlet fluid path exists through a drilled hole in the cam ring. This hole connects the inlet port directly to the inlet areas of the cam ring and provides an additional flow path for fluid to get into the cartridge. (See Figure 2.)

Fluid is trapped between the vanes and carried past a sealing land to the outlet section of the ring. As the outlet section is approached, the chamber volume decreases and the fluid is forced out into the system. System pressure is fed under the vanes, assuring their sealing contact against the ring during normal operation.

Hydraulic Balance

The pump ring is shaped so the two pumping chambers are formed 180˚ apart (Figure 3). Thus, opposing hydraulic forces which develop side loads on the shaft cancel out.

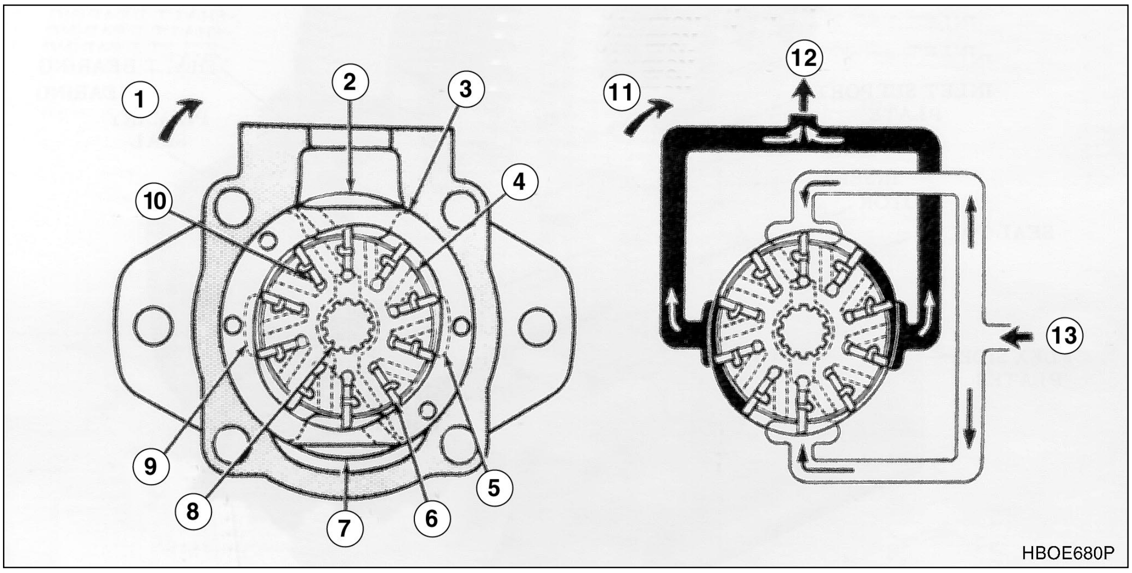

Figure 3 OPERATION OF BALANCED, VANE-TYPE CARTRIDGE.

Reference Number	Description
1	Rotation
2	Inlet
3	Ring
4	Rotor
5	Outlet
6	Vane
7	Inlet

Reference Number	Description
8	Shaft
9	Outlet
10	Insert
11	Rotation
12	Outlet
13	Inlet

Vane Pressure Feed

The intra-vane design provides a means of controlling the outward thrust of the vane against the ring and maintains tip loads within reasonable limits. In the intra-vane cartridge, full system pressure is continuously applied only to the area between the vane and insert. This area is small and thrust is correspondingly light.

During vane travel through pressure areas, full system pressure is applied against the bottom area of the outer vane. The valving of pressure to and from the bottom area of the vane is through holes drilled in the rotor, as shown in Figure 4. This selective application of pressure maintains the vane in substantially constant radial hydraulic balance in all positions.

Vane tip wear is compensated for automatically. As the vane wears, pressure moves the vane further out in the rotor slot holding the vane tip against the cam ring.

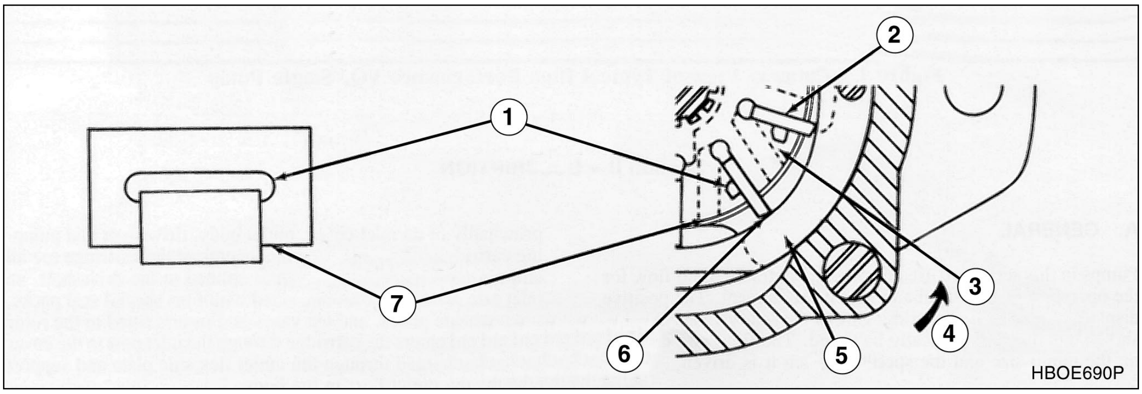

Figure 4 PRESSURE FEED TO VANES IN INTRA-VANE CARTRIDGE

Reference Number	Description
1	Pressure to Insert
2	Vane
3	Rotor
4	Direction of Rotation

Reference Number	Description
5	Ring
6	Sharper Edges (Lead Direction of Rotation
7	Pressure to Bottom of Vane

Flex Side Plate Operation

The flex side plates for both inlet and outlet are symmetrical. Pressure is fed behind each side plate into two kidney shaped cavities which are sealed by special seal packs. The two flex side plates and their associated kidney shaped cavities function in the following manner. As pressure builds up in the outlet, pressure also builds up in the cavities. The pressure in the cavities hold the flex side plates in hydrostatic balance against the rotor and provide optimum running clearances for minimum internal leakage and minimum friction (See Figure 5).

The flex side plates also provide passages for feeding under vane pressure to the space between the vane and insert.

The bronze faces of the flex side plates ride next to the rotor and provide excellent wear and cold start characteristics.

The inlet and outlet support plates hold the flex side plates in position and contain passages which allow fluid to pass from the inlet to the pumping cartridge and from the cartridge to the outlet port.

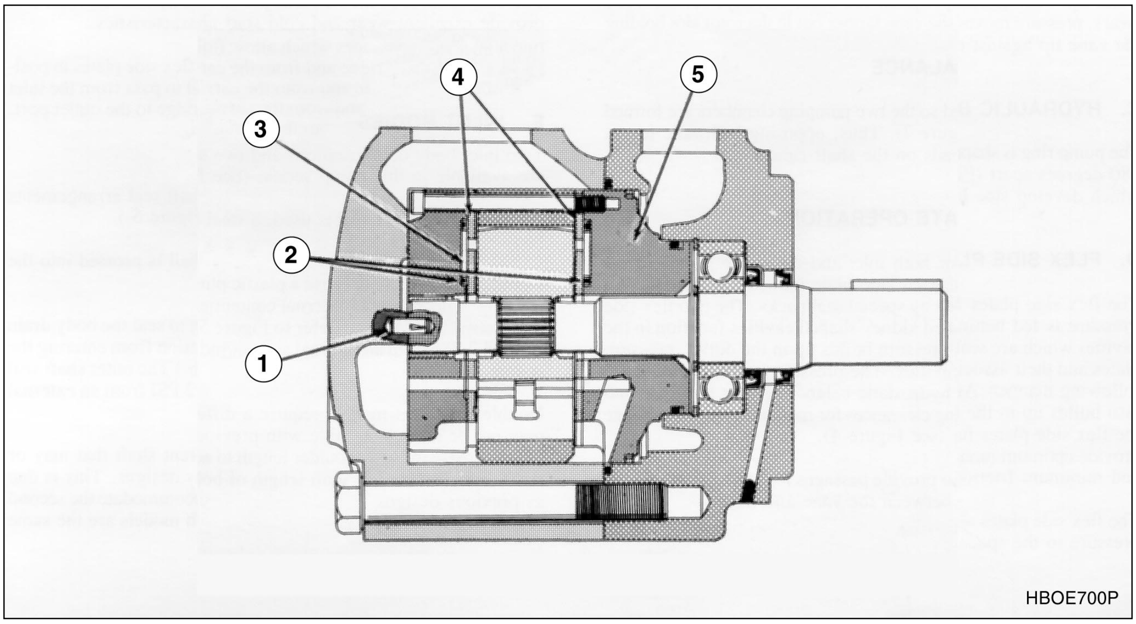

Figure 5 FLEX SIDE PLATE OPERATION

Reference Number	Description
1	Pin
2	Seal Packs
3	Kidney Shaped Cavities

Reference Number	Description
4	Flex Side Plates
5	**NOTE:** *Upper Section Rotated 45˚*

Inlet Bodies

Two inlet body configurations and two shaft seal arrangements are available in this pump series. (See Figure 6* and Figure 7.)

When a single shaft seal is used, a steel ball is pressed into the body. (See Figure 6.)

Double shaft seal models use a plastic plug to seal the body drain opening. This prevents external contamination from entering the area between the seals. (Refer to Figure 7.) The outer shaft seal is rated 0.48 bar (7.0 psi) from an internal source and 0.14 bar (2.0 psi) from an external source.

Double shaft seal models require a different shaft that may or may not be interchangeable with previous designs. This is due to an increase in shaft shoulder length to accommodate the second shaft seal. The overall shaft length of both models are the same as previous designs.

Reference Number	Description
1	Standard Shaft
2	Steel Ball
A	11.176 mm (0.440 in)
B	58.420 mm (2.30 in)

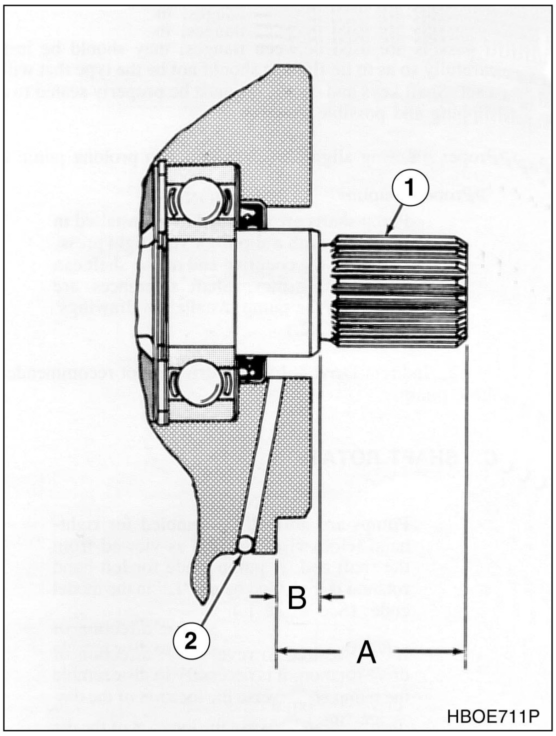

Figure 6 SINGLE SHAFT SEAL ARRANGEMENT*

Reference Number	Description
1	Primary Seal
2	Secondary Seal
3	Special Shaft (Longer Seal Area)
4	Plastic Plug
A	16.002 mm (0.630 in)
B	58.420 mm (2.30 in)

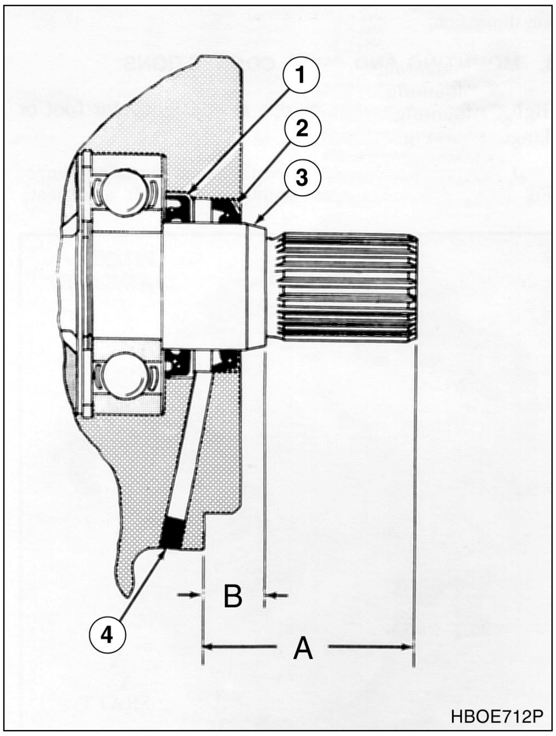

Figure 7 DOUBLE SHAFT SEAL ARRANGEMENT

PARTS LIST

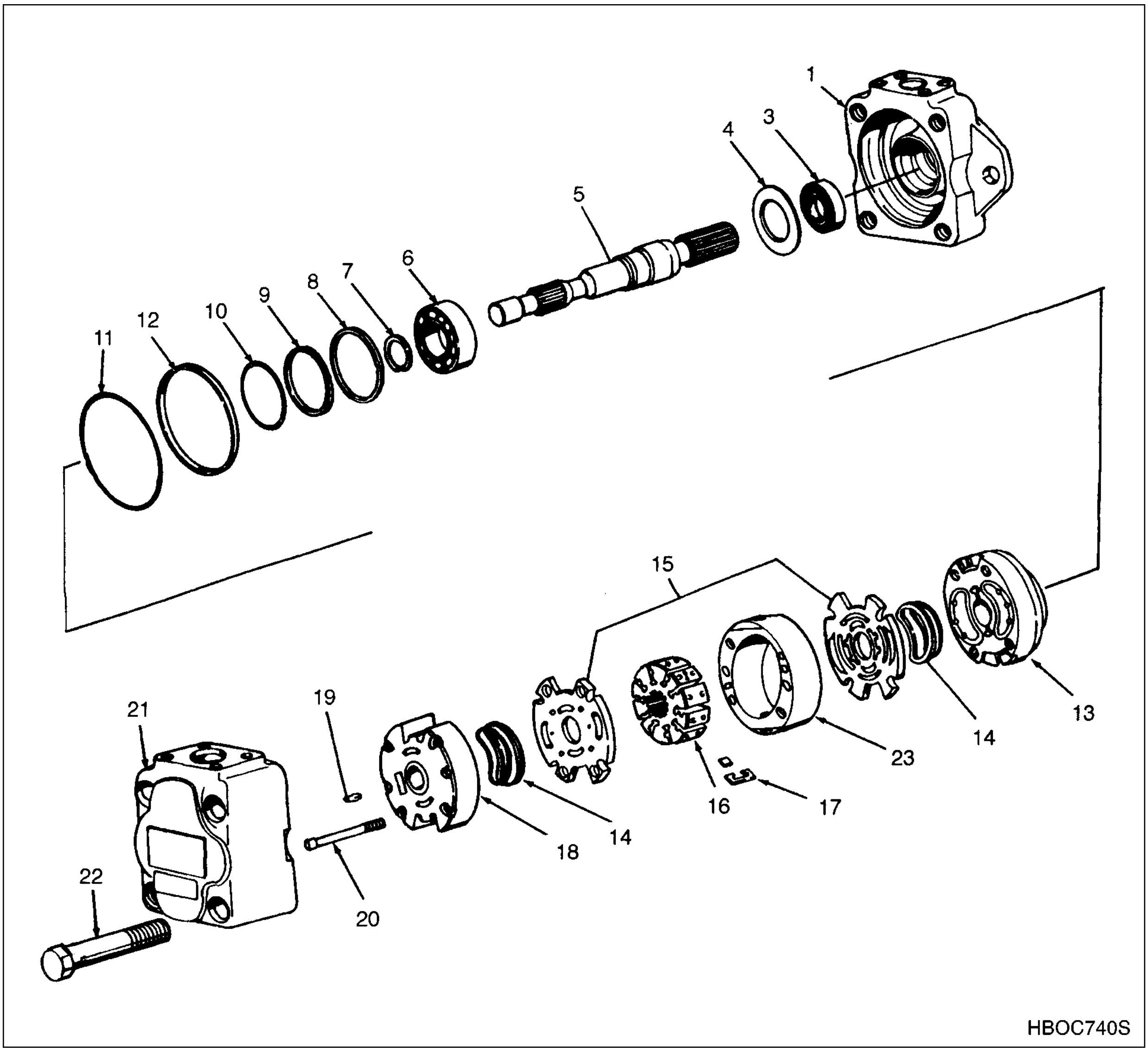

Figure 8

Reference Number	Description
1	Body; Outlet
3	Shaft; Seal
4	Spacer; Washer
5	Shaft (No. 127)
6	Bearing
7	Ring; Retaining
8	Ring; Spirolox
9	Ring; Backup
10	O-ring
11	O-ring
12	Ring; Seal

Reference Number	Description
13	Plate; Outlet Support
14	Pack; Seal
15	Plate Kit; Flex Side
16	Rotor
17	Vane & Insert
18	Plate; Inlet Support
19	Pin
20	Screw; Hex Head
21	Cover
22	Bolt
23	Ring

SPECIFICATIONS

Main Pump	Specification
Type	Fixed vane
Displacement	121.5 cc/rev. (7.41 in^3/rev.)
Maximum flow rate	240 liters/min. (63.4 gpm)

SPECIAL TOOLS AND MATERIALS

SPECIAL TOOLS

Two special tools are required to service these pumps. A driver should be used to assure installation of the primary shaft seal without damage, and a "bullet" should be placed over the end of the shaft, to avoid damaging the seal lip when the shaft is installed. Installation of the secondary seal does not require a driver. (See Figure 6.)

NOTE: *If a shaft seal bullet is unavailable, wrap splines on shaft with masking tape to prevent damage to seal. Coat tape with oil while installing shaft. Be sure to remove all tape after installation.*

The driver can be made from tubular stock as shown in Figure 9. The tool applies a uniform pressure to the recessed area of the seal, rather than to the lip of the seal. The inside diameter of the tool will not interfere with the garter spring around the lip of the seal.

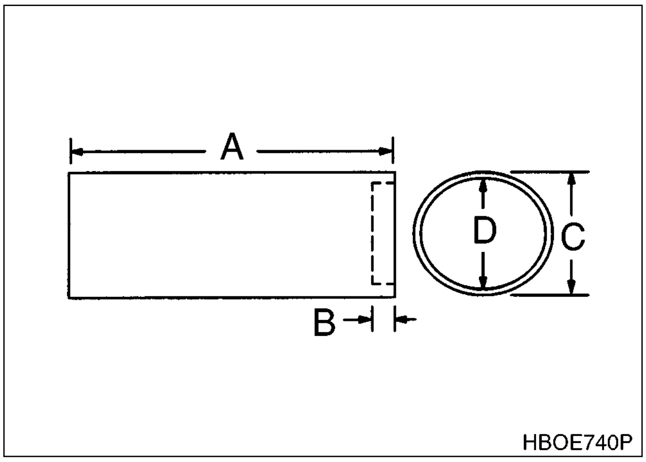

Figure 9 PRIMARY SHAFT SEAL DRIVER

Pump Series	Length "A"	Undercut "B"	O.D. "C"	I.D. "D"
T6DMY-038	88.9 mm (3.500 in)	8.407 mm (0.331 in)	44.831 mm (1.765 in)	41.199 mm (1.622 in)

TROUBLESHOOTING, TESTING AND ADJUSTMENT

The following table lists common difficulties experienced with vane pumps and hydraulic systems. It also indicates possible causes and remedies for each of the problems listed.

It should always be remembered that many apparent pump failures are actually the failures of other parts of the system. The cause of improper operation is best diagnosed with adequate testing equipment and a thorough understanding of the complete hydraulic system.

Problem	Possible Cause	Remedy
Pump not delivering fluid.	Driven in wrong direction of rotation.	The drive direction must be changed immediately to prevent seizure. Refer to “Reassembly” on page -22, for correct ring position for each direction of rotation.
	Coupling or shaft sheared or disengaged.	Disassemble pump and check shaft and cartridge for damage. Replace necessary parts.
	Fluid intake pipe in reservoir restricted.	Check all strainers and filters for dirt and sludge. Clean if necessary.
	Fluid viscosity too heavy to pick up prime.	Completely drain system. Add new filtered fluid of proper viscosity.
	Air leaks at intake. Pump not priming.	Check inlet connections to determine where air is being drawn in. Tighten any loose connections. See that fluid in reservoir, is above intake pipe opening. Check minimum drive speed which may be too slow to prime pump.
	Relief valve stuck open. (Models with integral relief valve only).	Disassemble pump and wash valve m clean solvent. Return valve to its bore and check for any stickiness. A gritty feeling on valve periphery can be polished with crocus cloth. Do not remove excess material round off edges of lands or attempt to polish bore. Wash all parts and reassemble pump.
	Vane(s) stuck in rotor slot(s).	Disassemble pump. Check for dirt or metal chips. Clean parts thoroughly and replace any damaged pieces. If necessary, flush system and refill it with clean fluid.
Insufficient pressure build-up.	System relief valve set too low.	Use a pressure gage to correctly adjust valve.

Problem	Possible Cause	Remedy
Pump making noise,	Pump intake partially blocked.	Service intake strainers. Check fluid condition and, if necessary, drain and flush system. Refill with clean fluid.
	Air leaks at intake or shaft seal. (Oil in reservoir would probably be foamy).	Check inlet connections and seal to determine where air is being drawn in. Tighten any loose connections and replace seal if necessary. See that fluid in reservoir is above intake pipe opening.
	Pump drive speed too slow or too fast.	Operate pump at recommended speed.
	Coupling misalignment.	Check if shaft seal bearing or other parts have been damaged. Replace any damaged parts. Realign coupled shafts.

DISASSEMBLY

1. Basic pump disassembly;

   A. Support pump on blocks or clamp body in a vise as shown in Figure 10. If a vise is used, use protective jaws to avoid damage to body and its machined surfaces. Match mark (1, Figure 10) pump body (2) and cover (3) for correct reassembly. Remove four cover screws (4) and lift cover off pump.

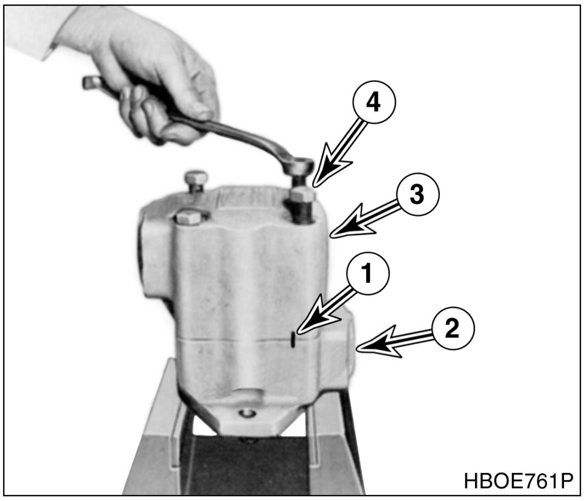

Figure 10

   B. Remove cover O-ring. Pull and/or pry out cartridge as shown in Figure 11.

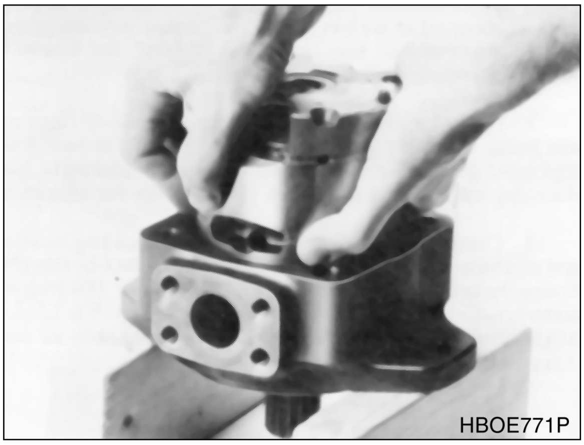

Figure 11

   C. Pry under coil and remove large spirolox ring and pull shaft and bearing from body. Drive shaft seals out of body. If it is necessary to remove shaft bearing, first remove small snap ring and then press shaft out of bearing while supporting bearing inner race.

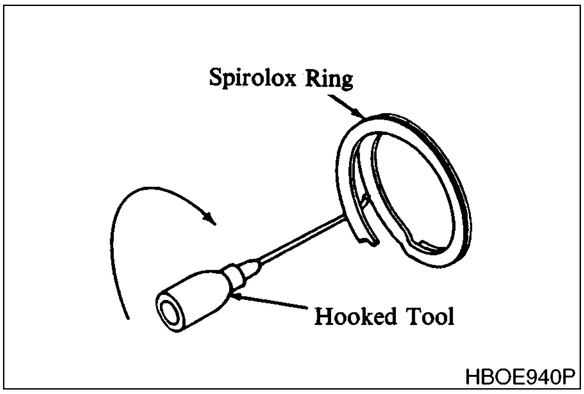

Figure 12 REMOVING SPIROLOX RING

2. Cartridge disassembly;

   A. Remove O-ring, back-up ring and square sealing ring from outlet support plate.

   B. Scribe a line across outer surface of cartridge kit. (See Figure 13.) Scribe marking will provide a reference for parts during assembly.

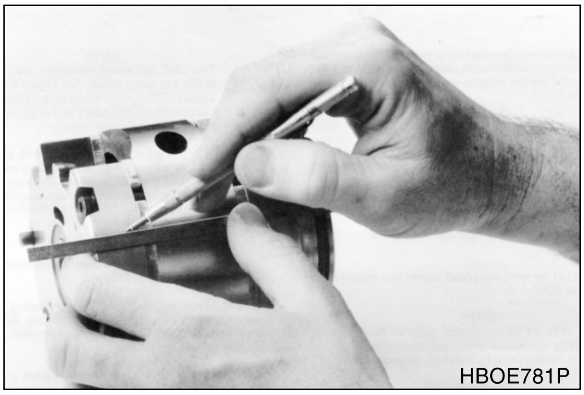

Figure 13

   C. Place cartridge on a flat surface (outlet support plate down) and remove two socket head screws.

WARNING!

Do not slide flex side plates across ring and rotor. Burrs on ring or rotor can cause deep scratches in soft brass surface.

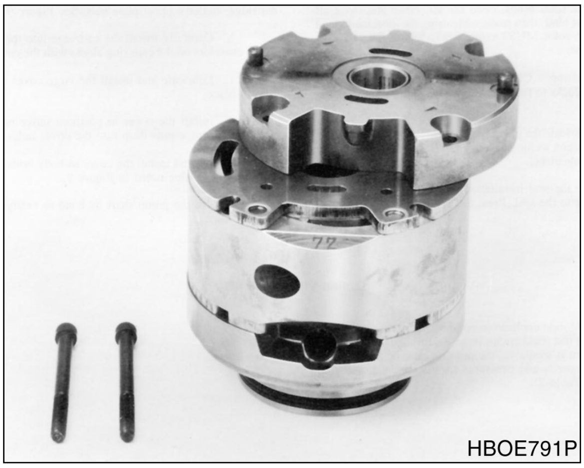

Figure 14

   D. Slide inlet support plate and seal packs off cartridge. DO NOT allow flex side plate to slide with support plate. (See Figure 14.)

   E. Move flex side plate off center just enough to grab edge and lift up and away without sliding. (See Figure 15.)

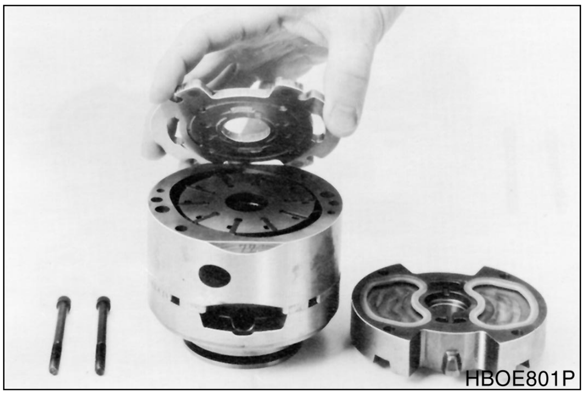

Figure 15

F. If a small flat piece of wood is available, place it over ring and rotor and reverse cartridge to have outlet support plate pointing up. (See Figure 16.)

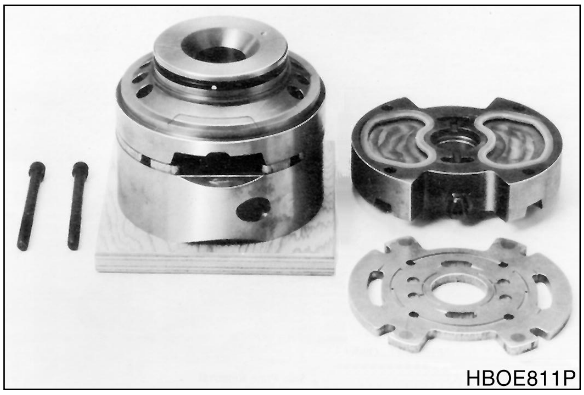

Figure 16

G. Slide outlet support plate and seal packs off cartridge, do not allow flex side plate to slide with support plate. Refer to Figure 17.

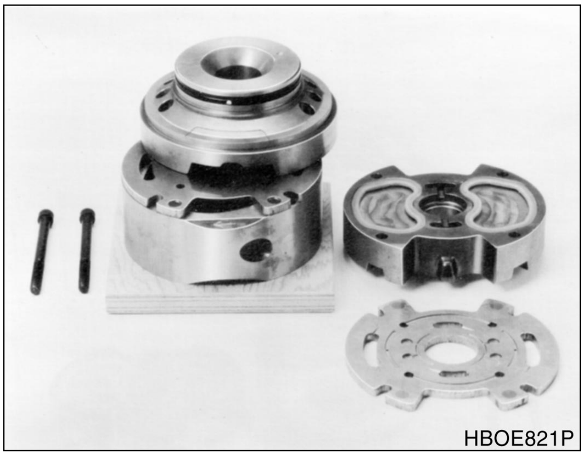

Figure 17

H. Move flex side plate off center just enough to lift up and away without sliding. (See Figure 18.)

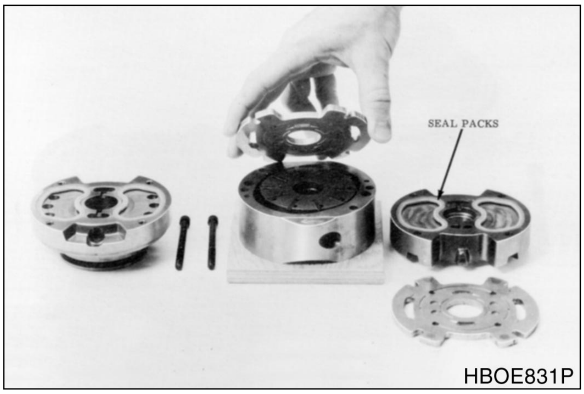

Figure 18

I. Remove cam ring from rotor and vanes. Locate arrow stamped into rotor periphery. Remove vanes and inserts in order, starting at arrow. Keep them in order for inspection. (See Figure 19.)

NOTE: *Do not remove cartridge locating pins from inlet support plate unless they are damaged. Pins are of a drive-loc type and can be difficult to remove.*

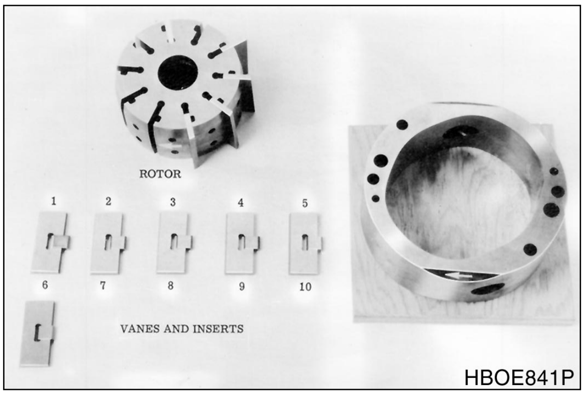

Figure 19

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

For general cleaning and inspection procedures, refer to "General Maintenance Procedures" section.

All parts must be thoroughly cleaned and kept clean during inspection and assembly. The close tolerance of the parts makes this requirement very important. Clean all removed parts, using a commercial solvent that is compatible with the system fluid. Compressed air may be used in cleaning, but it must be filtered to remove water contamination.

1. Discard shaft seal(s), O-rings, back-up rings and seal packs. Use a new seal kit for reassembly. Wash metal parts, blow them dry with air and place on a clean surface for inspection.
2. Check cartridge wear surfaces for pickup, scoring and excessive wear. Slight heat discoloration of flex side plate bronze surface is normal. Score marks deeper than 0.025 mm (0.001 in) and scratches deeper than 0.051 mm (0.002 in) indicate a new part is needed. Slight scoring and/or scratches can be removed with an oiled Arkansas stone.

CAUTION!

DO NOT use a dry stone on the bronze surface or scratches will result.

3. Inspect both sides of each vane and insert in order. If pickup, heavy wear or scoring is found, inspect the appropriate rotor slot. Replace scored parts.
4. Inspect the cam ring for vane chatter marks, wear and/or scratches. Replace if scoring is evident.

CAUTION!

Replacement ring width must be identical to the ring being replaced or reduced life and/or output flow will result. The minimum ring to rotor clearance limits are noted below.

MINIMUM ALLOWABLE RING ROTOR CLEARANCE	
MODEL	**MINIMUM CLEARANCE LIMITS IN MM (INCHES)**
T6DMY - 038	0.038 mm (0.0015 in)

NOTE: *All cartridge kit parts must be free of burrs. Stone the mating surfaces of each part with an oiled Arkansas stone before assembly.*

NOTE: *Pre-assembled replacement cartridge kits are available. If the old cartridge is worn extensively, a new kit should be used.*

5. Vane and rotor wear can be checked by inserting vane in rotor slot and checking for excessive play. Replace rotor and vanes if wear is evident.
6. Rotate bearing while applying pressure to check for wear, looseness and pitted or cracked races.
7. Inspect seal and bushing mating surfaces on shaft for scoring or wear. Replace shaft if marks cannot be removed by light polishing.

REASSEMBLY

NOTE: *Coat all parts except seals and back-up rings with clean hydraulic fluid to facilitate assembly and provide initial lubrication. Use small amounts of petroleum jelly to hold O-rings in place during assembly.*

IMPORTANT
During handling and shipping of precision machined cartridge parts, it is possible to raise burrs on sharp edges. All sharp edges on parts of a new cartridge kit should be stoned before installation.

NOTE: *To reverse direction of a new cartridge kit, simply reverse location of inlet and outlet support plates, and realign cartridge with cover. See steps 1H through 1J.*

1. Cartridge reassembly - The direction of rotation is as viewed from shaft end, right-hand rotation is clockwise; left-hand, counterclockwise.

NOTE: *If locating pins were removed from inlet support plate, install new pins with locking flutes within inlet support plate. Drive new pins into support plate, with a soft tip hammer.*

A. Place inlet and outlet support plates on a flat surface as shown in Figure 20. Install seal packs into cavities with seal retainer surface up. (O-rings facing downward into cavities.)

B. Place a flex side plate over each of support plates with bronze wear surface facing up. Align scribe marks to make sure correct flex side plate is used with correct support plate.

NOTE: *Flex side plates develop a wear pattern with rotor and vanes and should not be interchanged.*

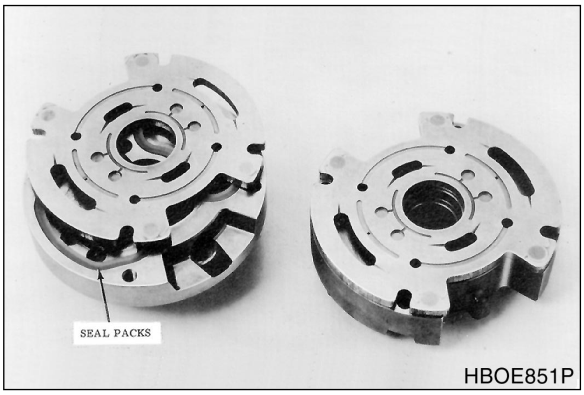

Figure 20

C. For right-hand rotation units, set rotor on flat wooden board with arrow pointing right. (For left-hand rotation arrow should point left.) Assemble vanes and inserts into rotor in reverse order. (See Figure 21.) Make sure sharp chamfer edge of each vane leads in direction of rotation. All vanes must move freely in rotor slots with no evidence of bind.

D. Assemble cam ring over rotor and vanes with arrow pointing in same direction as rotor. Lubricate top surface of rotor and vanes liberally with system fluid.

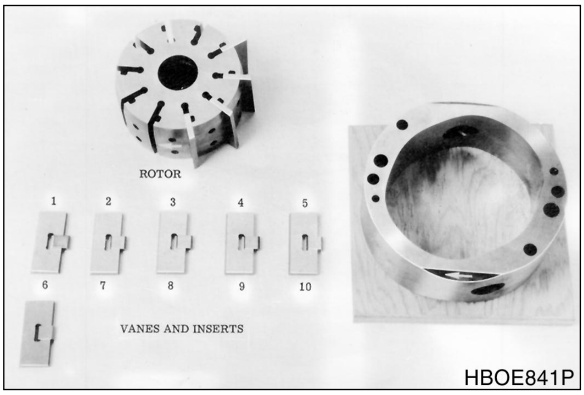

Figure 21

E. Locate scribe mark on cam ring, outlet support plate, and flex side plate. Hold outlet support plate and flex side plate together and assemble over cam ring and rotor with scribe marks in-line.

F. Hold cartridge together to prevent movement and turn assembly over so outlet support plate rests on a flat surface, and flat wooden board is up. (See Figure 22.) Remove flat wooden board.

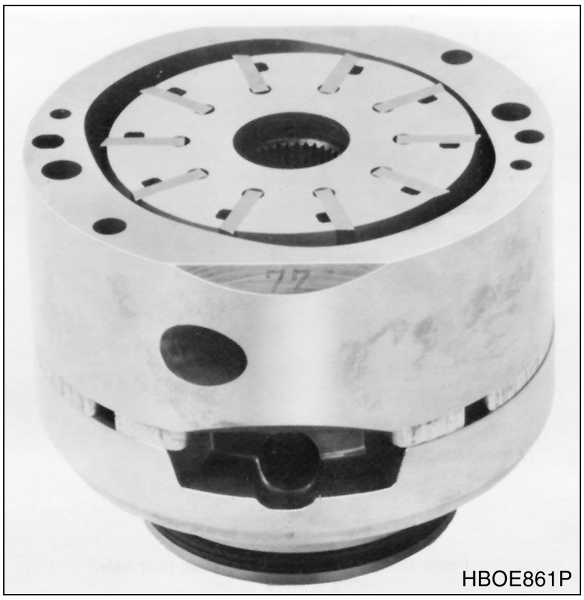

Figure 22

G. Lubricate exposed surface of rotor and vanes with system fluid. Locate scribe mark on inlet support plate and flex side plate. Hold inlet support plate and flex side plate together and assemble over cam ring and rotor with scribe marks in-line. (See Figure 23.)

NOTE: *The cast-in arrows next to socket head screws, indicate cartridge direction of rotation.*

H. Thread two socket head screws into cartridge until snug (hand tight).

NOTE: *The O.D. of all component parts of cartridge kit must be in-line with each other or cover cannot be installed. Align cartridge as follows:*

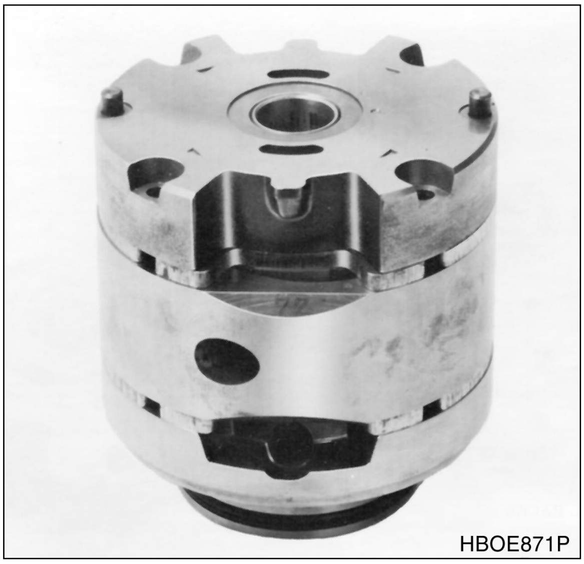

Figure 23

I. Install cover over cartridge. Tap lightly on cover with your hand until each part centers. Remove cover gently so as not to disturb alignment. Torque socket head screws to torque noted on Figure 8, and recheck kit alignment with cover. Repeat until cartridge kit is aligned. (See Figure 24.)

J. Check rotor for bind by inserting index finger through shaft opening of inlet support plate. Hold cartridge kit in a horizontal shaft position and lift rotor with finger. Rotor should move freely back and forth within cartridge. If rotor binds, open kit, clean and stone all possible areas of bind, then reassemble using aforementioned procedure. Rotor MUST move freely within cartridge when assembled.

Figure 24

2. Basic pump reassembly - Clamp body in a vise or place on 2x4 wooden blocks to facilitate assembly. (See Figure 10 and Figure 11.)

   A. Lubricate primary shaft seal with petroleum jelly and place in position within body, garter spring up. See Figure 6 for seal arrangements.

   B. Use seal installation tool shown in Figure 9 to prevent damage to seal. Press seal into body until it bottoms out.

   NOTE: *Two shaft seal arrangements are available in VQ pump series. See* Figure 6 *and Figure 7.*

   C. Lubricate secondary seal with petroleum jelly and place seal in position against shaft end of body. See Figure 7. Use a small hardwood block to drive seal evenly into body. Installation is complete when seal face is flush with front of body. DO NOT drive seal past flush as it can block body drain opening.

   NOTE: *If shaft bearing was defective, install a new bearing as follows:*

   D. Press shaft into new bearing with an arbor press while supporting bearing inner race. Refer to Figure 6 and Figure 8 for correct location of bearing on shaft. Install a small snap ring behind bearing.

   E. Place bearing spacer washer over shaft, against front of bearing. Use a "bullet" over shaft end to prevent damage to seal(s). Lubricate "bullet" with petroleum jelly and carefully push shaft through seals until bearing and spacer is in location within body. Install large spirolox ring into body snap ring groove behind bearing.

   F. Install square sealing ring into body. See Figure 2 and Figure 8 (sectional view) for location.

   G. Install O-ring and back-up ring on cartridge, outlet support plate hub. See Figure 8 for location.

   H. Carefully install cartridge into body so one of the chamfers on cam ring aligns with cover inlet port.

   I. Lubricate and install large cover to body O-ring in place.

J. Install cover in position; move back and forth until cartridge pins drop into cover holes.

K. Oil and install cover to body bolts (4 required). Torque to value noted in Figure 8.

L. Turn pump shaft by hand to verify freedom of cartridge.

START-UP PROCEDURES

Whenever it is possible to do so, fill pump ports with system hydraulic fluid. This will make it easier for pump to prime when it is first started.

Self-Priming - With a minimum drive speed of 600 rpm, a pump should prime almost immediately. Failure to prime within a reasonable length of time may result in damage due to lack of lubrication. Inlet lines must be tight and free from air leaks. However, it may be necessary to crack a fitting on outlet side of pump to purge entrapped air.

No-Load Starting - These pumps are designed to start-up with no load on pressure ports. They should never be started against a load or a closed center valve.

S0708470K

DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

STEERING AND BRAKE PUMP (DENISON T67DB SERIES)

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Mega 400-V	1001 and Up
Mega 500-V	1001 and Up

December 2000

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GENERAL DESCRIPTION

The operating principle of a vane pump is illustrated in Figure 1. A slotted rotor is splined to the drive shaft and turns inside a cam ring. Vanes are fitted to rotor slots and follow inner surface of cam ring as the rotor turns. Centrifugal force and pressure under vanes hold them out against the cam ring. Pumping chambers are formed between the vanes and cam ring and are enclosed by two end plates.

The pump is a balanced intra-vane design. See Figure 1. Outlet pressure is constantly applied to small intra-vane area of the vane. As the pump vane rotates through high and low quadrants, outlet pressure is alternately applied to the rest of under vane area. This varying pressure under the vane reduces wear and increases pump efficiency.

Pump delivery can be changed by changing the ring or installing a new cartridge kit. Cartridge kit part numbers are tabulated in parts and service drawings.

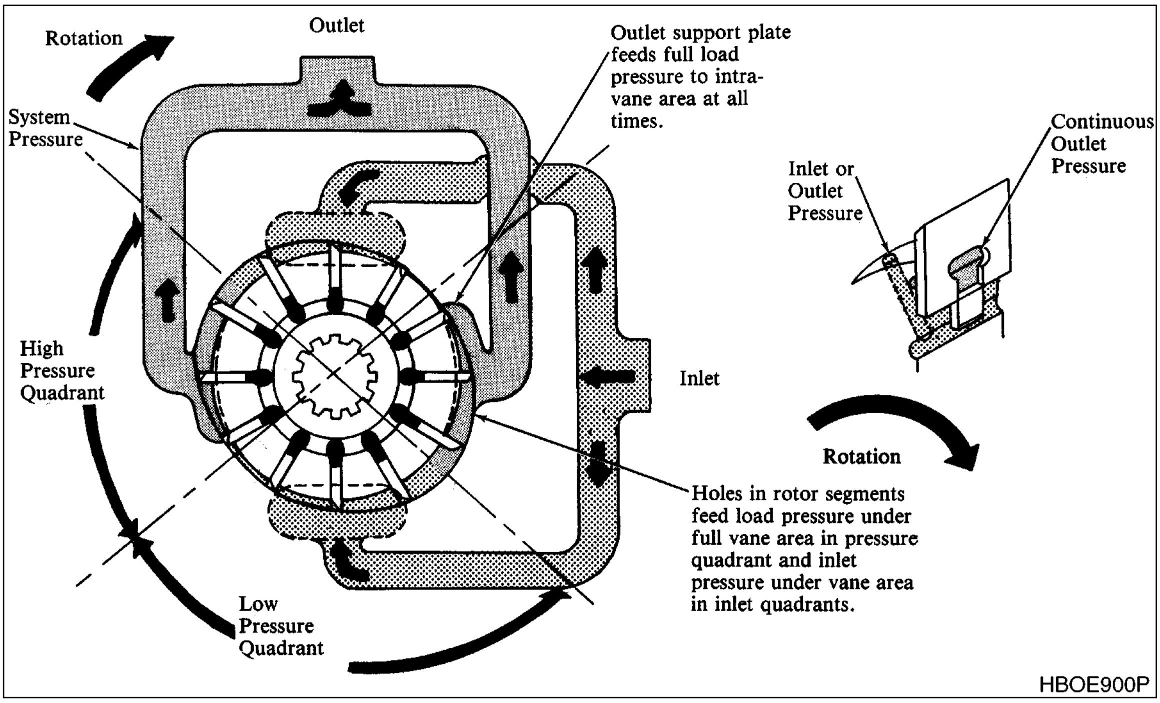

Figure 1 VANE PUMP OPERATION

PARTS LIST

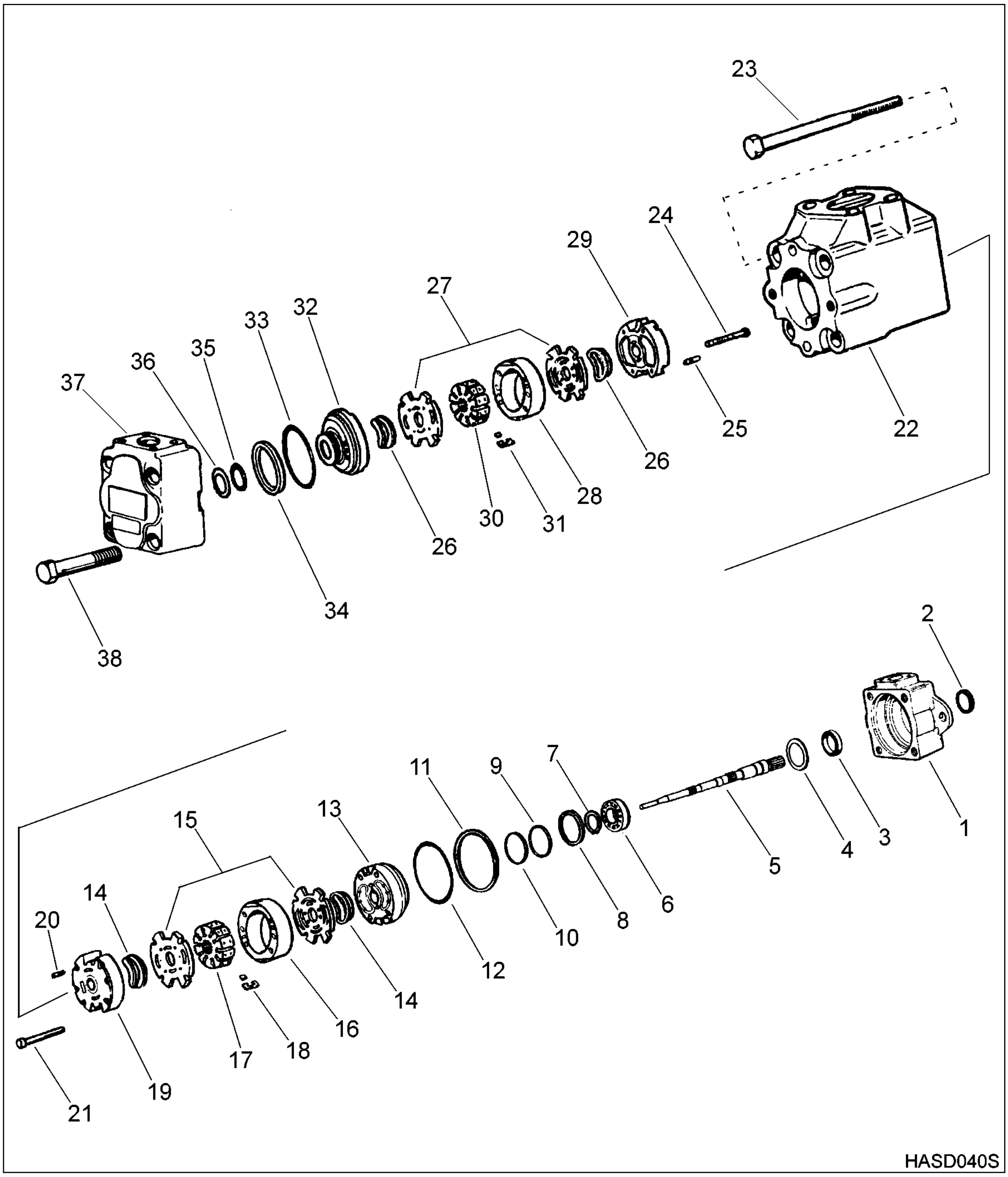

Figure 2

Reference Number	Description
1	Body
2	Seal; Secondary
3	Seal; Primary
4	Washer
5	Shaft
6	Bearing
7	Ring; Retaining
8	Ring; Lock
9	Ring; Backup
10	O-ring
11	Ring; Seal
12	O-ring
13	Plate; Outlet Support
14	Pack; Seal
15	Plate Kit; Flex Side
16	Ring
17	Rotor
18	Vane & Insert
19	Plate; Inlet Support
20	Pin
21	Screw

Reference Number	Description
22	Body; Inlet
23	Bolt
24	Screw
25	Pin
26	Pack Seal
27	Plate Kit; Flex Side
28	Ring
29	Plate; Inlet Support
30	Rotor
31	Kit; Vane
32	Plate; Outlet Support
33	O-ring
34	Ring; Seal
35	O-ring
36	U-ring
37	Cover; Rear Flange
38	Bolt
39	Cartridge Kit, Center (Consists of 24 thru 36
40	Cartridge Kit, Shaft End (Consists of 9 thru 21)

SPECIAL TOOLS

A shaft seal driver (Figure 3) is the only special tool required for overhaul.

NOTE: *In addition to the above tool, an arbor press may be required to service the shaft bearing.*

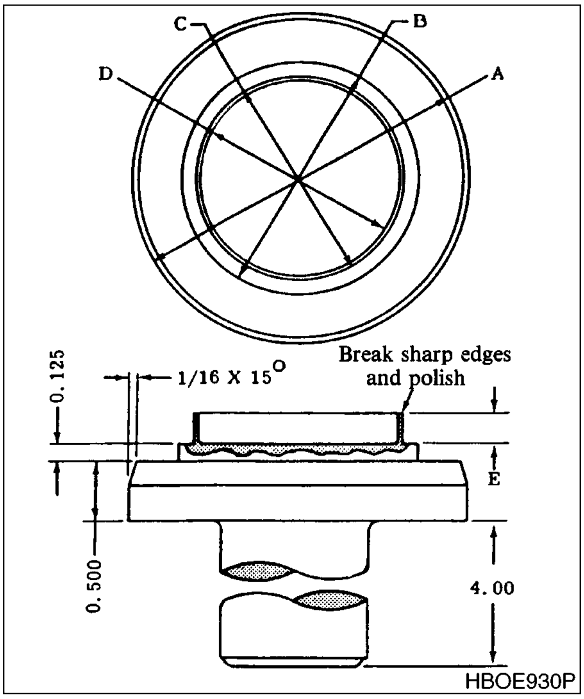

Figure 3 SHAFT SEAL DRIVER (DIMENSIONS ARE IN INCHES.)

Model	Dimension				
	A	B	C	D	E
T67DB - 031 - B08	71.933 ±0.025 mm (2.832 ±0.001 in)	50.216 ±0.025 mm (1.977 ±0.001 in)	44.653 ±0.025 mm (1.758 ±0.001 in)	42.850 ±0.025 mm (1.687 ±0.001 in)	6.350 mm (0.250 in)

TROUBLESHOOTING, TESTING AND ADJUSTMENT

Table below lists the common difficulties experienced with vane pumps and hydraulic systems. It indicates, possible causes and remedies for each of the problems listed.

Problem	Possible Cause	Remedy
Excessive noise in pump.	Low oil level in reservoir.	Fill reservoir to proper level with recommended fluid.
	Air in system.	Open reservoir cap and operate system until purged. Bleed hydraulic lines at highest point down stream of pump while system is under pressure.
	Vacuum condition.	Check inlet (suction) line and fittings for air leaks.
	Oil too thick.	Be certain correct type of oil is used in system. Warm up pump in cold weather until noise disappears.
	Damaged or missing pump seals at mating surfaces.	Locate and replace damaged or missing seals.
	Cartridge kit not assembled properly.	Reassemble cartridge kit.
	Pump inlet/outlet lines reversed.	Reconnect lines to proper port connections.
Pump overheating.	Internal leakage.	If excessive internal leakage exists, return to shop for complete overhaul.
	Heat exchanger not functioning.	Locate trouble and repair or replace.
System not developing pressure.	Relief valve open.	Repair or replace.
	Loss of fluid internally (slippage).	Return to shop for evaluation and repair.
	Cartridge kit not assembled properly.	Reassemble kit.
	Cartridge kit assembled for opposite rotation.	Reassemble kit to proper rotation.
	Pump inlet/outlet lines reversed.	Reconnect lines to proper port connections.
	Disconnected or broken drive mechanism.	Locate and repair.
Loss of fluid.	Ruptured hydraulic lines.	Locate and repair.
	Leaking or missing seals.	Locate and repair.

SERVICE AND MAINTENANCE

CIRCUIT INSPECTION

NOTE: *Periodic inspection of hydraulic fluid condition and tube or pipe line connections can save time consuming breakdowns and unnecessary and expensive repairs.*

1. All hydraulic connections must be kept tight. A loose connection in a pressure line will permit fluid to leak out. If hydraulic oil level becomes so low as to uncover inlet pipe opening in reservoir, extensive damage to pump can result. In suction or return lines, loose connections permit air to be drawn into system, resulting in noisy and/or erratic operation.
2. Clean hydraulic oil is the best insurance for long service life. Therefore, the reservoir should be checked periodically for dirt and other contaminants. If hydraulic oil becomes contaminated, the system should be drained and reservoir thoroughly cleaned before adding new oil.
3. Filter elements should be checked and replaced at regular service intervals. A clogged filter element results in a higher pressure drop. This can force particles through the filter which would ordinarily be trapped, or can cause the by-pass to open, resulting in a partial or complete loss of filtration.
4. Air bubbles in the reservoir can cause damage to pump and other components. If bubbles are seen, locate source of air and seal the leak.
5. A pump which is running excessively hot or noisy is a potential failure. Should a pump become noisy or overheated, immediately shut down the machine and correct problem.

ADDING HYDRAULIC OIL TO SYSTEM

1. When hydraulic oil is added to replenish the system, it should be poured through a clean wire screen (200 mesh or finer), or preferably pumped through a 10 micron (absolute) filter.
2. It is important that hydraulic oil be clean and free of any substance which could cause improper operation or wear pumps and other hydraulic components. Therefore, use of cloth to strain hydraulic oil should be avoided to prevent lint from entering system.

ADJUSTMENTS

1. No periodic adjustments are required, other than to maintain proper shaft alignment with driving medium.

LUBRICATION

1. Internal lubrication is provided by the hydraulic oil in the system. Coat shaft splines with a dry lubricant (Molycoat or equivalent) to prevent wear.

REPLACEMENT PARTS

1. Reliable operation throughout specified operating range is assured only if genuine Vickers parts are used (available through your Daewoo distributor). Sophisticated design process and material are used in the manufacture of these parts.

   NOTE: *Substitute replacement parts may result in early failure of pump assembly.*

2. Commonly replaced parts are usually provided in the form of repair kits available through your Daewoo distributor. It is strongly recommended to use repair kits when a pump is overhauled.

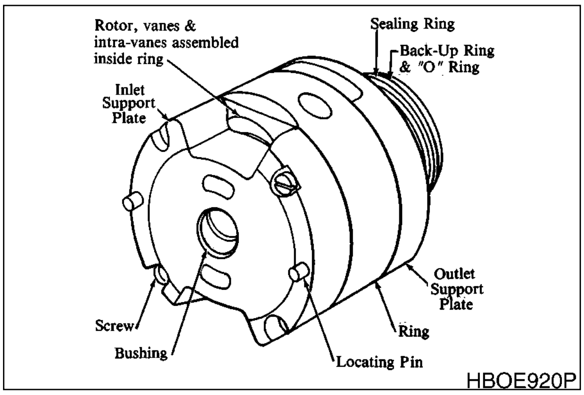

Figure 4 PREASSEMBLED CARTRIDGE KIT

DISASSEMBLY

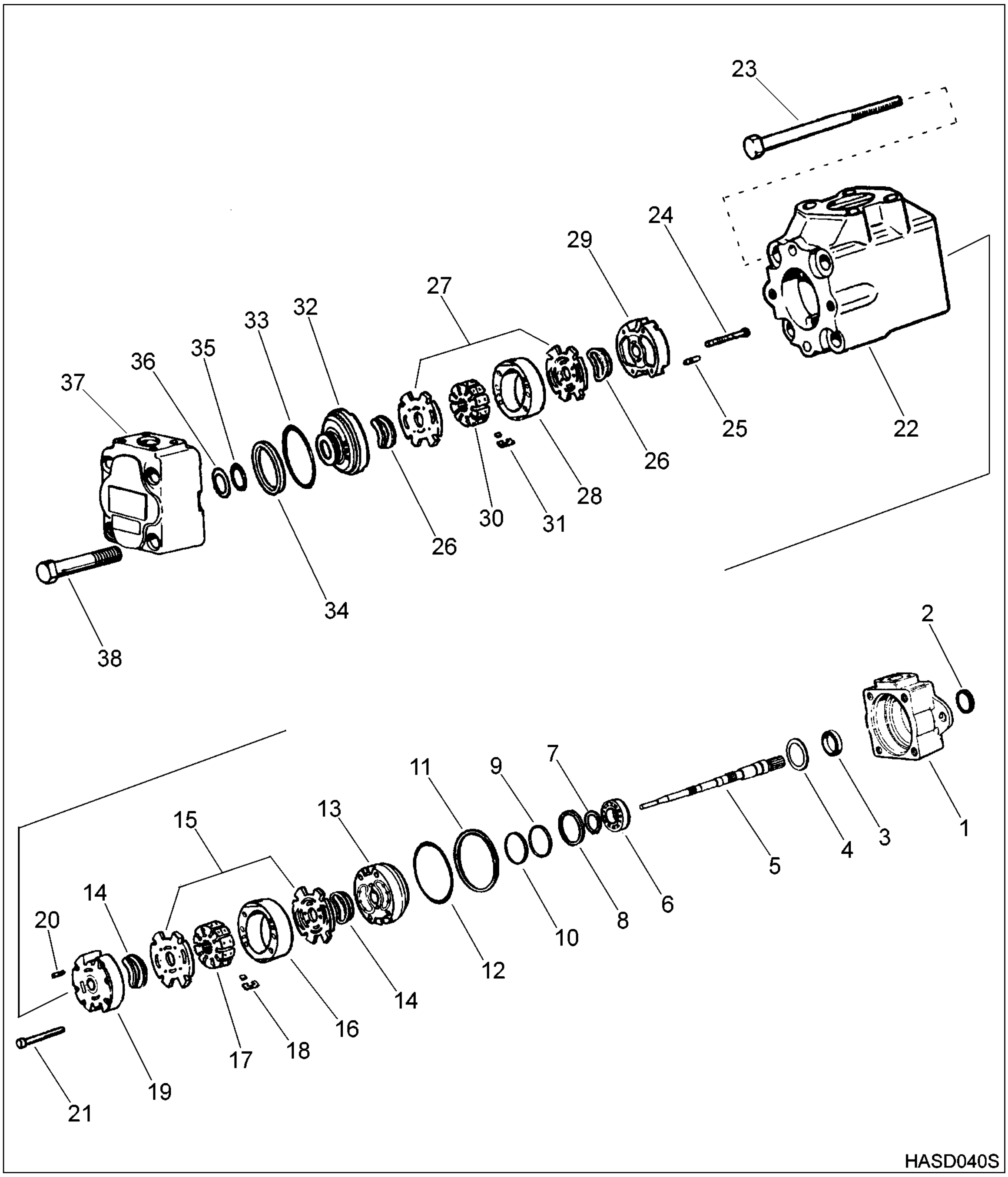

Figure 5

Reference Number	Description
1	Body
2	Seal; Secondary
3	Seal; Primary
4	Washer
5	Shaft
6	Bearing
7	Ring; Retaining
8	Ring; Lock
9	Ring; Backup
10	O-ring
11	Ring; Seal
12	O-ring
13	Plate; Outlet Support
14	Pack; Seal
15	Plate Kit; Flex Side
16	Ring
17	Rotor
18	Vane & Insert
19	Plate; Inlet Support
20	Pin
21	Screw

Reference Number	Description
22	Body; Inlet
23	Bolt
24	Screw
25	Pin
26	Pack Seal
27	Plate Kit; Flex Side
28	Ring
29	Plate; Inlet Support
30	Rotor
31	Kit; Vane
32	Plate; Outlet Support
33	O-ring
34	Ring; Seal
35	O-ring
36	U-ring
37	Cover; Rear Flange
38	Bolt
39	Cartridge Kit, Center (Consists of 24 thru 36
40	Cartridge Kit, Shaft End (Consists of 9 thru 21)

IMPORTANT

Thoroughly clean exterior surfaces of pump before disassembly. There should not be any visible dirt, grease or other type of accumulation on outside of pump case. Clean off or blow dry all traces of cleaner and solvent before starting work.

IMPORTANT

If at all possible, use a clean, dry container to catch oil. A clean container allows an evaluation to be made of the used oil. The presence or relative lack of metal wear shavings in used oil or obvious deterioration or contamination of the oil can provide a useful indicator of the pump's general condition.

NOTE: *Used oil is an environmental contaminant and should be disposed of promptly at approved recycling facilities. Prolonged physical contact with used oil has been thought by some to pose a health risk. Clean oil residue from hands and clothing promptly, and do not allow used oil containers to accumulate.*

NOTE: *The area where pump is to be rebuilt should be well-lit, clean and protected from dust and/ or wind gusts that could carry in dust or grit. Use a rubber mat or other protective overlay on workbench area to prevent damaging or scratching any precision machined components.*

NOTE: *4535V models are slightly different from the models shown in Figure 7. Screws (4) are longer and fasten cover (5), inlet housing (19), and body (38) together. Screws (18) are omitted.*

BASIC PUMP DISASSEMBLY

1. Thoroughly clean pump exterior.
2. Use a prick punch and mark position of cover (37) and body (1) with respect to inlet housing (22) for correct reassembly.
3. Support the pump on blocks or clamp body (1) in a vise. Remove four cover screws (38) and lift cover (37) off pump.

   NOTE: *If a vise is used, use protective jaws to avoid damage to body and its machine surfaces.*
4. Remove U-ring (36), O-ring (35), seal ring (34), and O-ring (33) from cartridge kit (39) and discard.
5. Pull and/or pry out center cartridge kit (39) from inlet housing (22).
6. Remove four screws (23) from inlet housing (22), then left off housing.
7. Pull shaft end cartridge kit (40) from body (1).
8. Pry under coil and remove spirolox ring (8) from body (1). (See Figure 6.)
9. Pull the shaft group (items 7, 6, and 5) from body (1). If bearing (6) or shaft (5) need replacement, remove retaining ring (7) with retaining ring pliers. Remove bearing (6) from shaft (5) by using an arbor press. Apply pressure to the inner race when removing bearing.
10. Remove washer (4) and primary shaft seal (3) from body (1).
11. Drive secondary shaft seal (2) out of mounting end of body (1).

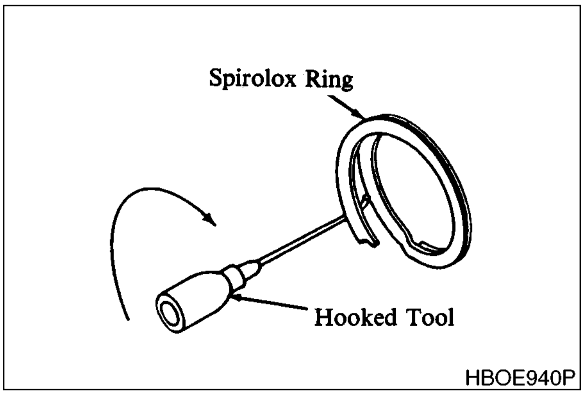

Figure 6 REMOVING SPIROLOX RING

CARTRIDGE DISASSEMBLY

1. Scribe a line across outer surface of cartridge kit to provide a reference for parts during assembly.

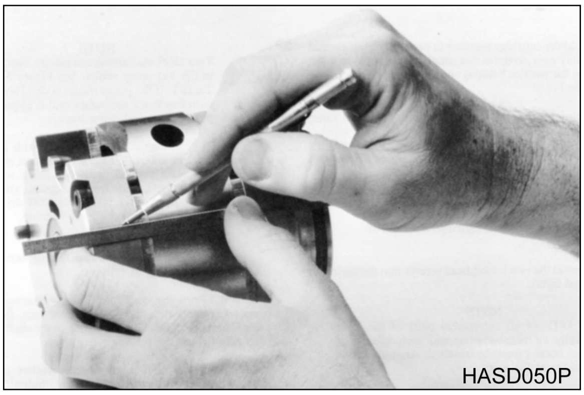

Figure 7

2. Place cartridge on a flat surface (outlet support plate down) and remove two socket head screws.

   NOTE: *Do not slide flex side plates across ring and rotor. Burrs on ring and rotor can cause deep scratches in soft brass surface.*

3. Slide inlet support plate and seal packs off cartridge. Do not allow flex side plate to slide with support plate.

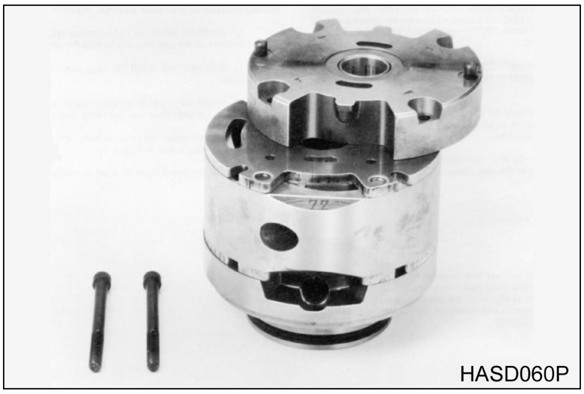

Figure 8

4. Move flex side plate off center just enough to grab edge and lift up and away without sliding.

Figure 9

5. If a small flat piece of wood is available, place it over ring and rotor and reverse cartridge to have outlet support plate pointing up. Use wood to hold ring, rotor and vanes.

Figure 10

6. Slide outlet support plate and seal packs off cartridge, do not allow flex side plate to slide with support plate.

Figure 11

7. Move flex side plate off center just enough to lift up and away without sliding.

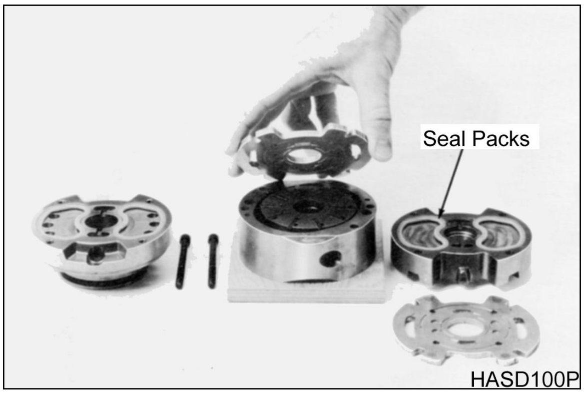

Figure 12

8. Remove cam ring from rotor and vanes. Locate the arrow stamped into rotor periphery. Remove vanes and inserts in order, starting at arrow. Keep them in order for inspection.

9. *Do not remove cartridge locating pins from inlet support plate unless they are damaged, Pins are of a drive-loc type and can be difficult to remove.*

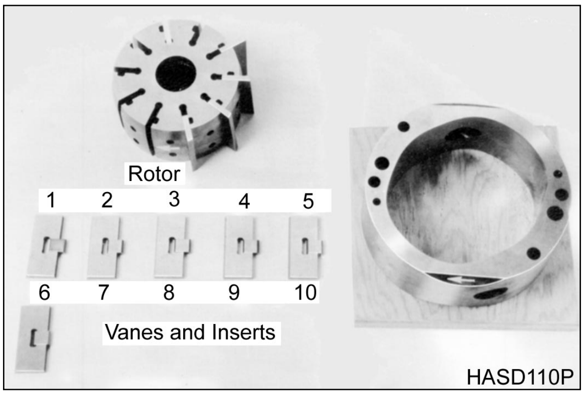

Figure 13

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

For general cleaning and inspection procedures, refer to "General Maintenance Procedures" section.

CLEANING

All parts must be thoroughly cleaned and kept clean during inspection and assembly. Contamination of unit will cause excessive wear, leakage, and decreased service life. Use a commercial solvent which is compatible with the system fluid. Thoroughly clean all parts. Drying parts with compressed air after cleaning is not recommended, unless the air is completely filtered to remove water and contamination.

INSPECTION, REPAIR AND REPLACEMENT

Check all internal passages. Make sure they are clean and unobstructed. Examine all mating surfaces for nicks and burrs. Check locating pins and holes for wear and burrs. Check the condition of threaded parts and threaded holes. Check all snap ring recesses. Minor burrs can be removed with an India stone. Replace any part which shows wear or damage. The following parts are subject to special attention:

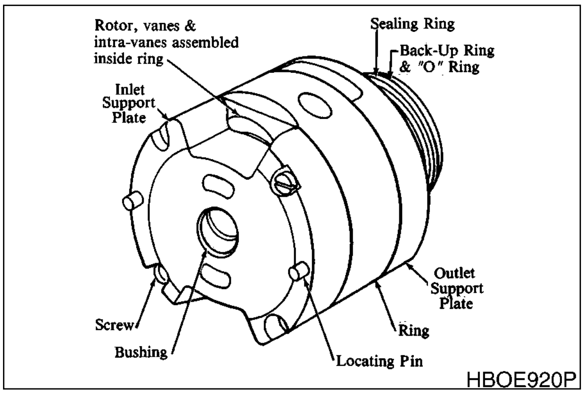

Figure 14 PREASSEMBLED CARTRIDGE

1. Cartridge kits (39 and 40). to obtain maximum overhaul life of the pump, a complete cartridge kit should be installed if wear or scoring is noticed during the following inspection steps.

   A. Inspect the mating surfaces of the rotors (15 and 28), outlet support plates (17 and 30), and inlet support plates (12 and 25) for wear and/or scoring.

   B. Inspect vanes and inserts (16 and 29) for burrs, wear, and play in slots of rotors (15 and 28). Remove minor burrs with an India stone.

   NOTE: ***DO NOT*** *use a dry stone on bronze surfaces or scratches will result*

   C. Inspect bushing for wear and scoring.

2. Check bearing (33) for wear, looseness, and pitted or cracked races.

3. Inspect seal and bushing mating surfaces on the shaft for scoring and wear. Replace shaft if marks cannot be removed by light polishing.

4. Remove burrs from outer edge of ring (27). Place rotor (15) and ring (27) on a flat surface. Measure ring/rotor clearance with a dial indicator. Ring/rotor clearance are noted in Table below.

Model	Minimum Clearance Limit In Inches
T67DB - 1308	0.018 mm (0.0007 in)
T67DB - 031	0.038 mm (0.0015 in)

REASSEMBLY

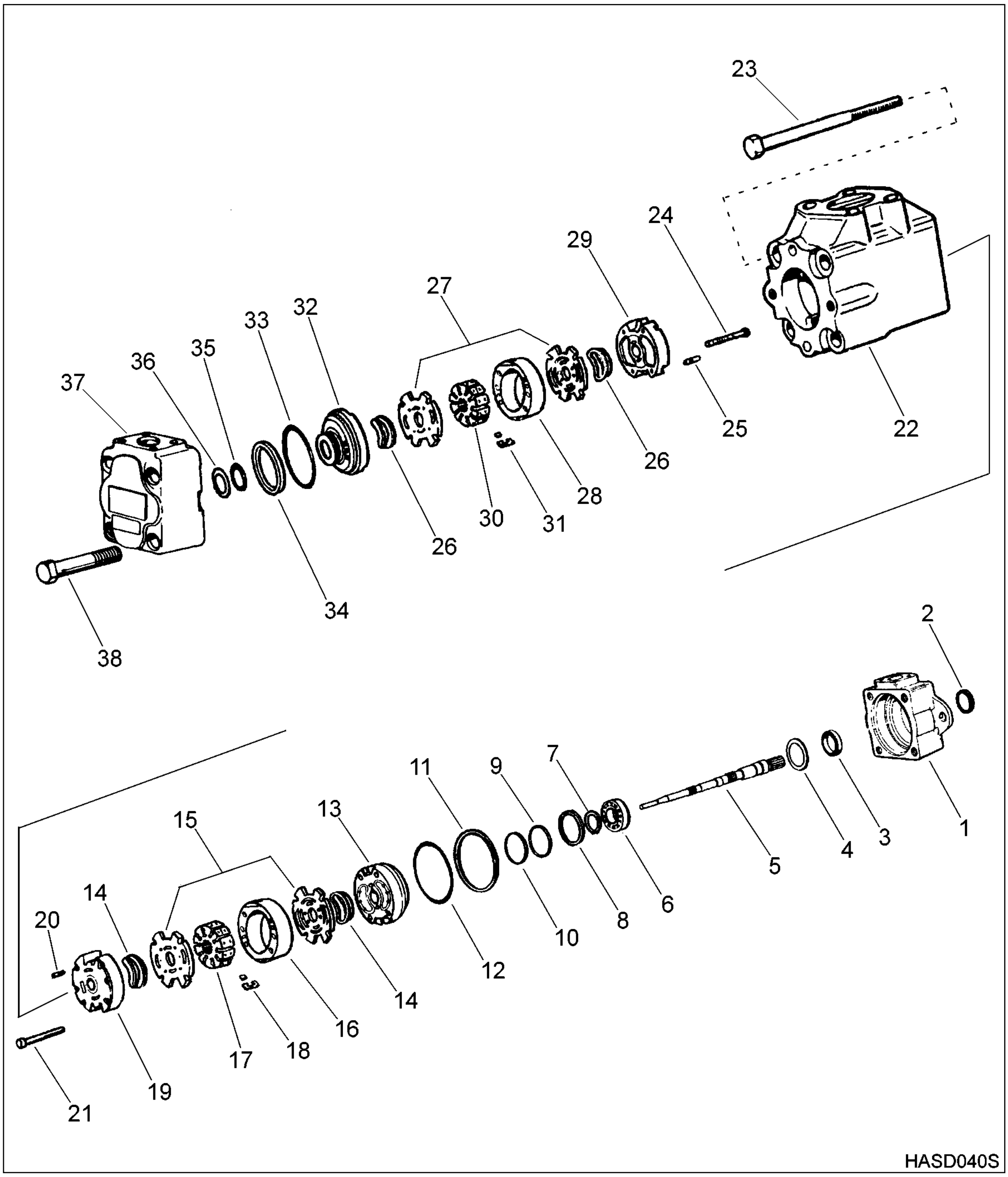

Figure 15

Reference Number	Description
1	Body
2	Seal; Secondary
3	Seal; Primary
4	Washer
5	Shaft
6	Bearing
7	Ring; Retaining
8	Ring; Lock
9	Ring; Backup
10	O-ring
11	Ring; Seal
12	O-ring
13	Plate; Outlet Support
14	Pack; Seal
15	Plate Kit; Flex Side
16	Ring
17	Rotor
18	Vane & Insert
19	Plate; Inlet Support
20	Pin

Reference Number	Description
21	Screw
22	Body; Inlet
23	Bolt
24	Screw
25	Pin
26	Pack Seal
27	Plate Kit; Flex Side
28	Ring
29	Plate; Inlet Support
30	Rotor
31	Kit; Vane
32	Plate; Outlet Support
33	O-ring
34	Ring; Seal
35	O-ring
36	U-ring
37	Cover; Rear Flange
38	Bolt
39	Cartridge Kit, Center
40	Cartridge Kit, Shaft End

NOTE: *Always replace old seals with new seals when overhauling a unit. If a cartridge kit needs replacement, new cartridge seals are included as part of the kit.*

NOTE: *Apply a light film of hydraulic oil to all component parts except seals and back-up rings to facilitate assembly and provide initial lubrication. Use small amounts of petroleum jelly to hold O-rings in place during assembly. Install parts in reverse order of disassembly*

IMPORTANT

During handling and shipping of precision machined cartridge parts, it is possible to raise burrs on the sharp edges. All sharp edges on parts of a new cartridge kit should be stoned before installation.

NOTE: *To reverse direction of a new cartridge kit, simply reverse location of the inlet and outlet support plated, and realign the cartridge with cover.*

CARTRIDGE ASSEMBLY

1. The direction of rotation is as viewed from shaft end, right-hand rotation is clockwise, left-hand rotation is counterclockwise.

   NOTE: *If locating pins were removed from the inlet support plate, install new pins with locking flutes within inlet support plate. Drive new pins into support plate with a soft tip hammer.*

2. Place inlet and outlet support plates on a flat surface. Install seal packs into cavities with seal retainer surface up and O-rings facing downward into cavities.
3. Place a flex side over each of the support plates with bronze wear surface facing up. Align scribe marks to make sure that correct flex side plate is used with correct support plate.

   NOTE: *Flex side plates develop a wear pattern with rotor and vanes, and should not be interchanged.*

4. For right-hand rotation units, set rotor on flat wooden board with arrow pointing right. For left-hand rotation units, set rotor on flat wooden board with arrow pointing left. Assemble the vanes and insert into rotor in reverse order of removal. Make sure that sharp chamfer edge of each vane leads in direction of rotation. All vanes must move freely in rotor slots with no evidence of bind.
5. Assemble cam ring over rotor and vanes with arrow pointing in the same direction direction as rotor arrow. Lubricate top surface of rotor and vanes liberally with hydraulic oil.
6. Locate scribe mark on cam ring, outlet support plate, and flex side plate. Hold the outlet support plate and flex side plate together and assembly over the cam ring and rotor with scribe marks in line.
7. Hold cartridge together to prevent movement and the assembly along with the wooden board over so outlet support plate rests on a flat surface, and the board is up. Remove the board.

Figure 16

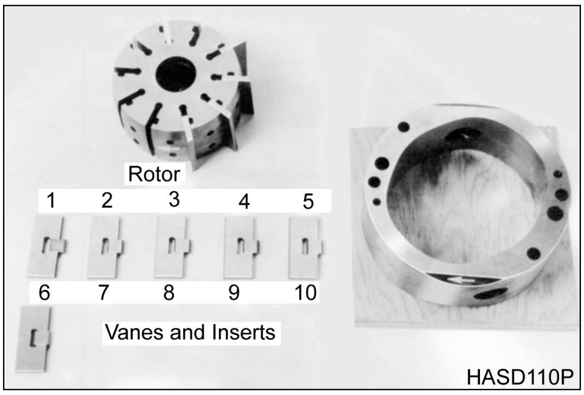

Figure 17

Figure 18

8. Lubricate the exposed surface of rotor and vanes with hydraulic oil. Locate the scribe mark on the inlet support plate and flex side plate. Hold inlet support and flex side plate together and assemble over cam ring and rotor with scribe mark in line.

   NOTE: *The cast-in arrows next to socket head screws, indicate cartridge of rotation.*

9. Thread the two socket head screws into cartridge until snug (hand tight).

10. The O.D. of all component parts of the cartridge kit must be in line with each other or cover cannot be installed. Align the cartridge as follows:

Figure 19

11. Install cover over the cartridge. Tap lightly on cover with your hand until each part centers. Remove the cover gently so as not to disturb alignment. Torque socket head screws to the torque noted below, and recheck kit alignment with cover. Repeat until cartridge is aligned.

    NOTE: *Center End Cartridge Kit Torque: 2 - 3 Nm (25 - 35 in lb)*

    NOTE: *Shaft End Cartridge Kit Torque: 11 Nm (100 in lb)*

12. Check rotor for bind by inserting index finger through shaft opening of inlet support plate. Hold the cartridge kit in a horizontal shaft position and lift rotor with your finger, The rotor should move freely back and forth within the cartridge. If the rotor binds, open kit, clean and stone all possible areas of bind, then reassemble the cartridge kit using aforementioned procedure. The rotor **MUST** move freely within cartridge when assembled.

BASIC PUMP ASSEMBLY

1. Lubricate secondary seal (2) with petroleum jelly and place in position against shaft end of body (1). Use a small hardwood block to drive the seal evenly into body. Installation is complete when seal face is flush with front of the body.

   NOTE: ***DO NOT*** *drive seal past flush as it can block body drain opening.*

2. Lubricate primary seal (3) with petroleum jelly and place in position inside of body (1) and press in place with shaft seal driver.

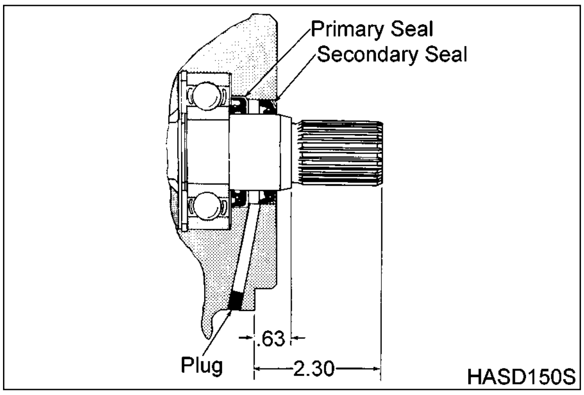

Figure 20

3. Install washer (4) into body (1).
4. If required, press bearing (6) on shaft (5) and secure with retaining ring (7). Use an arbor press for this operation and apply force to inner race area.
5. Check splined end of shaft to make certain it is free from nicks and burrs. A small nick or burr can damage shaft seal during installation. Coat splined portion of shaft with hydraulic oil. Carefully install the shaft group, (items 5, 6, and 7), through seals (2 and 3) and into body (1). Spread Spirolox ring (8) and feed it into groove behind bearing. This will secure the shaft group within body (1).
6. Install sealing ring (11) into body (1).
7. If center cartridge kit (40) is replaced with a new kit, install kit into inlet body (1). If cartridge kits requires assembly, assemble in reverse order of disassembly. See "Cartridge Assembly." During assembly, note the following precautions:

   A. Make sure the arrows on rotor (17) and cam ring (16) are in same direction of pump rotation.

   B. Make certain that sharp edges of vane (18) lead in direction of rotation.

   C. Make sure O-ring (10) and back-up ring (9) are assembled correctly. Apply a small amount of hydraulic oil to screws (21) and thread screws into cartridge (40). Install cartridge kit (40) into body (1).

8. Install O-ring (11) over cartridge kit (40) and into O-ring groove of body (1).

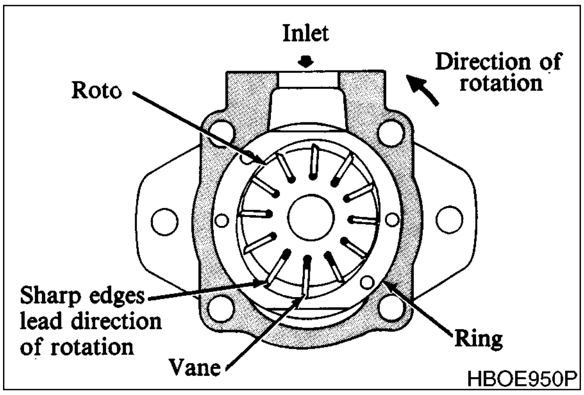

Figure 21 POSITIONING VANES IN ROTOR

9. Line up the two cartridge kit pins (20) with holes in housing (22) and then install housing. Position the housing according to punch marks made during step 2 of disassembly procedure. Attach housing to body with four screws (23).

   NOTE: *Torque screws (23) to: 189 - 216 Nm (140 - 160 ft lb).*

10. If cartridge kit (39) is replaced with a new kit, line up pins (25) with holes in housing (22) and install kit into housing.

    If cartridge kit requires assembly, assemble in reverse order of disassembly. During assembly, note the following precautions:

    A. Make sure the rotation arrows on rotor (30) and cam ring (28) are in direction of pump rotation.

    B. Be certain sharp edges of vanes (31) lead in direction of pump rotation.

    C. Make sure O-ring (35) and back-up ring (36) are assembled in the correct position.

    NOTE: *Cartridge kit (39) is assembled into housing (22) in reverse manner of cartridge kit (40). Make sure rotation arrow of ring points in direction of rotation.*

    D. Apply a small amount of hydraulic oil to screws (24) and thread screws into cartridge kit.

11. Install sealing ring (34) into cover (37).

12. Install O-ring (33) over cartridge kit (39) against housing face.

13. Position cover (37) over cartridge kit (39) according to prick marks made during step 2 of disassembly procedures. Install cover (37) and secure with screws (38).

    NOTE: *Torque screws (23) to: 54 - 68 Nm (40 - 50 ft lb).*

START-UP PROCEDURES

START-UP

1. Install the pump into the system. Make sure that drive shaft is aligned properly. All connections are tight, and hydraulic oil source is open to pump inlet, if an overhead reservoir is used, purge air from inlet line.

2. The pump should prime almost immediately with a minimum drive speed of 600 rpm. Intermittently operate (jog) the pump until it primes. It may be necessary to loosen the outlet fitting temporarily to purge trapped air. Failure of pump to prime in a short period of time indicates incorrect assembly or restricted flow from reservoir.

   NOTE: *With a minimum drive speed of 600 rpm, a pump should prime almost immediately if provision is made to initially purge air from the system.*

TEST

Use machine’s hydraulic system to test the pump.

S0709240K

DAEWOO
DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

BRAKE PEDAL VALVE

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Mega 500-V	1001 and Up

May 2001

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GENERAL DESCRIPTION

THEORY OF OPERATION

The brake pedal valve is attached to, and operated by, the brake pedal (Figure 1). The valve contains two spools (Figure 2). One spool ports fluid to the brake pistons in the front axle, and the other spool ports fluid to the brake pistons in the rear axle. Maximum system operating pressure is 60 bars (870 psi). If something in one of the circuits should fail, the other circuit will continue to operate.

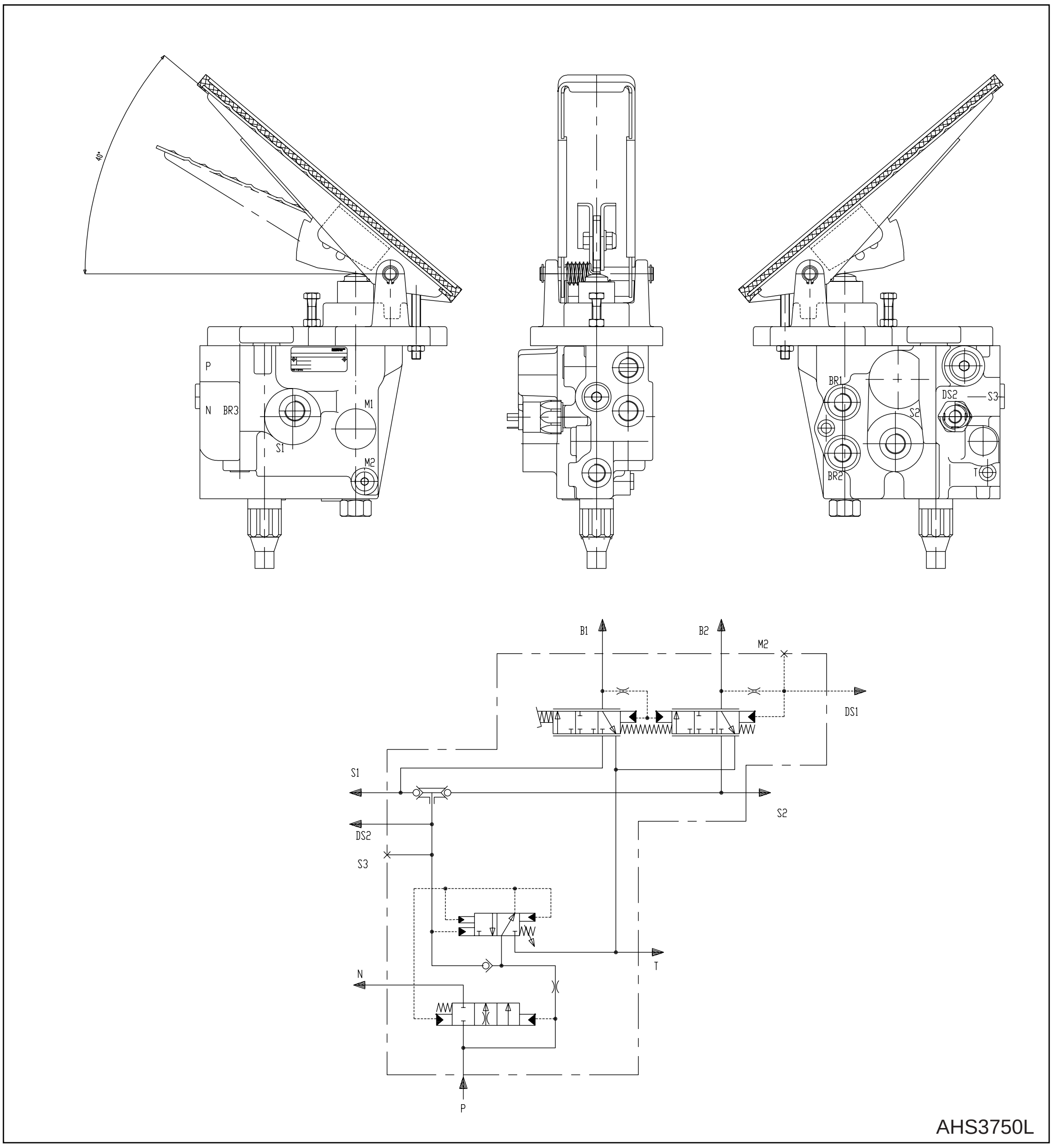

Figure 1

When the brake pedal is depressed, force is applied to the working element (6, Figure 2). This force is transferred to the primary control spool (1) and the secondary control spool (2) by the main control spring (5). This causes the control spool lands to close the path from the supply ports (P1 and P2) to the tank ports (T1 and T2). Simultaneously, the spool then opens a path from the brake circuit ports (Br1 and Br2) to the supply ports (P1 and P2). Drilled passages in control spools (1 and 2) allow fluid pressure in ports P1 and P2 to act against the main control spring (5). This allows brake pressure in both circuits to rise proportionally to the force applied to the brake pedal.

As the force applied to the brake pedal becomes constant, the control spools (1 and 2) move into a balanced position and hold the braking pressure constant.

When force is removed from the brake pedal, this removes force from the control spring. The return springs (3 and 4) now move the control spools (1 and 2) to the upward. The spools open a path from the brake circuit ports (B1 and B2) to the tank ports (T1 and T2) and this releases the pressure from the brake circuits.

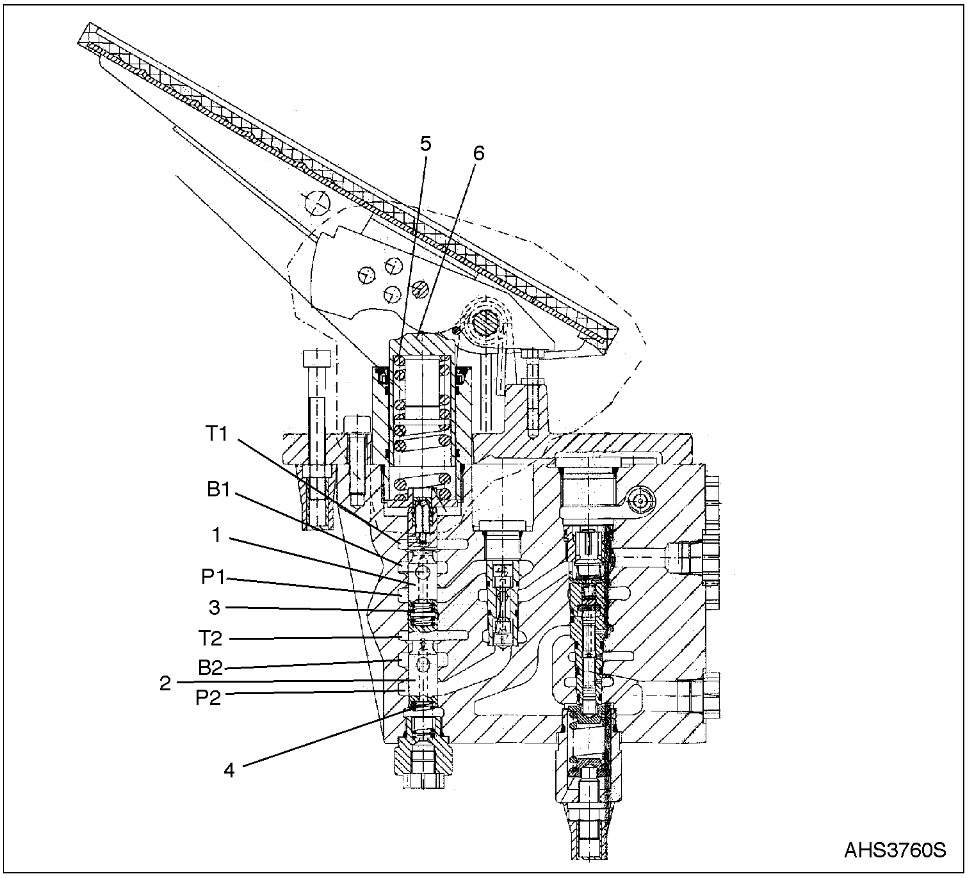

Figure 2

Reference Number	Description
1	Primary Control Spool
2	Secondary Control Spool
3	Lower Spring

Reference Number	Description
4	Upper Spring
5	Main Control Spring
6	Working Element

SPECIFICATION

Item	Specification
Braking Pressure	60.0 bar (870 psi)
Pedal Force	24 ±2.0 kg (53 ±4.4 lb)
Operating Angle	18 ±2°

BRAKE SYSTEM

Multiple wet disc brakes for stopping vehicle movement are contained in the axle-end planetary gear sets. A brake pump (10, Figure 3) supplies pressurized fluid to the brake hydraulic system. Force on the brake pedal (5) moves two spools in the brake valve (9). The spools are proportional. The farther the brake pedal is pushed, the greater the amount of fluid that passes through each spool. One spool ports fluid to brake pistons in the front axle (3). The other spool ports fluid to brake pistons in the rear axle (1). Pressure on the brake pistons applies pressure to the brake discs, and this stops axle shaft and wheel rotation.

The brake hydraulic system also contains four accumulators (8). The accumulators hold a volume of pressurized fluid large enough to allow the brakes to be applied nine times with full pressure, after the engine has been turned off.

The brake hydraulic system includes a pressure operated transmission cutoff switch (2, Figure 3). Pressing the brake pedal (5) will open cutoff switch (2). When the transmission cutoff switch in the operator's cab is selected, this will cut off current to a solenoid operated hydraulic valve in the transmission. This prevents operation of the forward clutch in the transmission. This prevents the transmission from driving the wheels forward when the brake pedal is pressed.

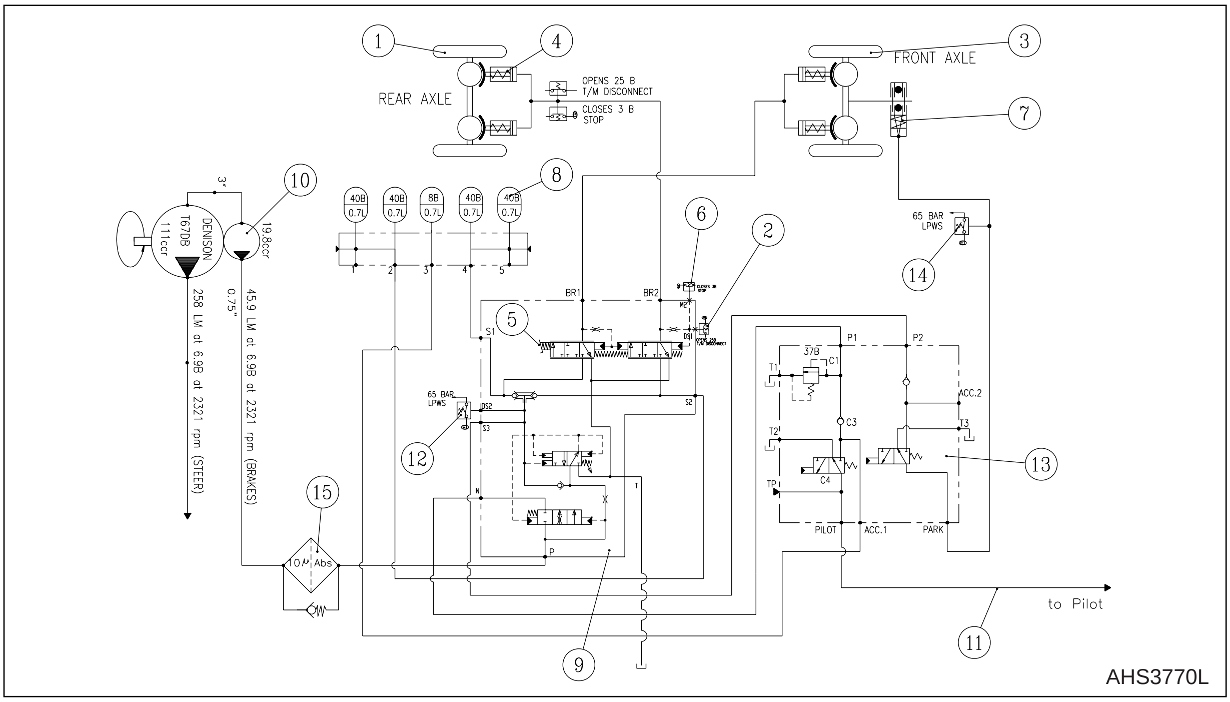

Figure 3 BRAKE HYDRAULIC CIRCUIT

Reference Number	Description
1	Rear Axle
2	Transmission Cutoff Switch
3	Front Axle
4	Brake
5	Brake Pedal
6	Stop Light Switch
7	Parking Brake
8	Accumulators: Brake

Reference Number	Description
9	Brake Valve
10	Pilot Pump
11	Pilot Supply Line
12	Low Pressure Warning Switch
13	Pilot and Parking Valve
14	Low Pressure Warning Switch
15	Brake and Pilot Filter

BRAKE, PILOT AND PARKING BRAKE SUPPLY VALVE

This valve controls oil flow to the brake pedal valve for braking, to the pilot controller for operation of bucket and boom and to the parking brake.

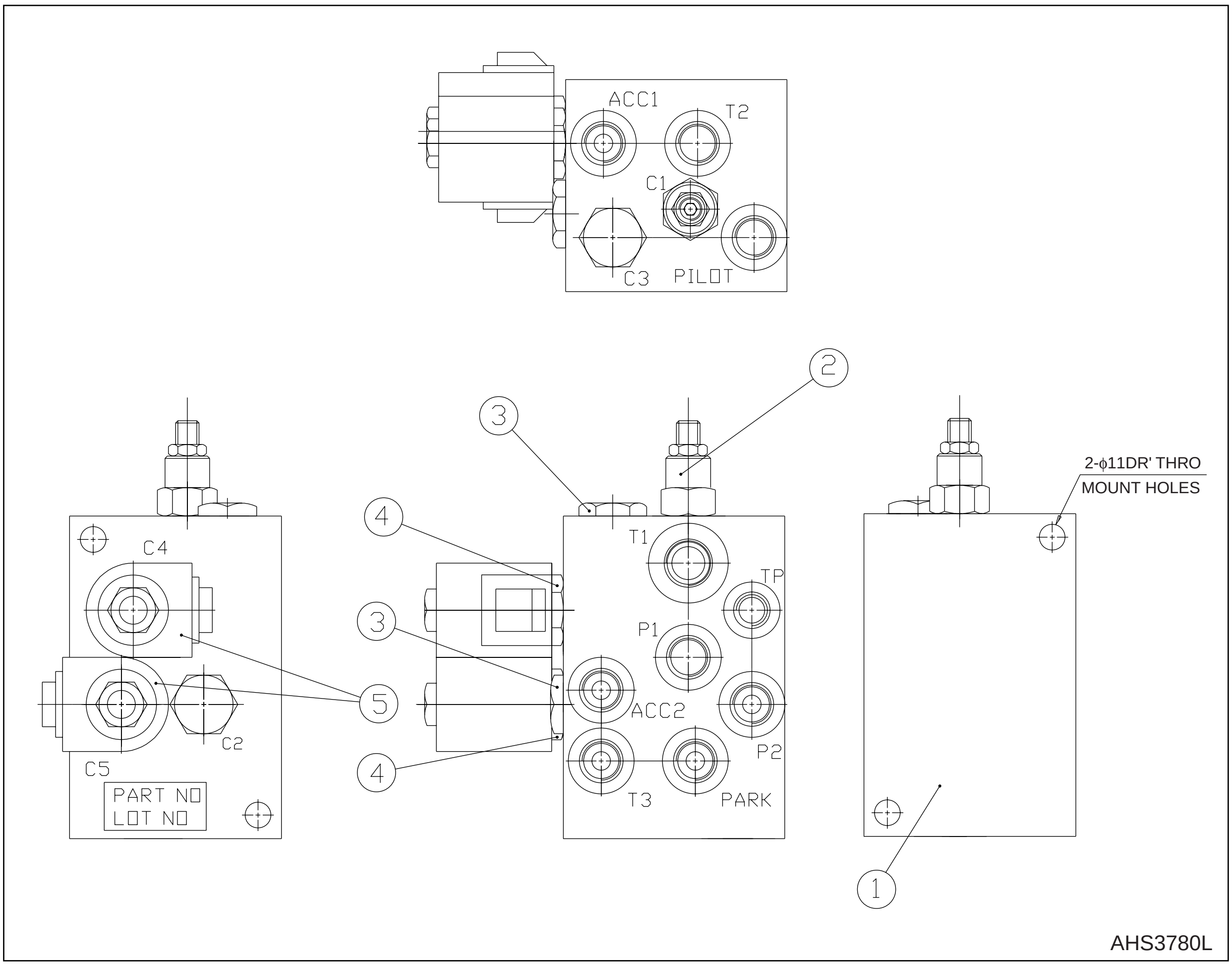

Figure 4 VALVE CARTRIDGE IDENTIFICATION AND PILOT LOCATION

Reference Number	Description
1	Body (200 x 120 x 79)
2	Relief (C1)
3	Check (C2, C3)

Reference Number	Description
4	Solenoid (C4, C5)
5	Coil (C4, C5)
6	Plug

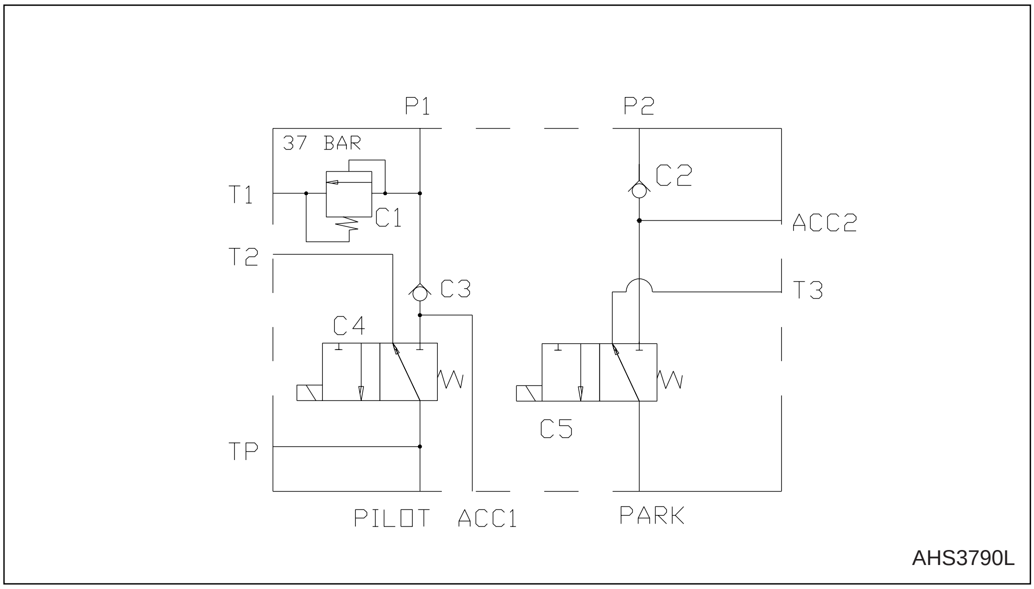

Figure 5 HYDRAULIC CIRCUIT

SPECIFICATIONS

Item		Specifications
System Flow		41 *l*/min @ 37 bar (10.8 gpm @ 535 psi)
Setting Pressure	C1	37 ±2 kg/cm^2 @ 20 *l*/min (526 ±28 psi @ 5.3 gpm)
Port Size	T1	PF 1/2 O-ring
	TP	PF 1/4 O-ring
	All other ports	PF 3/8 O-ring

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S0709455K

MAIN CONTROL VALVE (TOSHIBA)

CAUTION!

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Use lifting and hoisting equipment capable of safely handling load.

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MODEL	SERIAL NUMBER RANGE
Mega 400-V	1001 and Up
Mega 500-V	1001 and Up

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GENERAL DESCRIPTION

The main control valve controls the operation of the bucket, boom, and option cylinders. The bucket spool has priority over the boom spool.

Pump output flows to port P on the main control valve. See Figure 1. Maximum pressure is prevented from exceeding the desired level by the main relief valve (1). See hydraulic schematic (Figure 2). When all spools on the main control valve are in the neutral position (when the pilot valve is not being operated), oil passes through port P, the bucket spool, the boom spool, the option spool, and passes out T, the tank port. Oil that passes out the tank port passes through a filter and returns to tank.

Two overload relief valve (2) are installed in the bucket circuit to protect circuit components in the event of abnormally high pressure. One valve works as a relief valve while the other valve works as an anticavitation valve to provide additional oil flow to the opposite side of the bucket cylinders.

Boom spool has two important roles in loader work at the floating position. One is that it is possible to lower the boom by its weight without oil supply from the pump, and that, at the same time, the oil from the pump makes it possible to combine with the bucket crowd at the max. height of bucket through the bucket line. Another is that boom and bucket are positioned at the level as the cylinder ports A and B are open as a leveling function of ground. There is a suction check valve (3) in the boom power port. When the boom is dropped suddenly by its weight, the cylinder bottom has a cavitation with a lack of oil supply. The check valve supplements oil to prevent the cavitation.

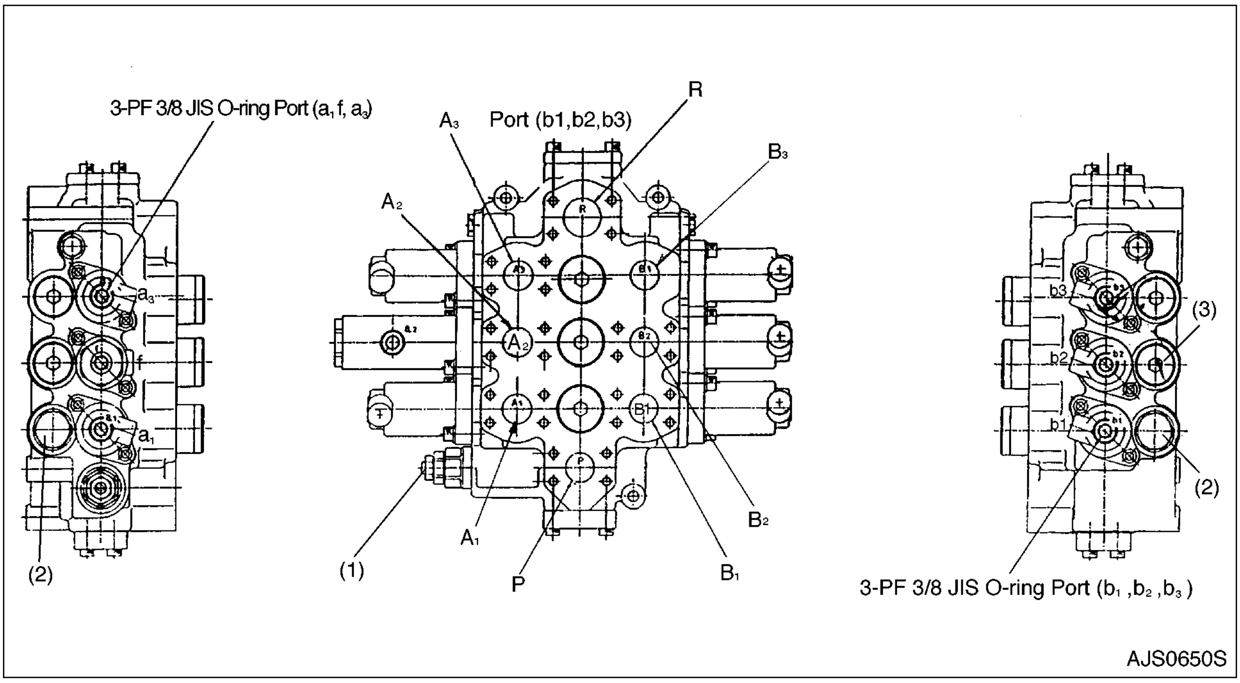

Figure 1

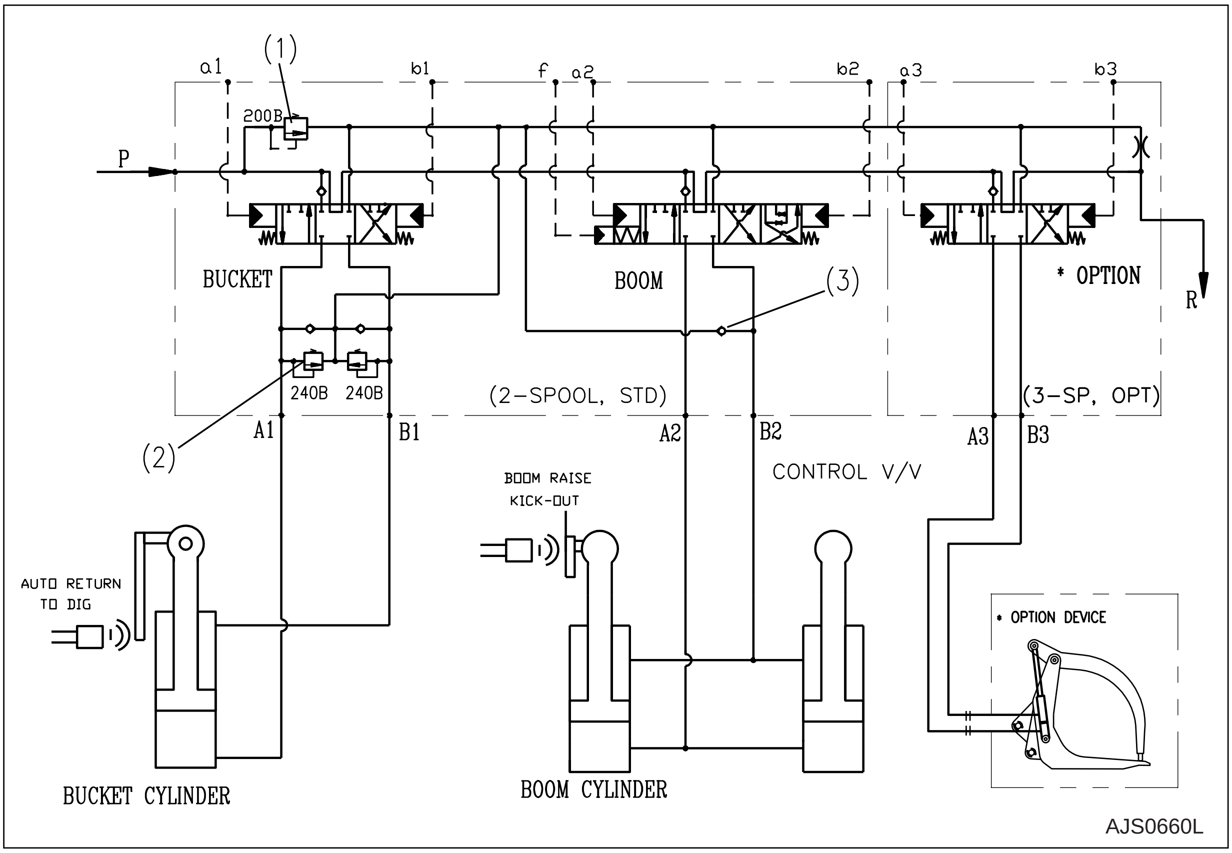

Figure 2 Control valve hydraulic circuit

Reference Number	Description
a3	Option Valve Port
a1	Bucket Crowd Valve Port
b2	Boom Down Valve Port
b3	Option Valve Port
b1	Bucket Dump Valve Port
a2	Boom Up Valve Port
f	Float Valve Port
A1	Bucket Crowd Port (to Bucket Cylinder Tube)
(1)	Main Relief Valve
B2	Boom Lower Port (to Boom Cylinder Rod)

Reference Number	Description
B3	Option Cylinder Port (to Option Cylinder Tube)
B1	Bucket Dump Port (to Bucket Cylinder Rod)
A2	Boom Up Port (to Boom Cylinder Tube)
P	Pump Port
R	Tank Port
A3	Option Cylinder Port (to Option Cylinder Rod)
(2)	Overload Relief Valve
(3)	Anticavitation Check Valve

SPECIFICATIONS

	2-Spool (STD.)	3-Spool (OPT.)
Name	MRT40D1F1 - 56	MRT40D1F1D1 - 52
Type	Pilot Control with Float spool	
Spool Diameter	ø 40.0 mm (1.5748 in)	
Spool Arrangement	Bucket - Boom	Bucket - Boom - Auxilary
Main relief pressure	200 kg/cm^2 @ 210 ℓ/min. (2,840 psi @ 55.4 gpm)	
Overload relief pressure	240 kg/cm^2 @ 20 ℓ/min. (3,400 psi @ 5.3 gpm)	

OPERATION

NEUTRAL

When the spools of the bucket section and the boom section are in neutral, both the cylinder ports A (rod side) and B (tail side) are closed by the spools.

The pressure oil which has reached the control valve flows through the inlet section, past the neutral oil passages in the bucket section and the boom section to the outlet section from which it is directed to the low-pressure oil passage and leaves the control valve through the exhaust port of the inlet section.

BUCKET/OPTION SPOOL OPERATION

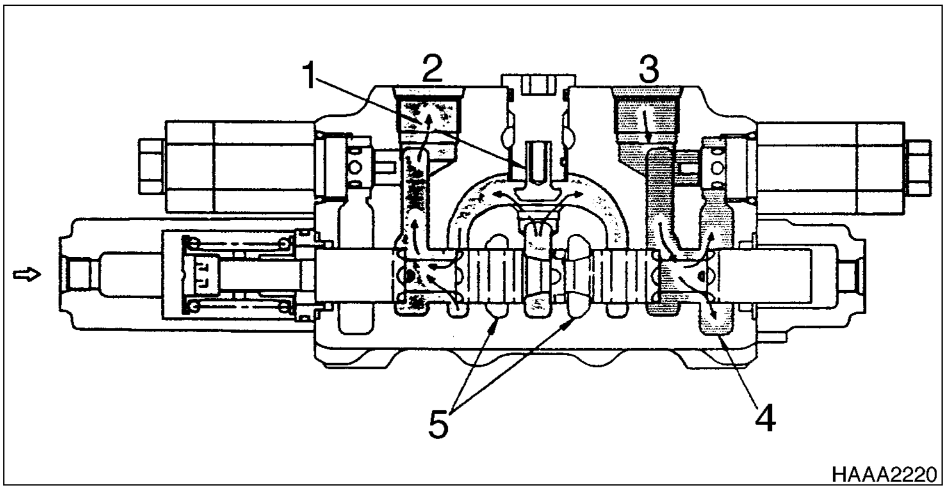

Figure 3 OPERATION IN BUCKET/OPTION

Reference Number	Description
1	Load Check
2	Port A1
3	Port B1

Reference Number	Description
4	Tank Passage
5	Center By-pass Passage

When the bucket spool moves in the direction indicated by the arrow

The neutral oil passage is closed by the spool and the pressure oil pushes open the load check valve to flow to the cylinder port (A1) from which it is directed into the bucket cylinder rod side.

The oil discharged from the bucket cylinder tail side flows through the cylinder port (B1) to the low pressure oil passage.

BOOM SPOOL OPERATION

Boom Float

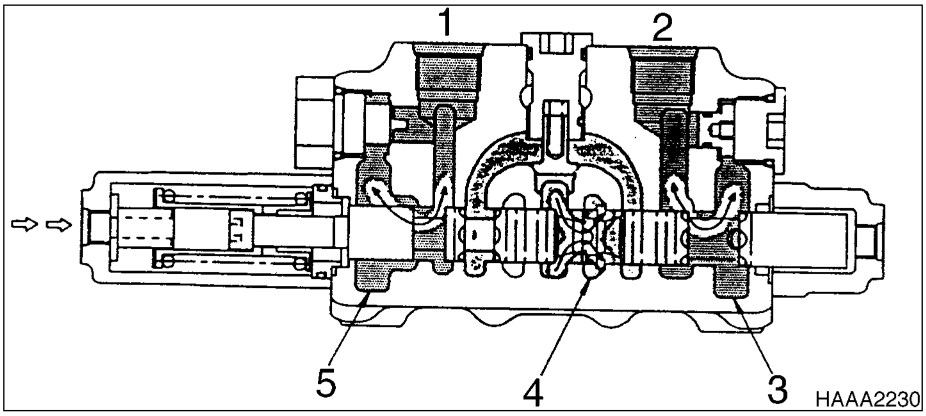

Figure 4 OPERATION IN BOOM FLOAT

Reference Number	Description
1	Port A2
2	Port B2
3	Tank Passage

Reference Number	Description
4	Center By-pass Passage
5	Tank Passage

When the control lever is further pushed down from the "Down" position to the "Float" position, the boom spool moves as indicated in the illustration.

Due to this motion the neutral passage is opened. The pressure oil flows as if in neutral position. The cylinder ports (A2) and (B2) are connected to the low-pressure oil passage. As a result, the booms float over the ground surface according to its irregularities. The oil discharged from the boom cylinder rod side is sent to the tail side and the oil forced out from its tail side is sent to the rod side respectively through the low-pressure oil passage in the control valve.

RELIEF VALVE

Main Relief Valve

The main relief valve is between the neutral oil passage and the low pressure oil passage (return oil passage) in the inlet section.

Port Relief Valve

The port relief valve is between the rod side cylinder port and the low-pressure oil passage (return oil passage) in the bucket spool section.

The combination valve, used as the port relief valve, serves both as the relief valve and an anticavitation valve.

OPERATION (MAIN RELIEF VALVE)

Operation in Inoperative State

The pressure oil in the neutral oil passage (HP) flows through the throttle hole (2) in the main poppet (1) to fill the internal cavity (3). Owing to the difference in area on which the hydraulic pressure acts, the main poppet (1) closely seats to the sleeve (4).

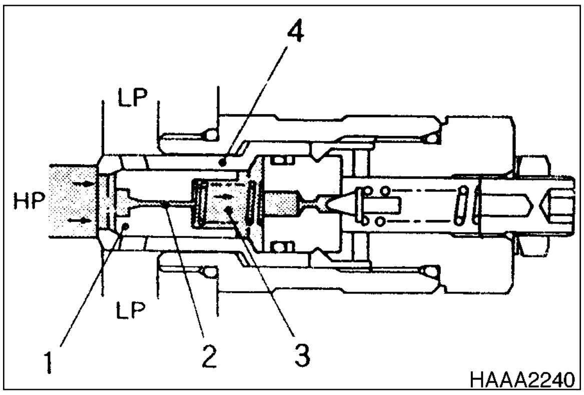

Figure 5 IN INOPERATIVE STATE

Operation (A)

When the pressure in the neutral oil passage (HP) rises and exceeds the relief pressure setting. the pilot poppet (5) opens. The pressure oil flows from the pilot poppet into the low pressure oil passage (LP). passing between the sleeve (4) and the housing (6).

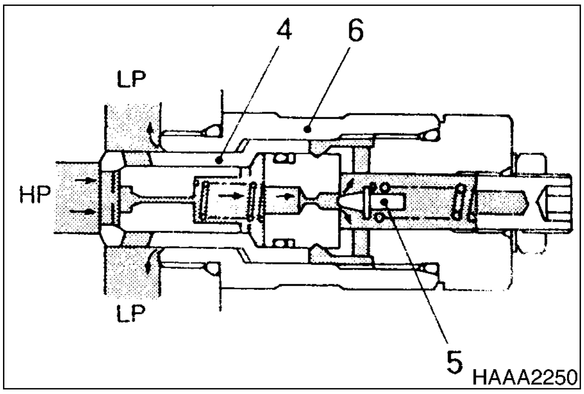

Figure 6 OPERATION (A)

Operation (B)

As the pilot poppet (5) opens, the pressure in the internal cavity (3) lowers to move the main poppet (1) so that the pressure oil in the neutral oil passage (HP) flows directly into the low pressure oil passage (LP).

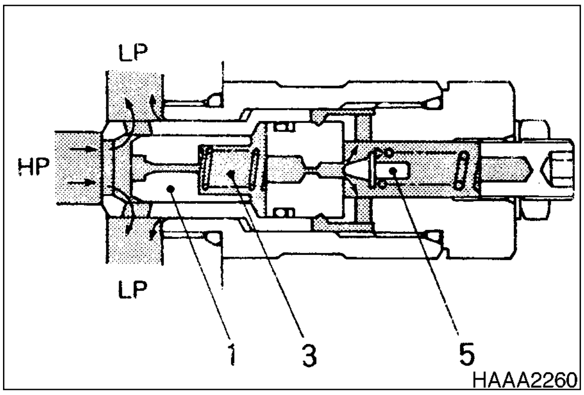

Figure 7 OPERATION (B)

OPERATION (PORT RELIEF VALVE)

In the Inoperative State

The pressure oil at the cylinder port (HP) flows through the hole in the piston poppet (1) to act from the opposite sides of the check valve poppet (2) and relief valve poppet (3). Owing to the difference in area on which the hydraulic pressure acts, both poppets close to seat the same time.

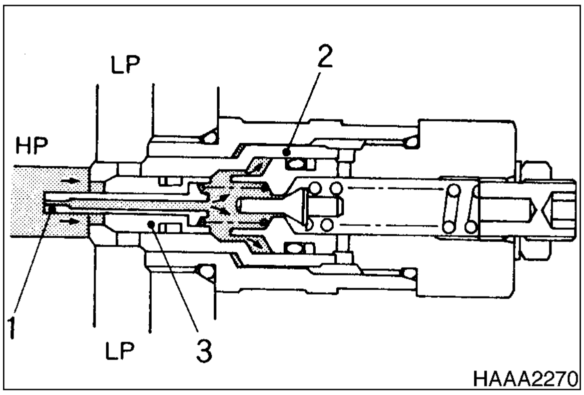

Figure 8 IN INOPERATIVE STATE

Operation (A)

When the pressure at the cylinder port (HP) rises and exceeds the relief pressure setting, the pilot poppet (4) opens. The pressure oil flows from the pilot poppet into the low-pressure oil passage (LP), passing between the check valve poppet (2) and the housing (5).

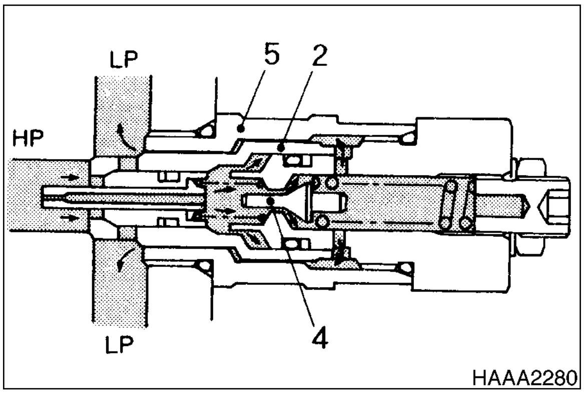

Figure 9 OPERATION (A)

Operation (B)

As the pilot poppet (4) opens, the pressure at the back of the piston poppet (1) lowers to move the piston poppet (1). As a result, the hole in the piston poppet (1) is closed so that the pressure at the back of the relief valve poppet (3) drops further.

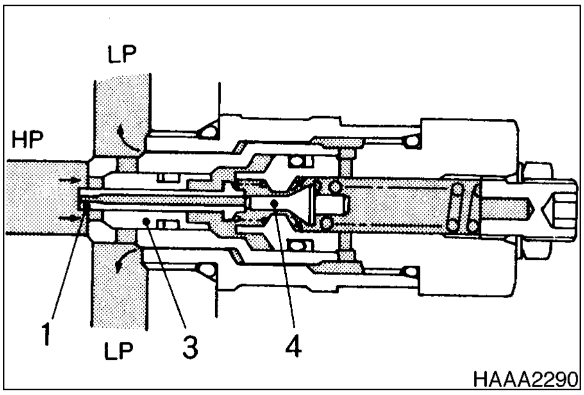

Figure 10 OPERATION (B)

Operation (C)

The pressures across the relief valve poppet (3) loses balance. Due to pressure differential, the relief valve poppet moves so that the pressure oil at the cylinder port (HP) flows directly to the low-pressure oil passage (LP).

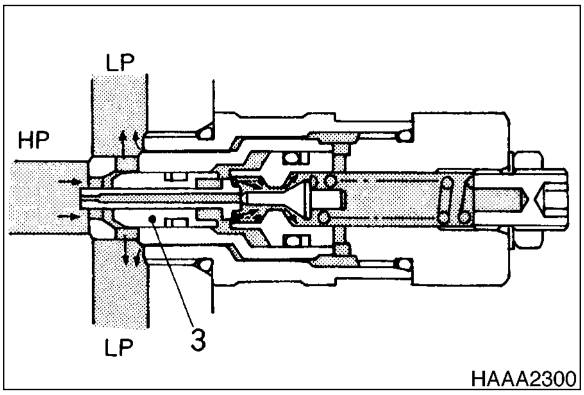

Figure 11 OPERATION (C)

Sucking Operation

If the pressure at the cylinder port (HP) becomes lower than that at the low-pressure oil passage (LP) due to the development of cavitation, the check valve poppet (2) moves depending upon the difference in area on which negative pressure acts across the check valve poppet. Consequently, oil is supplied from the low-pressure oil passage (LP) to the cylinder port side (HP) to eliminate the cavitation.

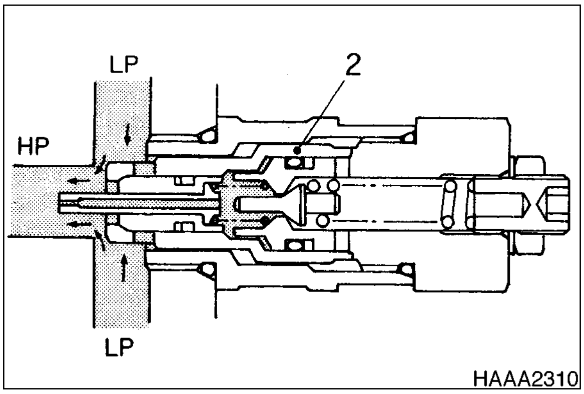

Figure 12 SUCKING OPERATION

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S0709476K

PILOT CONTROL VALVE

CAUTION!

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Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Mega 500-V	1001 and Up

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GENERAL DESCRIPTION

When no force is applied to lever (1, Figure 1), return spring (4) positions lever at "NEUTRAL" position. When lever is moved, plunger (5) is moved, which pushes down return spring (4). At this time, spool (2) is moved by spring (3). When spool (2) moves down, a groove (6) in spool (2) opens the pilot pressure line to the line that the lever controls. This allows pilot pressure to flow to the boom or bucket control valve, where pilot pressure operates the control valve. When the lever is completely moved in one direction, solenoid (7) energizes electromagnet (8) and holds the lever in the fully moved position.

PILOT VALVE OPERATION

The lever handle is positioned on the right side of the operator's seat. This single lever controls the following machine functions: raise boom, lower boom, bucket crowd, and bucket dump. The lever positions are identified as follows:

F-Float

L-Lower

N-Neutral

R-Raise

H-Hold Position

C-Bucket Crowd

D-Bucket Dump

HR-Holds lever in Raise Mode.

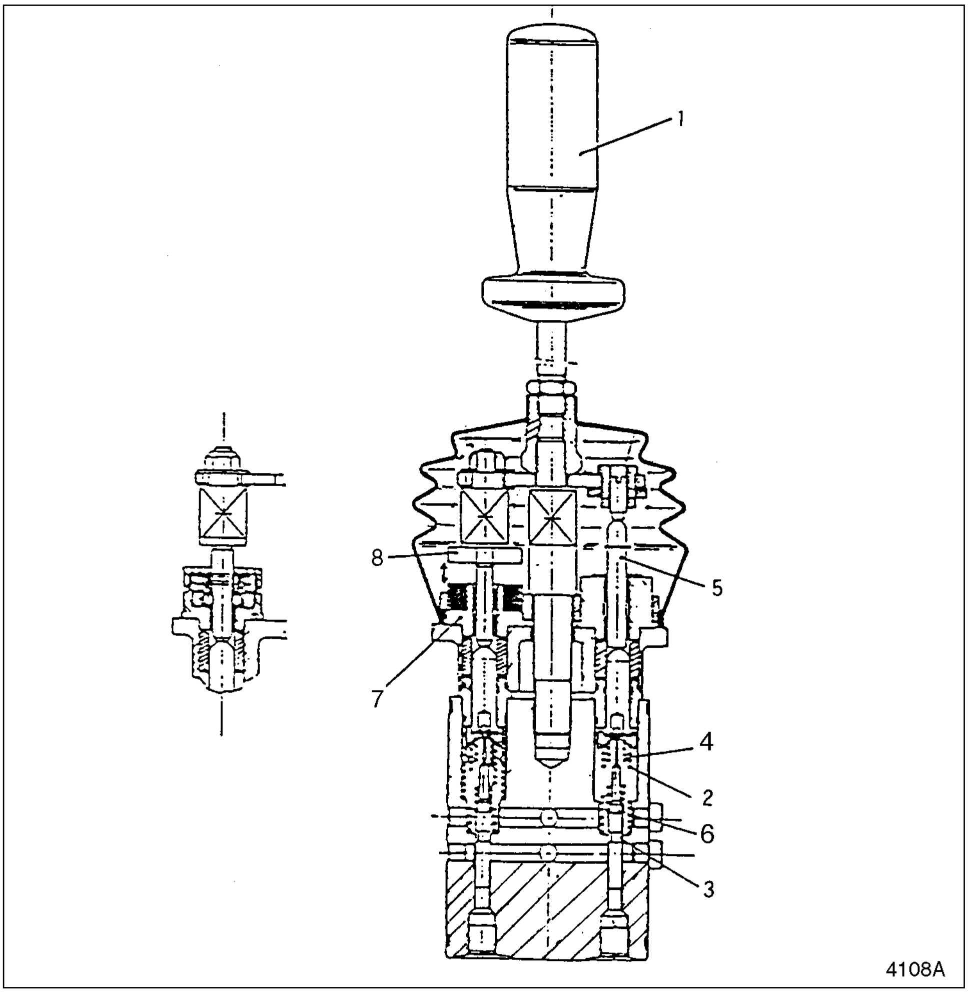

Figure 1

Reference Number	Description
1	Lever
2	Valve Spool
3	Regulating Spring
4	Return Spring

Reference Number	Description
5	Plunger
6	Spool Groove
7	Solenoid
8	Electromagnet

PILOT SYSTEM

The pilot system uses low pressure oil to operate the main control valves. The main components of the pilot system are pump (1), pressure relief valve (3), accumulator (4), pilot cutoff valve (5) and pilot valves (6 and 7).

With the engine running, oil flows from hydraulic tank to pilot pump (1) The oil flows from the pump through pressure relief valve (3) to pilot cutoff valve (5). The pressure relief valve maintains pilot system pressure at 37 kg/cm^2 (450 psi).

From the pilot cutoff valve the oil flows into the pilot control valves. Pilot valve (6) is a closed center valve. The oil cannot flow through the valve when it is in the HOLD position because it is a closed center valve.

When the control lever is moved to the DUMP position, oil flows through oil lines to the ends of the bucket spool of main control valve (8). This causes the main control valve spool to move. Movement of the spool opens passages for attachment pressure oil to flow to the rod end of the bucket cylinder (9).

Spool movement also opens a passage for return oil from the head end of the bucket cylinder to flow back to hydraulic tank. Attachment pressure oil acts on the rod end of the bucket cylinder and, because the head end of the cylinder is now vented to tank, the bucket will dump.

When the control lever is moved to the CROWD position, oil flows through oil lines to the ends of the bucket spool of main control valve (8). This causes the main control valve spool to move in the opposite direction.

Movement of the spool in this direction opens passages for pressure oil to flow to the head end of the tilt cylinder. Spool movement also opens a passage for return oil from the rod end of the tilt cylinder to flow back to the hydraulic tank. Attachment pressure oil acts on head end of the tilt cylinder and because the rod end of the cylinder is now vented to tank, the bucket will crowd.

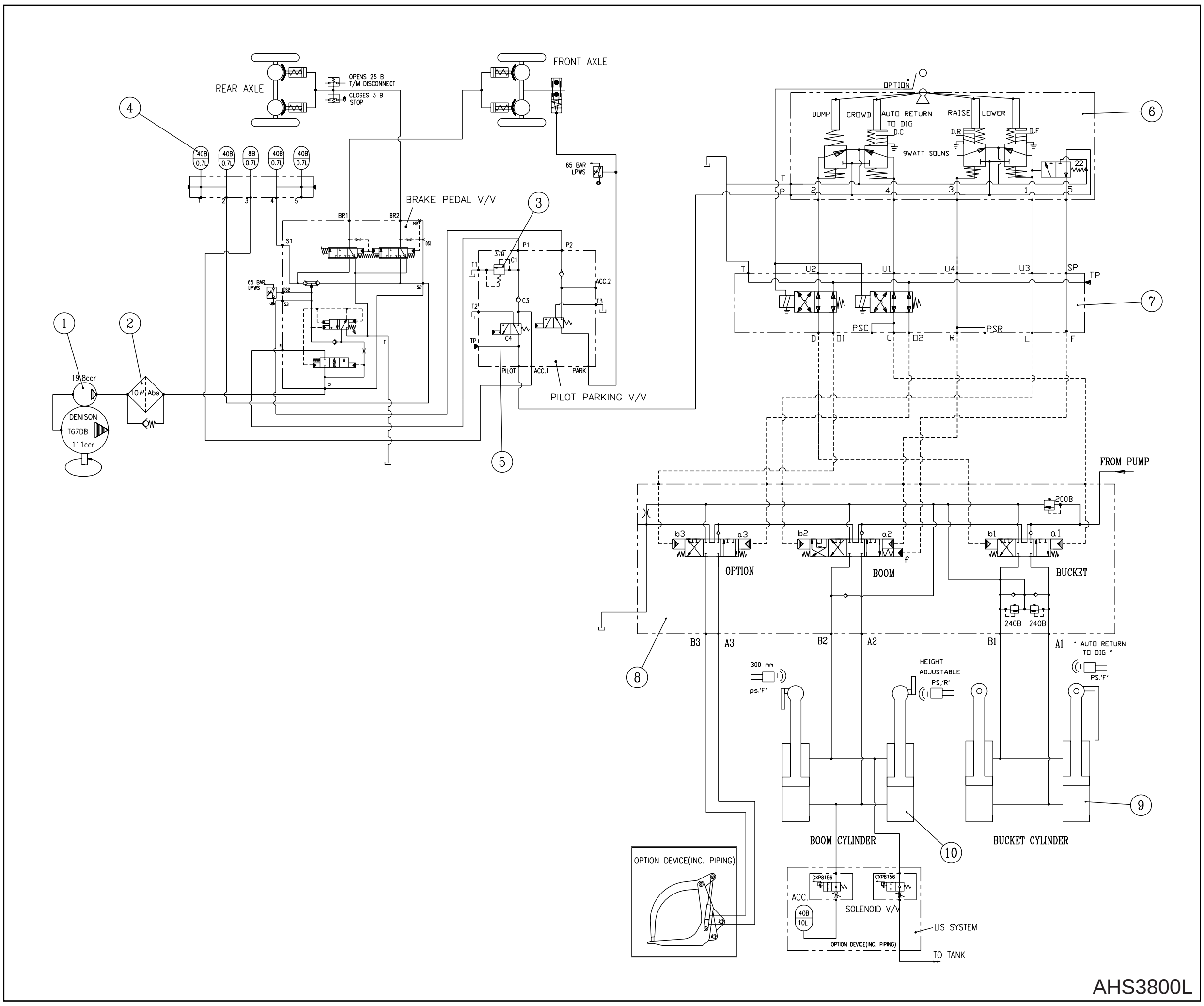

Figure 2

Reference Number	Description
1	Pilot Pump
2	Brake and Pilot Filter
3	Pressure Relief Valve
4	Accumulator: Pilot
5	Pilot Cutoff Valve

Reference Number	Description
6	Pilot Valve (Mono, STD.)
7	Solenoid Valve (OPT.)
8	Main Control Valve
9	Bucket Cylinder
10	Boom Cylinder

S0709665K

FLOW AMPLIFIER (DANFOSS)

CAUTION!

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MODEL	SERIAL NUMBER RANGE
Mega 400-V	1001 and Up
Mega 500-V	1001 and Up

December 2000

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GENERAL DESCRIPTION

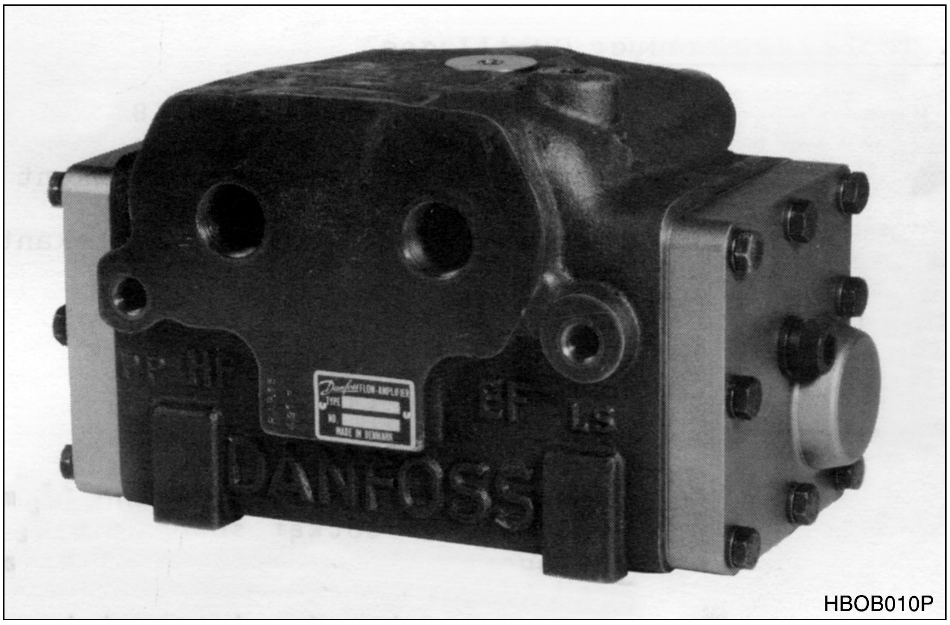

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Figure 1

PARTS LIST

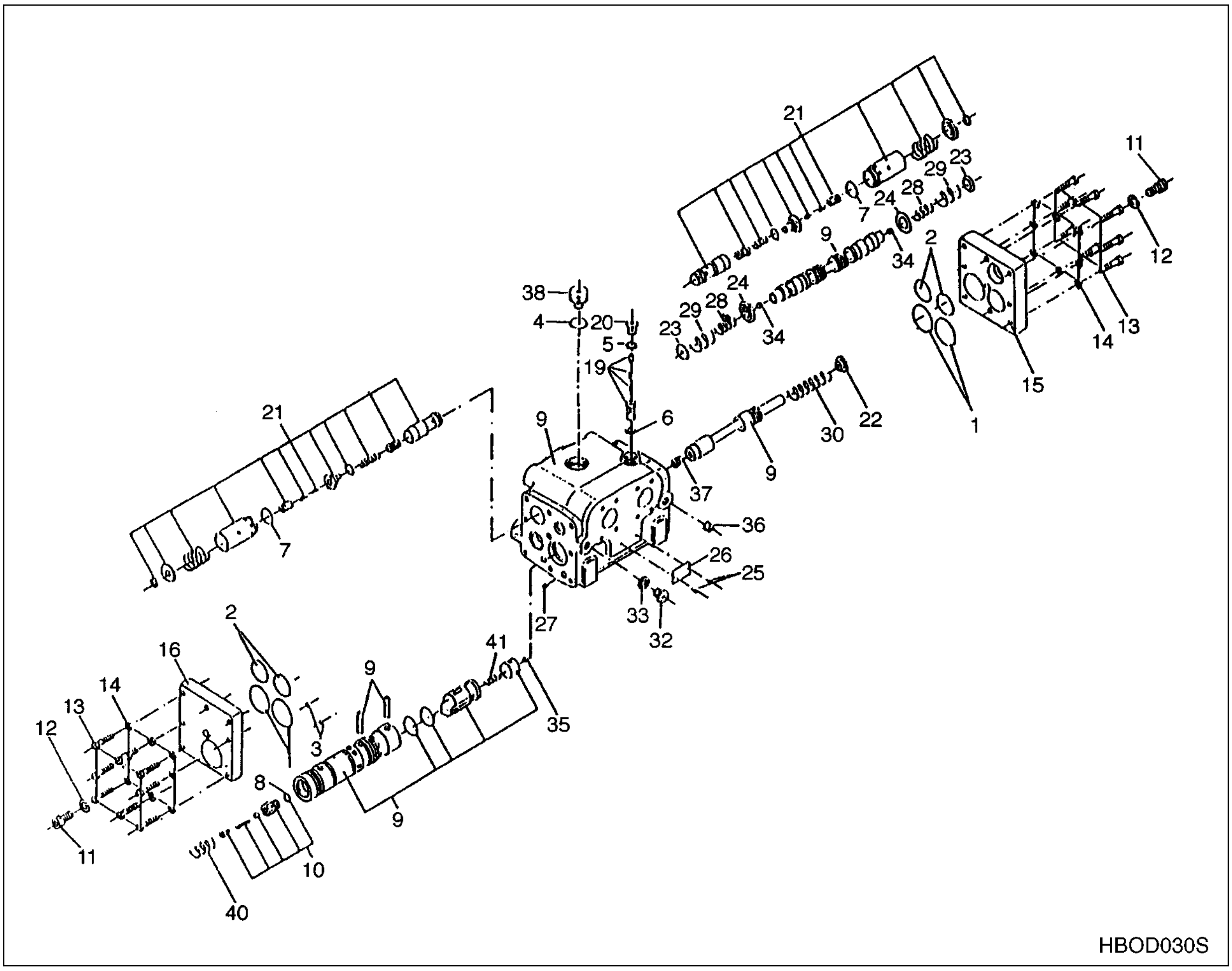

Figure 2

Reference Number	Description
1	O-ring
2	O-ring
3	O-ring
4	O-ring
5	Washer
6	Washer
7	O-ring
8	O-ring
9	Housing
10	Check Valve
11	Screw
12	Washer; Spring
13	Screw
14	Washer; Spring
15	End Cover
16	End Cover
17	Relief Valve
20	Plug
21	Shock and Suction Valve

Reference Number	Description
22	Stopper
23	Stopper
24	Guide; Spring
25	Screw; Drive
26	Plate; Name
27	Orifice
28	Spring
29	Spring
30	Spring
31	Plug
32	Washer
34	Orifice
35	Orifice
36	Orifice
37	Throttle Check Valve
38	Plug
40	Spring
41	Spring

SPECIFICATIONS

Flow Amplifier	Specification
Type	Contains a directional valve, an amplification stage, a priority valve, a pilot pressure relief valve and suction valve.
Amplification Factor	8
Control Pressure	10.50 kg/cm^2 (149.35 psi)
LS Relief Valve Setting	185.0 ±5.0 bar (2,683.24 ±72.52 psi))
Max. Oil Flow to Steering	125.0 l/min. (33.0 U.S. gpm)

SPECIAL TOOLS AND MATERIALS

SPECIAL TOOLS

Guide screws Material: M8 x 1

Hook Material: Wire

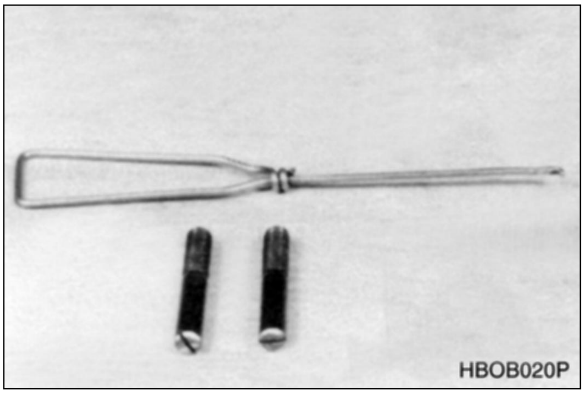

Figure 3

TROUBLESHOOTING, TESTING AND ADJUSTMENT

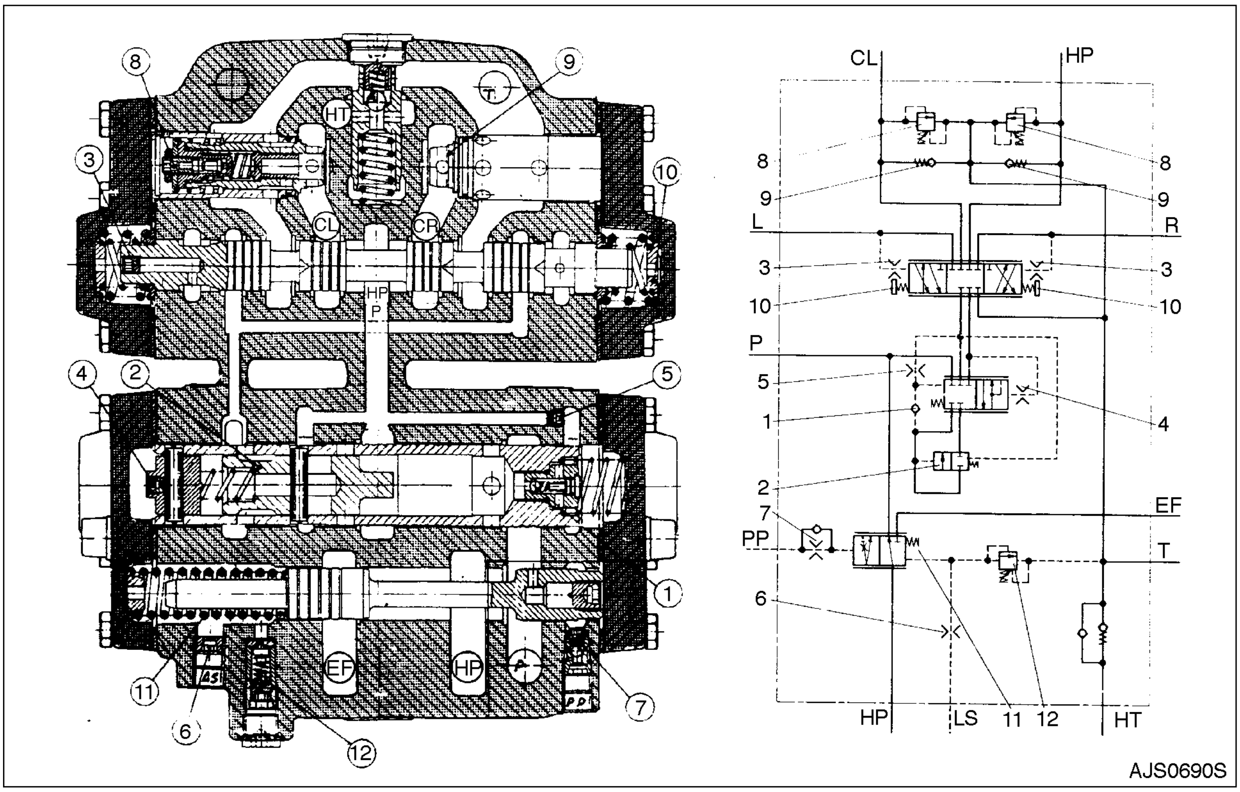

Figure 4 Flow Amplifier Circuit

STEERING SYSTEM WITH OSQA/B AND OSPBX-LS

Problem	Possible Causes	Remedies
Amplification too large	Dirty, leaky or missing check valve (1).	Clean or replace check valve.
	Piston (2) sticks in the open position.	Clean and check that the piston moves easily.
Amplification too small	Piston (2) sticks in the closed position.	Clean and check that the piston moves easily.
	Piston (2) incorrectly installed (only OSQA/B-5).	Rotate the piston 180˚ on its axle.
Heavy turning of steering wheel and slow increase of amplification	Dirty orifices (3) in directional valve.	Clean or replace orifice.
	Dirty orifices (4) in the combi-valve spool.	Clean or replace orifice.
	Dirty orifices (5) in housing.	Clean or replace orifice.
	Dirty orifices (6) in LS-port.	Clean or replace orifice.
	Dirty orifices in throttle/check valve (7) in PP-port.	Clean or replace throttle/check valve.
No end stop in one or both directions.	One or both shock valves (8) set too low.	Setting takes a long time without special equipment. Contact the nearest service shop.
	One or both anti-cavitation valves (9) leaky, or sticks.	Clean or replace completely shock/anti-cavitation valve(s).
	Missing end-stop plate(s) pos. 10 for directional valve.	Fit end-stop plates.
"Hard" point when starting to turn the steering wheel	Air in LS and/or PP pipes.	Bleed pipes.
	Spring force in the built in priority valve too weak (11).	Replace spring with one which is more powerful. (There are three sizes: 4, 7 and 10 bar).
	Orifices in respectively LS-(6) or PP-(7) ports blocked.	Take out and clean orifices.
No pressure build-up	LS-pressure limitation valve (12) adjusted too low.	Remove plug and set to specified pressure.
	Spool and sleeve in OSPBX steering unit put together incorrectly.	Take out spool set and turn the inner spool 180˚ in the outer sleeve. (See service manual)
	Emergency control ball in steering unit missing.	Install new ball.
	Pump does not run or is defective.	Repair or replace pump.

DISASSEMBLY

1. Dismantling counter pressure valve.

   A. Unscrew plug with O-ring. (Hexagon socket for 8 mm internal hexagon.)

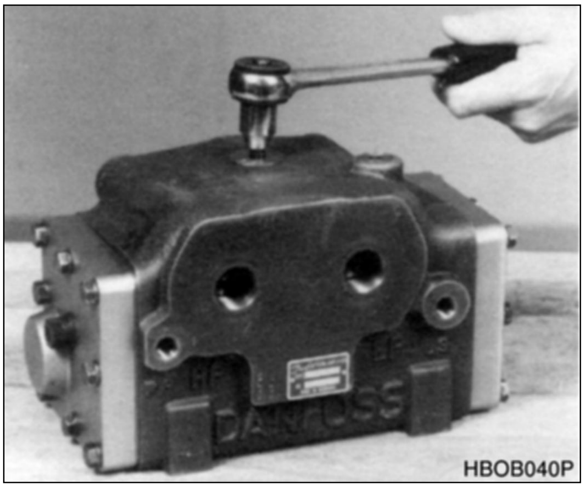

Figure 5

   B. Remove small spring (hook).

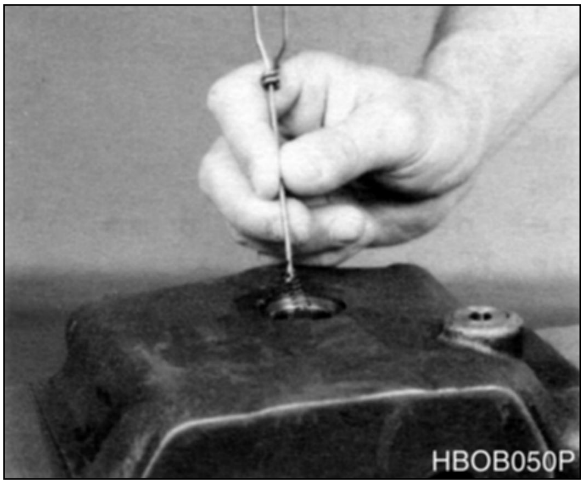

Figure 6

   C. Remove ball (magnetic rod).

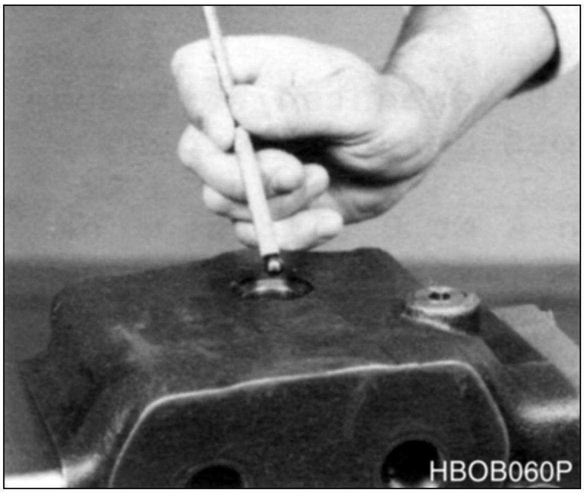

Figure 7

D. Remove piston.

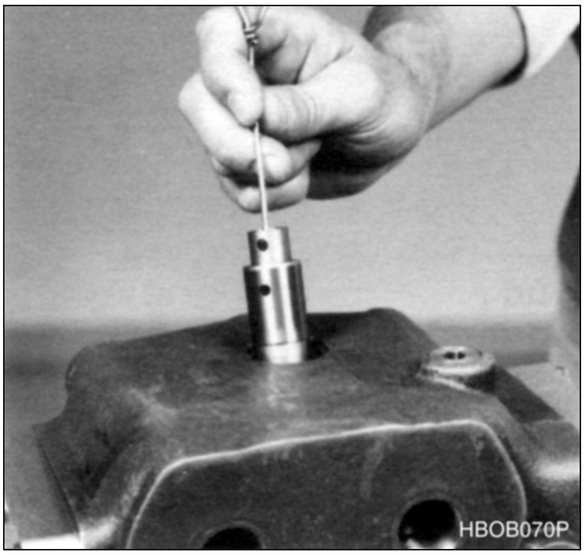

Figure 8

E. Remove spring.

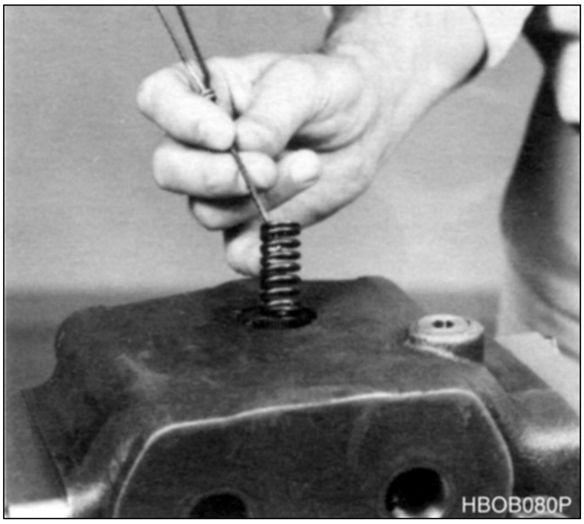

Figure 9

F. Counter pressure valve shown dismantled.

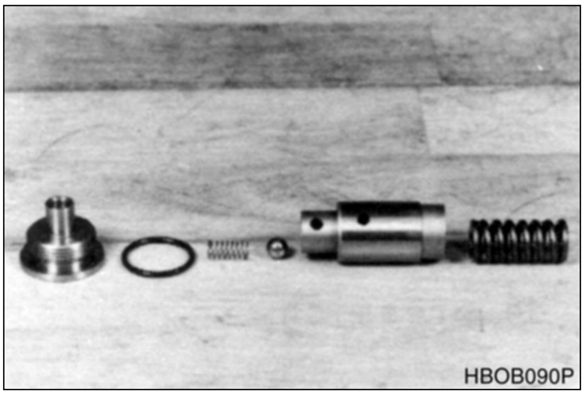

Figure 10

G. Counter pressure valve with orifice shown dismantled.

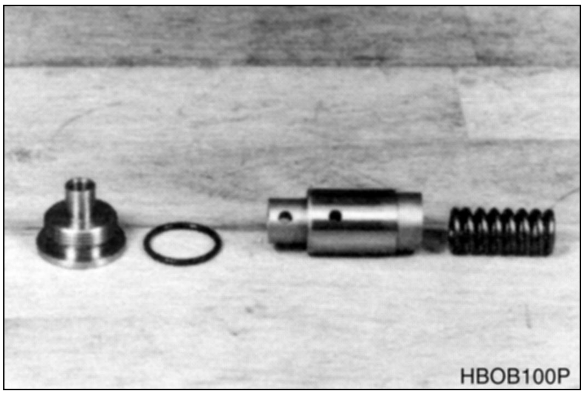

Figure 11

2. Removing pressure relief valve.

A. Unscrew plug with washer (hexagon socket for 8 mm internal hexagon).

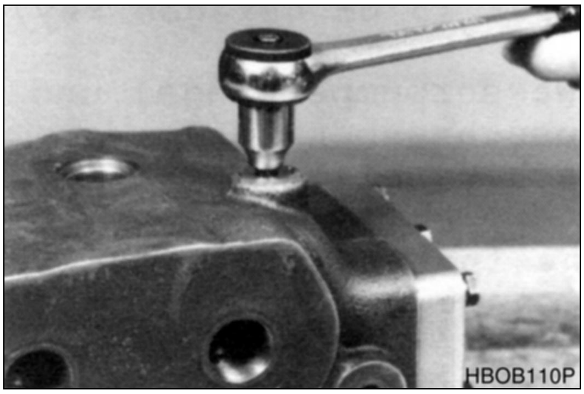

Figure 12

B. Screw pressure relief valve out (10 mm hexagon key).

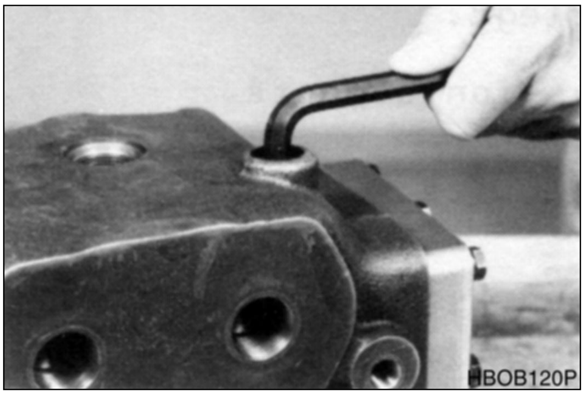

Figure 13

C. Remove washer (magnetic rod).

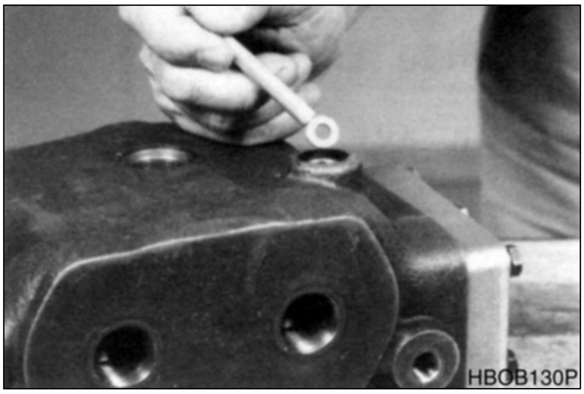

Figure 14

3. Dismantling pressure relief valve.

   A. Hold cartridge and screw adjustment screw out (5 mm hexagon key).

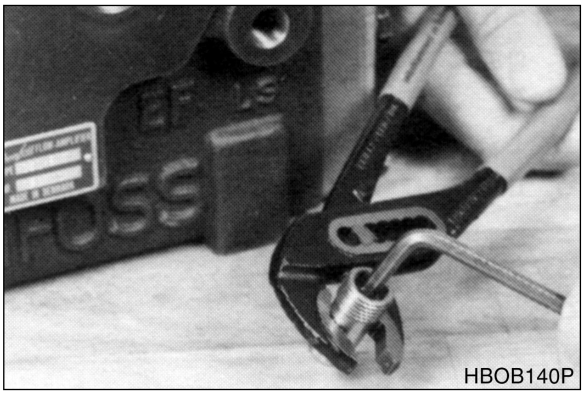

Figure 15

   B. Pressure relief valve shown dismantled.

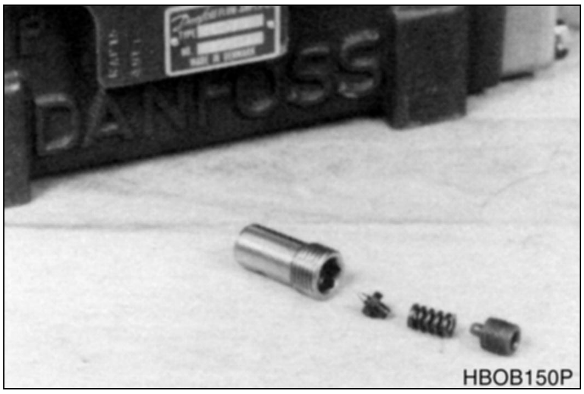

Figure 16

4. Removing end cover at PP-connection.

   A. Unscrew screws with spring washer hexagon socket for 13 mm external hexagon and 10 mm internal hexagon.

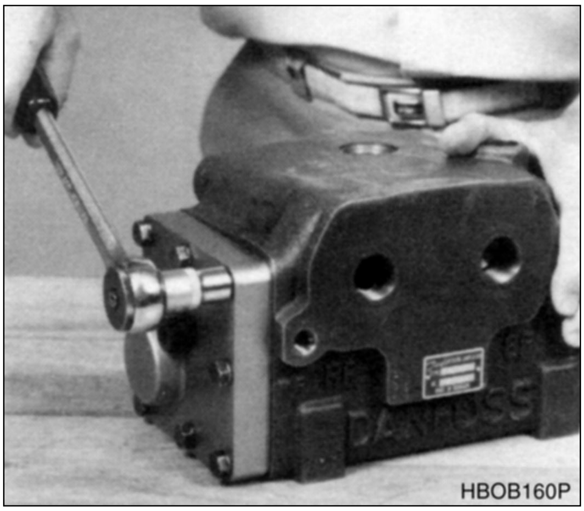

Figure 17

B. Remove end cover.

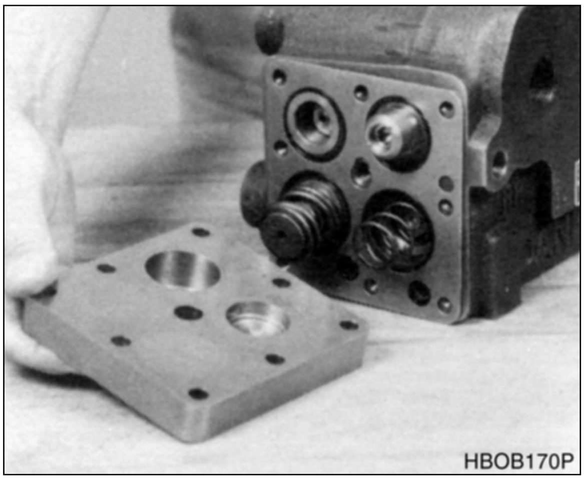

Figure 18

C. Remove stop and 2 springs.

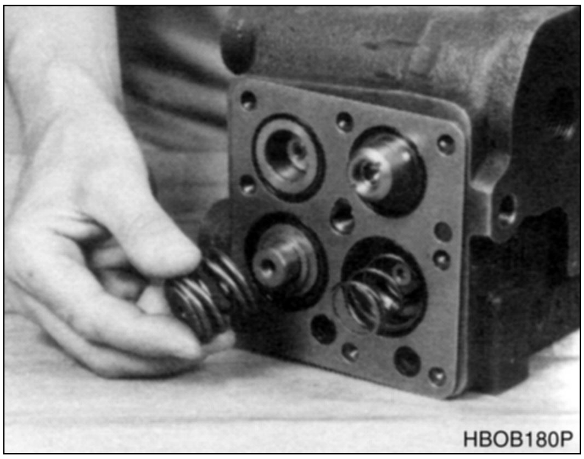

Figure 19

D. Remove spring.

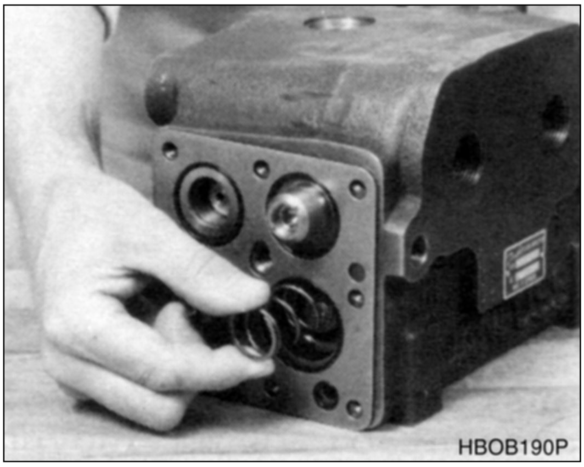

Figure 20

E. Remove plate and six O-rings.

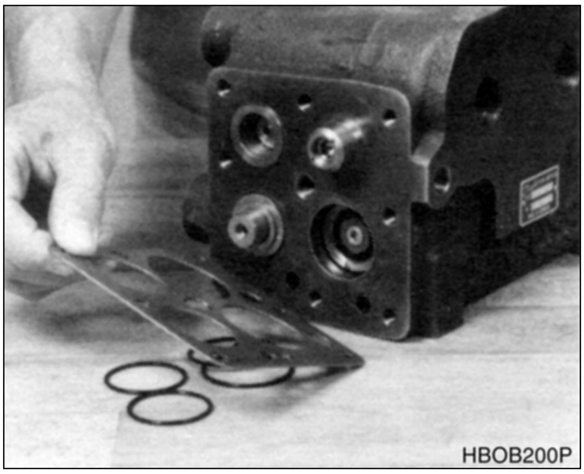

Figure 21

F. Remove spring guide.

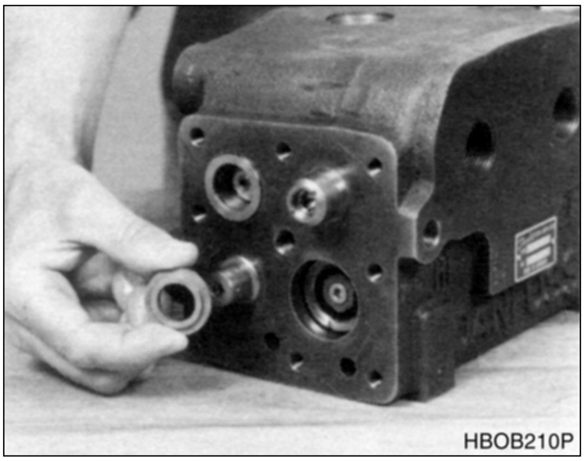

Figure 22

5. Removing end cover at LS-connection.
   A. Unscrew screws with spring washer using hexagon socket for 13 mm external hexagon and 10 mm internal hexagon.

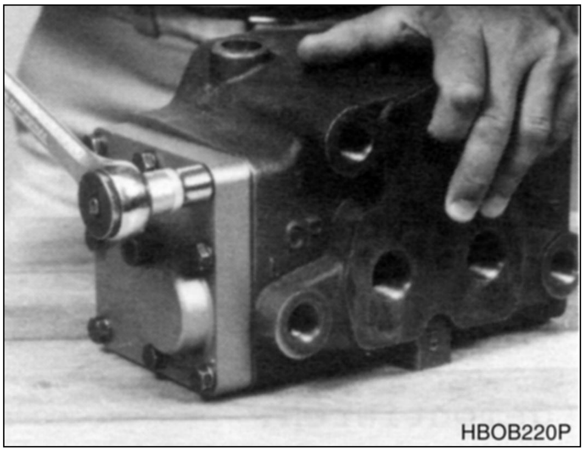

Figure 23

B. Remove end cover.

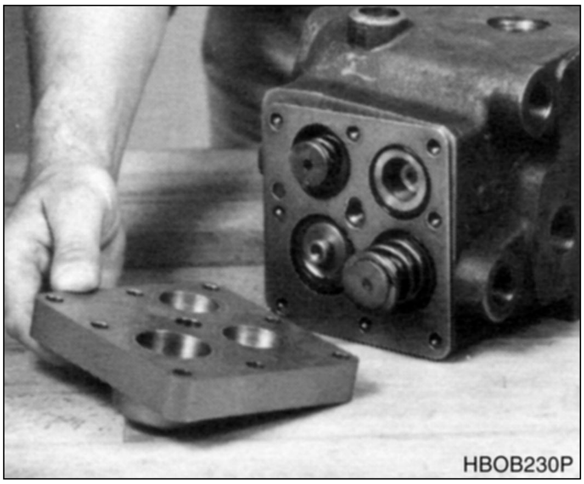

Figure 24

C. Remove stop and two springs.

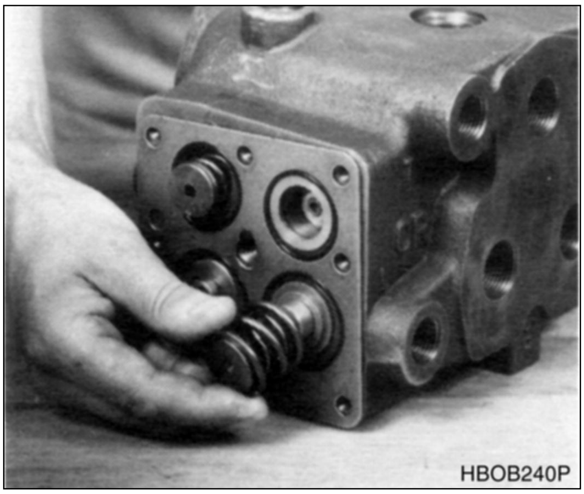

Figure 25

D. Remove stop and spring.

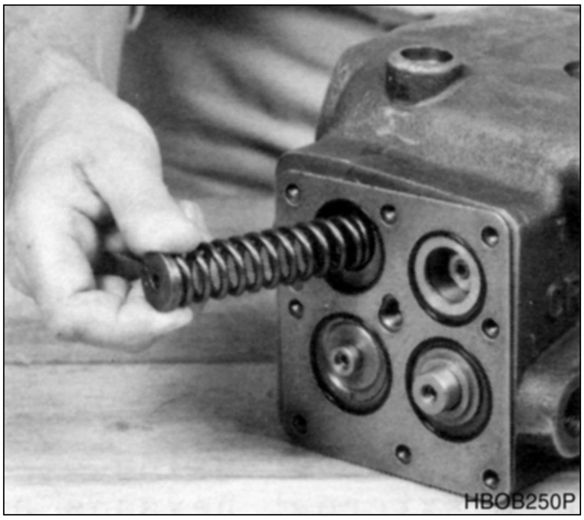

Figure 26

E. Remove plate and four O-ring.

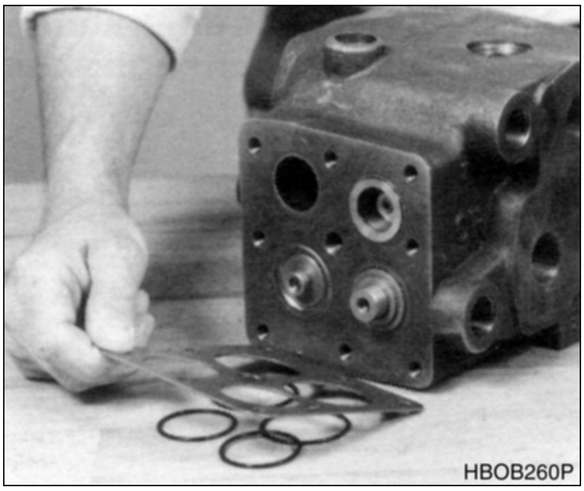

Figure 27

F. Remove spring guide.

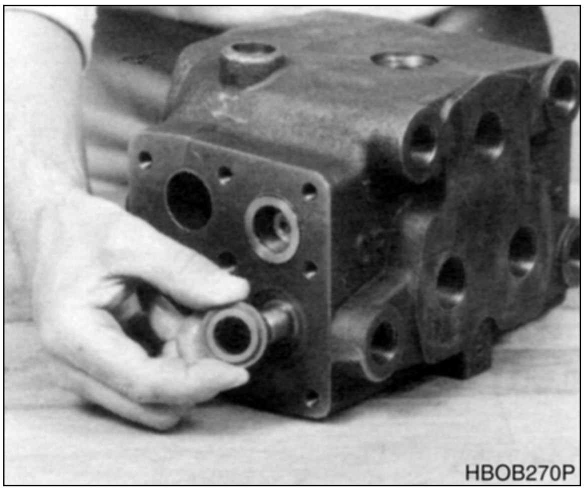

Figure 28

6. Removing spools.
   A. Remove directional spool.

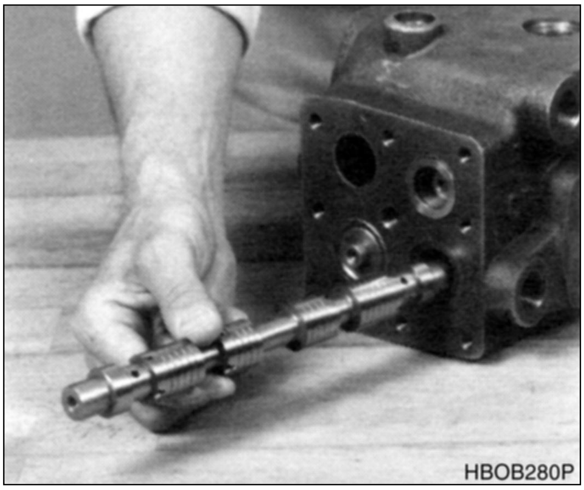

Figure 29

B. Remove amplifier spool.

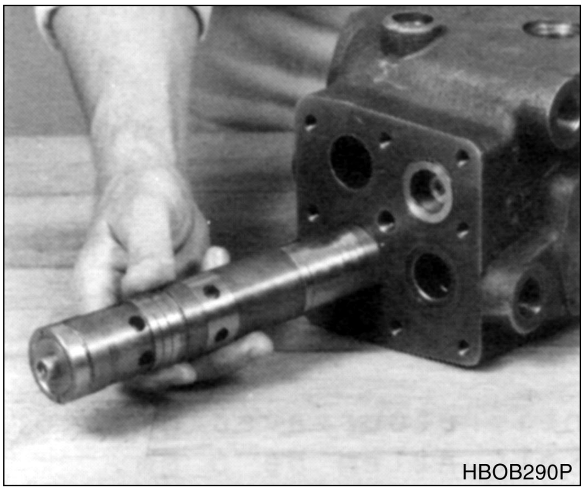

Figure 30

C. Remove priority valve spool.

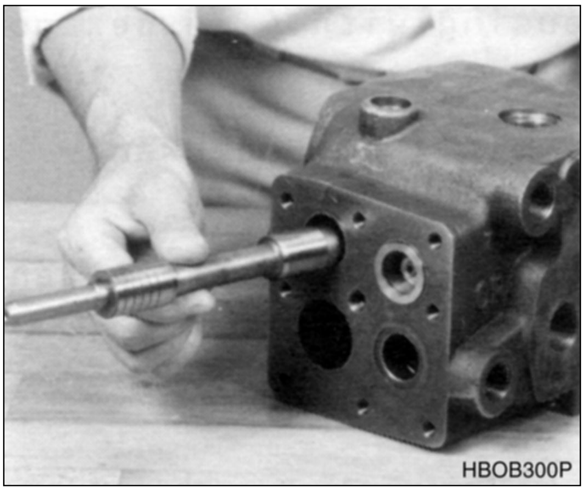

Figure 31

7. Removing orifice and throttle check valve.

   A. Unscrew orifice in LS-connection with 6 mm hexagon key.

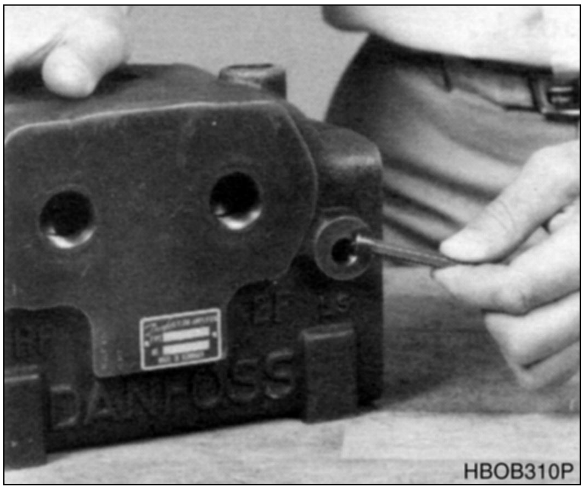

Figure 32

B. Unscrew throttle check valve in PP-connection with 6 mm hexagon key.

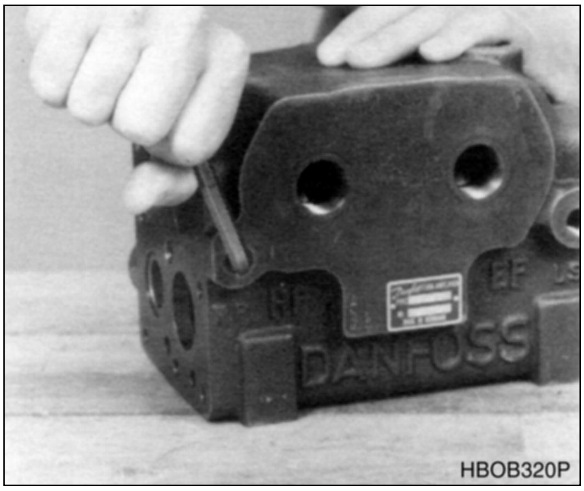

Figure 33

C. Unscrew orifice in housing with 4 mm hexagon key.

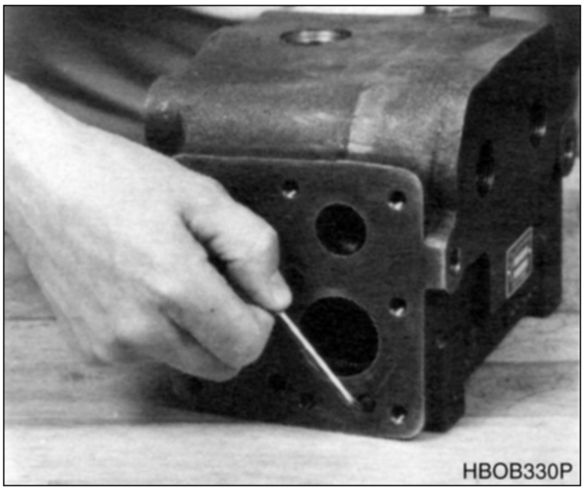

Figure 34

8. Removing shock valves.

A. Remove shock valve with screwdriver and hexagon key.

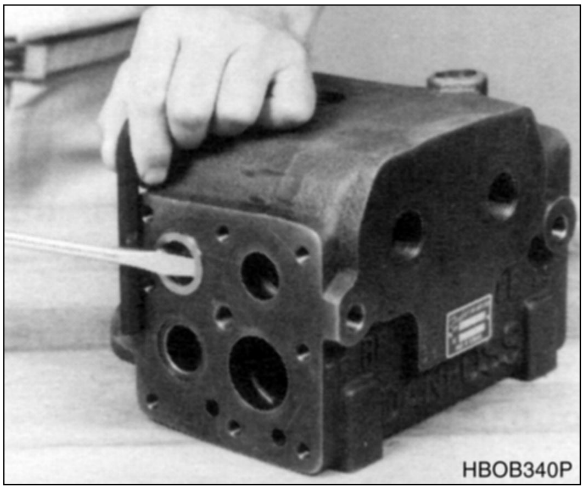

Figure 35

9. Overview of dismantled parts.

   A. Housing and end cover with accessories.

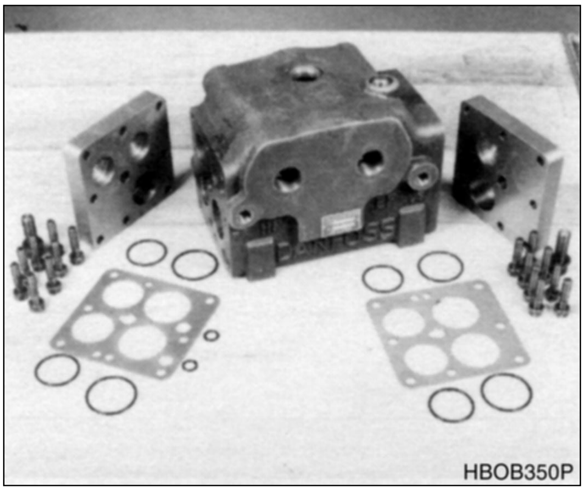

Figure 36

   B. Spool with accessories.

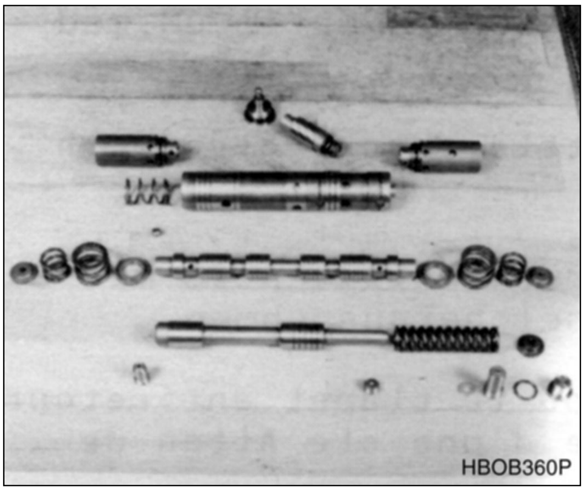

Figure 37

10. Dismantling of directional spool.

   A. Unscrew orifice with 4 mm hexagon key. Use a mandrel.

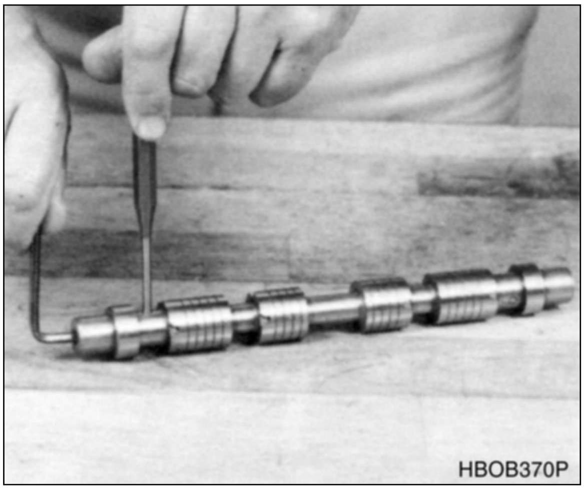

Figure 38

B. Directional spool shown dismantled.

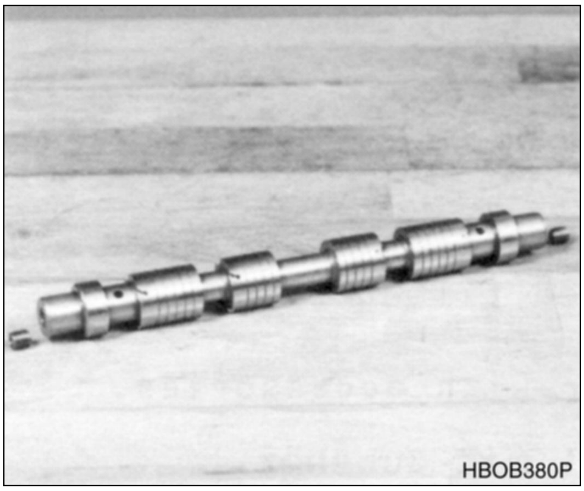

Figure 39

11. Dismantling of priority valve spool.

A. Unscrew plug or throttle check valve with 8 mm hexagon key.

Figure 40

B. Priority valve spool with plug for external PP shown dismantled.

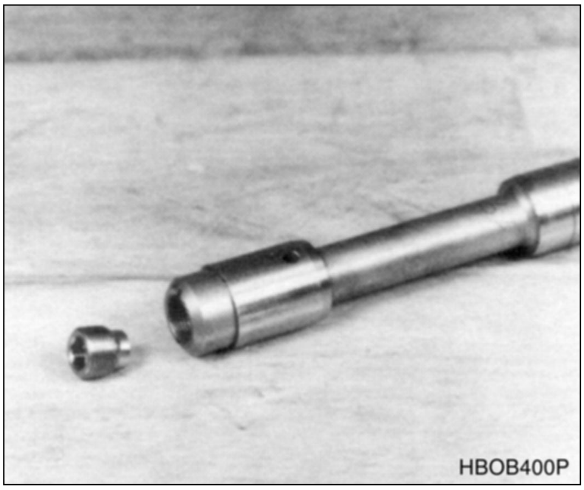

Figure 41

C. Priority valve spool with throttle check valve for internal PP shown dismantled.

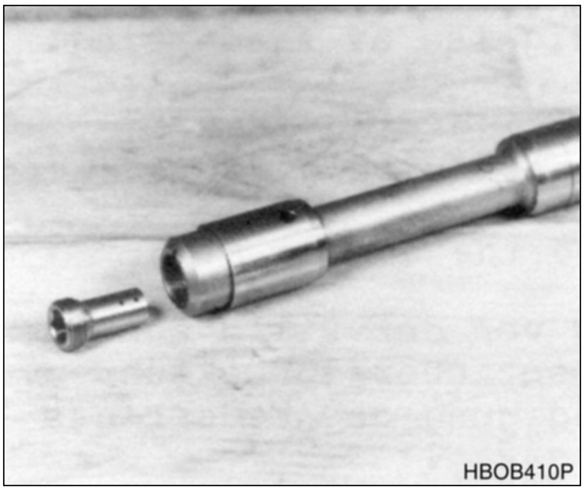

Figure 42

12. Dismantling of amplifier spool.

    A. Carefully remove spring from recess with 3 mm screwdriver.

    NOTE: *Avoid damage to spring ring.*

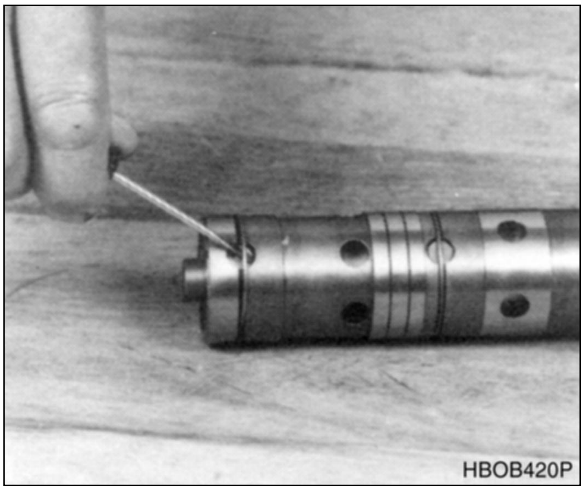

Figure 43

    B. Carefully guide spring ring back.

Figure 44

C. Carefully take spring ring from recess and guide it back with 3 mm screwdriver.

NOTE: *Avoid damage to spring ring.*

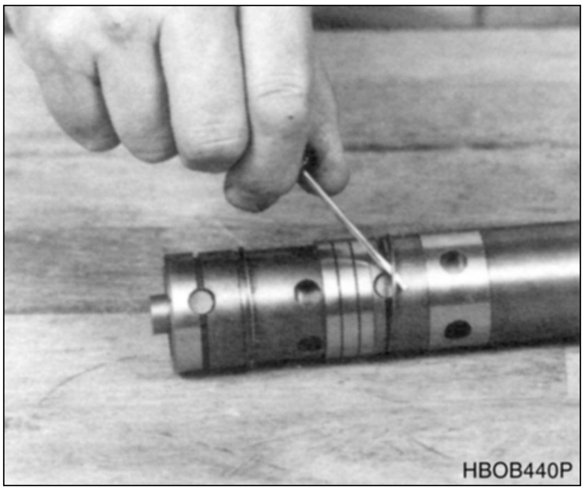

Figure 45

D. Press pin out gently with finger.

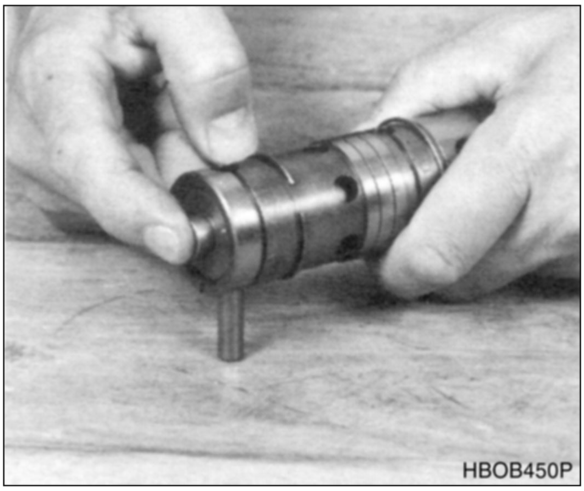

Figure 46

E. Remove plug.

Figure 47

F. Remove spring.

Figure 48

G. Remove pin with 3 mm screwdriver.

Figure 49

H. Remove inner spool.

Figure 50

I. Unscrew check valve with hexagon socket for 17 mm external hexagon and mandrel in pin hole.

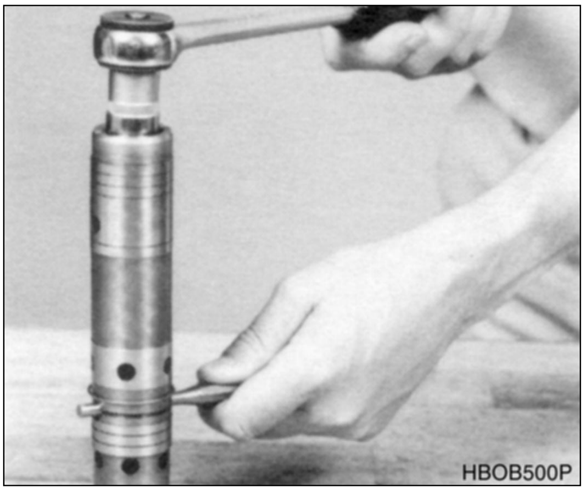

Figure 51

J. Unscrew orifice out of plug with 4 mm hexagon key. Use a mandrel.

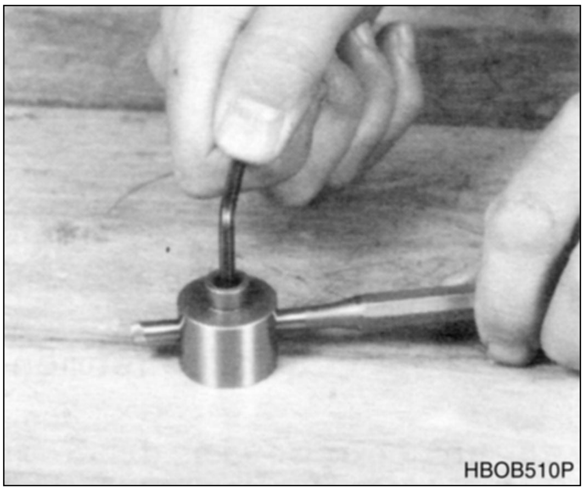

Figure 52

K. Amplifier spool shown dismantled.

Figure 53

13. Dismantling of check valve.

    A. Unscrew plug with 4 mm hexagon key and hexagon socket for 17 mm external hexagon.

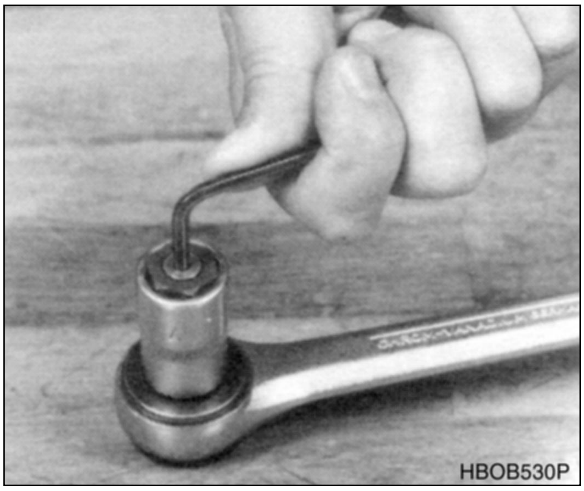

Figure 54

    B. Check valve shown dismantled.

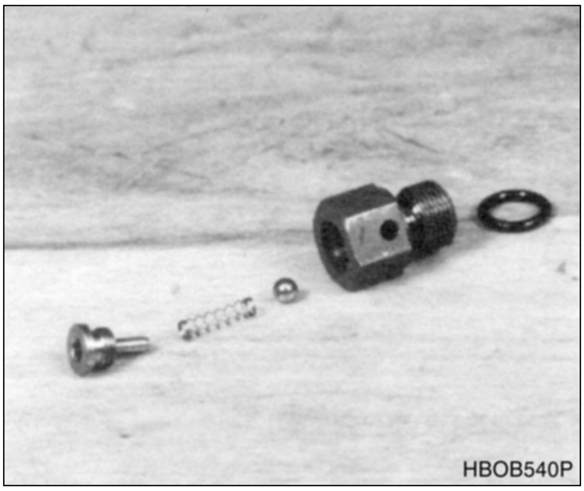

Figure 55

14. Dismantling of shock valve / suction valve.

    A. Unscrew lock nut with hexagon socket for 13 mm external hexagon. Use a mandrel.

NOTE: *When readjusting shock valve hold lock nut with 13 mm ring spanner.*

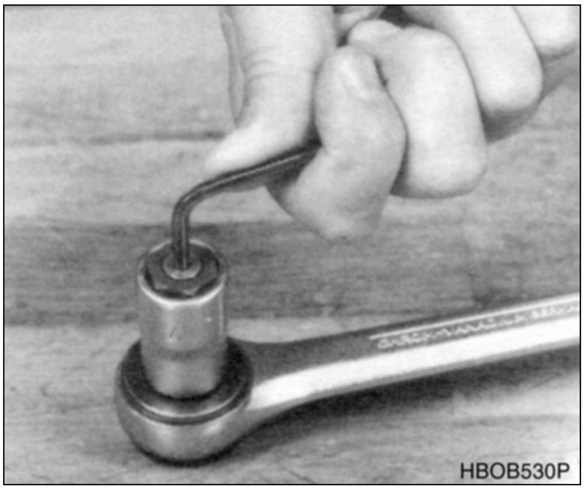

Figure 56

B. Remove disc and spring.

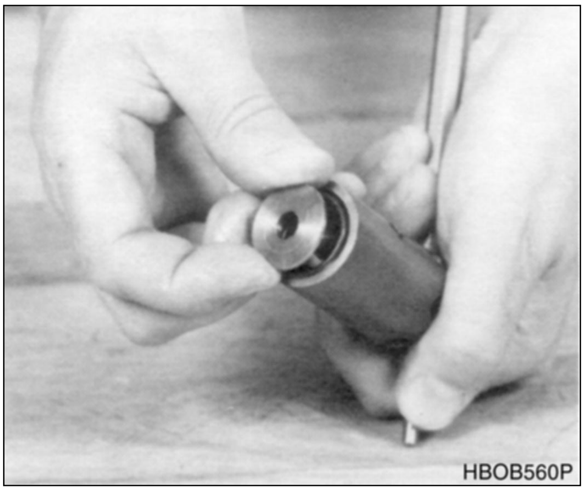

Figure 57

C. Remove housing.

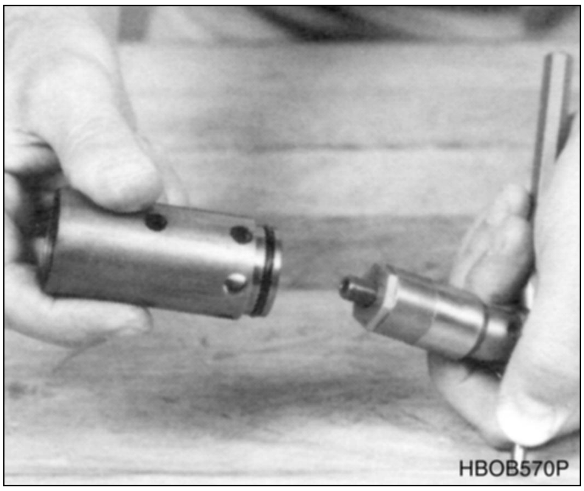

Figure 58

D. Unscrew pilot valve with hexagon socket for 19 mm external hexagon. Use a mandrel.

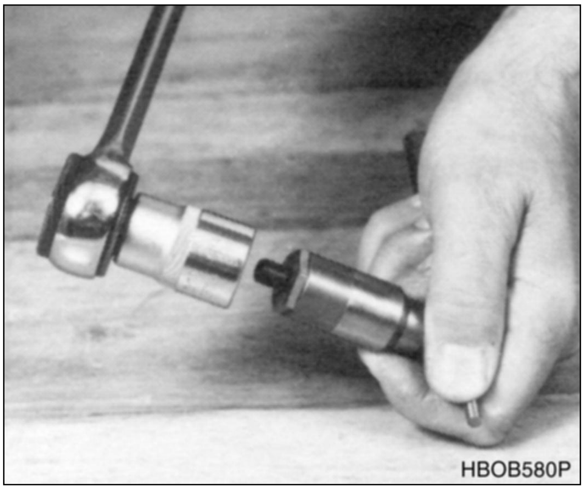

Figure 59

E. Remove pilot valve and spring.

Figure 60

F. Remove spool.

Figure 61

G. Unscrew adjustment screw and remove spring and ball.

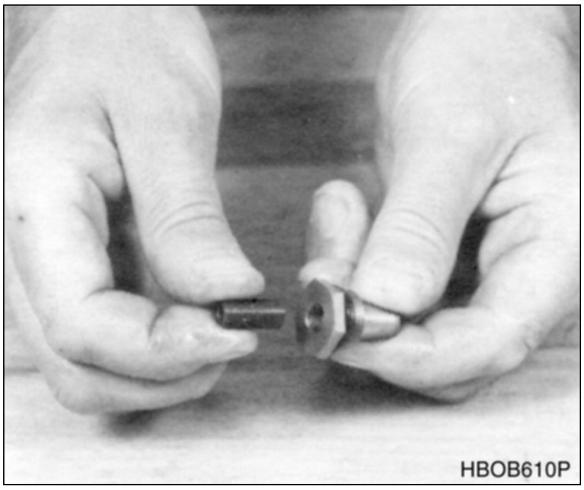

Figure 62

H. Shock valve/suction valve shown dismantled.

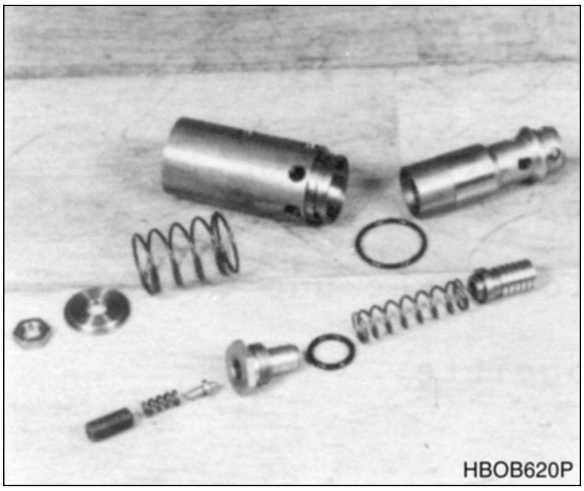

Figure 63

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

For general cleaning and inspection procedures, refer to "General Maintenance Procedures" section.

CLEANING

Clean all parts carefully with low aromatic kerosine.

INSPECTION AND REPLACEMENT

Replace all gaskets and sealing washers. Check al other parts carefully and replace if necessary.

LUBRICATION

Before assembly, lubricate all parts with hydraulic oil.

REASSEMBLY

1. Assemble shock valve/suction valve.
    A. Guide spring with cone into housing.

Figure 64

B. Install adjustment screw.

Figure 65

C. Install spool.

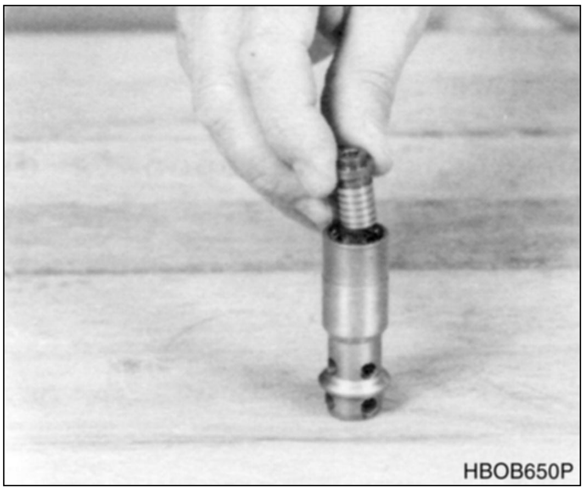

Figure 66

D. Install spring.

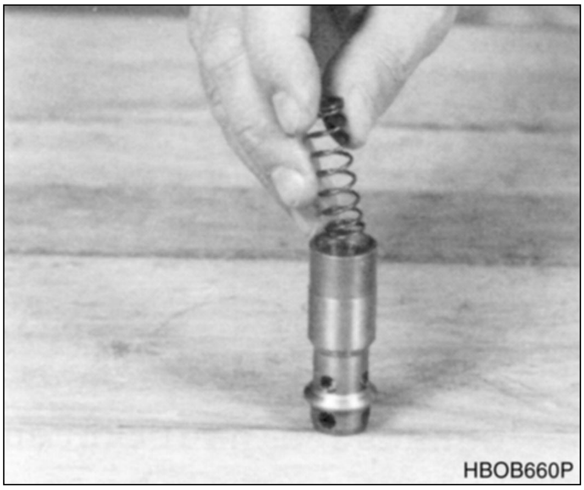

Figure 67

E. Install pilot valve. Remember O-ring.

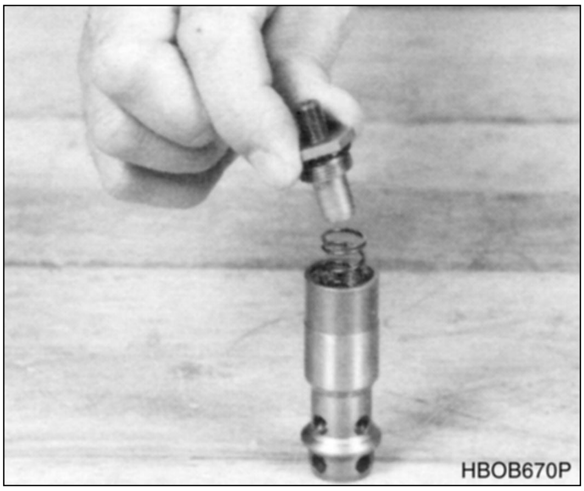

Figure 68

F. Tighten with torque wrench for 19 mm external hexagon. Use a mandrel. Tightening torque: 2 ±0.5 daNm. (175 ±45 in lb).

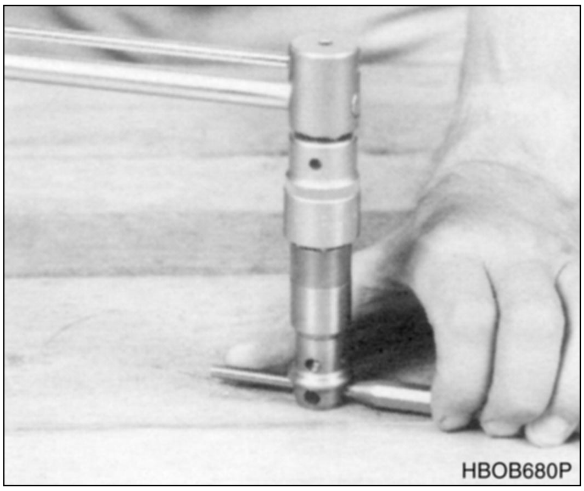

Figure 69

G. Install housing.

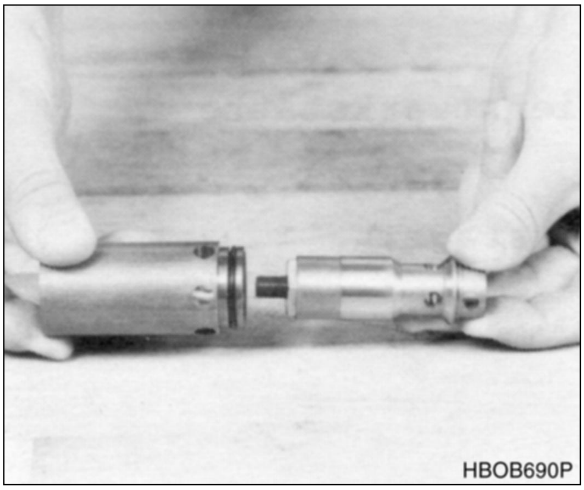

Figure 70

H. Install spring.

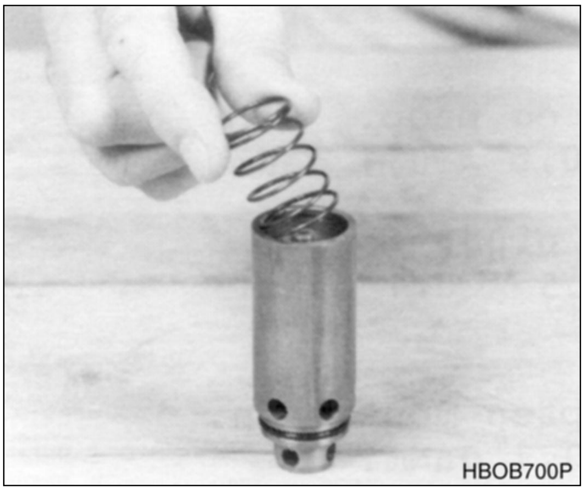

Figure 71

I. Fir disc.

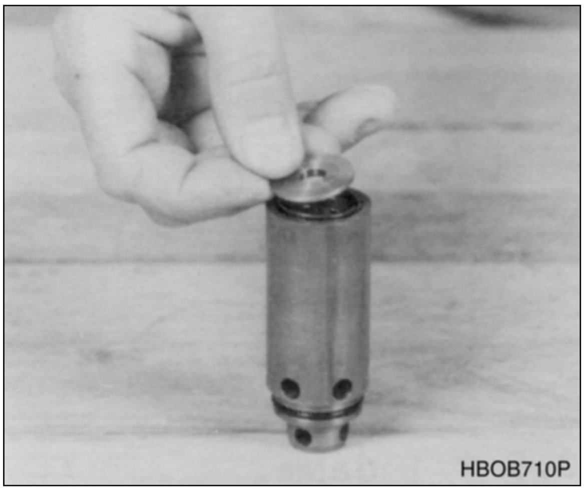

Figure 72

J. Install lock nut. Tighten torque 1.5 ±0.2 daNm. (135 ±20 in lb).

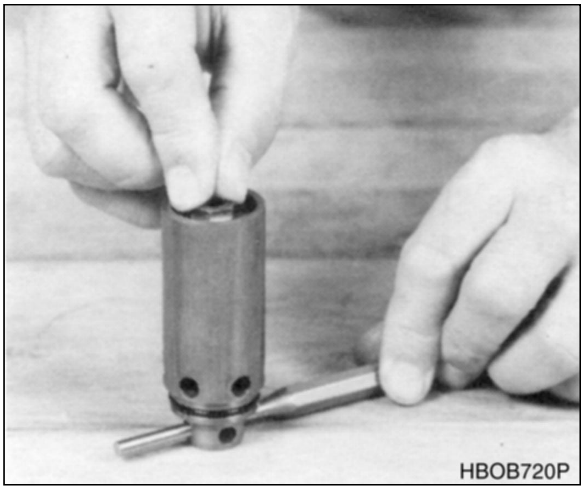

Figure 73

2. Assemble check valve.

   A. Install ball, spring and plug.

   B. Tightening torque: 0.5 ±1 daNm. (45 ±90 in lb).

Figure 74

3. Assembly of amplifier spool.

   A. Install orifice in plug. Tightening torque: 0.5 ±1 daNm. (45 ±90 in lb).

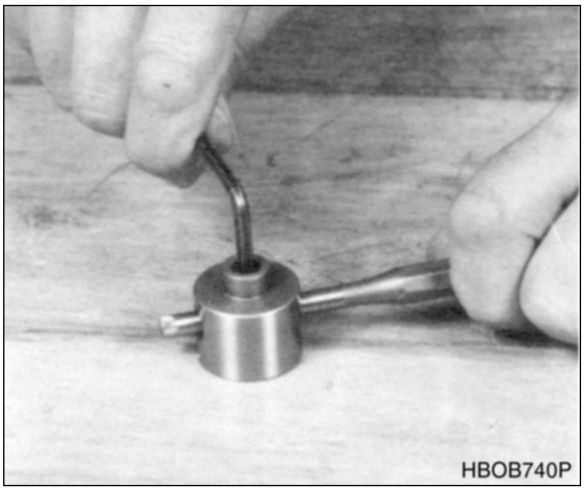

Figure 75

   B. Install check valve. Tightening torque: 2 ±0.3 daNm. (175 ±25 in lb).

NOTE: *Avoid damaging spool surface. Remember O-ring.*

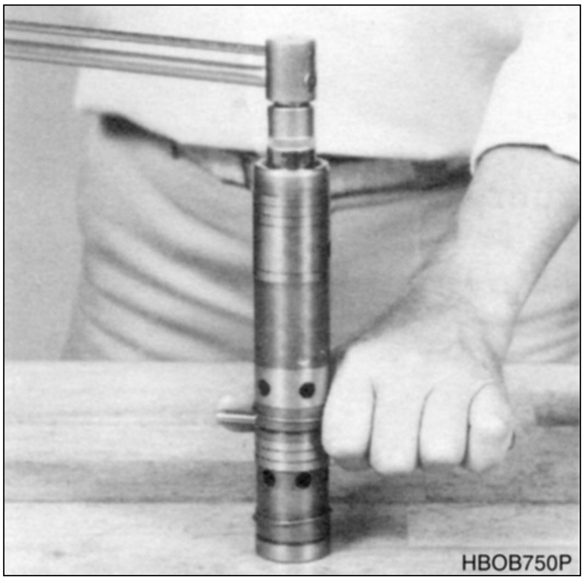

Figure 76

C. Place inner spool in correct position.

NOTE: *When assembling OSQA 5 and OSQB 5 there are two ways of installing inner spool. Only one is correct. The pilot channel which is faced upwards must be lined up with one of five amplification holes in the outer spool.*

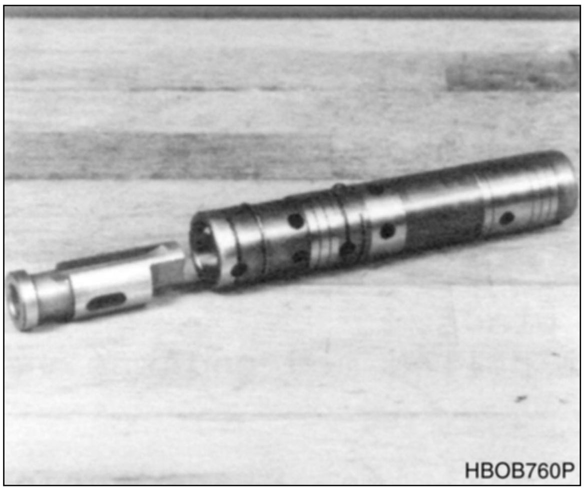

Figure 77

D. Guide inner spool in.

Figure 78

E. Install pin.

Figure 79

F. Push spring ring into position. Place spring ring into recess with ends facing away from pin plate.

Figure 80

G. Install spring.

Figure 81

H. Install plug.

Figure 82

I. Install pin.

Figure 83

J. Push spring ring into position. pLace spring ring into recess with ends facing away from pin holes.

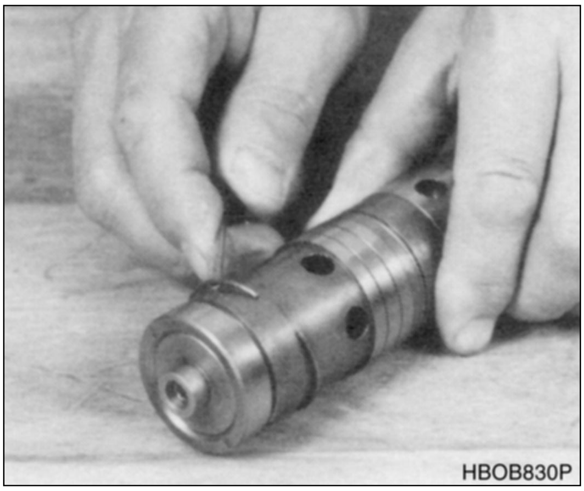

Figure 84

4. Assembly of priority valve spool.

    A. Install plug or throttle check valve.

    B. External pp: plug.

    C. External pp: throttle check valve.

    D. Tightening torque: 1 ±0.03 daNm. (90 ±25 in lb).

Figure 85

5. Assembly of directional spool.

   A. Screw in orifice.

   B. Tightening torque: 0.5 ±0.1 daNm. (45 ±10 in lb).

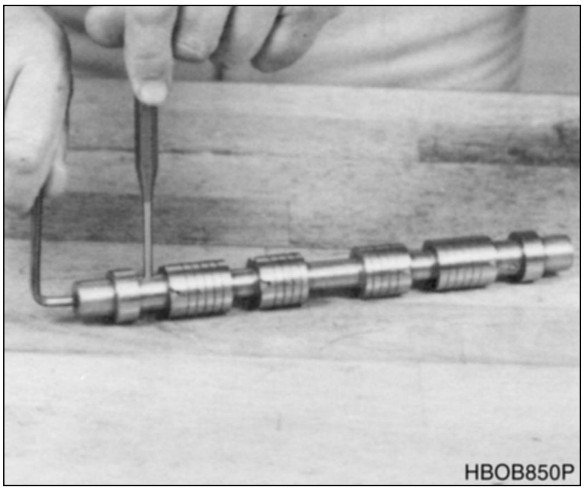

Figure 86

6. Installation of orifice and throttle check valve.

   A. Install orifice in housing.

   B. Tightening torque: 0.5 ±0.1 daNm (45 ±10 in lb).

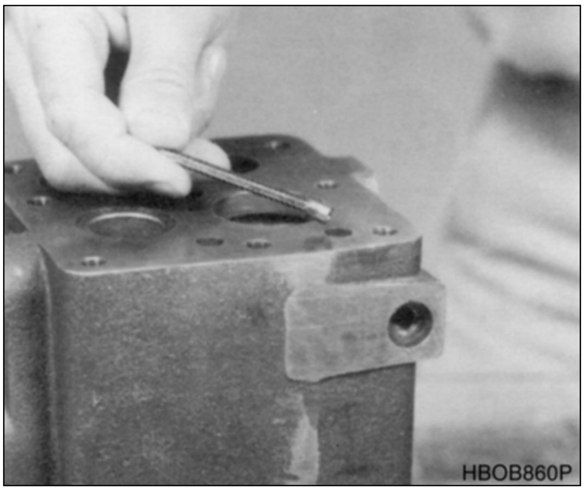

Figure 87

   C. Install orifice in LS-connection.

   D. Tighten torque: 1 ±0.3 daNm. (90 ±25 in lb.).

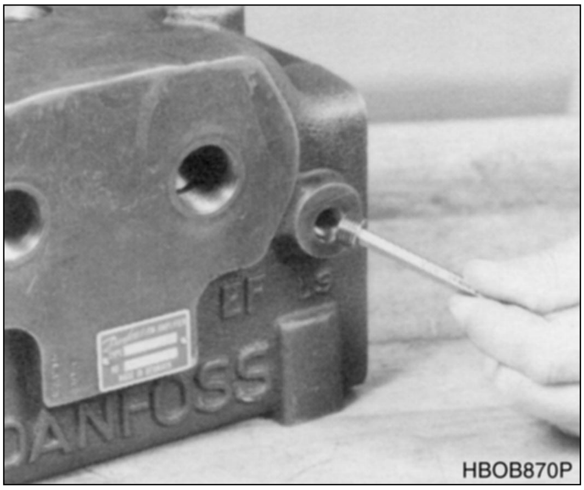

Figure 88

E. Install throttle check valve in PP-connection.

F. Tighten torque: 1 ±0.3 daNm. (90 ±25 in lb.).

7. Comments on flow amplifiers with internal PP:

A. 1/4 BSP.F in PP-connection: Install washer and plug. Tightening torque 4 ±0.3 daNm (355 ±25 in lb).

B. 7/116 - 20 UNF in PP-connection: Install O-ring and plug. Tightening torque: 1.5 ±0.5 daNm (135 ±45 in lb).

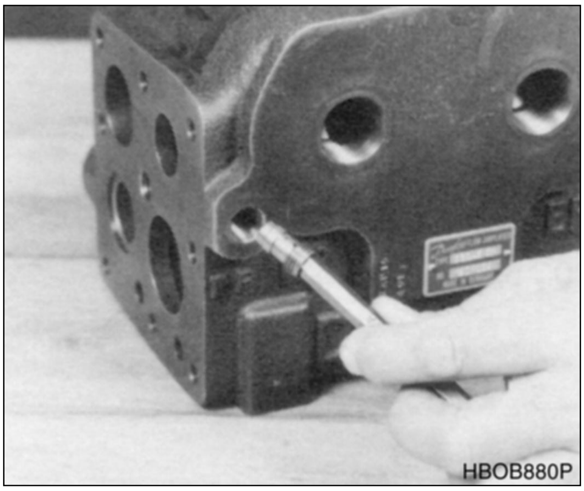

Figure 89

8. Installation of shock valves.

A. Guide shock valve in and secure it by hand. Remember O-ring.

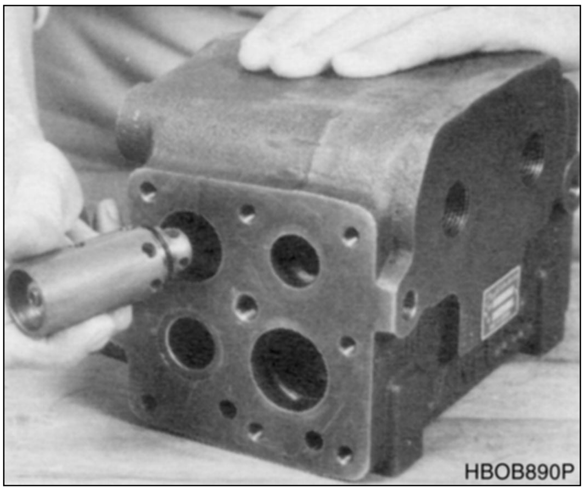

Figure 90

9. Assembly of pressure relief valve.

A. Guide adjustment screw, spring and cone up into cartridge.

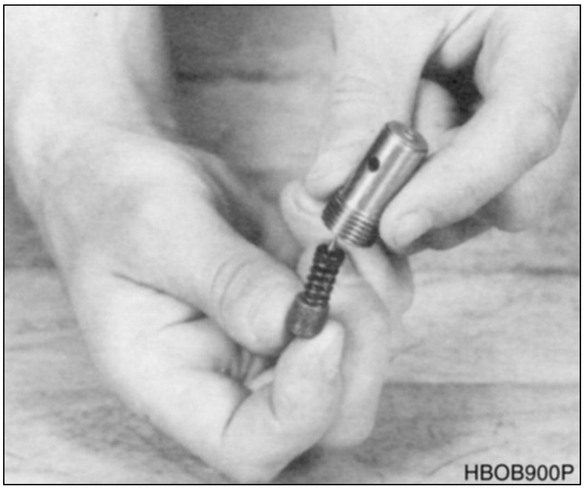

Figure 91

B. Screw adjustment screw so far in that 10 mm hexagon key fully engages.

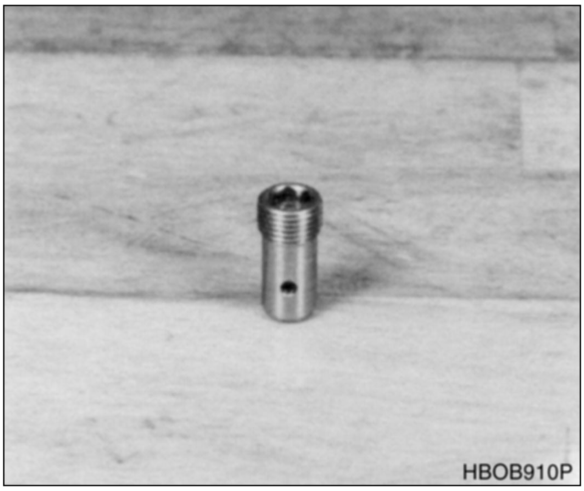

Figure 92

10. Installation of pressure relief valve.

A. Let washer drop into hole.

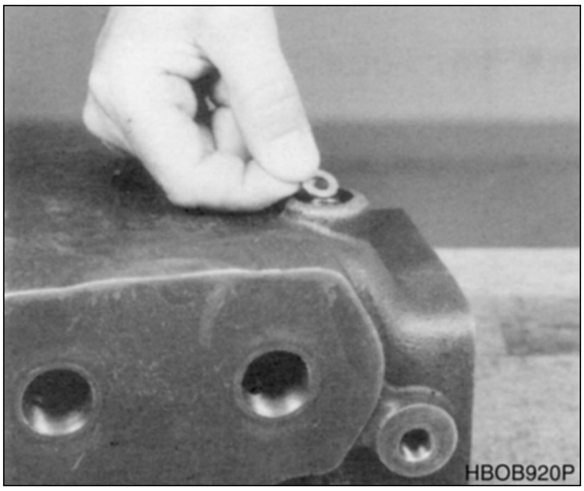

Figure 93

B. Install pressure relief valve. Tighten torque: 3 ±0.3 daNm. (265 ±25 in lb).

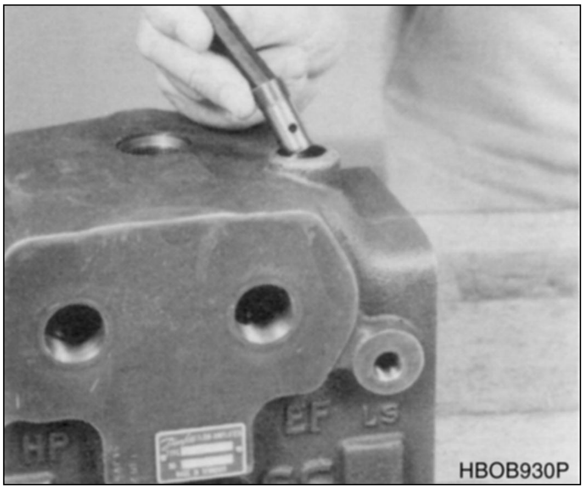

Figure 94

C. Install plug with washer. Tighten torque: 6 ±0.5 daNm. (530 ±45 in lb).

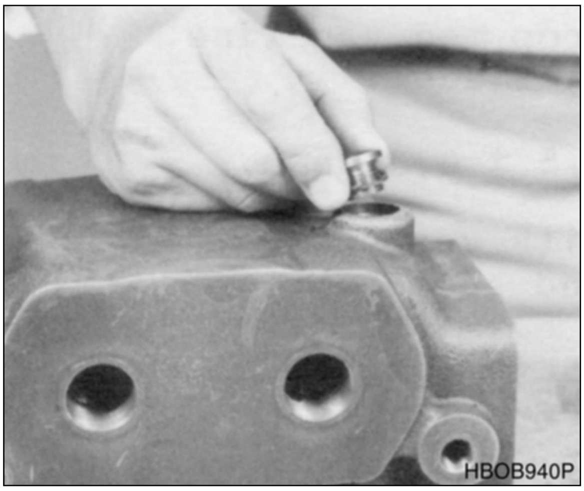

Figure 95

11. Installation of back pressure valve.

A. First Install spring in piston with Vaseline. Install assembled piston and spring.

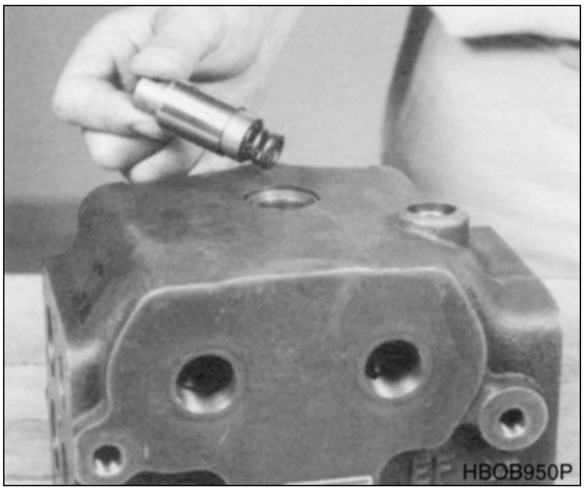

Figure 96

B. Let ball drop down.

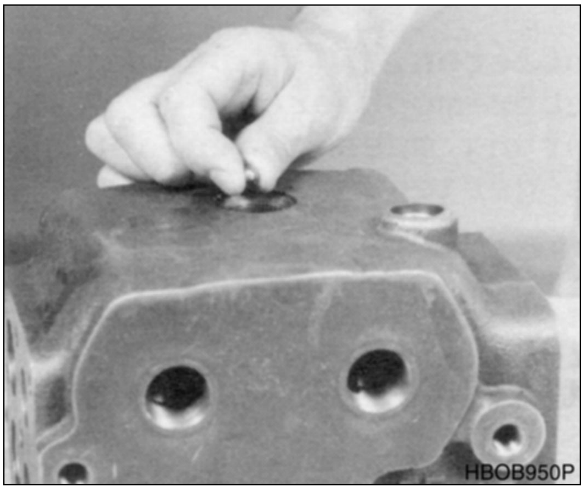

Figure 97

C. Install spring in plug with Vaseline. Install assembled plug and spring. Remember O-ring. Tightening torque 2.5 ±0.03 daNm (220 ±25 in lb).

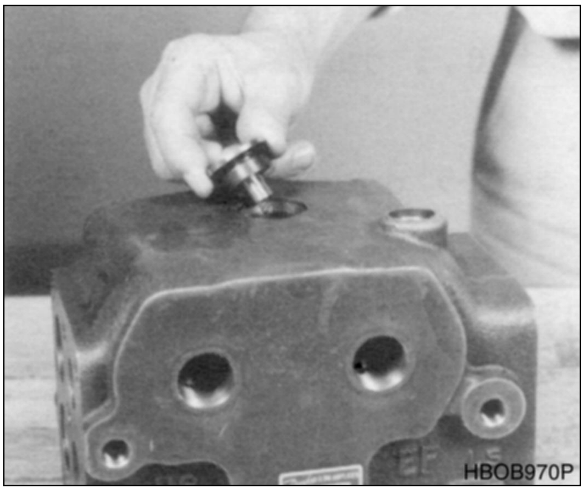

Figure 98

12. Installation of spools.

A. Install directional spool. Install priority valve spool.

NOTE: *Spring control must be placed in correct position against LS-connection.*

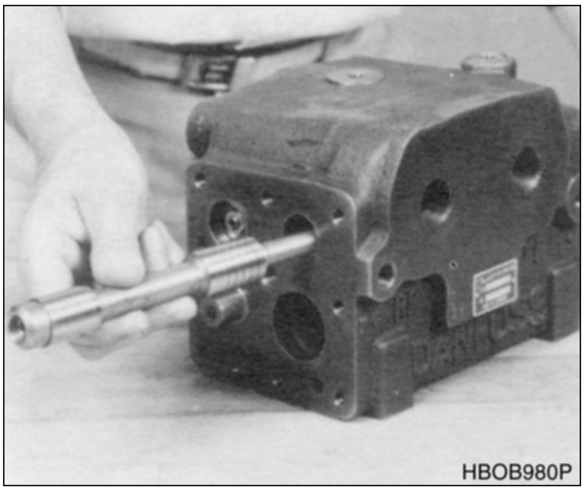

Figure 99

B. Install spring.

NOTE: *Spring must be by LS-connection.*

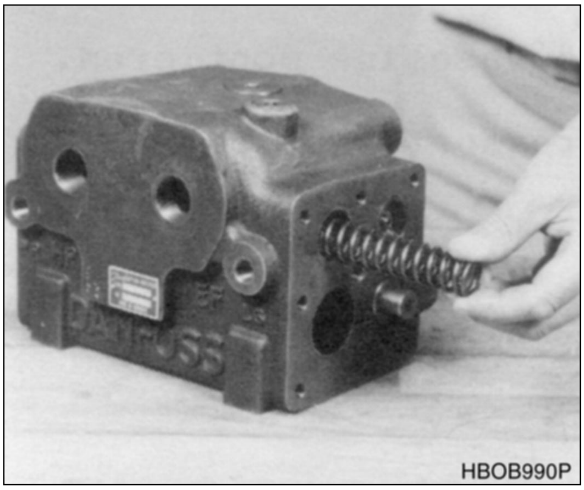

Figure 100

C. Install amplifier spool.

NOTE: *The orifice must be placed in correct position against LS-connection.*

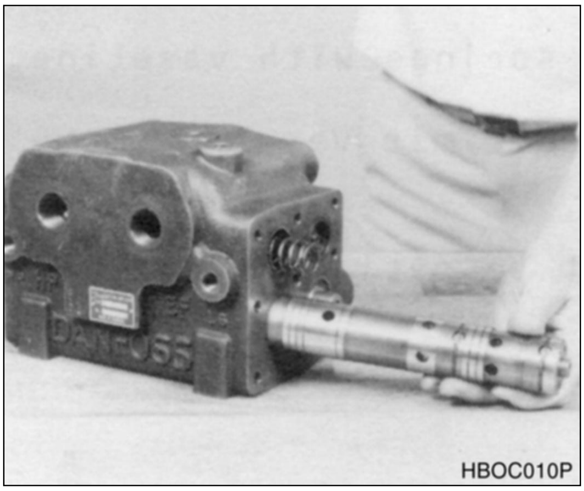

Figure 101

13. Installation of end cover at PP-connection.

A. Install spring with Vaseline on amplifier spool.

NOTE: *The spring must be installed at PP-connection.*

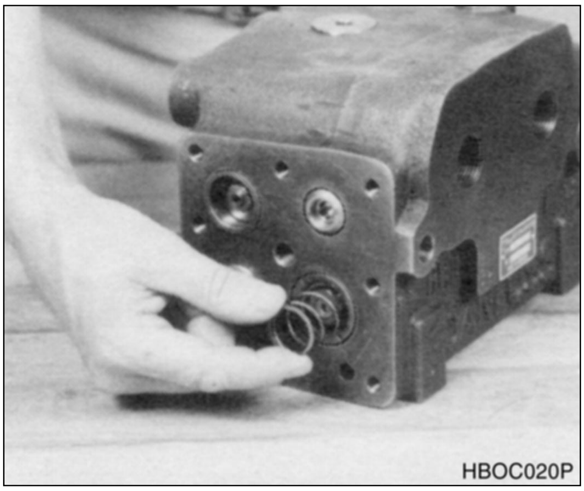

Figure 102

B. Install spring guide with Vaseline.

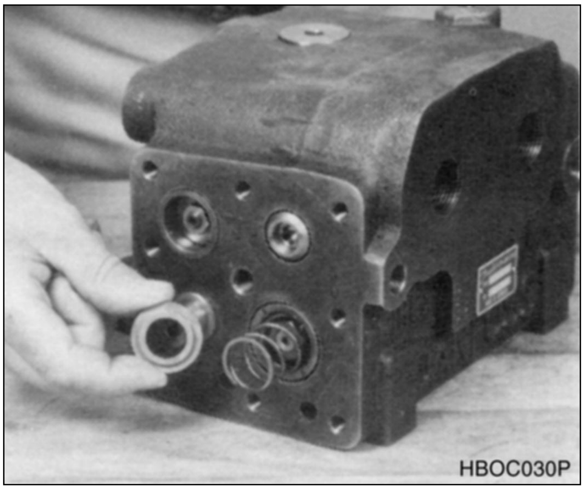

Figure 103

C. Install large and small springs with Vaseline.

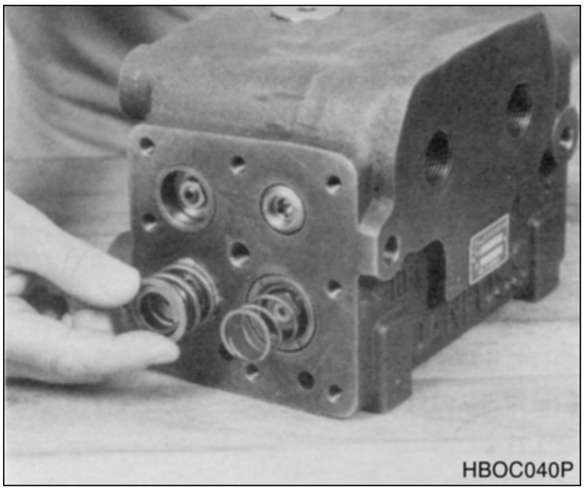

Figure 104

D. Install guide screws.

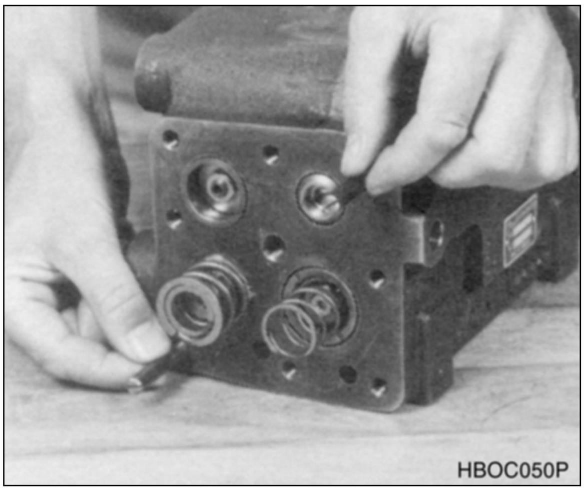

Figure 105

E. Install four large and two small O-rings.

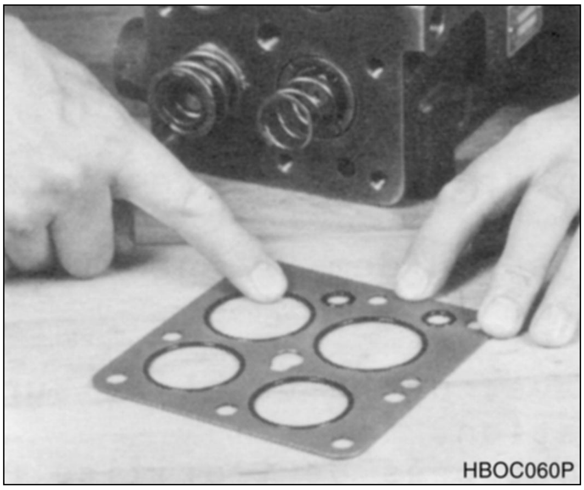

Figure 106

F. Guide plate in.

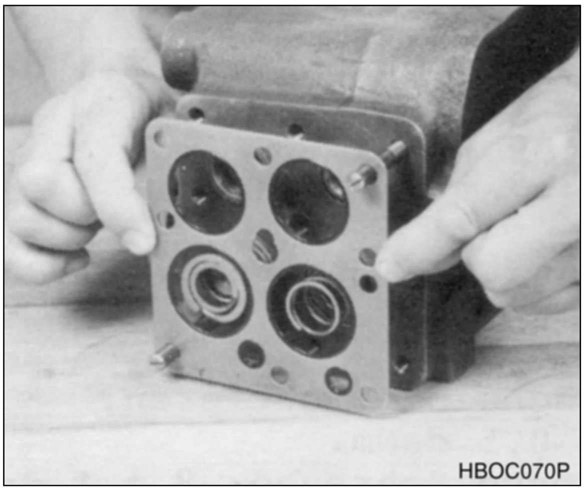

Figure 107

G. Install stop (thickness: 5 mm) in end cover with Vaseline.

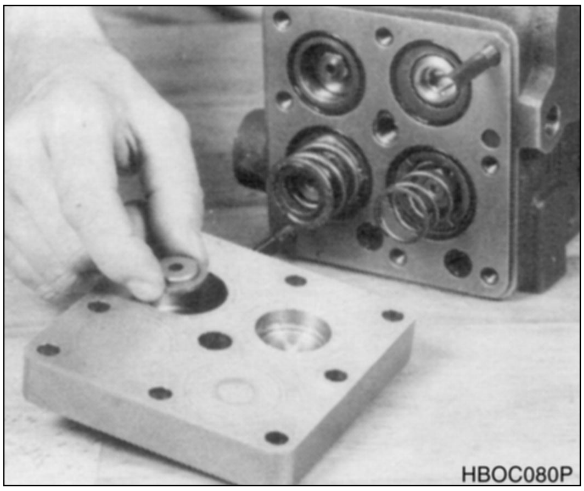

Figure 108

H. Guide end cover in.

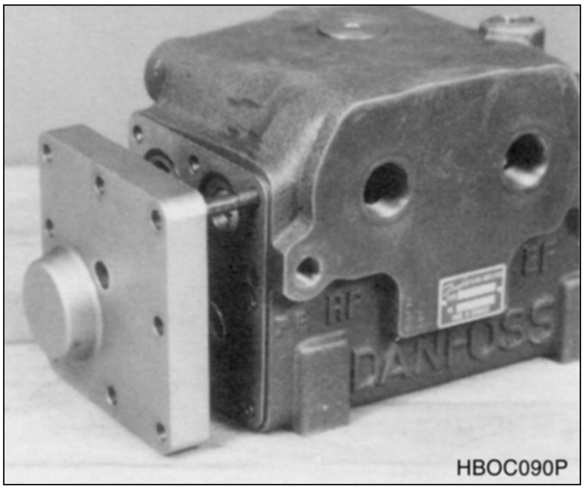

Figure 109

I. Install screw with spring washer.

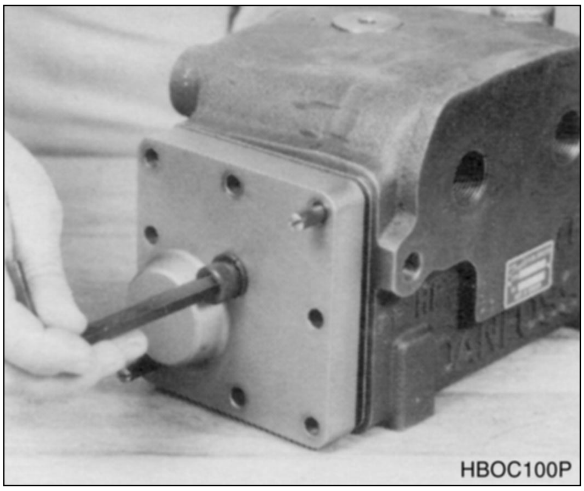

Figure 110

J. Install screw with spring washer. Tightening torque: 2.5 ±0.5 daNm.(220 ±45 in lb).

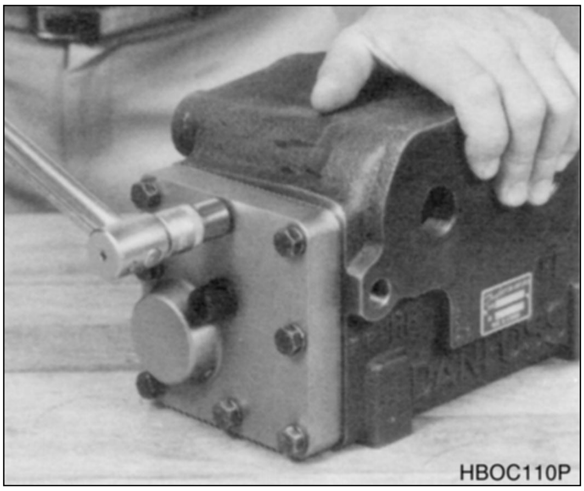

Figure 111

14. Installation of end cover at LS-connection.

    A. Install guide screws.

    B. Install remote control valve with Vaseline.

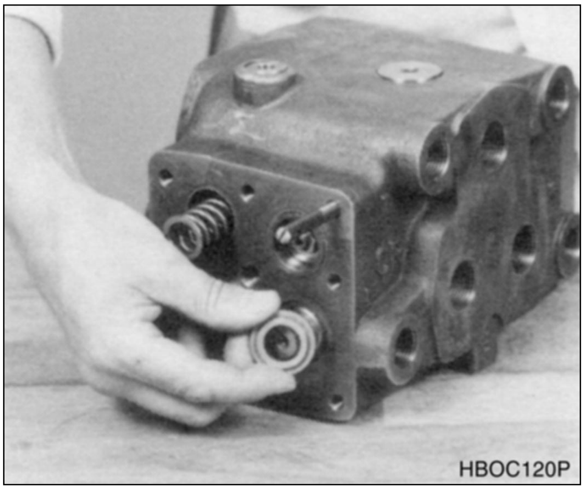

Figure 112

C. Install large and small springs with Vaseline.

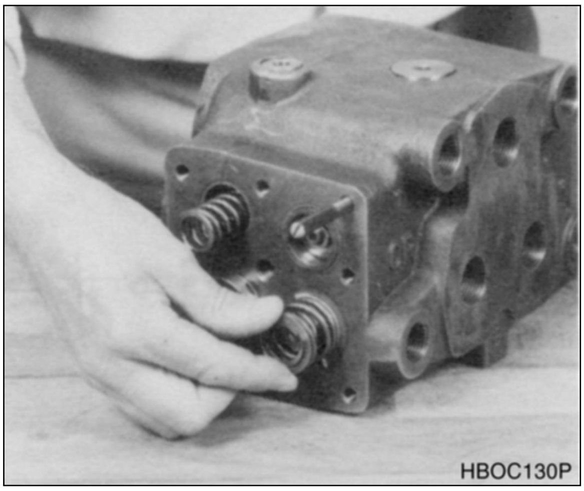

Figure 113

D. Guide in plate with four O-rings.

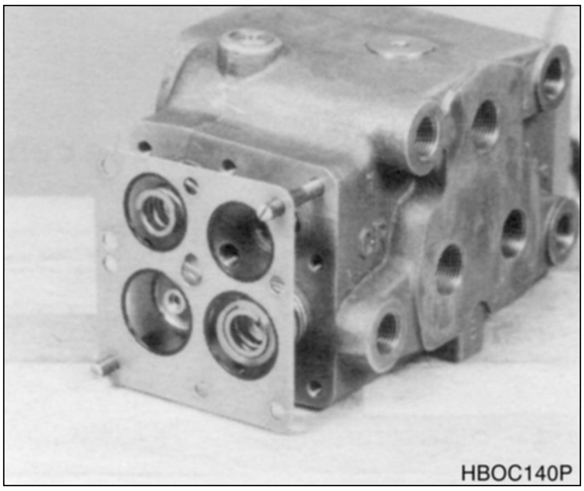

Figure 114

E. Install stop priority valve spool.

F. (thickness: 8 mm) with Vaseline.

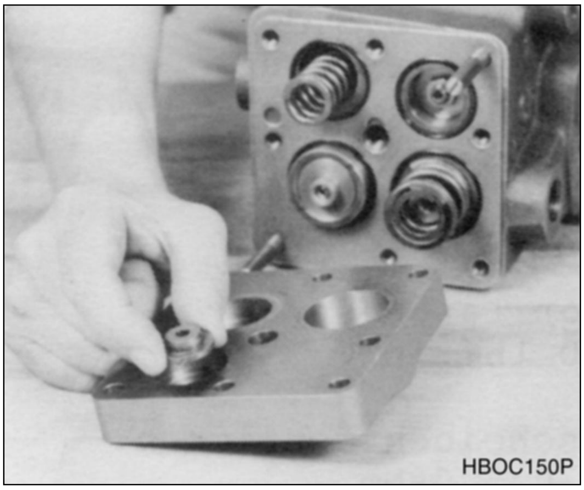

Figure 115

G. Install stop for directional spool (thickness: 5 mm) with Vaseline.

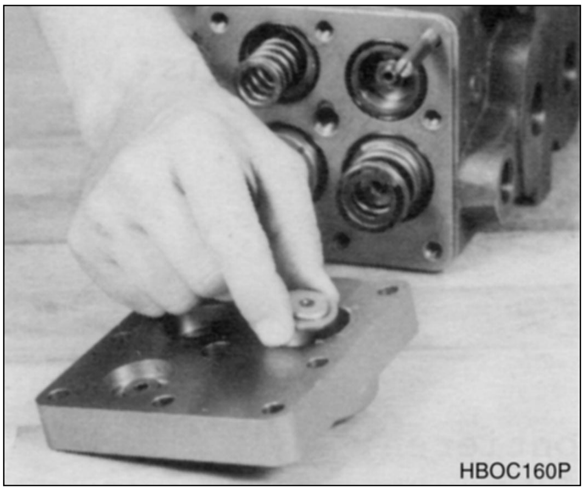

Figure 116

H. Guide in end cover.

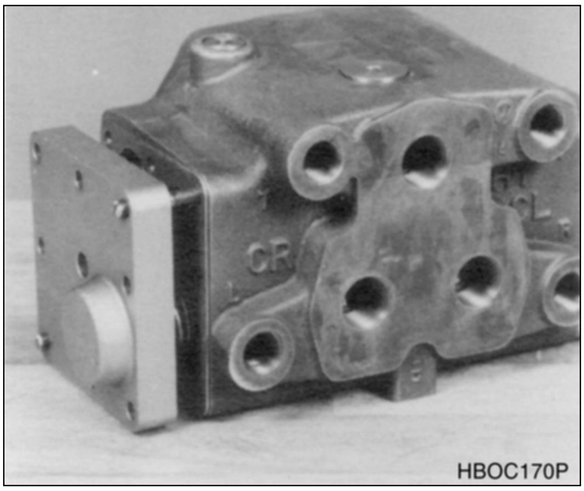

Figure 117

I. Install large screw with spring washer.

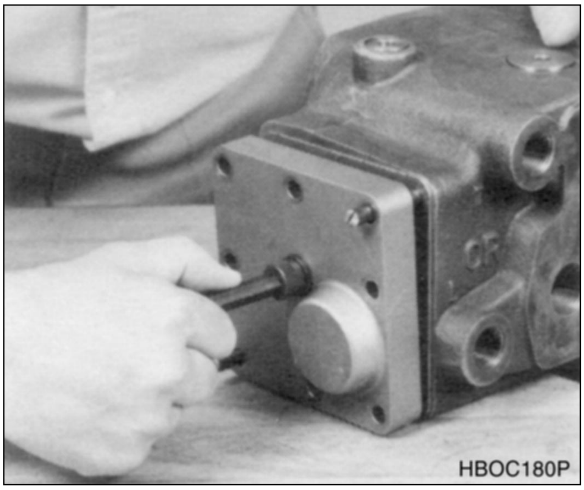

Figure 118

J. Install screws with spring washers. Tightening torque: 2.5 ±0.5 daNm. (220 ±45 in lb). Tightening torque for large screw: 8 ±1 daNm (710 ±90 in lb).

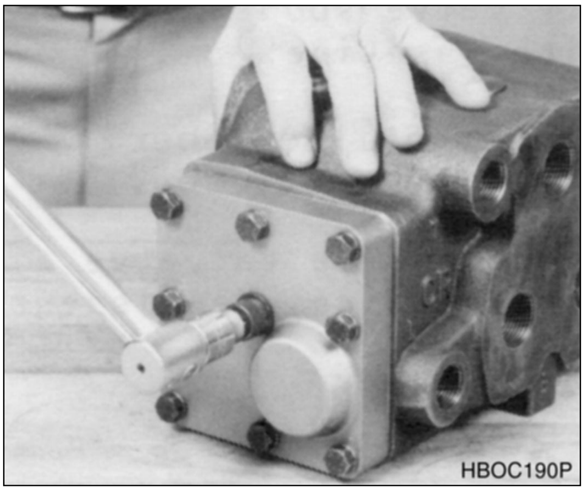

Figure 119

K. Install plastic plugs.

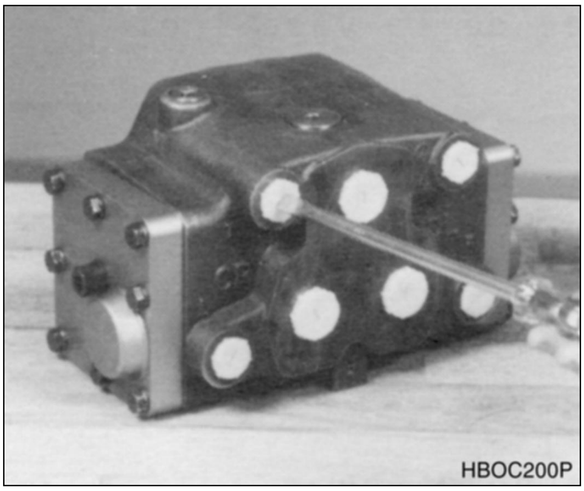

Figure 120

DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

S0709730K
R1

POWER STEERING UNIT

CAUTION!
Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.
Always use tools and equipment that is in good working order.
Use lifting and hoisting equipment capable of safely handling load.
Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Mega 300-V	1001 and Up
Mega 400-V	1001 and Up
Mega 500-V	1001 and Up

May 2001

TABLE OF CONTENTS

GENERAL DESCRIPTION

POWER STEERING SYSTEM

Power Steering Unit.

The machine contains a fully hydraulic steering unit. See Figure 1. Rotating the steering wheel controls hydraulic flow through the steering valve. Figure 2, shows the hydraulic schematic for the steering system. The steering valve meters the volume of pump flow that is supplied to the steering cylinders

Reference Number	Description
1	Bearing
2	Centering Springs
3	Sleeve
4	Center Pin
5	Check Valve
6	Gerotor
7	End Cap
8	Spool
9	Drive Shaft
10	Housing

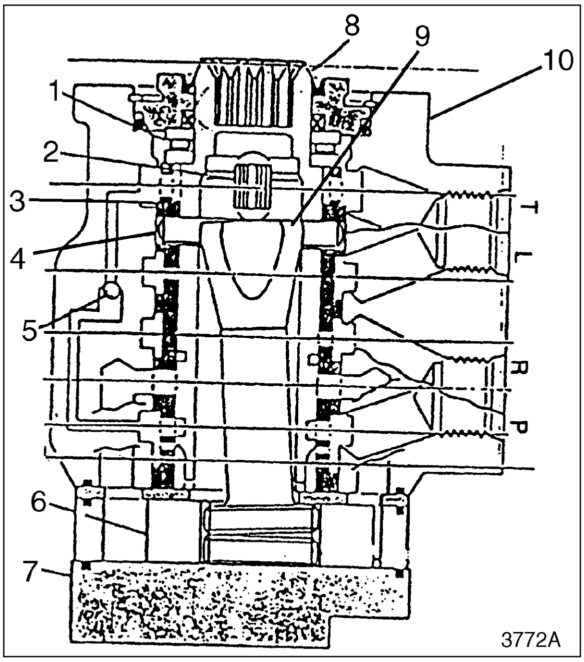

Figure 1

The steering unit contains a gerotor. This allows the operator to steer the machine when the engine is not running or when the steering pump has failed. The gerotor functions as a manual hydraulic pump that is powered by the rotation of the steering wheel. Rotating the steering wheel will cause the gerotor to draw oil from the hydraulic tank and send this oil to the steering cylinders.

The shaft that is rotated by the steering wheel is attached to the spool (8, Figure 1) by the engagement of a spline. The spool is surrounded by a sleeve (3). The spool and sleeve are connected by the centering spring (2). At the steering wheel neutral position, the center pin does not contact the spool. A drive shaft (9) extends through the spool. The upper end of the drive shaft engages the center pin (4). The lower end of the drive shaft engages the spline in the gerotor (6).

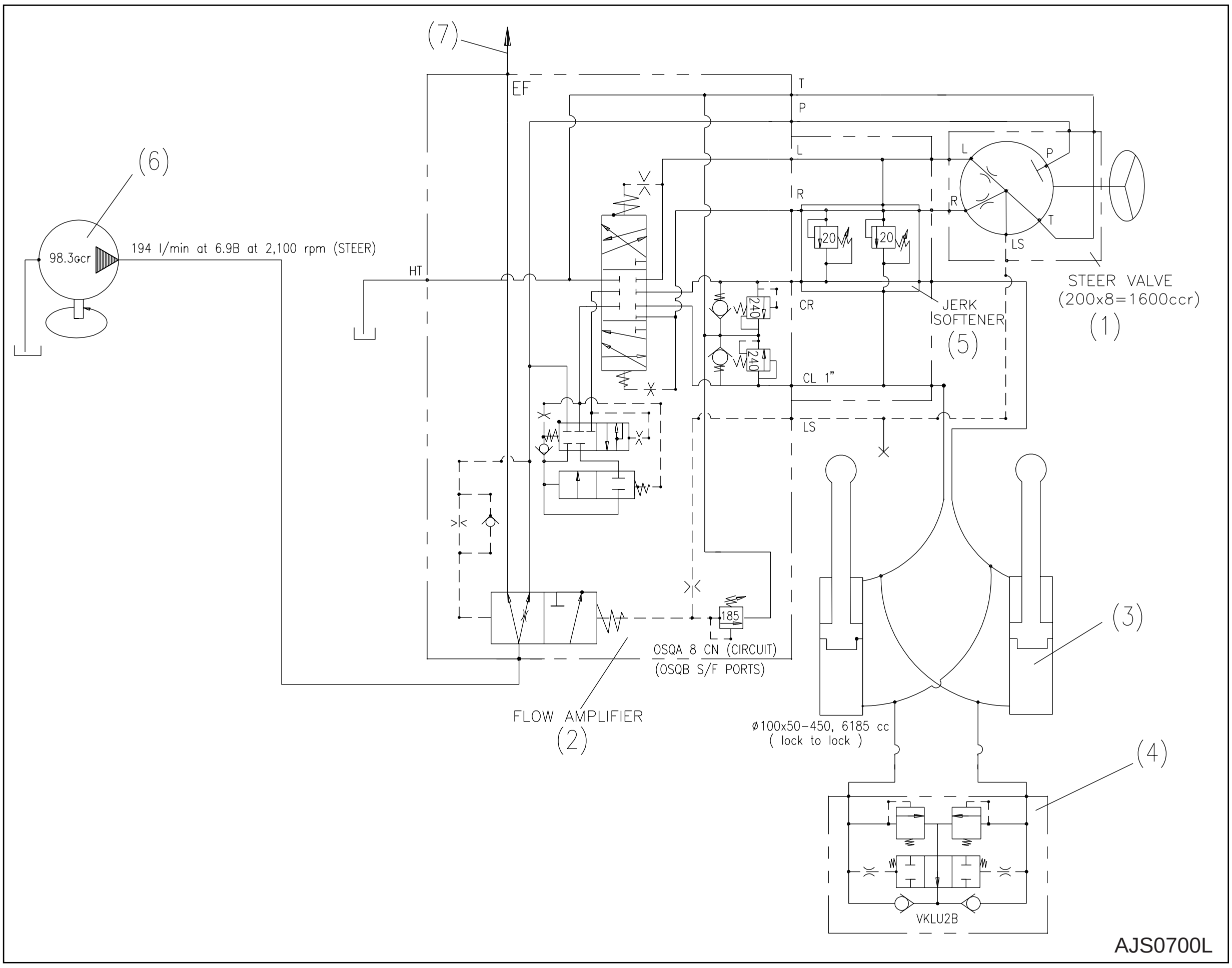

Figure 2 Steering Circuit

Reference Number	Description
1	Steering Unit
2	Priority Valve
3	Steering Cylinder
4	Cushion Valve

Reference Number	Description
5	Valve block
6	Steer Pump
7	Supply Line to Main Control Valve

Neutral Operation

With the steering wheel in the neutral position (wheels turned neither right nor left), the spool (2, Figure 3) and sleeve (1) are stationary at the position where the center pin (6) becomes centered in the spool space by the centering springs (3). Oil flow through the load sensing line (LS), port L, port R, and port T are bypassed to the tank line and the oil supply (P) is blocked by the directional spool in the steering unit (1, Figure 2). Even if an external force is applied to the steering cylinder, the steering unit is protected because the oil path is blocked by the directional spool.

Reference Number	Description
1	Sleeve
2	Spool
3	Centering Spring
4	Spool
5	Sleeve
6	Center Pin
7	Drive shaft

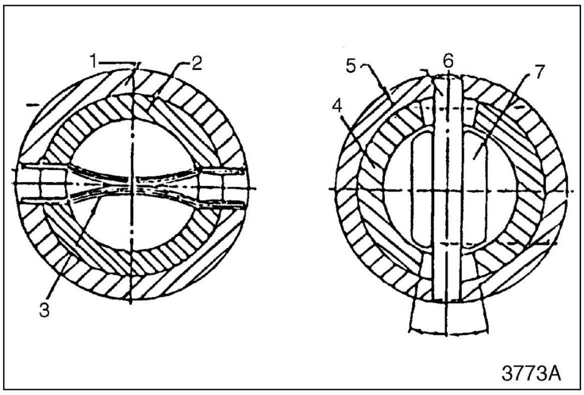

Figure 3

Right Turn

The spool (2, Figure 3) is engaged with the spline of the steering shaft. When the steering wheel is turned to the right, the spool turns. The sleeve (1) is connected to the spool (2) by centering springs (3). When spool turns, the sleeve turns. The sleeve turning angle is about 10° less than the spool turning angle. This allows the longitudinal slots in the spool to align with the ports in the sleeve. Oil from port P on the steering unit (1, Figure 2) travels through the control spool and is directed to port R which directs the oil to the steering cylinders (3, Figure 2). The amount of flow metered to port R is controlled by the amount of steering wheel rotation. Excess oil flow through port P that is not metered to port R, is directed by the spool to port T and is then directed through the il cooler and into the tank.

Left Turn

The spool (2, Figure 3) is engaged with the spline of the steering shaft. When the steering wheel is connected to the spool (2) by centering springs (3). When the spool turns, the sleeve turns. The sleeve turning angle is about 10° less than the spool turning angle. This allows the longitudinal slots in the spool to align with the ports in the sleeve. When the steering wheel is turned to the left, oil from port P on the steering unit (1, Figure 2) is directed through the control spool in the steering unit, out port L and into the steering cylinders (3, Figure 2). The amount of oil flow metered to port L is controlled by the amount of steering wheel rotation. Excess oil flow through port P that is not metered to port L, is directed by the spool to port T and is then directed through the oil cooler and into the tank.

GEROTOR OPERATION

If the engine or pump is not operating, the steering unit (1, Figure 2) works as a manual pump when the steering wheel is turned. The gerotor will work when the input torque to the steering wheel is less than 12 kg•m (87 ft lb). If the necessary input torque is greater than this, the gerotor will not function. When the steering wheel is turned, the gerotor creates a vacuum that draws oil from port T. See Figure 2. The gerotor pumps this oil through the control spool and into the steering cylinders. Return oil flows back to the spool and is used to lubricate the steering unit (1, Figure 2). The return oil then flows back into the tank line and is recirculated back to the gerotor and the steering cylinders.

CUSHION VALVE OPERATION

Function

The cushion valve absorbs any excessive peak pressure that my be generated during initial movement of the steering wheel or during a change in steering direction. The cushion valve also prevents excessive high pressure and shock that can result from steering load inertia.

Working Principle

If a high pressure oil is fed back to the port R, it pushes the spring (3) and opens the poppet (2). And this operation directs the high pressure oil to the port L through the center hole in the spool (12) and the check valve poppet in the port L part. At the same time, oil reaches the pressure room of the plug through the orifice (8). This operation closes the passage from the port R to the port L. This releases the pressure and prevents machine shock by intercepting oil. If a low pressure oil flows, the cushion operation is not necessary. It is due that the speed of the closing the spool (12) is faster than the speed of the opening the poppet (2), therefore, the cushion valve does not work.

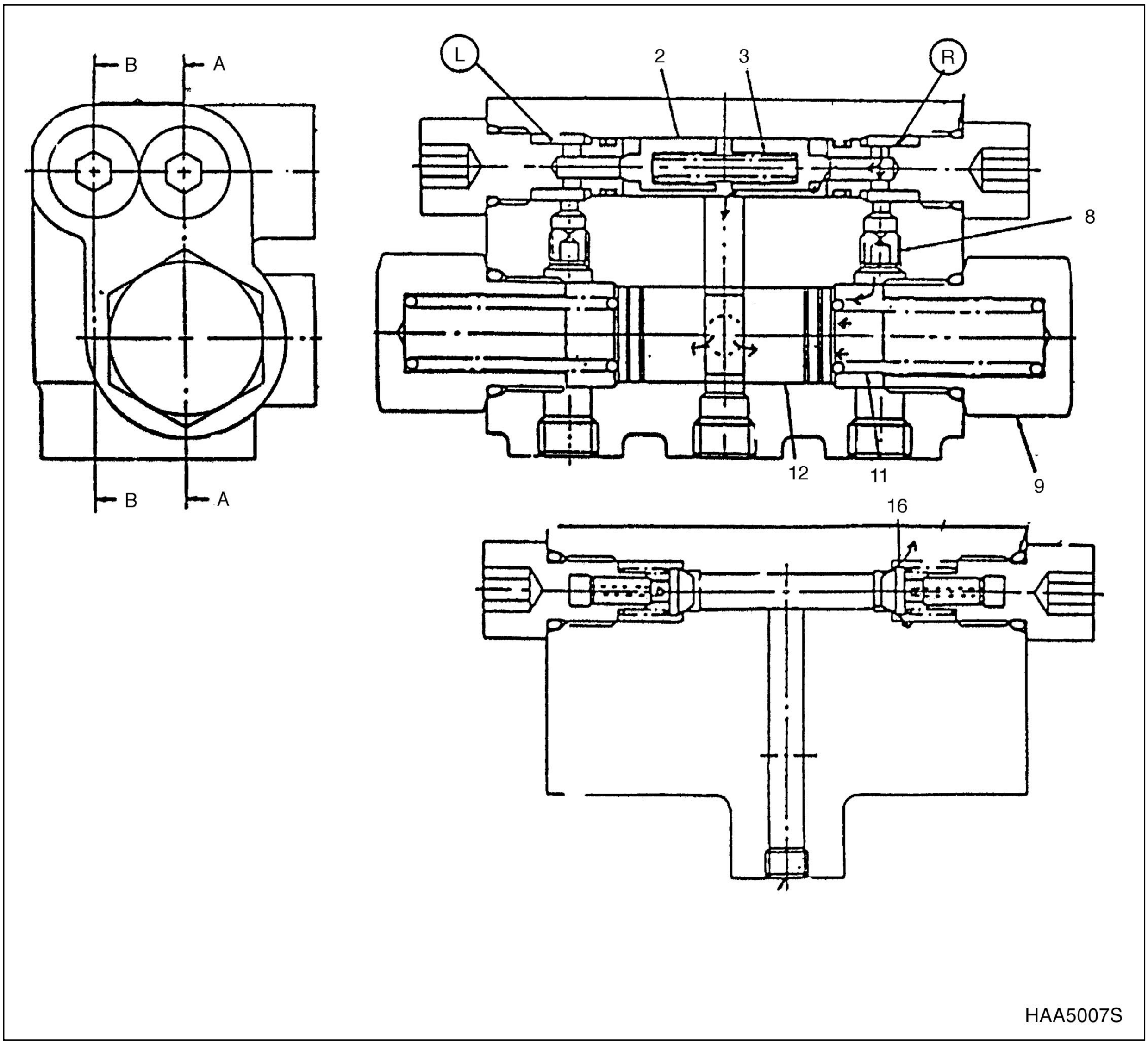

Figure 4

PARTS LIST

An exploded view of the steering unit is shown in Figure 5.

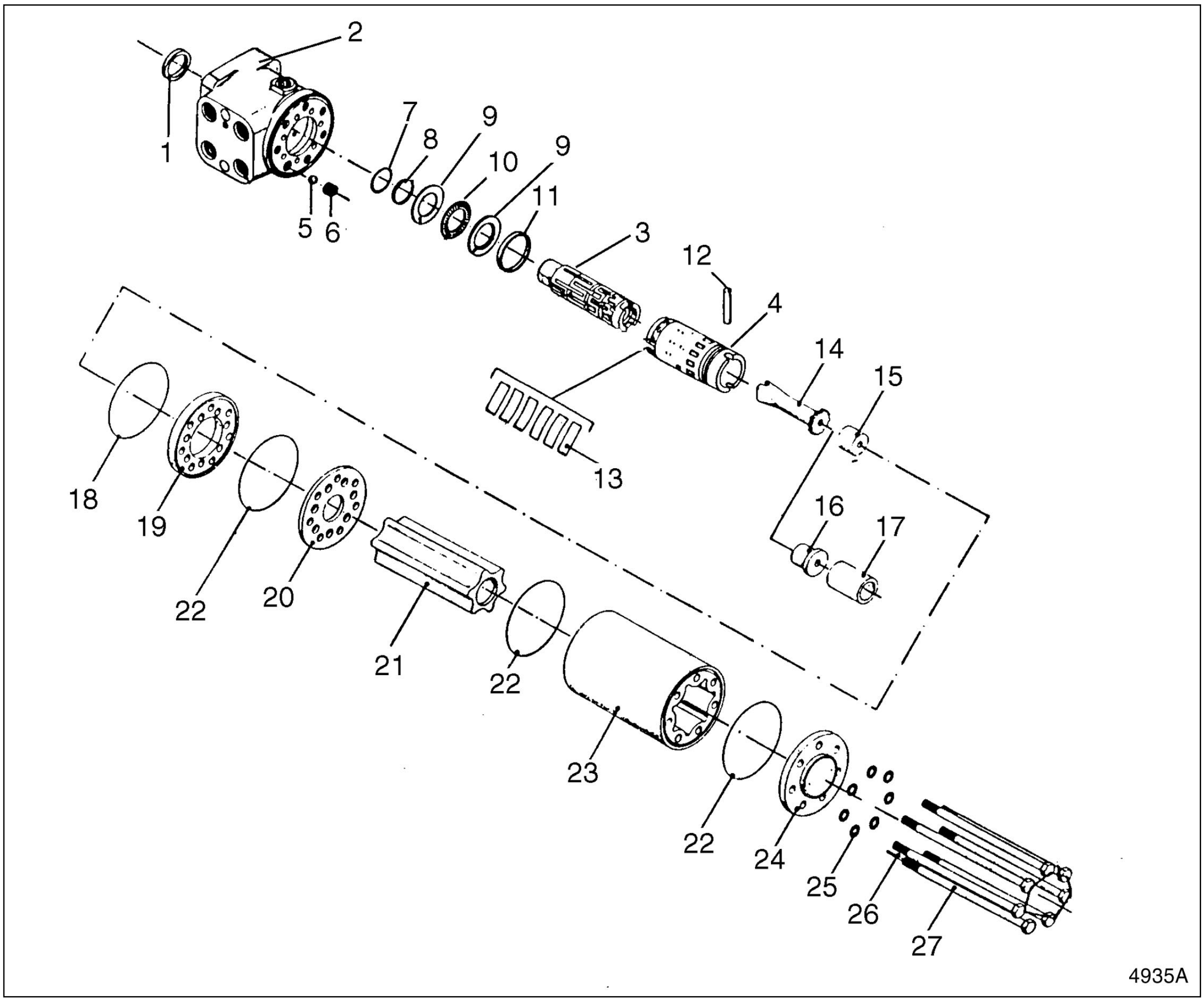

Figure 5

Reference Number	Description
1	Seal Ring
2	Housing
3	Spool
4	Sleeve
5	Ball
6	Threaded Bushing
7	O-ring
8	Backing Ring (If equipped)
9	Thrust Washers
10	Thrust Bearing
11	Spacer Ring
12	Cross Pin
13	Neutral Springs
14	Shaft
15	Spacer - 13.8 mm (If equipped)

Reference Number	Description
16	Spacer - 25 mm (If equipped)
17	Spacer Bushing (If equipped)
18	O-ring 80.5 x 1.5 mm
19	Middle Plate
20	Distributor Plate
21	Rotor
22	O-ring - 79.92 x 1.78 mm
23	Cylinder Gear
24	End Cover
25	Washer
26	Roll Pin 2.5 x 32 mm
27	Bolt

SPECIFICATIONS

Steering Unit	Specification		
	M300-V	M400-V	M500-V
Type	Load Sensing, Dynamic Signal, Non-reaction		
Gerotor Displacement	1,000 cc/rev (61 cu. in./rev)	200.0 cc/rev (12.20 cu. in./rev)	200.0 cc/rev (12.20 cu. in./rev)

SPECIAL TOOLS

The tools necessary for steering unit repair are illustrated below.

1. Stabilizing base. See Figure 6.

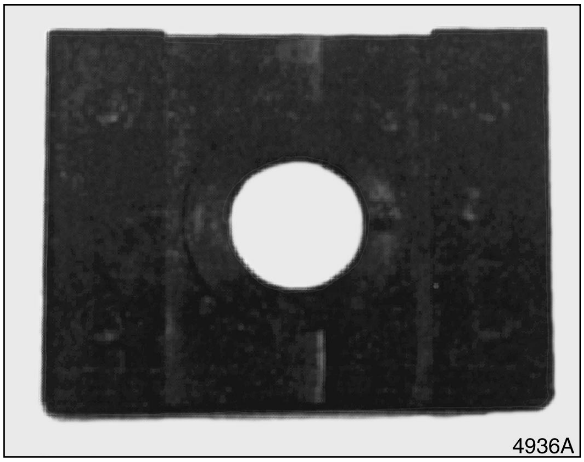

Figure 6

2. O-ring assembly tool. See Figure 7.

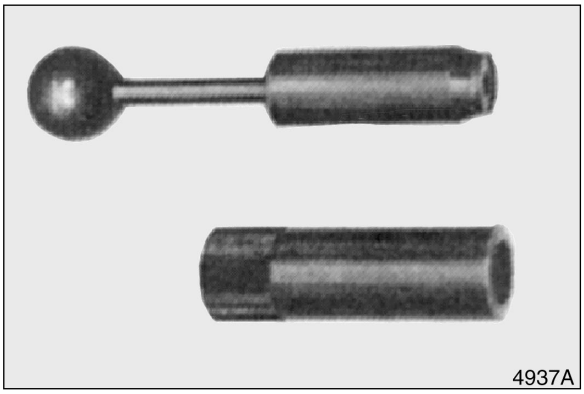

Figure 7

3. Seal driver. See Figure 8.

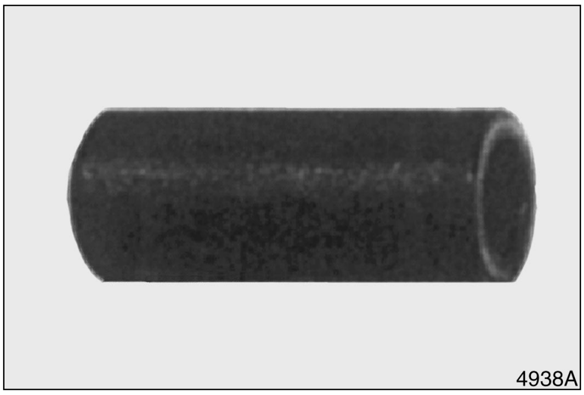

Figure 8

4. Torque wrench, 0 - 5 kg•m (0 - 35 ft lb). See Figure 9. 13 mm socket. Ratchet handle. 12 mm screwdriver. 6 mm screwdriver. 2 mm screwdriver. Plastic hammer.

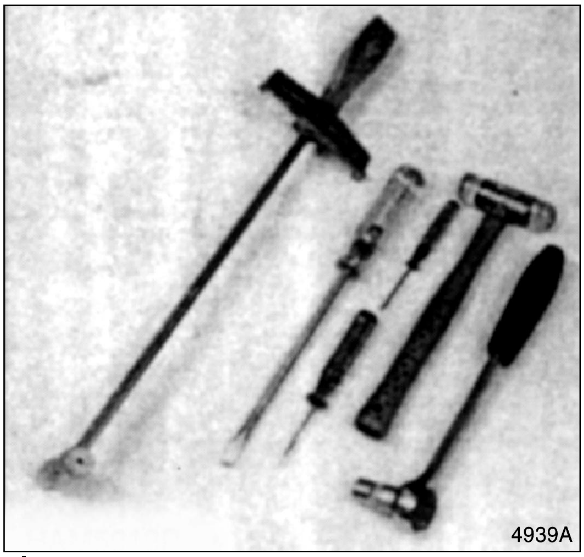

Figure 9

TROUBLESHOOTING, TESTING AND ADJUSTMENT

Problem	Cause	Remedy
Steering wheel does not operate smoothly	Broken or damaged oil pump.	Replace pump.
	Stuck or damaged relief valve.	Repair or replace.
	Stuck, damaged or worn out steering valve.	Clean, repair or replace.
	Restricted hose or pipe. Leaking or restricted hose, pipe, or connection.	Clean, repair or replace.
	Mechanical defect in steering gear.	Repair or replace.
Steering wheel has a heavy feel.	Oil level low in reservoir.	Add oil.
	Low oil pressure due to broken or damaged oil pump.	Replace pump.
	Steering valve stuck.	Clean, repair or replace.
	Low oil level in steering gearbox.	Inspect oil level, fill to proper level.
	Damaged bolt and nut in steering gearbox.	Replace damaged parts.
Difficult to drive in a straight line	Defective spool in steering valve.	Tighten lock nut.
	Stuck or damaged steering valve or damaged or defective spring.	Repair or replace.
	Improper fit of track line.	Repair or replace.
Noise during steering	Low oil level in reservoir.	Add oil.
	Restricted inlet pipe or filter.	Clean or replace
Steering system leaking oil	Worn or damaged O-ring and oil seal of pipe and steering valve.	Replace worn or damaged parts.

DISASSEMBLY

It is very important to keep the inside of the steering unit clean. Make sure that the outside of the steering unit is clean before opening the unit. Use a wire brush and solvent to clean the entire unit.

1. Remove steering column from steering unit. Bolt steering unit to stabilizing base. Bolt base to work bench.
2. Remove bolts from steering unit end cover. See Figure 10.

Figure 10

3. Remove end cover from unit. See Figure 11.

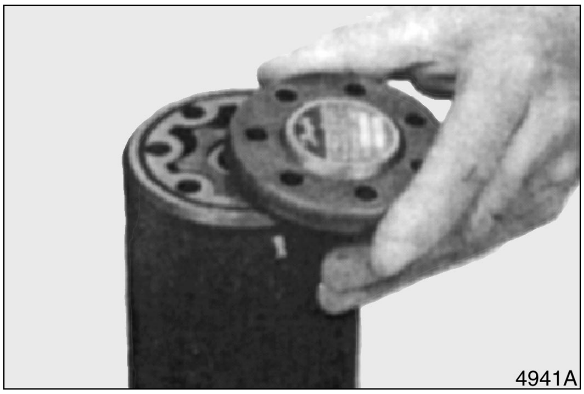

Figure 11

4. Lift cylinder gear off unit. See Figure 12. Remove two O-rings.

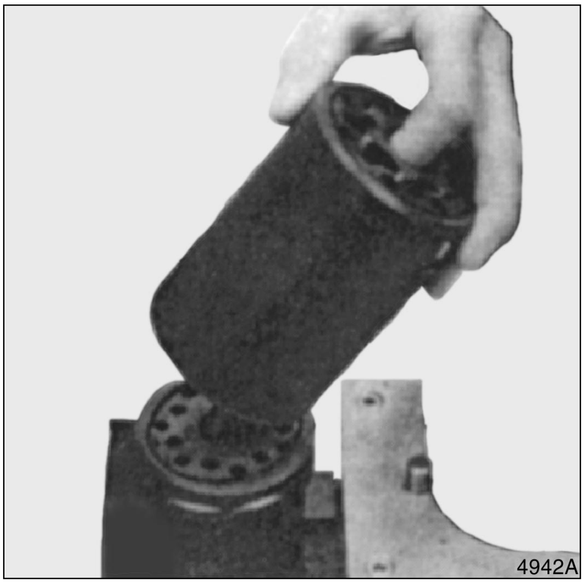

Figure 12

5. Remove spacer bushing and spacer from cylinder gear (If equipped). See Figure 13.

NOTE: *Refer to parts manual for our unit to determine if these parts are installed.*

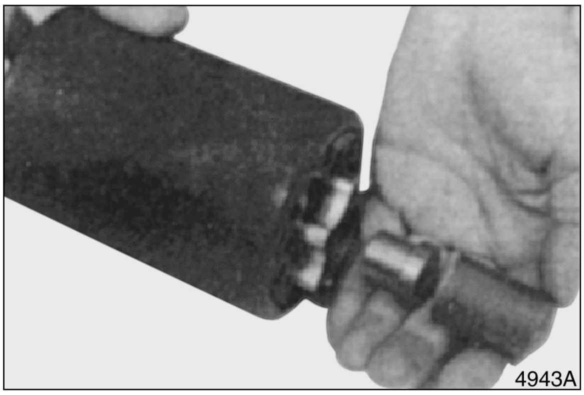

Figure 13

6. Remove shaft from housing. See Figure 14.

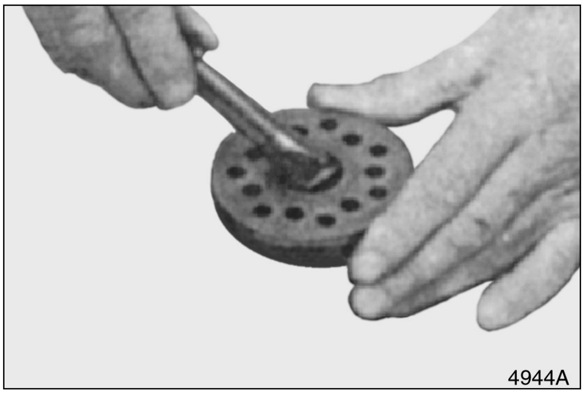

Figure 14

7. Remove distributor plate from housing. See Figure 15.

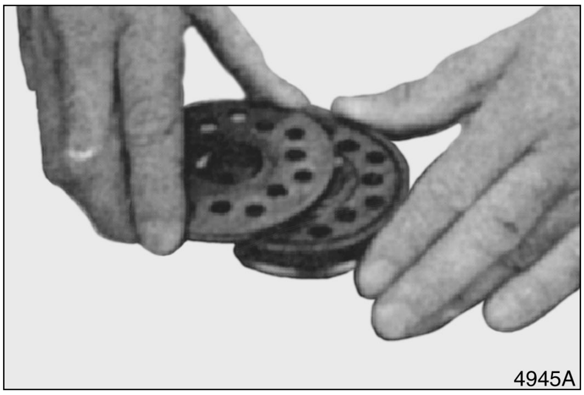

Figure 15

8. Remove O-ring from top of middle plate. See Figure 16.

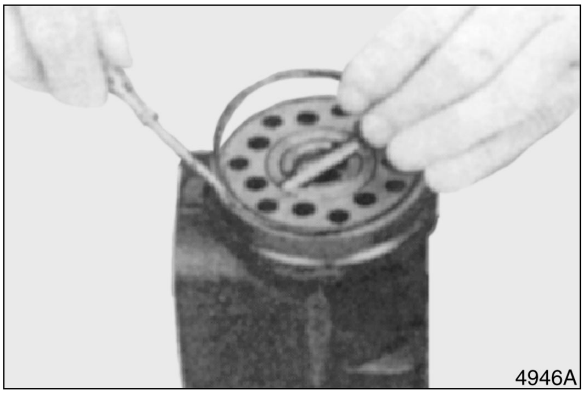

Figure 16

9. Lift middle plate off housing. See Figure 17.

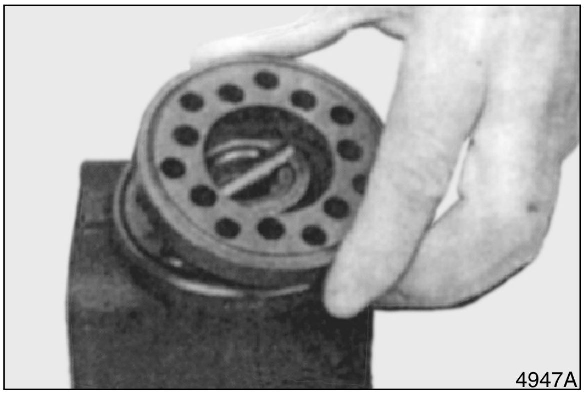

Figure 17

10. Remove O-ring from housing. See Figure 18.

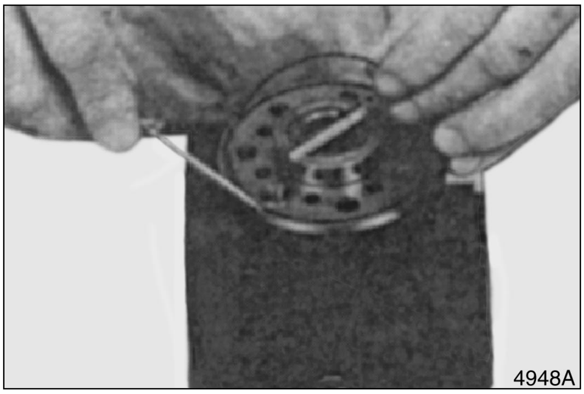

Figure 18

11. Unscrew threaded bushing and remove it. See Figure 19.

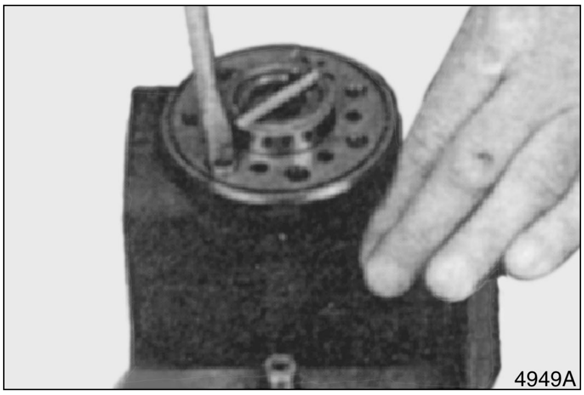

Figure 19

12. Remove cross pin. See Figure 20.

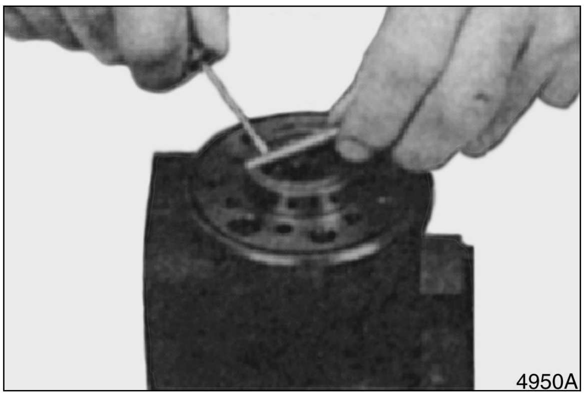

Figure 20

13. Shake ball out of housing. See Figure 21.

Figure 21

14. Pull sleeve and spool out of housing. See Figure 22.

Figure 22

15. Remove thrust bearing and thrust washers from sleeve. See Figure 23. Remove spacer ring. Be sure to remove spacer ring. It can stick in sleeve.

Figure 23

16. Carefully slide control spool out of sleeve. See Figure 24.

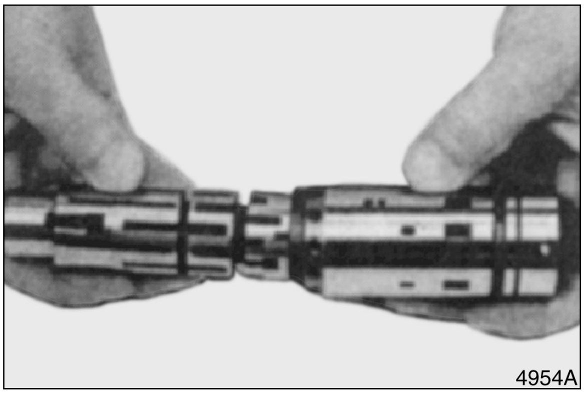

Figure 24

17. Push neutral position springs out of groove in spool. See Figure 25.

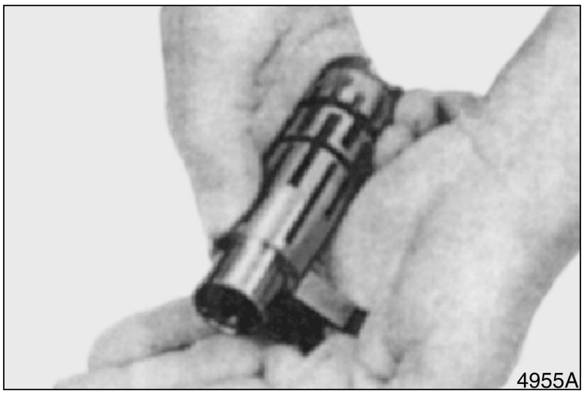

Figure 25

18. Remove dust seal from housing. See Figure 26. Remove O-ring and backup ring from inside housing.

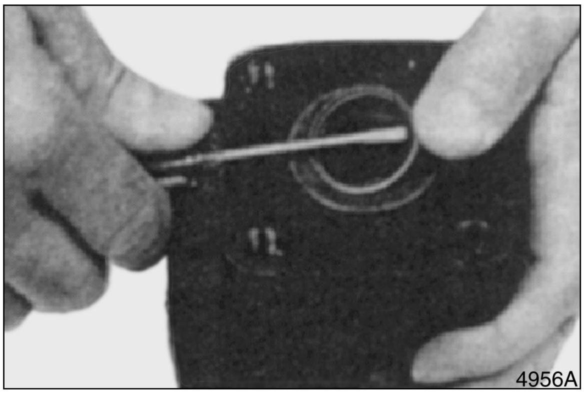

Figure 26

19. Figure 27, shows all parts removed from steering unit. Clean all parts before assembly. Use only new O-rings and seals.

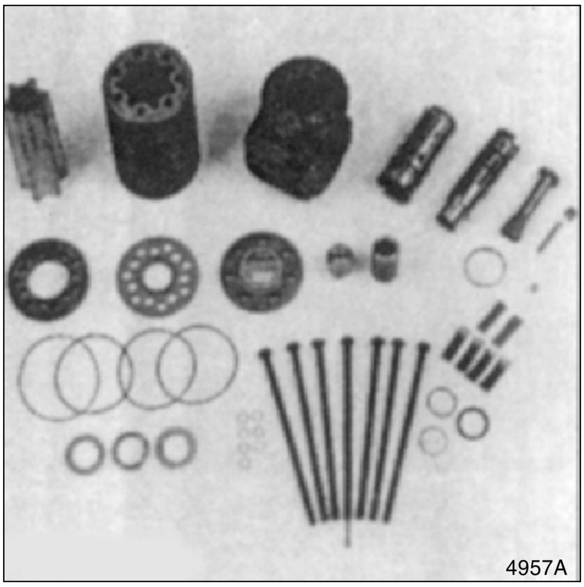

Figure 27

CLEANING AND INSPECTION

For general cleaning and inspection procedures, refer to "General Maintenance Procedures" section.

REASSEMBLY

NOTE: *Use bolt torque chart that follows to tighten bolts as steering unit is assembled.*

Bolt Torque Chart	
Bolt Size	**Torque Value**
M10	4.8 kg•m (35 ft lb)
3/8 - 16 NC	4.8 kg•m (35 ft lb)

1. Install springs in spool slot. See Figure 28. Springs must be positioned as shown in Figure 29.

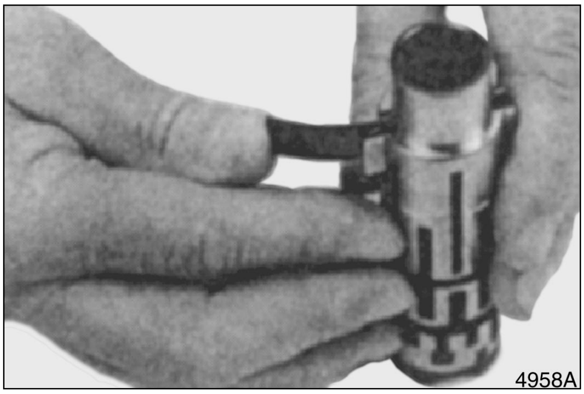

Figure 28

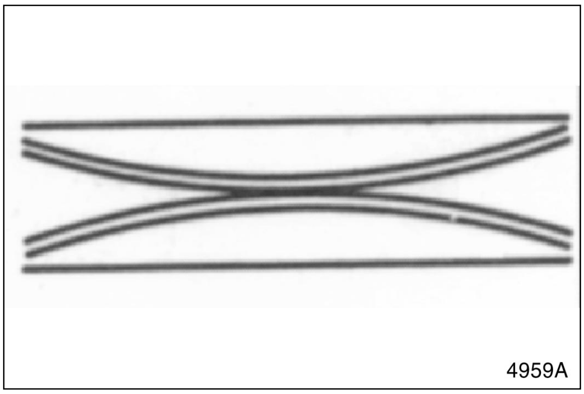

Figure 29

2. Position springs so that amount of spring protruding out of spool is equal on both sides. See Figure 30.

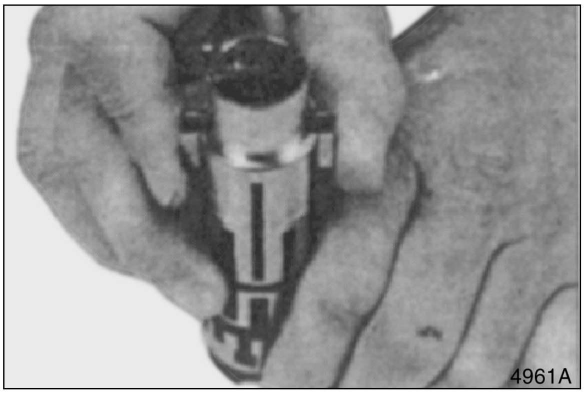

Figure 30

3. Insert spool into sleeve. See Figure 31. Use care so that sleeve and spool are correctly assembled. The spring slot in sleeve must align with spring slot in spool. Also, one of the T shaped slots (A) in the spool must align with one of the small holes (B) in sleeve. See Figure 32.

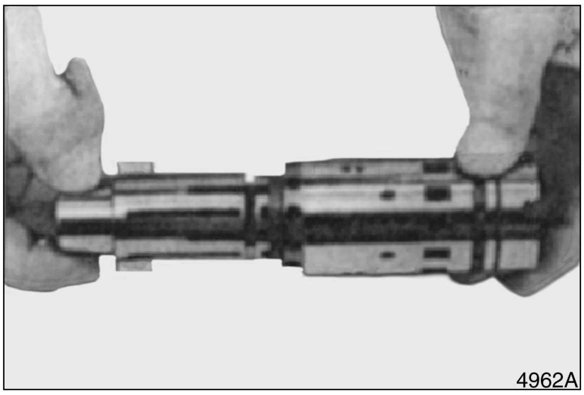

Figure 31

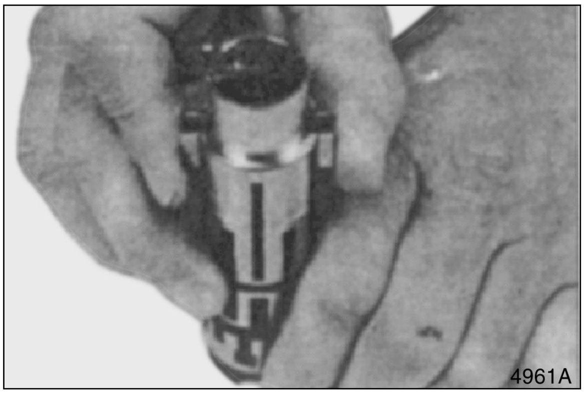

Figure 32

4. Center springs in sleeve. See Figure 33.

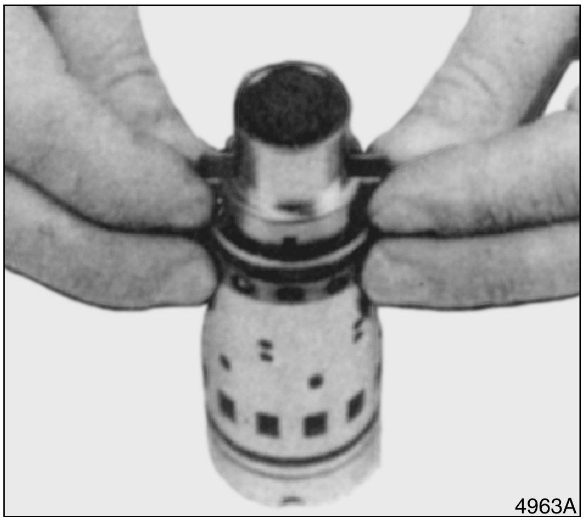

Figure 33

5. Install seal ring on sleeve. See Figure 34. Burnish seal ring with a smooth object until seal does not protrude past diameter of sleeve.

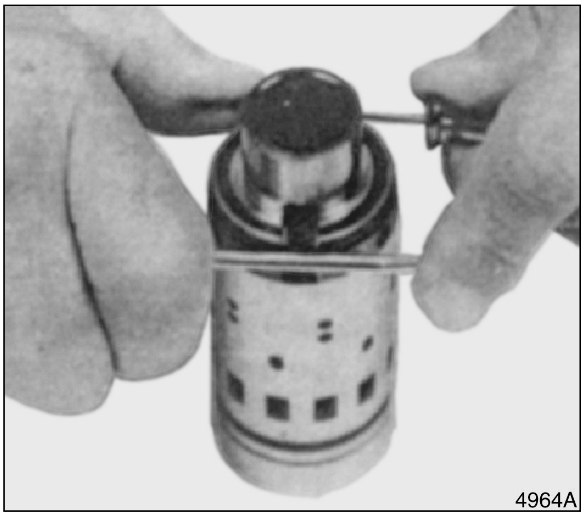

Figure 34

6. Rotate seal ring. See Figure 35. It must rotate freely without resistance.

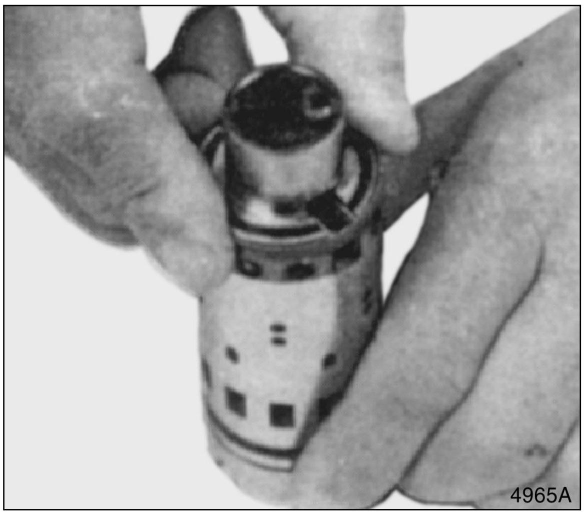

Figure 35

7. Turn sleeve 180°. Install cross pin into sleeve and spool. See Figure 36.

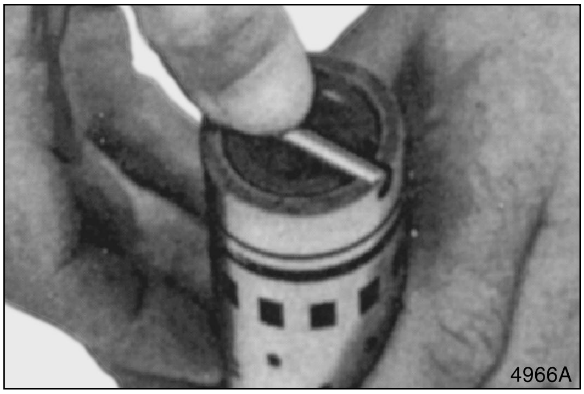

Figure 36

8. Install two thrust washers and thrust bearing over end of spool. See Figure 37. The sequence of the parts installation is shown in Figure 38.

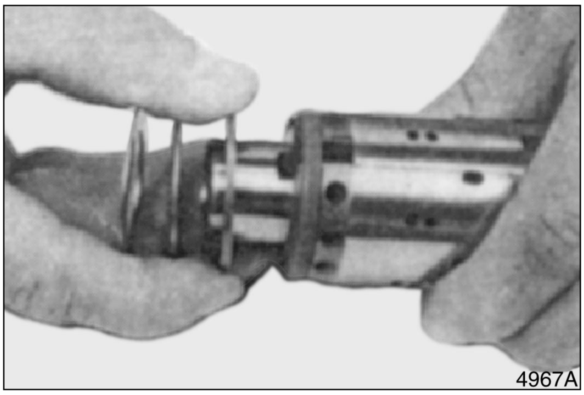

Figure 37

Reference Number	Description
1	Thrust Washer
2	Thrust Bearing
3	Thrust Washer
4	Spool
5	Sleeve

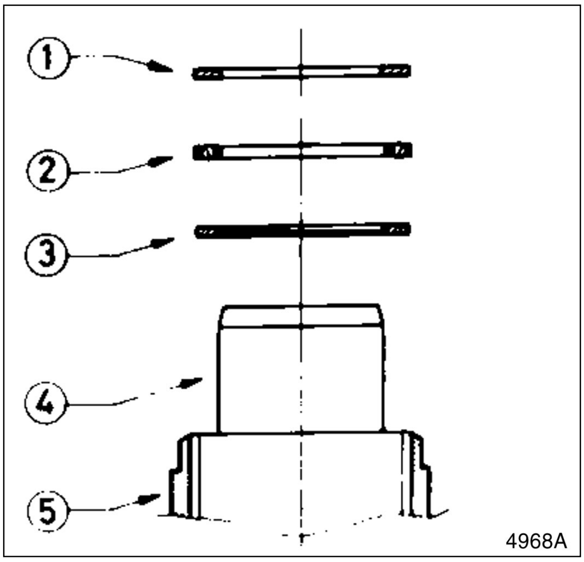

Figure 38

9. Oil O-ring and backup ring and then install them on an O-ring assembly tool. See Figure 39.

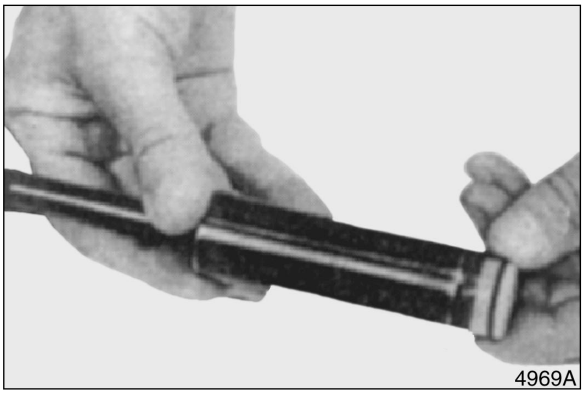

Figure 39

10. Insert assembly tool down into bore of steering unit. See Figure 40.

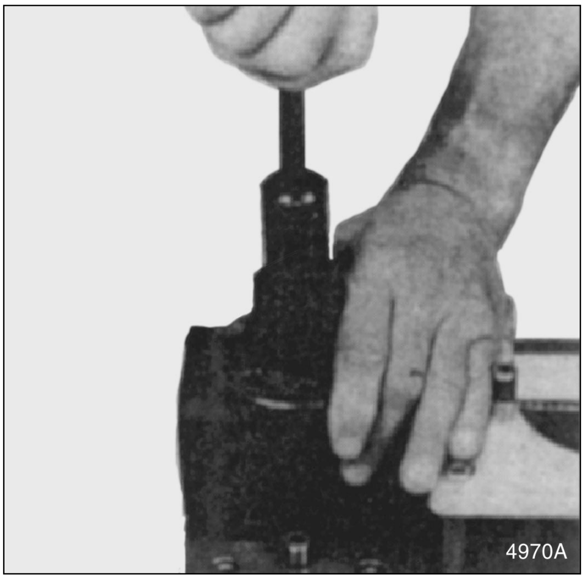

Figure 40

11. Use assembly tool to install O-ring and backup ring into bore. See Figure 41.

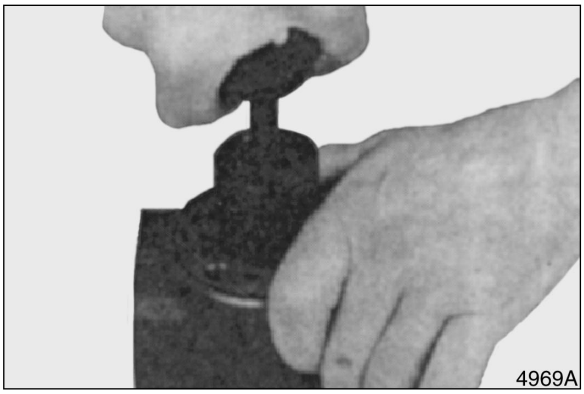

Figure 41

12. Unbolt housing from stabilizing base. Hold housing in a horizontal position. See Figure 42. Insert sleeve and spool into bore.

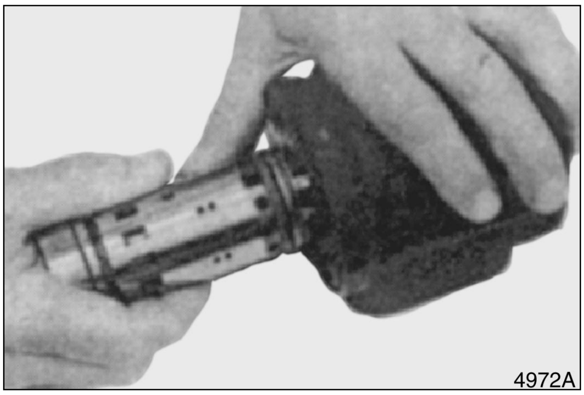

Figure 42

13. The sleeve will push the O-ring and backup ring into correct position. See Figure 43.

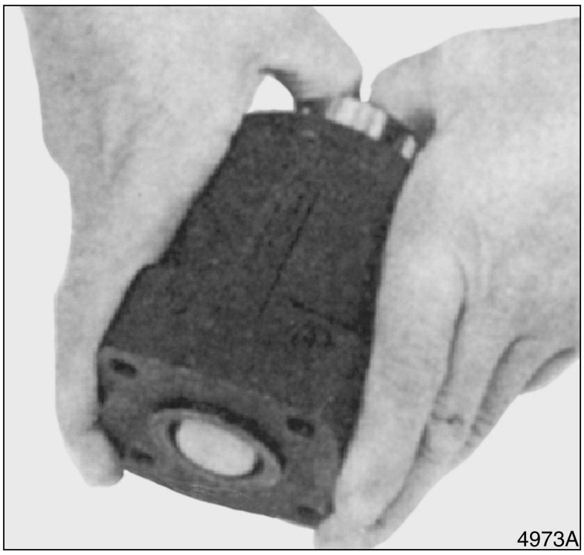

Figure 43

14. Bolt housing back into stabilizing base. See Figure 44.

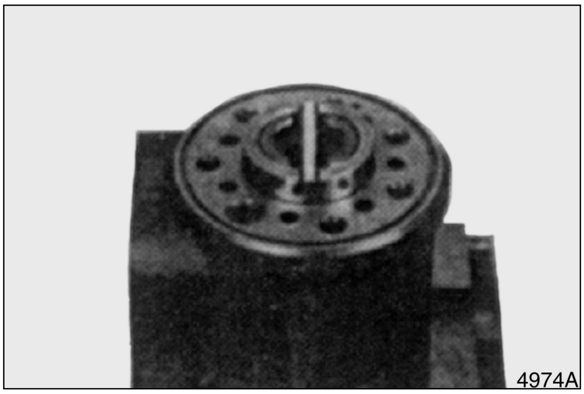

Figure 44

15. Insert ball into hole. See Figure 45.

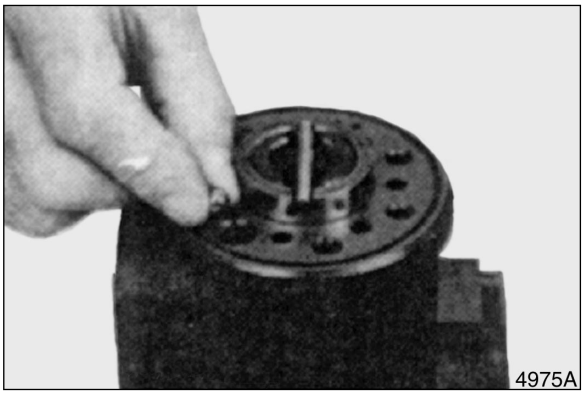

Figure 45

16. Install threaded bushing into hole that ball was placed into. See Figure 46. Lightly tighten bushing. The top of the bushing must be lower than the surface of housing.

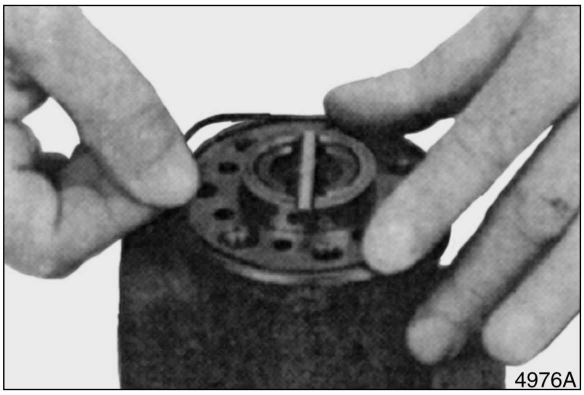

Figure 46

17. Lubricate O-ring with 20 weight mineral oil and install it in groove. See Figure 47.

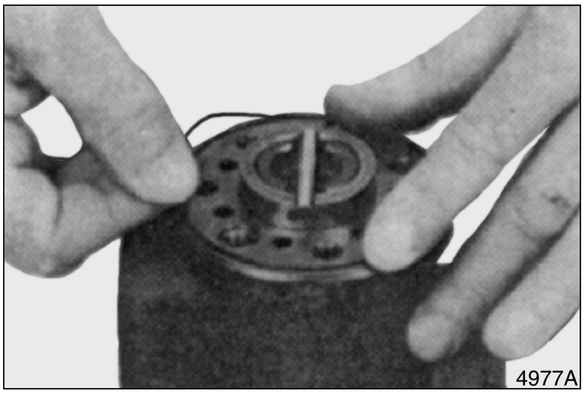

Figure 47

18. Install middle plate onto housing. See Figure 48. Be sure to properly align plate holes with holes in housing.

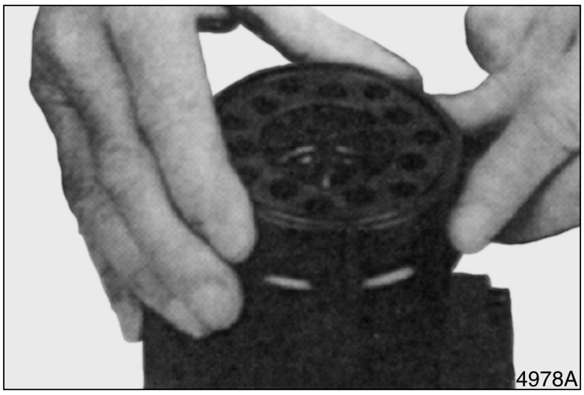

Figure 48

19. Lubricate O-ring with 20 weight mineral oil and install it in groove. See Figure 49.

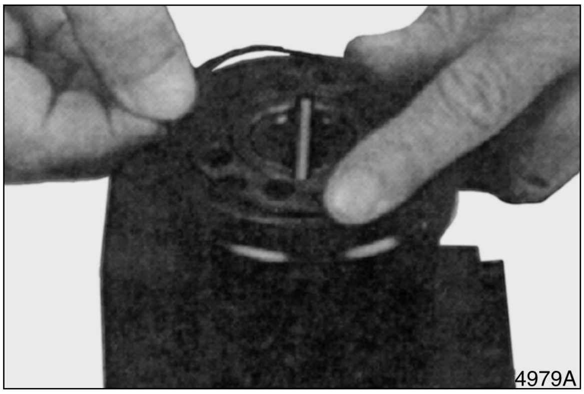

Figure 49

20. Install distributor plate. See Figure 50. Be sure to properly align plate holes with holes in middle plate.

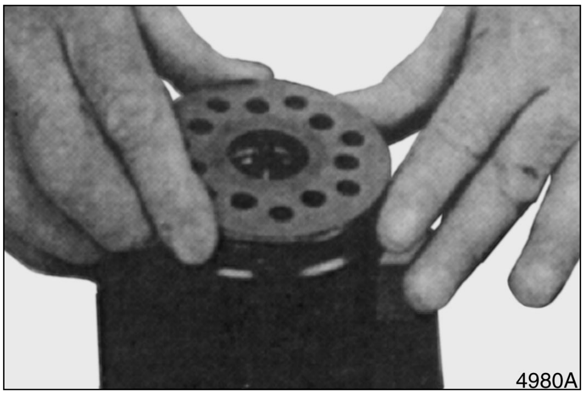

Figure 50

21. Install shaft into bore of housing. See Figure 51. Position slot in shaft to engage cross pin.

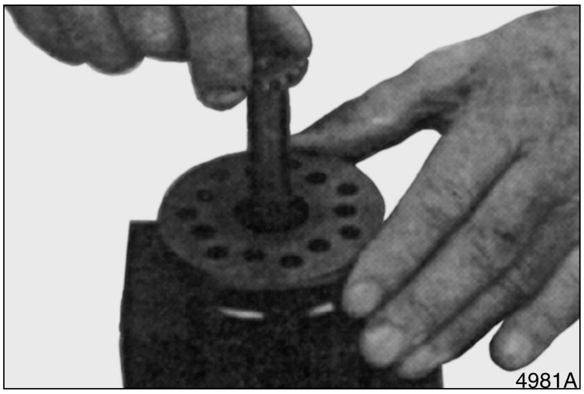

Figure 51

22. Position rotor so that cross pin is between two teeth as shown by position of screwdriver. See Figure 52.

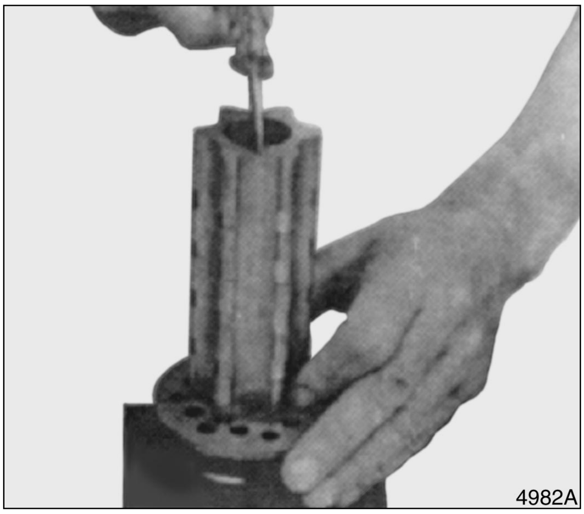

Figure 52

23. Lubricate two O-rings with 20 weight mineral oil and install them in grooves of cylinder gear. Slide cylinder gear into position on housing. See Figure 53.

Figure 53

24. Use a bolt to align holes in cylinder gear with bolt holes in housing. See Figure 54.

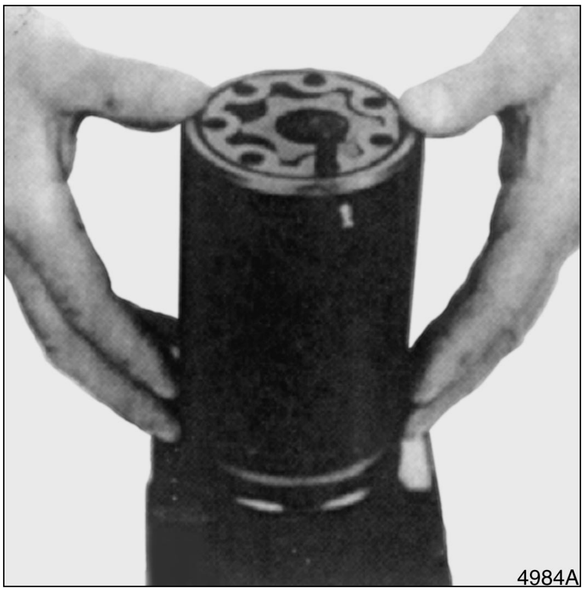

Figure 54

25. Install spacer bushing. See Figure 55. Remove bolt that was installed in previous step (If equipped.).

    OSPL 630:1 = 3.80 mm (0.1496 in) (15, Figure 5)

    OSPL 800 (16, Figure 5)

    OSPL 1000 (16, Figure 5)

    NOTE: *Refer to parts manual for our unit to determine if these parts are installed.*

Figure 55

26. Use a screwdriver to install OSPL 800 and 1000 spacers (If equipped.). See Figure 56.

    NOTE: *Refer to parts manual for our unit to determine if these parts are installed.*

Figure 56

27. Install end cover. See Figure 57.

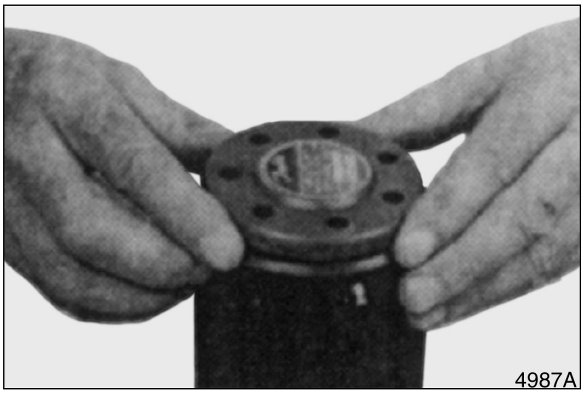

Figure 57

28. Install a washer and roll pin into hole shown in Figure 58.

Figure 58

29. Install six remaining bolts and tighten them. See Figure 59. Cross tighten bolts and roll pin to 48.1 Nm (35 ft lb).

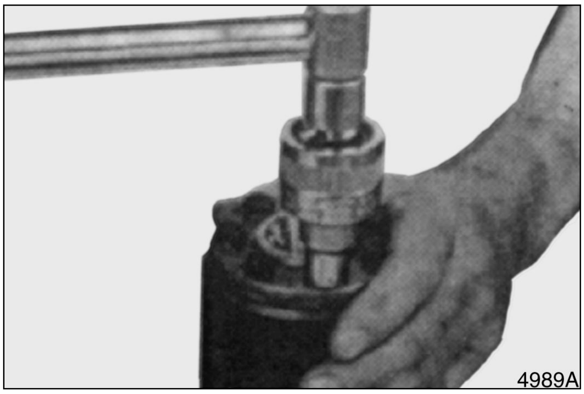

Figure 59

30. Turn steering unit over and work from opposite side. Set dust seal in position on housing. See Figure 60.

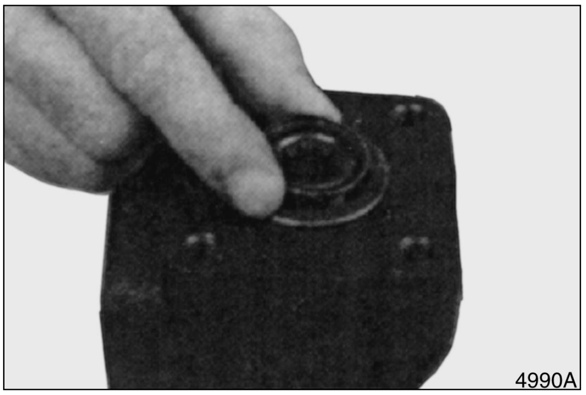

Figure 60

31. Use a seal driver and a plastic hammer to install dust seal. See Figure 61.

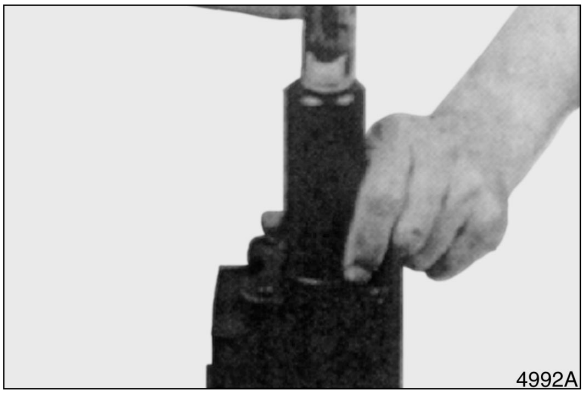

Figure 61

32. Install plastic plugs to prevent dirt from entering steering unit. See Figure 62.

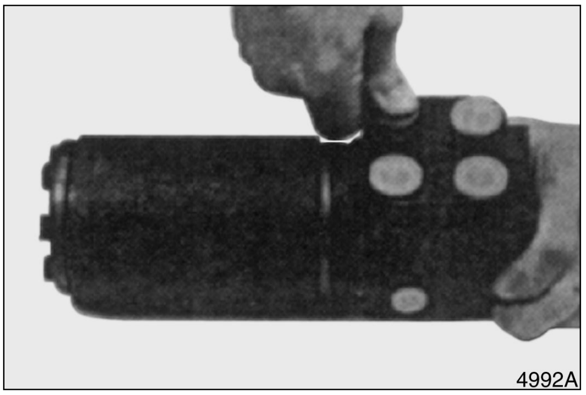

Figure 62

33. Figure 63, shows port identification for steering unit.

    L = Left pressure port.

    R = Right pressure port

    T = Tank port

    P = Pressure from pump.

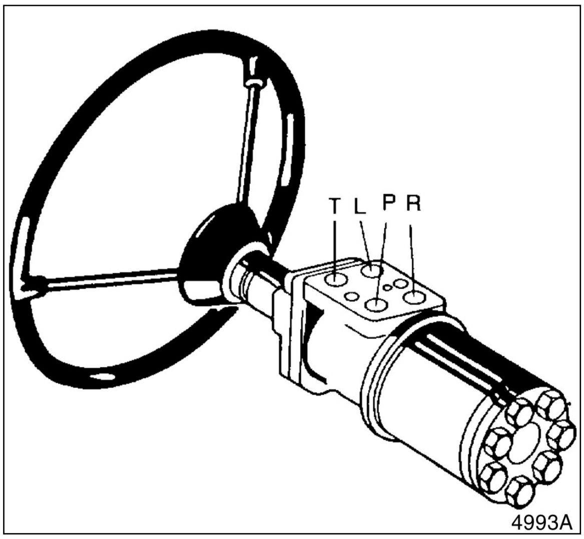

Figure 63

INSTALLATION

The following table shows torque specifications for hydraulic fittings used to install steering unit.

Type of Screw Fitting	Tightening Torque kg•m (ft lb)		
	1/4 RG 1/4 BSP.F R 1/4 G l/4	1/2 RG 1/2 BSP.F R 1/2 G 1/2	7/16-20UNF
Cutting Edge	4 (29)	10 (72)	
Copper Washer	2 (15)	3 (22)	
Aluminum Washer	3 (22)	8 (58)	
O-ring			2 (15)

S0709750K

DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

RESTRICTION VALVE

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Mega 500-V	1001 and Up

May 2001

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GENERAL DESCRIPTION

THEORY OF OPERATION

The restriction valve is made up of one cartridge C1 and four bypass check valves C2, C3, C4, and C5.

Output from the steering pump passes through the priority valve that is part of the flow amplifier. See the hydraulic schematic (Figure 1). This flow then passes out of the flow amplifier and enters the restriction valve at port EF. This allows output from the steering pump to join flow from the main pump to supply the boom, bucket and option control valves.

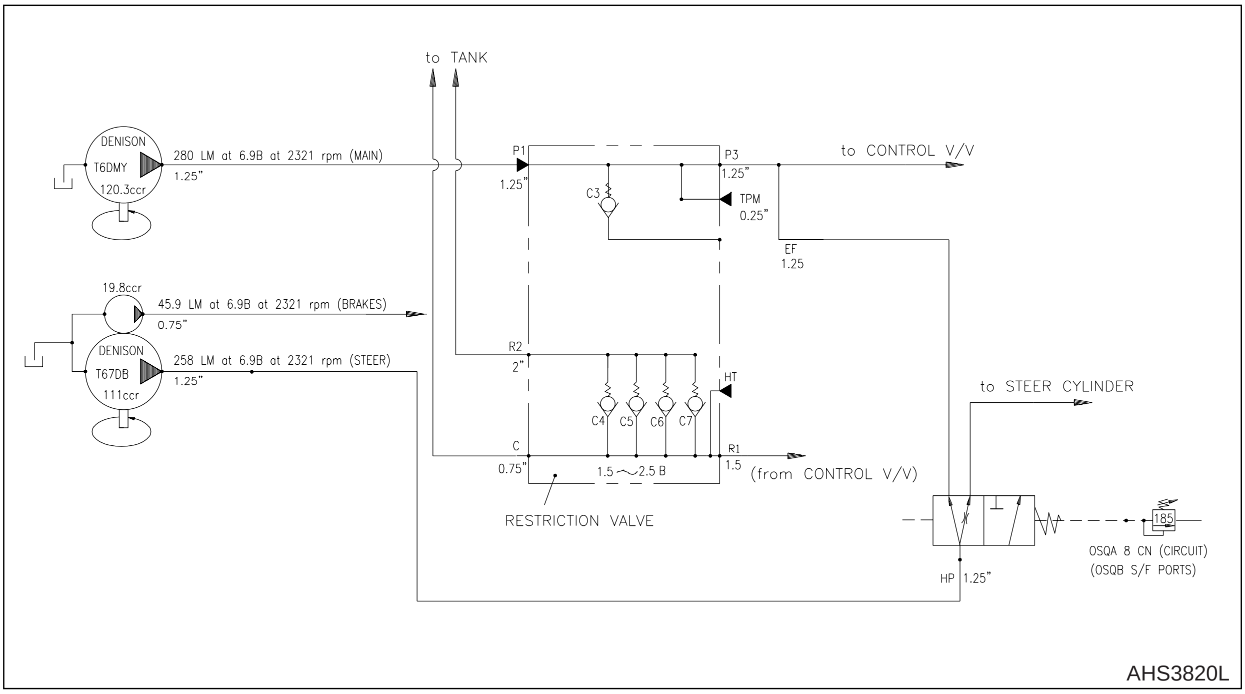


Figure 1 RESTRICTION CIRCUIT

UNLOADER CARTRIDGE IDENTIFICATION

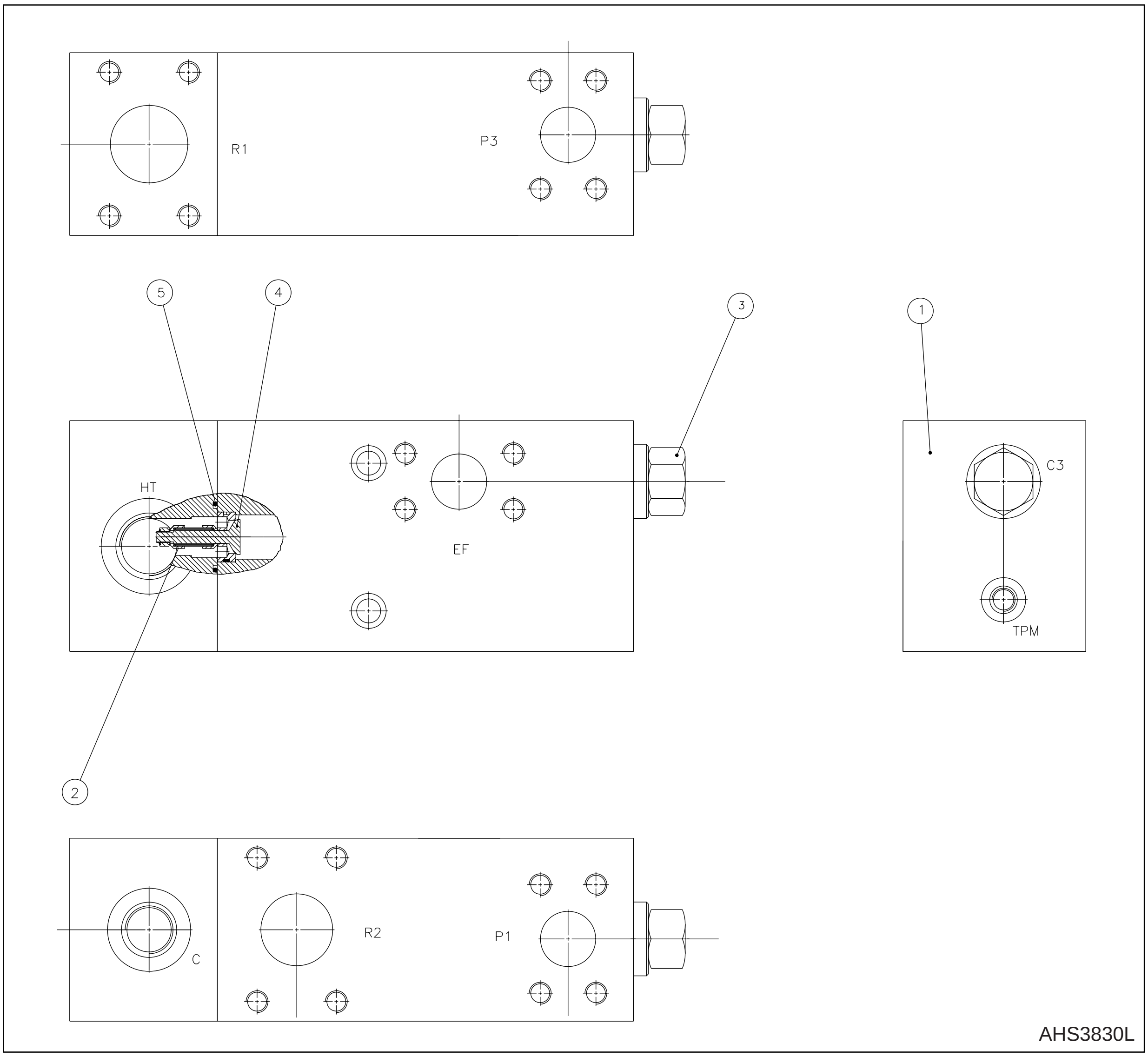


Figure 2 VALVE CARTRIDGE IDENTIFICATION

Reference Number	Description	Remark
1	Body	$125 \times 99 \times 184$
2	Sub Block	$125 \times 99 \times 79$
3	Check Valve	C3
4	Check Valve	C4, 5, 6, 7
5	O-ring	

SPECIFICATIONS

Item		Specification
Maximum Rated Pressure		210.0 bar (3,045.84 psi)
Rated Flow Ports to R1,R3,C		200 ℓ/min. (52.8 gpm)
Rated Flow Ports to R2		700 ℓ/min. (184.8 gpm)
Setting Pressure	C4, 5, 6, 7	0.7 ± 0.1 Bar (10 ±1.5 psi) Cracking Pressure
Port Size	R1, R2	2" SAE Flange Port (M12, 1.75)
	P1, EF, P3	1-1/4" SAE Flange Port (M12, 1.75)
	HT	1" PF O-ring
	TPM	1/4" PF O-ring
	R3	1/4" PF O-ring (Supplied Plugged)
	C	3/4" PF O-ring

S0793060K

DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

HYDRAULIC SCHEMATIC (MEGA 500-V)

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Mega 500-V	1001 and Up

May 2001

TABLE OF CONTENTS

GENERAL DESCRIPTION

Schematic(s) presented in this section are laid out on facing pages.

An overlapping edge has been taken into consideration so that a photocopy can be made and pasted together to make a complete schematic.

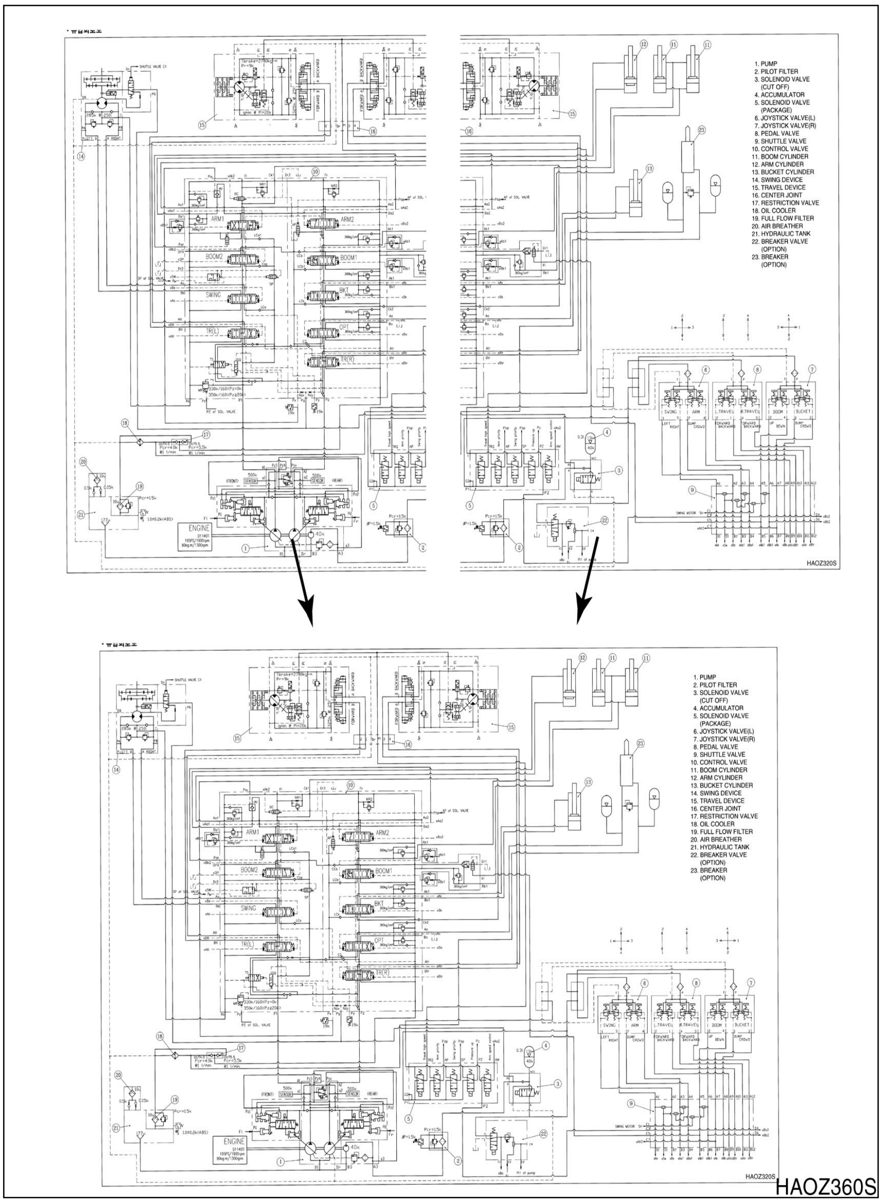


Figure 1

MEGA 500-V

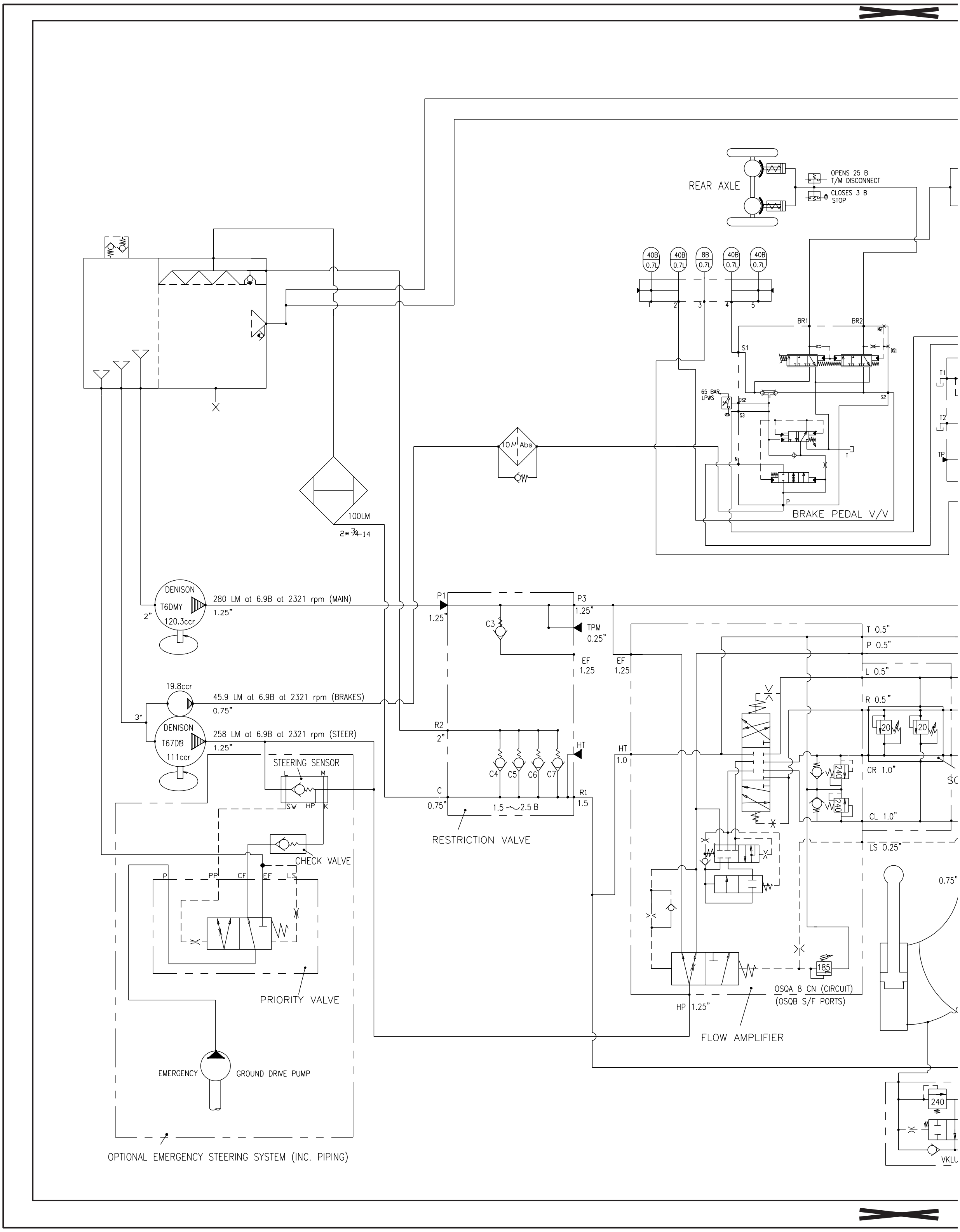
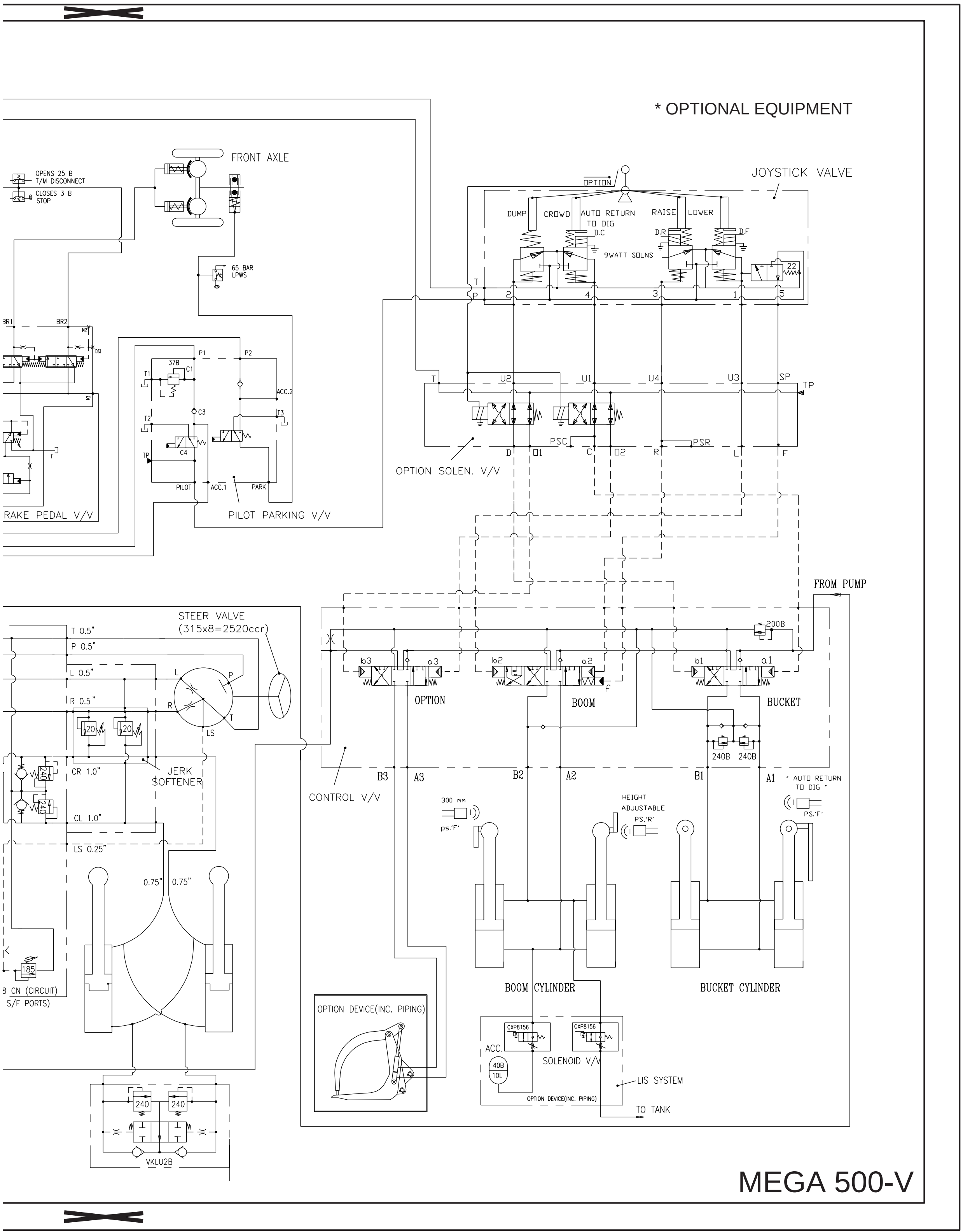


Figure 2


* OPTIONAL EQUIPMENT
FRONT AXLE
JOYSTICK VALVE
OPTION
DUMP
CROWD
AUTO RETURN TO DIG
RAISE
LOWER
9WATT SOLNS
OPENS 25 B T/M DISCONNECT
CLOSES 3 B STOP
65 BAR LPWS
RAKE PEDAL V/V
PILOT PARKING V/V
OPTION SOLEN. V/V
FROM PUMP
STEER VALVE (315x8=2520ccr)
JERK SOFTENER
CONTROL V/V
OPTION
BOOM
BUCKET
HEIGHT ADJUSTABLE
AUTO RETURN TO DIG
BOOM CYLINDER
BUCKET CYLINDER
OPTION DEVICE(INC. PIPING)
SOLENOID V/V
LIS SYSTEM
TO TANK
VKLU2B
CN (CIRCUIT) S/F PORTS)
MEGA 500-V

AHS3670L

ELECTRICAL SYSTEM

S0802190K

ELECTRICAL SYSTEM

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Mega 500-V	1001 and Up

May 2001

TABLE OF CONTENTS

OVERVIEW

The electrical system for this equipment is DC 24 volts. The rated voltage for all electric components is 24 volts with the exception of the car stereo and the air-conditioning control actuator. The system contains two 12 volt batteries connected in series and a three phase AC generator with a rectifier. The electric wiring used in the system is easily identifiable by the insulator color. The color symbols used in the electric system is listed in the following chart.

Electric Wire Color

Symbol	Color
W	White
G	Green
Or	Orange
B	Black
L	Blue
Lg	Light Green

Symbol	Color
R	Red
Gr	Gray
P	Pink
Y	Yellow
Br	Brown
V	Violet

NOTE: *RW: Red wire with White stripe*

R - Base Color, W - Stripe Color

NOTE: *0.85G: Nominal sectional area of wire core less insulator = 0.85 mm^2 (0.03 in^2)*

ELECTRIC SUPPLY SYSTEM

The electric power circuit supplies electric current to each electric component. It consists of a battery, battery relay, starter switch, circuit breaker, fusible link and fuse box.

The negative terminal of the battery is grounded to the vehicle body.

Even when the starter switch is in the "OFF" position, electric current is supplied to the following components through battery → fusible link → fuse circuit.

1. Cabin light, fuel pump switch, No. 1 terminal of DC-DC converter (back up for car stereo memory).
2. "B" terminal of starter switch and No. 22 terminal of air conditioner control panel.
3. Power terminal "B" of engine stop motor.

When the starter switch is in the preheat, on and start positions, the current flows from the battery → fusible link → fuse → starter switch "B" terminal/starter switch "BR" terminal → diode → battery relay "BR" terminal which activates the coil of the battery relay and the electric supply system is energized.

When the battery relay's contacts are connected, all electric devices can be operated.

While the engine is not running, the electric power for all electric devices are supplied by the battery. Once the engine is started the power is supplied from the alternator.

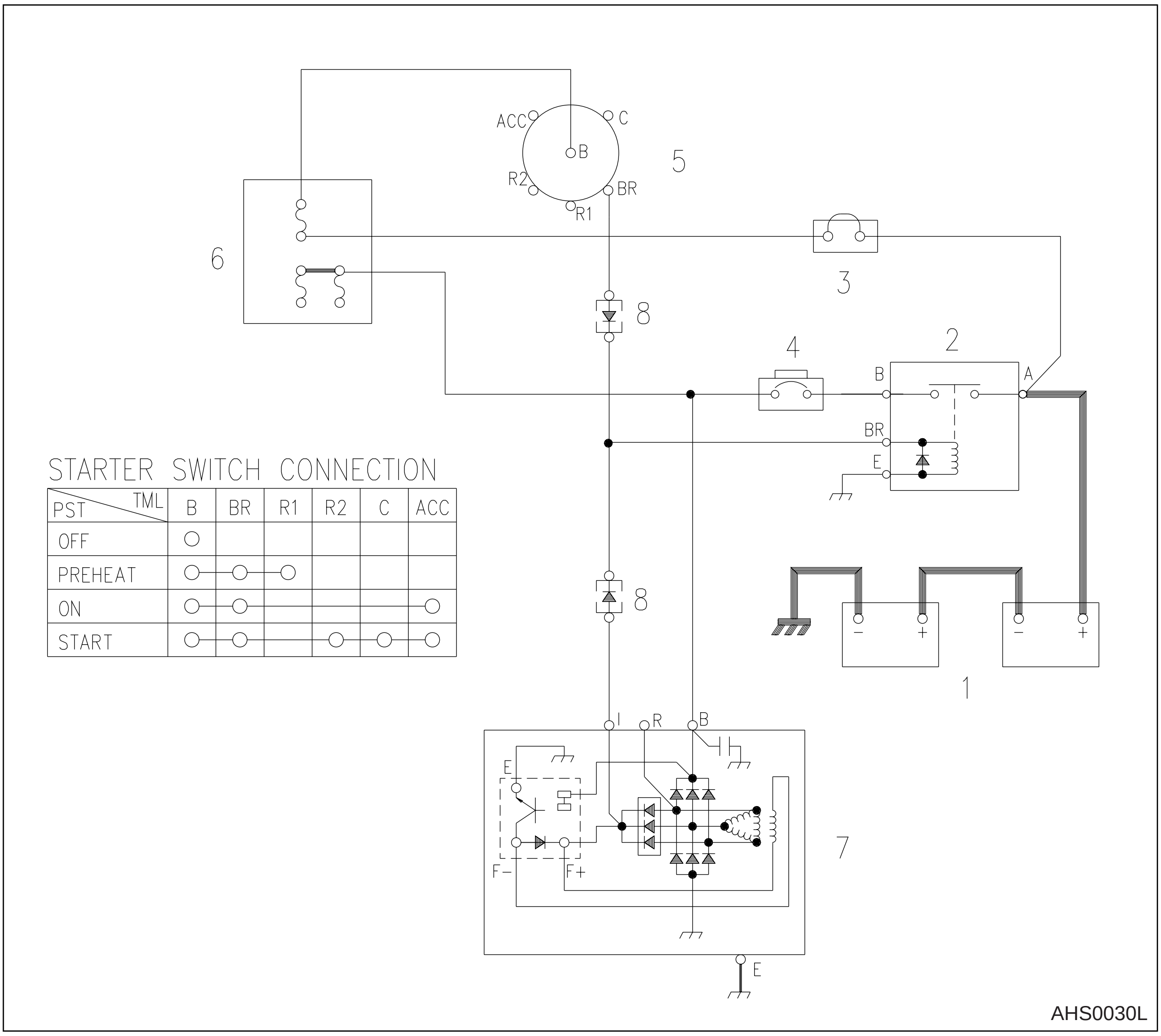


Figure 1 ELECTRICAL POWER CIRCUIT DIAGRAM

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker

Reference Number	Description
5	Starter Switch
6	Fuse Box
7	Alternator
8	Diode

ENGINE STARTING CIRCUIT

OPERATION DURING START PROCESS

When the starter switch is turned to the start position, the safety relay (14) is opened by the current flow from the connected "52" and "67" terminals of the transmission controller (13) and the "S" and "E" terminals of the starter controller (7) are connected. At this time the contacts in the starter relay (8) are closed by the current flow from the battery (1), to the fusible link (3), to the "B" terminal of the starter switch (5), to the "C" terminal of the starter relay (8), to the "D" terminal of the starter relay (8), to the "S" terminal of starter controller (7), to the "E" terminal of the starter controller, and then to the ground.

When the contact point "B" and "PP" of starter relay (8) are connected, the pinion gear of the starter (9) is pushed forward and makes contact with the ring gear of the flywheel and the internal contacts of the starter are connected.

The current flows from the battery (1), to the "A" terminal of the battery relay (2), to the "B" terminal of the battery relay (2), and then to the "B" terminal of the starter (9). The starter motor is rotated and the engine is started.

The engine can be cranked only when the transmission selector switch (11) is the neutral position. If the transmission selector switch (11) is in forward or reverse, the current that flows the switch (11) to the starter controller (7) opens the path to ground for the starter relay (8). This prevents the starter relay (8) from closing.

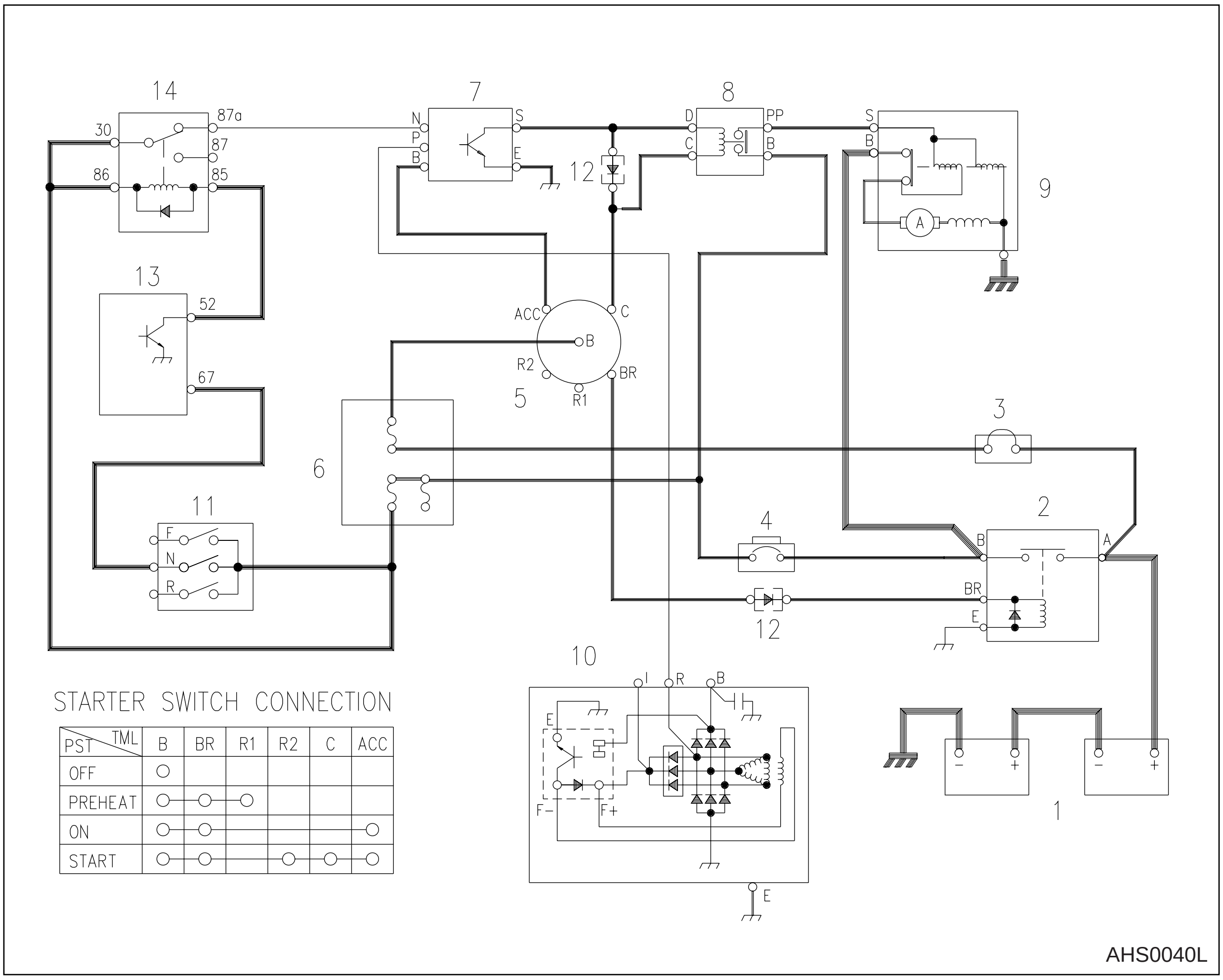


Figure 2 STARTER CIRCUIT (1) - WHILE STARTING

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker
5	Starter Switch
6	Fuse Box
7	Starter Controller

Reference Number	Description
8	Starter Relay
9	Starter
10	Alternator
11	Transmission Selector Switch
12	Diode
13	Transmission Controller
14	Safety Start Relay

OPERATION AFTER START PROCESS

Once the engine has been started, the belt driven alternator (10) generates a current. The output generated by the alternator is a square wave pulse voltage through the "P" terminal and the frequency of the pulse voltage is proportional to the rotation of the alternator. The starter controller (7) monitors the frequency of the output current. Once the frequency equivalent to 500 rpm is sensed the connection between "S" and "E" terminals and the connection between "B" and "PP" terminals are opened. As a result the rotation of the starter (9) is stopped. Once the engine is running, the starter (9) will not operate even if the starter switch (5) is moved to the start position, preventing possible damage to the starter (9).

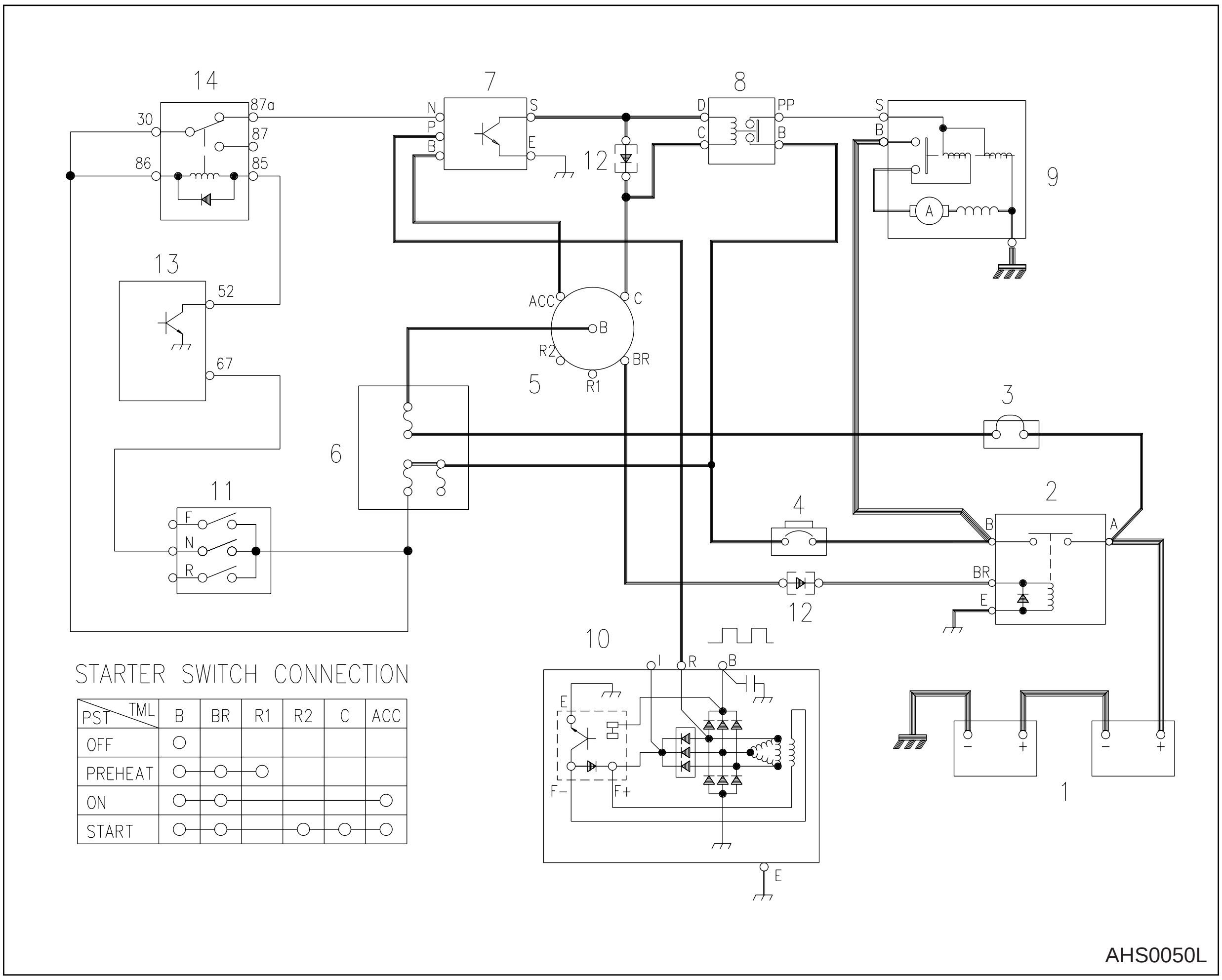


Figure 3 OPERATION OF START CIRCUIT (2) - IMMEDIATELY AFTER START

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker
5	Starter Switch
6	Fuse Box
7	Starter Controller

Reference Number	Description
8	Starter Relay
9	Starter
10	Alternator
11	Transmission Selector Switch
12	Diode
13	Transmission Controller
14	Safety Starter Switch

COLD WEATHER STARTING AID SYSTEM (OPTION)

Includes valve assembly, valve fitting, ether switch, 1219 mm [48 in] length of nylon tubing, fuel cylinder, single hole straight atomizer nozzle and bracket.

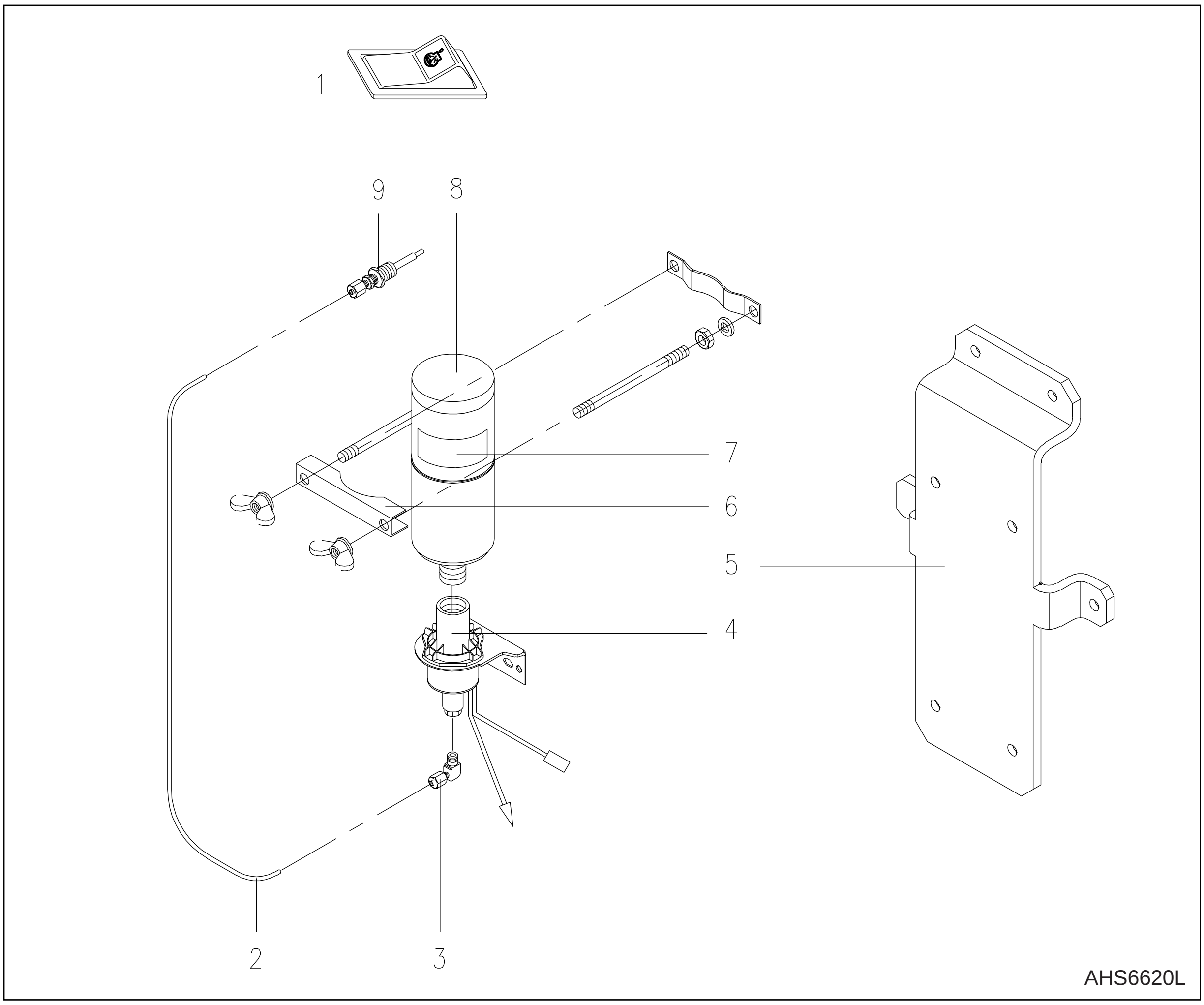


Figure 4

Reference Number	Description
1	Ether Switch
2	Nylon Tube
3	Valve Fitting
4	Valve Assembly
5	Bracket

Reference Number	Description
6	Fuel Cylinder Clamp
7	Dash Label
8	Fuel Cylinder
9	Atomizer

PRINCIPLE OF OPERATION

When the ether switch (7) is pressed and released, the valve (8) is operated and the ether is dispensed into the intake manifold of engine. After this operation the starter switch is turned to the start position, the engine can be cranked more easy.

NOTE: *Never hold the ether switch (7) in for more than 5 seconds, as this can damage the electric solenoid valve.*

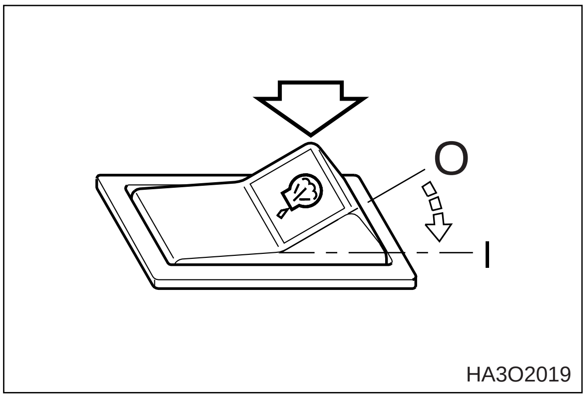


Figure 5

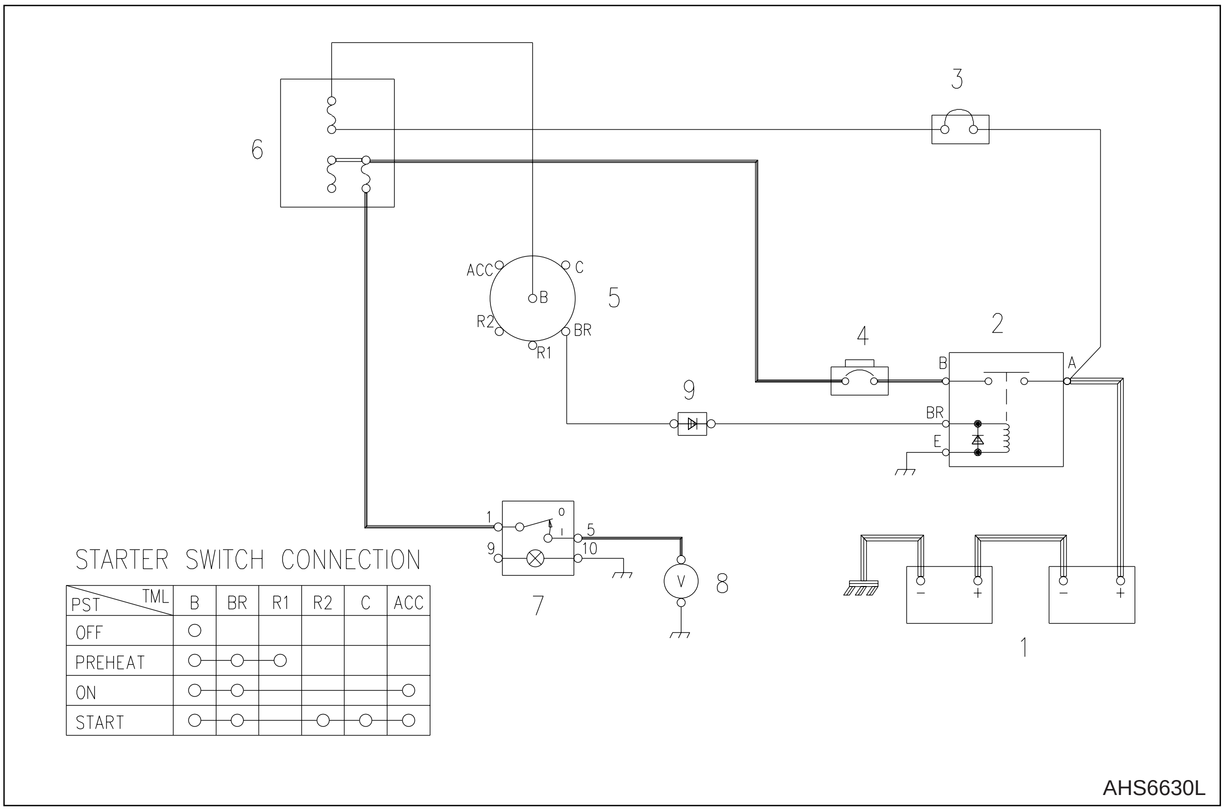


Figure 6 COLD WEATER STARTING AID CIRCUIT

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker
5	Starter Switch

Reference Number	Description
6	Fuse Box
7	Ether Switch
8	Ether Valve
9	Diode

ENGINE STOP AND DERATING SYSTEM

OPERATION IN ENGINE STOP MODE

The engine stop is achieved by the "open" or "closed" operation of the fuel shutoff valve in fuel pump with limited speed governor and duel lever control.

When the starter switch (5) is in the "ON" position, the fuel shutoff valve is opened due to the current flowing from the "BR" terminal of the starter switch (5) the fuel shutoff valve (7) and fuel is supplied to the cylinder. As a result the engine is being started.

When the starter switch (5) is in the "OFF" position during the engine running, because the current is not applied to the fuel shutoff valve (7), it is closed and fuel is not supplied to the cylinder. As a result the engine is stopped.

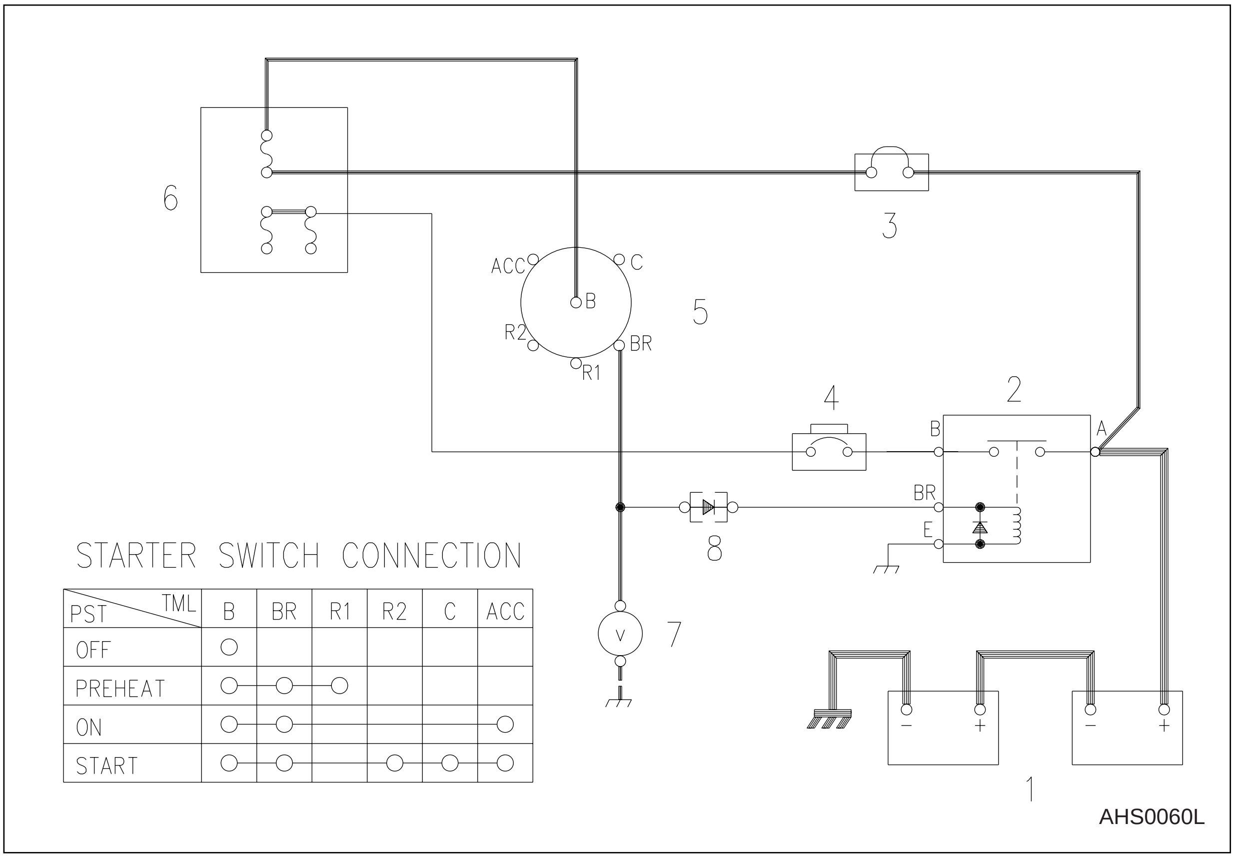


Figure 7 ENGINE STOP CIRUIT

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker

Reference Number	Description
5	Starter Switch
6	Fuse Box
7	Fuel Shot Off Valve
8	Diode

OPERATION IN ENGINE DERATING

For the purpose of reducing the input torque during the clutch slip when a shuttle shifting is done, engine derating is to be used.

When the shuttle shifting is occurred, the contacts points "30" and "87" of the engine derating relay (7) are closed due to the signal of the transmission controller (10). Then the engine derating relay (7) supply current to the engine derating solenoid which actuates a throttle lever linked limited speed governer in fuel injection pump.

In accordance with this, the engine rpm will be dropped down for maximum 0.7 seconds. (The operating time is set automatically in dependent of vehicle speed.)

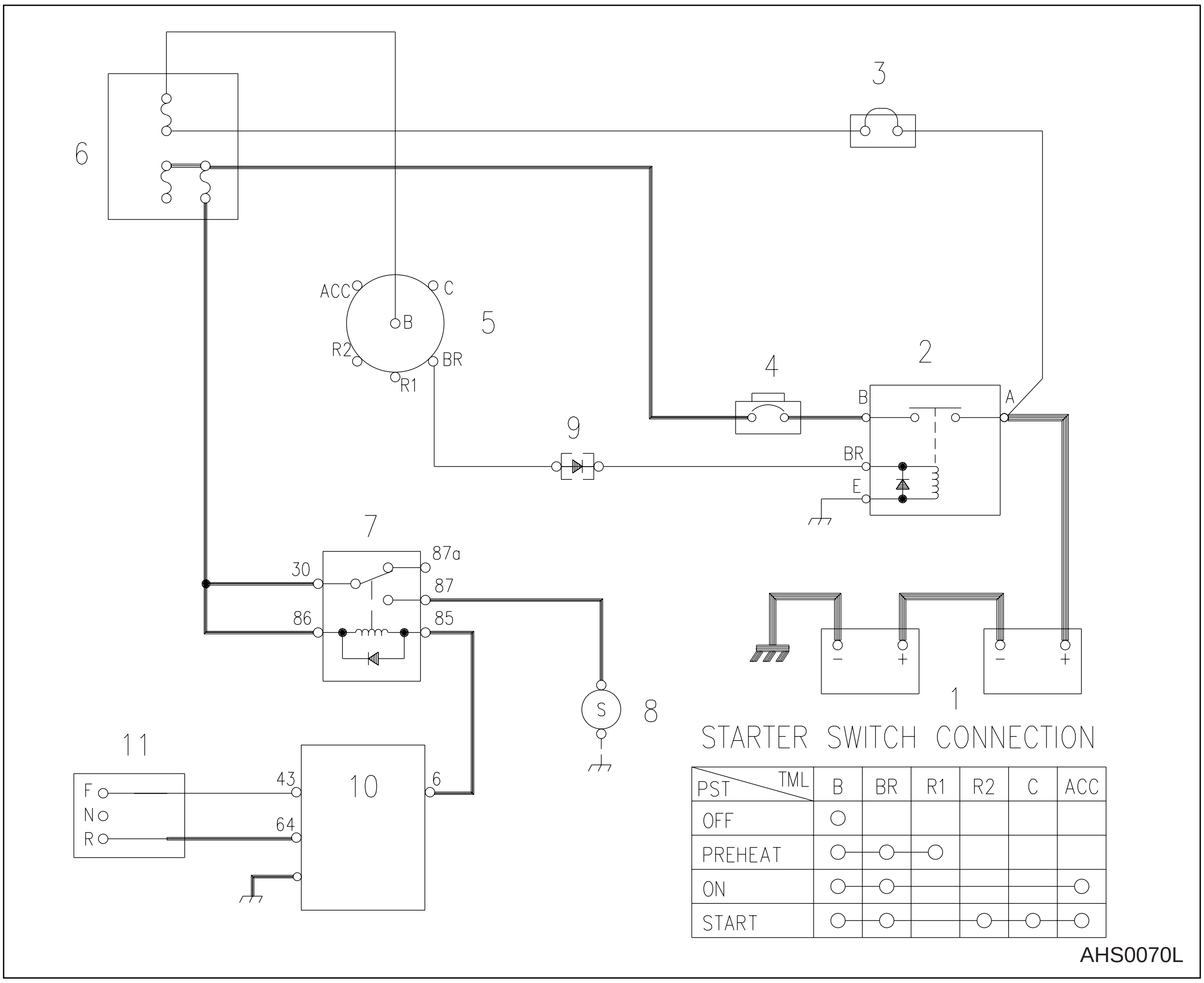


Figure 8 ENGINE DERATING CIRCUIT

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker
5	Starter Switch
6	Fuse Box

Reference Number	Description
7	Engine Derating Relay
8	Engine Derating Solenoid
9	Diode
10	Transmission Controller
11	Shift Lever Switch

CHARGING SYSTEM

When the starter switch (5) is turned to the "ON" position, an initial excited current flows to the field coil of the alternator (7) through the battery relay (2) and circuit breaker (4). When the engine is started from this condition the alternator (7) starts charging. The current flows from the "B+" terminal of alternator (7), to the circuit breaker (4), to the battery relay (2), and to the battery (1).

The alternator also supplies electric current to other electrical components. When the alternator (7) starts to operate, a current flows from the "R" terminal of alternator to the diode (8) and then to the battery relay (2) coil securing a path for the charging current to the battery (1). Thus, preventing the possibility of a high voltage build up and possible damage to the electrical system.

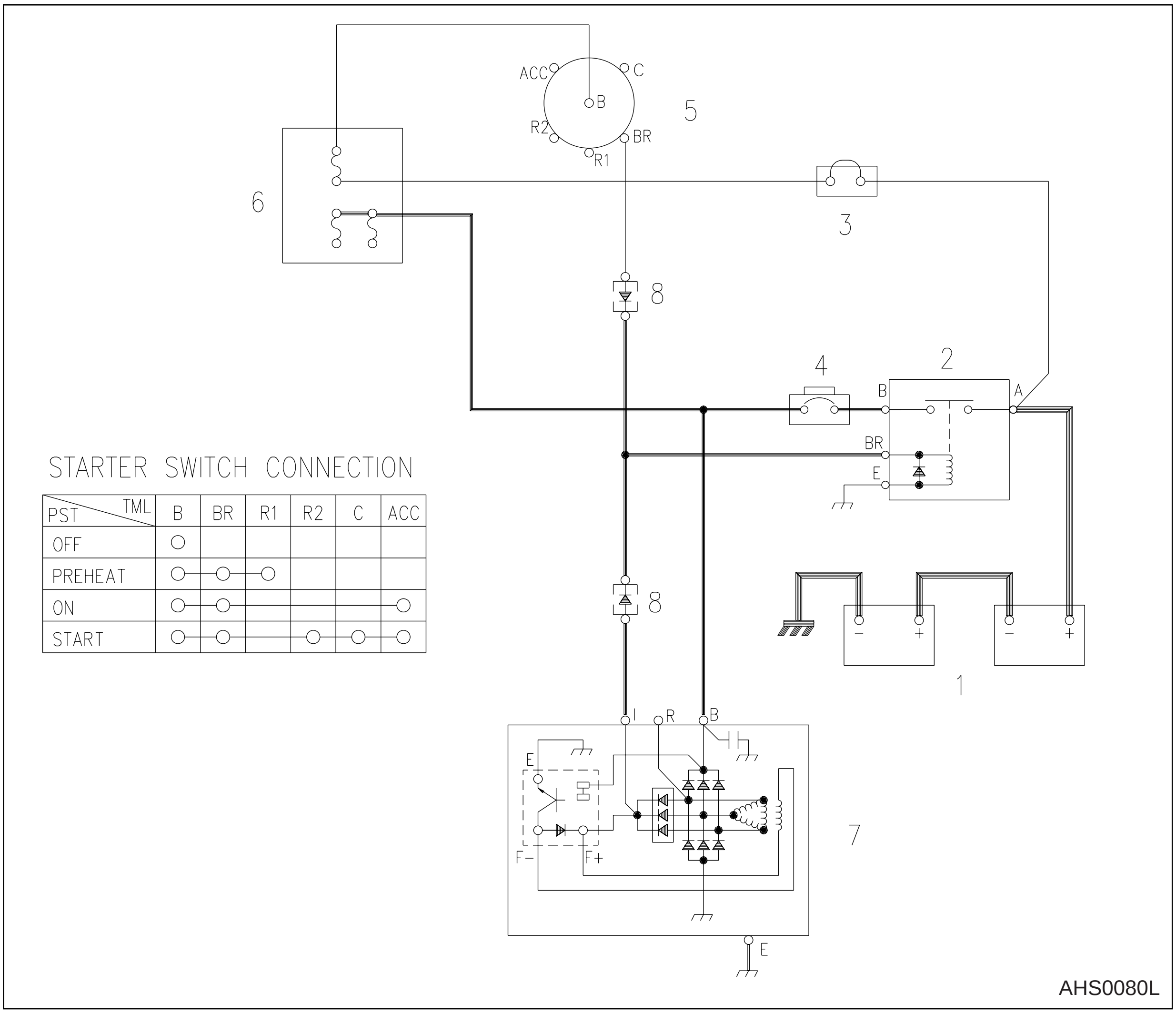


Figure 9 CHARGING CIRCUIT

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker

Reference Number	Description
5	Starter Switch
6	Fuse Box
7	Alternator
8	Diode

MONITORING SYSTEM

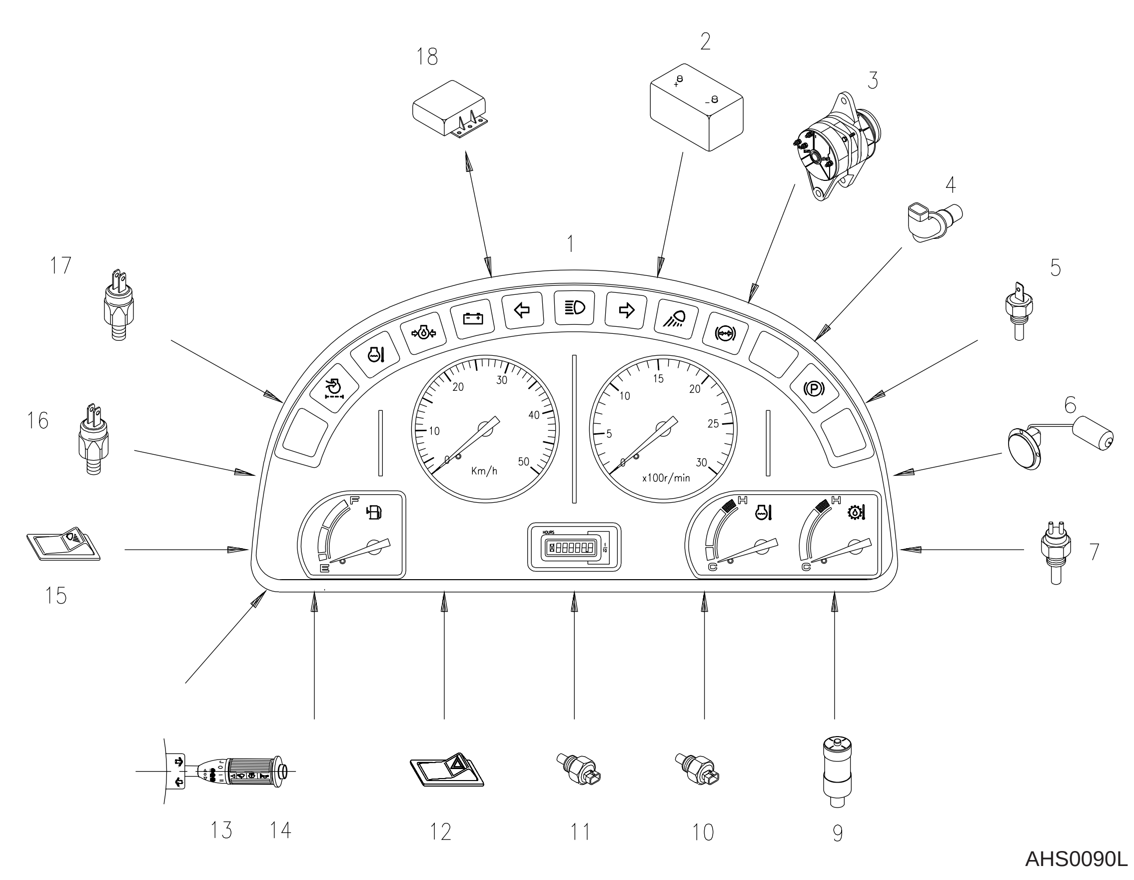


Figure 10

Reference Number	Description
1	Instrument Panel
2	Battery
3	Alternator
4	Speed Sensor
5	Coolant Temperature Sensor
6	Fuel Sensor
7	Transmission Oil Temperature Sensor
9	Air Cleaner Indicator
10	Engine Coolant Temperature Switch

Reference Number	Description
11	Engine Oil Pressure Switch
12	Hazard Warning Light Switch
13	Turn Signal Light Switch
14	High Beam Switch
15	Work Light Switch
16	Brake Oil Pressure Switch
17	Parking Brake Pressure Switch
18	Control Unit

The monitoring system displays the various data and warning signals onto the instrument panel by processing the information gathered from the various sensors throughout the equipment.

INSTRUMENT PANEL

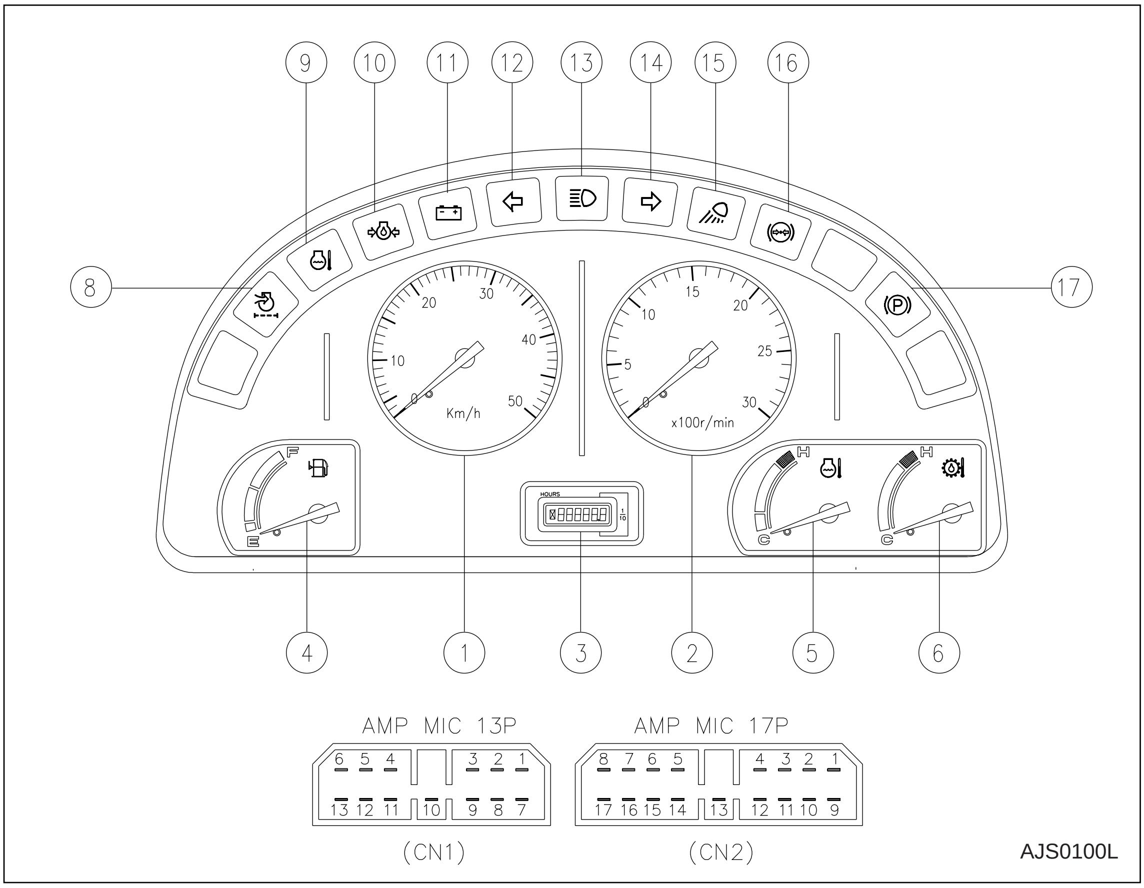


Figure 11

Reference Number	Description
1	Speed Meter
2	Tachometer (M160)
3	Hour Meter
4	Fuel Gauge
5	Engine Coolant Temperature Gauge
6	Transmission Oil Temperature Gauge
8	Air Cleaner Clogging Warning Light
9	Engine Coolant Temperature Warning Light

Reference Number	Description
10	Engine Oil Pressure Warning Light
11	Charging Warning Light
12	Turn and Hazard Warning Light
13	High Beam Indicator
14	Turn and Hazard Warning Light
15	Work Light Indicator
16	Brake Oil Pressure Warning Light
17	Parking Brake Indicator

FUNCTION CHECK

When the starter switch is turned to the "ON" position, all displays, switch lights and warning lights except turn and hazard warning light, high beam indicator and working light indicator will be lit for two seconds and the warning buzzer will sound. Any lights which do not turn "ON" during the function check should be replaced.

MONITORING SYSTEM SCHEMATIC

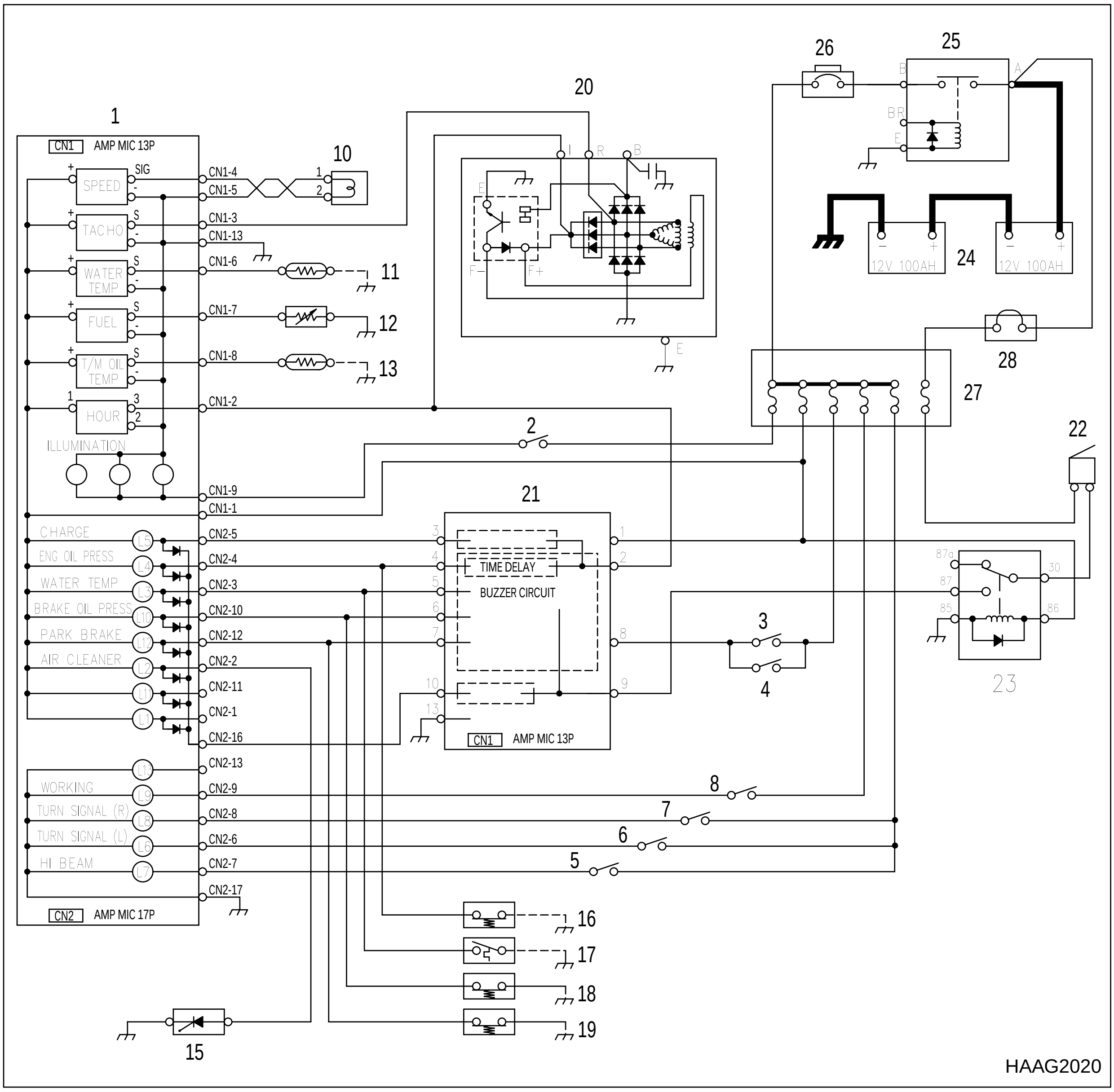


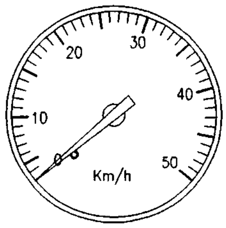
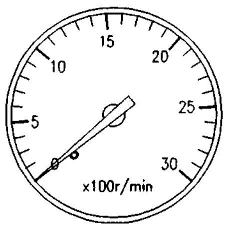
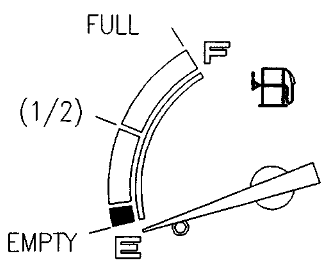
Figure 12

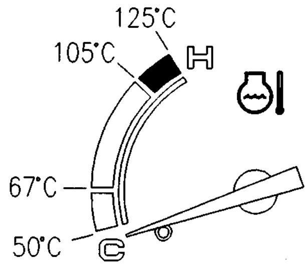
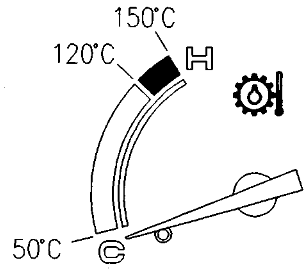
Reference Number	Description
1	Instrument Panel
2	Headlight Switch
3	Forward Lever Switch
4	Reverse Lever Switch
5	High Beam Switch
6	Left Turn Light Switch
7	Right Turn Light Switch
8	Work Light Switch
9	Emergency Steering Switch
10	Speedometer
11	Coolant Temperature Sensor
12	Fuel Sensor
13	Transmission Oil Temperature Sensor
14	Brake Oil Filter Switch
15	Air Cleaner Clogging Warning Indicator

Reference Number	Description
16	Engine Oil Pressure Switch
17	Coolant Temperature Switch
18	Brake Oil Pressure Switch
19	Parking Brake Pressure Switch
20	Alternator
21	Control Unit
22	Alarm Buzzer
23	Alarm Relay
24	Battery
25	Battery Relay
26	Circuit Breaker
27	Fuse Box
28	Fusible Link
29	Preheat Controller

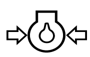
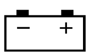
OPERATION

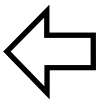
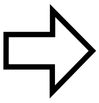
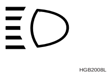
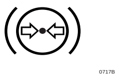
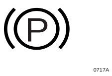
Instruments

Function	Display	Sensor Specification	
		Input Terminal	Input Specification
Speedometer	HAAG0360	CN1-4 CN1-5	10 km/h- 905 Hz 20 km/h- 1,811 Hz 30 km/h- 2,716 Hz 40 km/h- 3,622 Hz *F = 90.55 V [Hz] F : Frequency of transmission controller V: Speed (km/h)
Tachometer	HAAG0370	CN1-3	500 rpm - 143 Hz 1000 rpm - 287 Hz 1500 rpm - 430 Hz 2000 rpm - 573 Hz 2500 rpm - 717 Hz 3000 rpm - 860 Hz *F = 0.2867 N [Hz] F : Frequency of alternator "P" terminal N: Engine rpm
Hour Meter	0012	CN1-2	ALTERNATOR "I" Terminal voltage (24V)
Fuel Level Gauge	HAAG0380	CN1-7	EMPTY - Above 90 Ohm 1/2 - 38 Ohm FULL - Below 10 Ohm

Function	Display	Sensor Specification	
		Input Terminal	Input Specification
Engine Coolant Temperature Gauge	 HAAG0390	CN1-6	50°C - Above 188.2 Ohm 67°C - 102 Ohm 105°C - 32 Ohm 125°C - Below 19.8 Ohm
Transmission Oil Temperature Gauge	 HAAG0400	CN1-8	50°C - Above 322.8 Ohm 120°C - 36.5 Ohm 150°C - Below 18.6 Ohm

Indicator Lights

Symbol	Description	Input Terminal	Operation	Remarks
	Air Cleaner	CN2-2	Light turns "ON" when air cleaner is clogged	
	Coolant Temperature	CN2-3	Light turns "ON" when coolant temperature increases over 103°C (When terminal input is connected)	
	Engine Oil Pressure	CN2-4	Light turns "ON" when engine oil pressure drops below 1.6 kg/cm^2	After starting engine, if engine oil pressure is insufficient after 8 seconds, a warning buzzer will sound.
	Charging	CN2-5	Light turns "ON" when not charging. (and R terminal output drops below 24V)	Under normal conditions, will turn "ON" before engine start-up and turn "OFF" once engine is running.

Symbol	Description	Input Terminal	Operation	Remarks
	Left Turn and Hazard Light	CN2-6	Light turns "ON" when left turn signal or hazard light is operated. (Terminal input is to 24V)	
	Right Turn and Hazard Light	CN2-8	Light turns "ON" when right turn signal or hazard light is operated. (Terminal input is to 24V)	
	High Beam	CN2-7	Light turns "ON" when high beam is operated. (Terminal input is to 24V)	
	Work Light	CN2-9	Light turns "ON" when work light is operated. (Terminal input is to 24 V)	
	Brake Oil Pressure	CN2-10	Light turns "OFF" when brake oil pressure increases over 65 kg/cm^2, and light turns "ON" when brake oil pressure drops below 60 kg/cm^2. (When terminal input is connected)	Under normal conditions, will turn "ON" before engine start-up and turn "OFF" once engine is running.
	Parking Brake	CN2-12	Light turns "OFF" when parking brake pressure is above 65 kg/cm^2, Light turns "ON" when parking brake pressure drops below 60 kg/cm^2.	Under any condition, will be "ON" before engine start-up.

Initial Operation

Item	Input (Terminal)	Output (Operation and initial setting mode)
Initial Operation	CN 1-1	• All indicator lights are turned on and turned off after 2 seconds. (Except for turn signal indicator, high beam indicator and working light indicator.) • Warning buzzer is activated and turned off after 2 seconds. • Monitoring system displays present condition.

Control Unit Operation

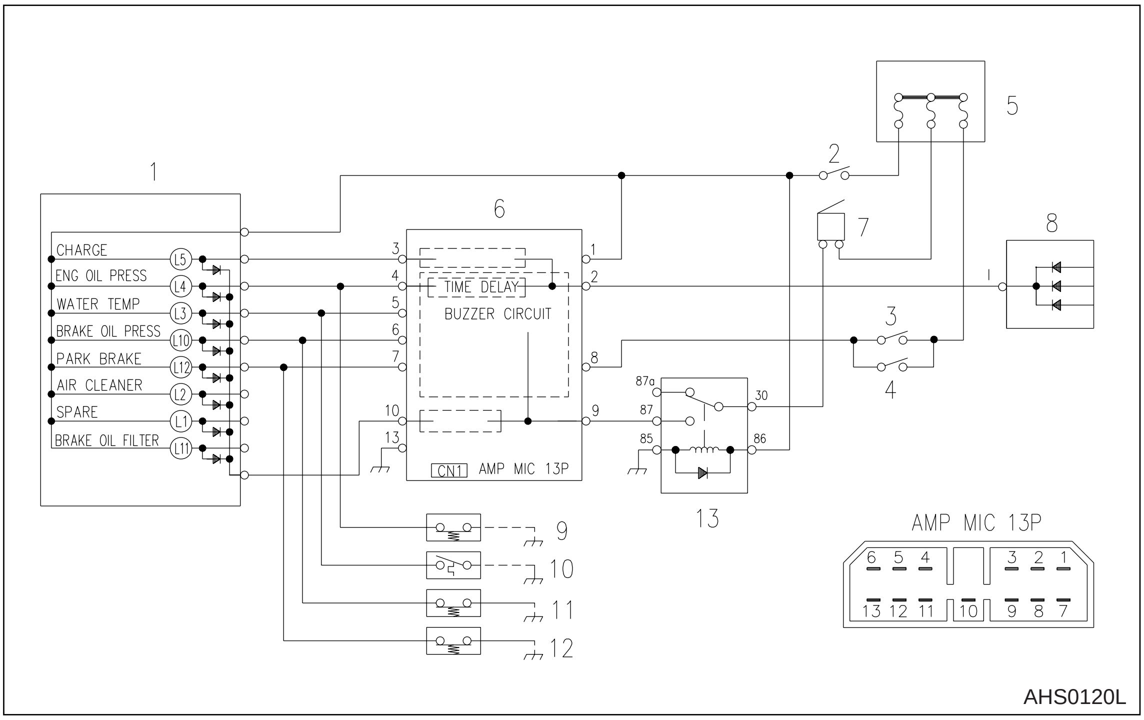


Figure 13

Reference Number	Description
1	Instrument Panel
2	Starter Switch
3	Forward Lever Switch
4	Reverse Lever Switch
5	Fuse Box
6	Control Unit
7	Warning Buzzer

Reference Number	Description
8	Alternator
9	Engine Oil Pressure Switch
10	Coolant Temperature Switch
11	Brake Oil Pressure Switch
12	Parking Brake Pressure Switch
13	Alarm Relay

Characteristic of Operation

<table>
<tr><th></th><th colspan="2">Input</th><th>Output</th></tr>
<tr><td>1</td><td colspan="2">When starter switch is "ON."</td><td>All indicator lights are turned on and turned off after 2 - 2.5 seconds. At this time the warning buzzer will sound.</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">When "I" terminal voltage of alternator.</td><td>is below 12 ±1 V.</td><td>Charging light, L5, will be "ON."</td></tr>
<tr><td>is above 12 ±1 V.</td><td>Charging light, L5, will be "OFF."</td></tr>
<tr><td rowspan="4">3</td><td rowspan="4">When "I" terminal voltage of alternator is above 12 ±1 V.</td><td>Engine oil pressure switch is "ON."</td><td>Warning buzzer sounds after 8 ±1 seconds.</td></tr>
<tr><td>Coolant temperature switch is "ON."</td><td>Warning buzzer sounds immediately.</td></tr>
<tr><td>Brake oil pressure switch is "ON."</td><td>Warning buzzer sounds immediately.</td></tr>
<tr><td>Forward and reverse lever switch is "ON" and parking brake pressure switch is "ON."</td><td>Warning buzzer sounds immediately.</td></tr>
</table>

WINDSHIELD WIPER

FRONT WINDSHIELD WIPER

You can control windshield wiper by operating wiper washer switch (2).

1. Low speed wiper action (1st)

   Wiper acts in low speed through fuse box (1) to the 15,53 terminal of wiper switch (2) to the L,E terminal of wiper motor (5).

2. High speed wiper action (2nd)

   Wiper acts in high speed through Fuse box (1) to the 15,53b terminal of wiper switch (2) to the H,E terminal of wiper motor (5).

3. When you turn off switch during Low speed wiper action (1st) or High speed wiper action (2nd), electric currents flow through Fuse box (1) to the B,S terminal of wiper motor (5) to the 87a,30 terminal of wiper relay (3) to the 31b,53 terminal of wiper switch (2) - L,E terminal of wiper motor (5). Wiper acts until wiper rotates to the stop position, than the wiper stops.

4. Intermittent wiper action

   Fuse box (1) to the 15,J terminal of wiper switch (2) to the 1,4 terminal of wiper timer (4) are connected intermittently, and electric current flow into 86,85 terminal of wiper relay (3) than 87 terminal and 30 terminal are connected.

   Therefore, electric current flow through fuse box (1) to the 87,30 terminal of wiper relay (3) to the 31b,53 terminal of wiper switch (2) to the L,E terminal of wiper motor (5), and wiper operates intermittently in low speed.

Front Windshield Wiper Circuit

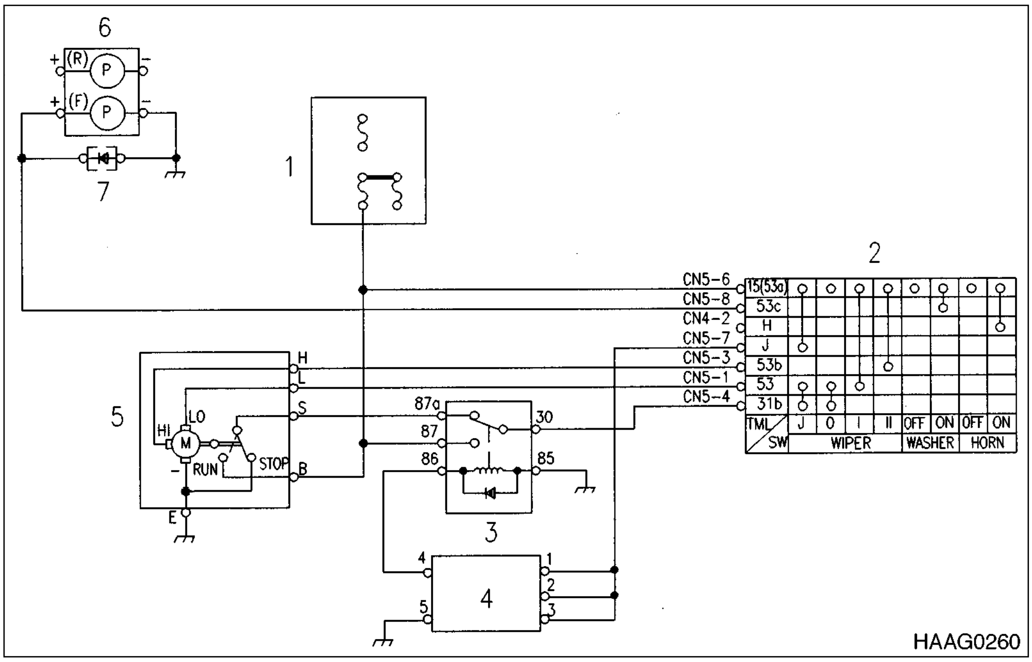


Figure 14

Reference Number	Description
1	Fuse Box
2	Wiper Washer Switch
3	Wiper Relay
4	Wiper Timer

Reference Number	Description
5	Wiper Motor
6	Washer Tank
7	Diode

REAR WINDSHIELD WIPER

You can control rear windshield wiper by pressing wiper washer switch (2) in the switch panel.

1. 1st wiper action (Wiper and washer activate the same time, automatic return)

   Fuse box (1), to the washer tank (4), to the 5,7 terminal of switch (20) are connected, then activates windshield washers. Also fuse box (1), to the B,L terminal of wiper motor (3), to the diode (5), to the 5,7 terminal of switch (2) are connected, then activates wiper.

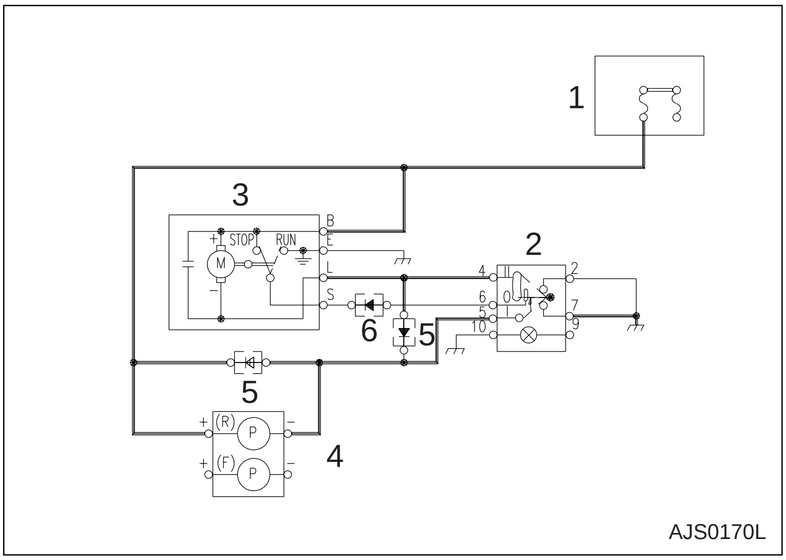


Figure 15 REAR WINDSHIELD WIPER 1ST ACTION CIRCUIT

Reference Number	Description
1	Fuse Box
2	Wiper/washer Switch
3	Wiper Motor

Reference Number	Description
4	Washer Tank
5	Diode
6	Diode

2. 2nd wiper action (Only wiper action)

   Fuse box (1), to the B,L terminal of wiper motor (3), to the 4,2 terminal of switch (2) are connected, then activates wiper.

3. When you turn off windshield wiper switch in 1st or 2nd position, electric current flows fuse box (1), to the B,L terminal of wiper motor (3), to the 4,6 terminal of wiper switch (2), to the diode (6), to the S,E terminal of wiper motor (3).

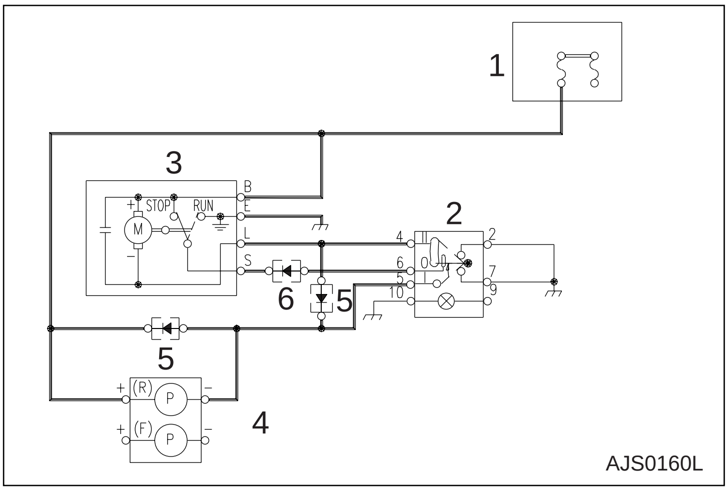


Figure 16 REAR WINDSHIELD WIPER STOP CIRCUIT

Reference Number	Description
1	Fuse Box
2	Wiper/washer Switch
3	Wiper Motor

Reference Number	Description
4	Washer Tank
5	Diode
6	Diode

LIGHTING SYSTEM

LIGHT CIRCUIT

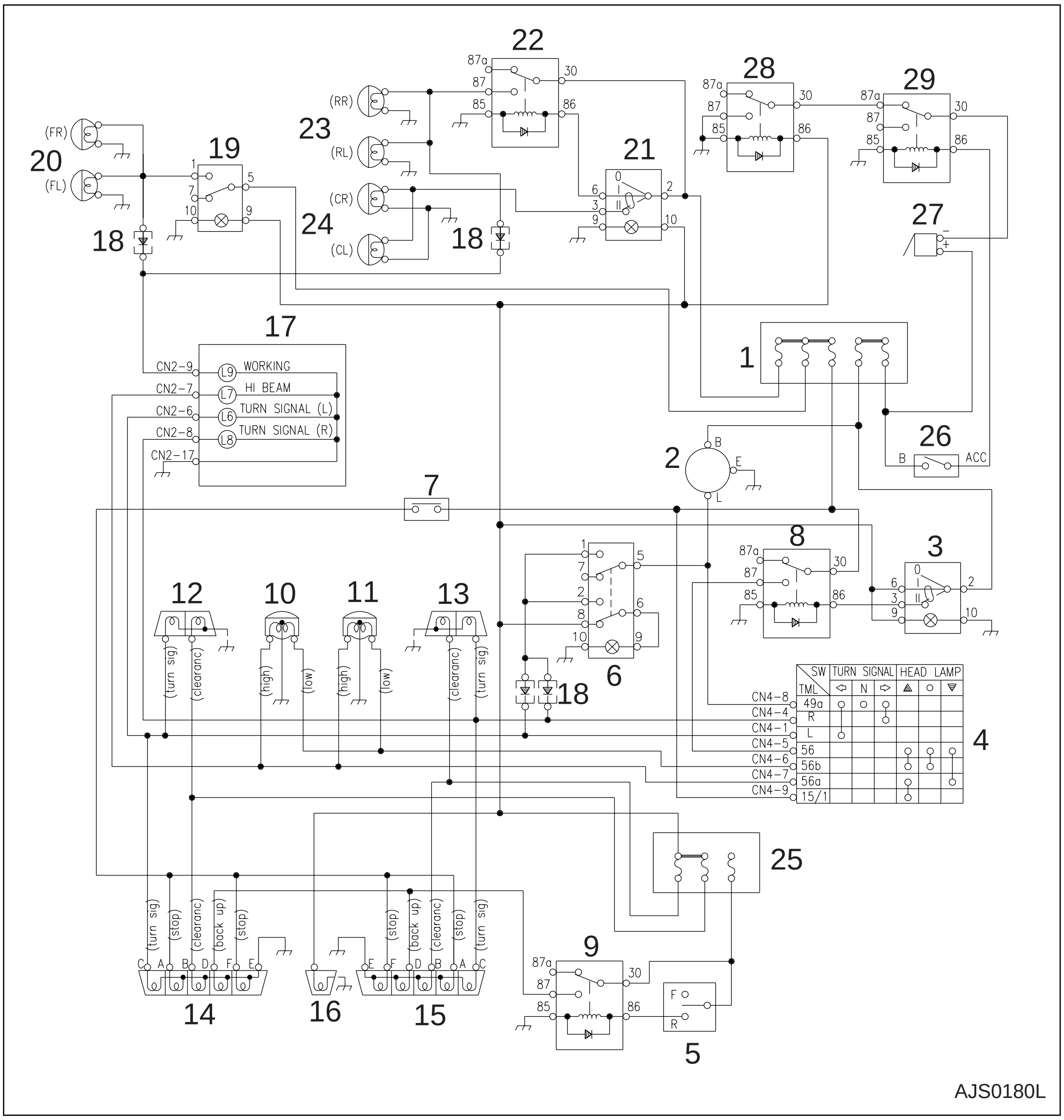


Figure 17 LIGHT CIRCUIT

Reference Number	Description
1	Fuse Box 1
2	Blinker Unit
3	Headlight Switch
4	Combination Switch
5	Shift Lever Switch
6	Hazard Switch
7	Stop Light Switch
8	Headlight Relay
9	Reverse Relay
10	Headlight (L)
11	Headlight (R)
12	Front Combination Light (L)
13	Front Combination Light (R)
14	Rear Combination Light (L)

Reference Number	Description
15	Rear Combination Light (R)
16	License Plate Light
17	Instrument Panel
18	Diode
19	Front Working Light Switch
20	Front Working Light
21	Rear Working Light Switch
22	Working Light Relay
23	Rear Working Light 1
24	Rear Working Light 2
25	Fuse Box 2
26	Starter Switch
27	Pilot Buzzer
28	Alarm Relay 1
29	Alarm Relay 2

The lighting system consists of the headlight, the position light, the turn signal light, the hazard light, the stop light, the license plate light, the working light, the rotating beacon light (option) and the switches, which are used to turn on the lights.

1. When the headlight switch (3) is in the first step, through the fuse box 1 (1) to the "2," "6" terminal of headlight switch (3), the following lights will be "ON."
   A. The front combination light (L)(12) and rear combination light (L) through the fuse box 2 (23).
   B. The front combination light (R)(13) and rear combination light (R) through the fuse box 2 (23).
   C. The illumination lights through the "9" terminal of all kind of rocker switches include the headlight switch (3), the front working light switch (19), the rear working light (21) and the hazard switch (6).
   D. The license plate light (16).
2. When the headlight switch (3) is in the second step, the current flows through the fuse box 1 (1), to the "2," "3" terminal of headlight switch (3) and to the "86," "85" terminal of headlight relay (8), and the "30," "87" terminal of headlight relay (8) is connected. As a result, through the fuse box 1 (1) to the "30," "87" terminal of headlight relay (8), the voltage is applied to the "56" terminal of combination switch (R)(4).
   A. At this time if the combination switch (4) is in the "0" position, the current flows to the "56b" terminal and it allow the low light, which is in the headlight (L)(10) and the headlight (R)(11), to be turned "ON."
   B. Also if the combination switch (4) is in the "t" position, the current flows to the "56a" terminal and it allow the high light, which is in the headlight (L)(10) and the headlight (R)(11), to be "ON." At the same time the current flows to the "CN2-7" terminal of instrument panel (17) and the headlight indicator L7 will be "ON,"
   C. And if the combination switch (4) is in the "s" position, the current flows to the "56b" terminal and it allows the low light, which is in the headlight (L)(10) and the headlight (R)(11), to be "ON."

      At the same time another current flows from the fuse box 1 (1) to the "15/1," "56b" terminal of combination switch (4) and the high light, which is in the headlight (L)(10) and the headlight

(R)(11) will be turned "ON," and the other current flows to the "CN2-7" terminal of instrument panel (17) and the headlight indicator will be "ON."

The combination switch (4) is returned automatically.

3. When the combination switch (4) is in the "←" (or "→") position, the current flows from the fuse box 1 (1), to the blinker unit (2), to the "L" (or "R") terminal through "49a" terminal of combination switch (4), to the "C" terminal of front combination light (L)(12) and the rear combination light (L)(14) (or to the front combination light (R)(13) and the rear combination light (R)(15)). This current makes the turn signal light turn "ON." At the same time the current flows to the "CN2-6" terminal (or to the CN2-8 terminal) of instrument panel and the turn signal light indicator L6 (or L8) will be "ON."

4. If you operates the hazard light switch (6), the current flows from to the fuse box 1 (1), to the blinker unit (2), to the "5," "1" terminal of hazard switch (6), to the diode (18), to the front combination light (L)(12) and the front combination light (R)(13), to the "C" terminal of rear combination light (L)(14) and rear combination light (R)(15). This current makes the turn signal light turn "ON."

   At the same time through the "2," "6" terminal of hazard switch (6), the voltage is applied to the "9" terminal and the illumination light used to symbol light will be "ON." Also the current flows to the "CN2-6," "CN2-8" terminal of instrument panel (17) and the turn signal light indicator "L,"" "L8" will be "ON."

5. When the shift lever switch (5) is in the "R" position, the contact points "30" and "87" of the reverse relay (9) are closed due to current flowing from the fuse box 2 (23), to the shift lever switch (5), to the "86" terminal of reverse relay (9) and to the ground. Thus the current flows from fuse box 2 (23), to the reverse relay (9) and to the "D" terminal of rear combination light (L)(14) and rear combination light (R)(15). And the reverse light will be "ON."

6. When the brake pedal is depressed and at the same time the stop light switch (7) is turned "ON," the current flows the from fuse box 1 (1), to the stop light switch (7) and to the "F" terminal of rear combination light (L)(14) and rear combination light (R)(15). And the stop light will be "ON."

7. When the front working light switch (19) is in the "ON" position, the current flows from the fuse box 1 (1), to the "5," "1" terminal of front working light switch (19) and to the front working light (20).

   This current makes the front working lights turn "ON." At the same time the working light indicator, L9," is turned "ON" due to the current flowing from the diode (8) to the "CN2-9" terminal of instrument panel (17).

8. When the rear working light switch (21) is in the second step, the contact points "30" and "87" of the working light relay (22) is closed due to the flowing current from the fuse box 1 (1), to the "2" and "6" terminal of the working light switch (21), to the "86" terminal of the working light relay (22) and to the ground. Thus the current flows from the fuse box 1 (1), to the working light relay (22) and to the rear working light 1 (23) mounted on radiator guard. As a result the rear working light (23) turns "ON". At the same time the working light indicator "L9" turns "ON" due to the current flowing from the diode (18) to the "CN2-9" terminal of the instrument panel.

9. When the rear working light switch (21) is in the second step, the contact points "30" and "87" of the working light relay (22) is closed due to the flowing current from the fuse box 1 (1), to the "2" and "6" and "3" terminal of the working light switch (21), the rear working (23) is operated like being described above clause "8" and the rear working light (24) mounted on the cabin turns "ON" at the same time.

10. When the headlight switch (3) is in the first step or in the second step while the starter switch (26) is in the "OFF" position, the contact point "30," "87" of alarm relay 1 (28) is closed due to the excited current, which flows to the coil of alarm relay 1 (28) and the pilot buzzer (27) will sound. But when the headlight switch (3) is in the first step or in the second step while the starter switch (26) is in the "ON" position, the contact point "3," "87" of alarm relay 2 (29) is closed due to the excited current, which flows to the coil of alarm relay 2 (29). At the same time the current is not supplied to the "30" terminal of alarm relay 1 (28) and the pilot buzzer will not sound any more.

DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

S0893060K

ELECTRICAL SCHEMATIC (MEGA 500-V)

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that is in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Mega 500-V	1001 and Up

May 2001

TABLE OF CONTENTS

GENERAL DESCRIPTION

Schematic(s) presented in this section are laid out on facing pages.

An overlapping edge has been taken into consideration so that a photocopy can be made and pasted together to make a complete schematic.

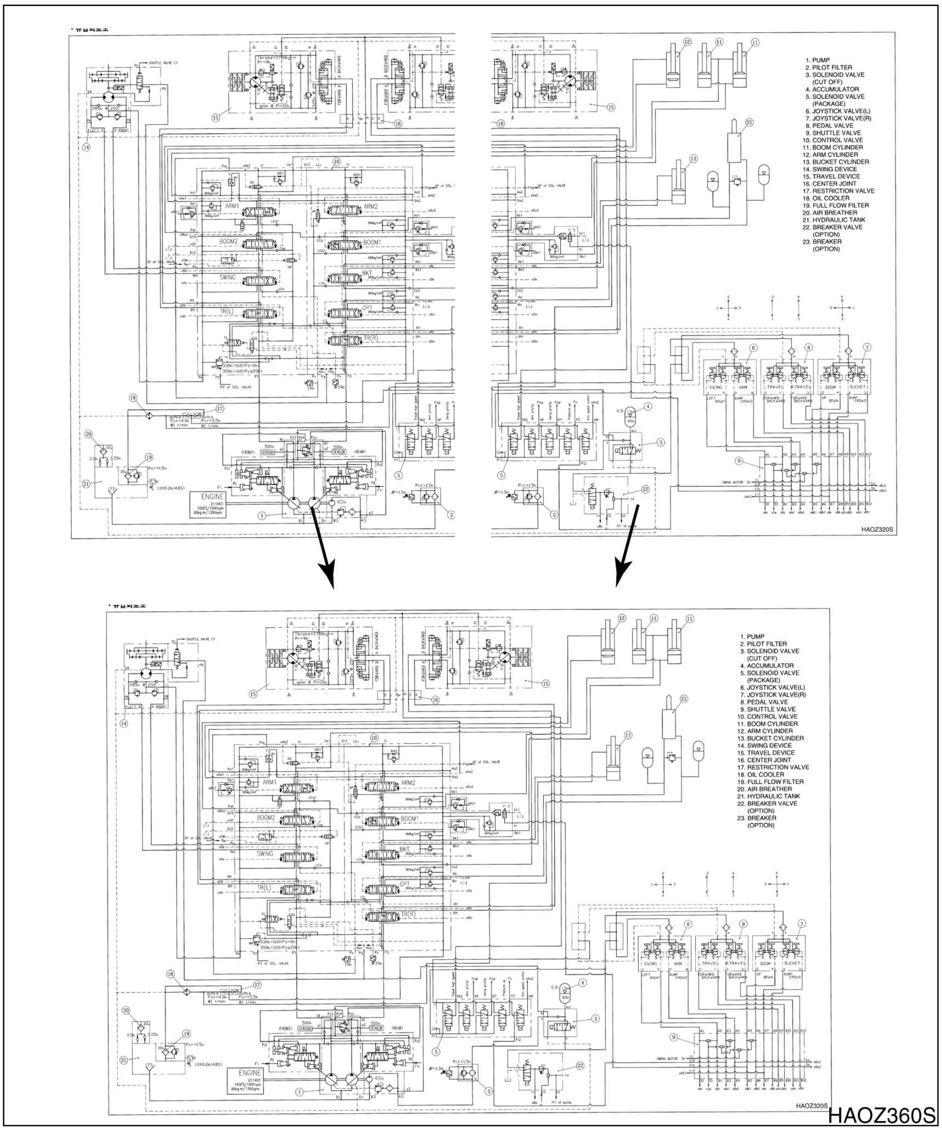


Figure 1

MEGA 500-V

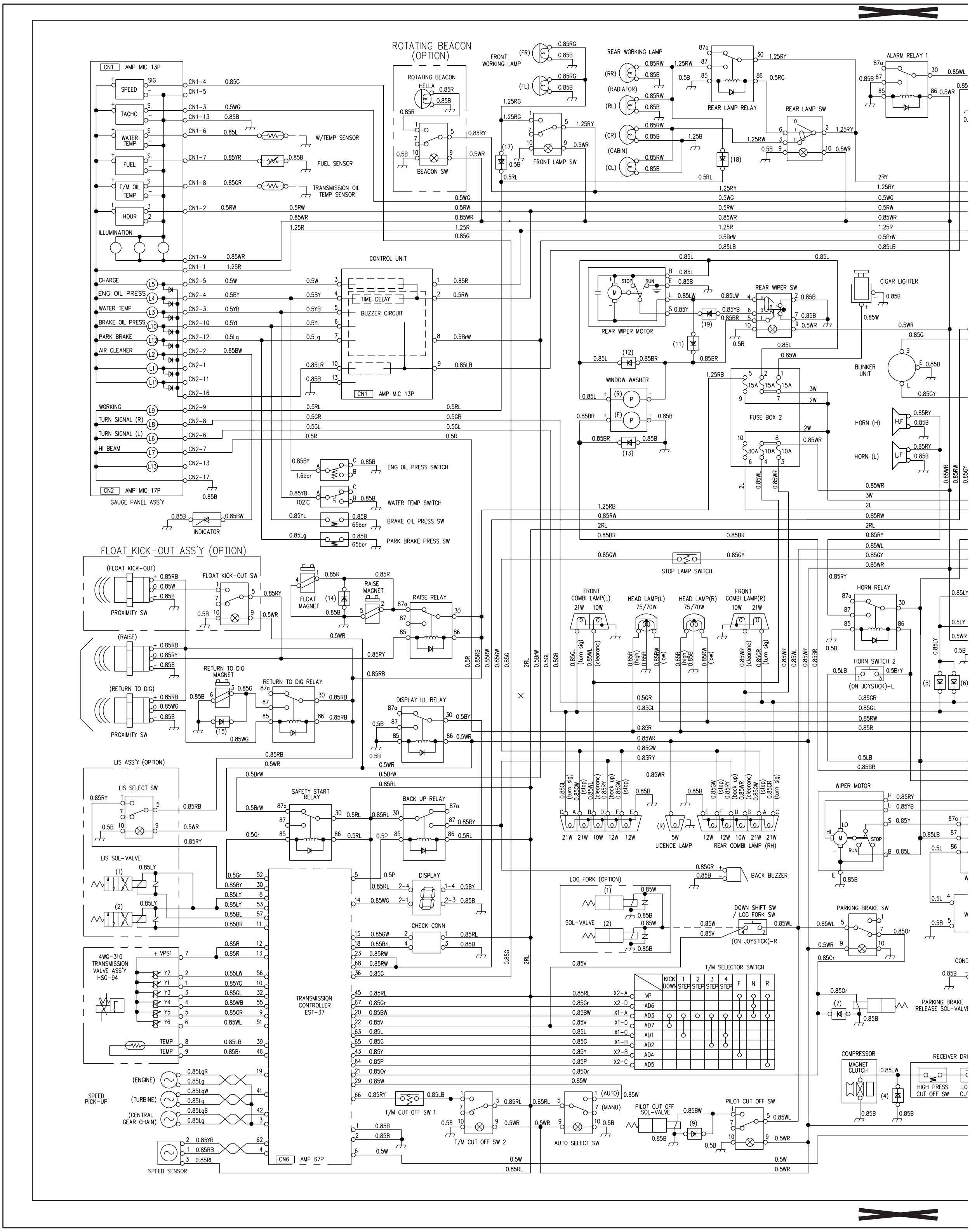
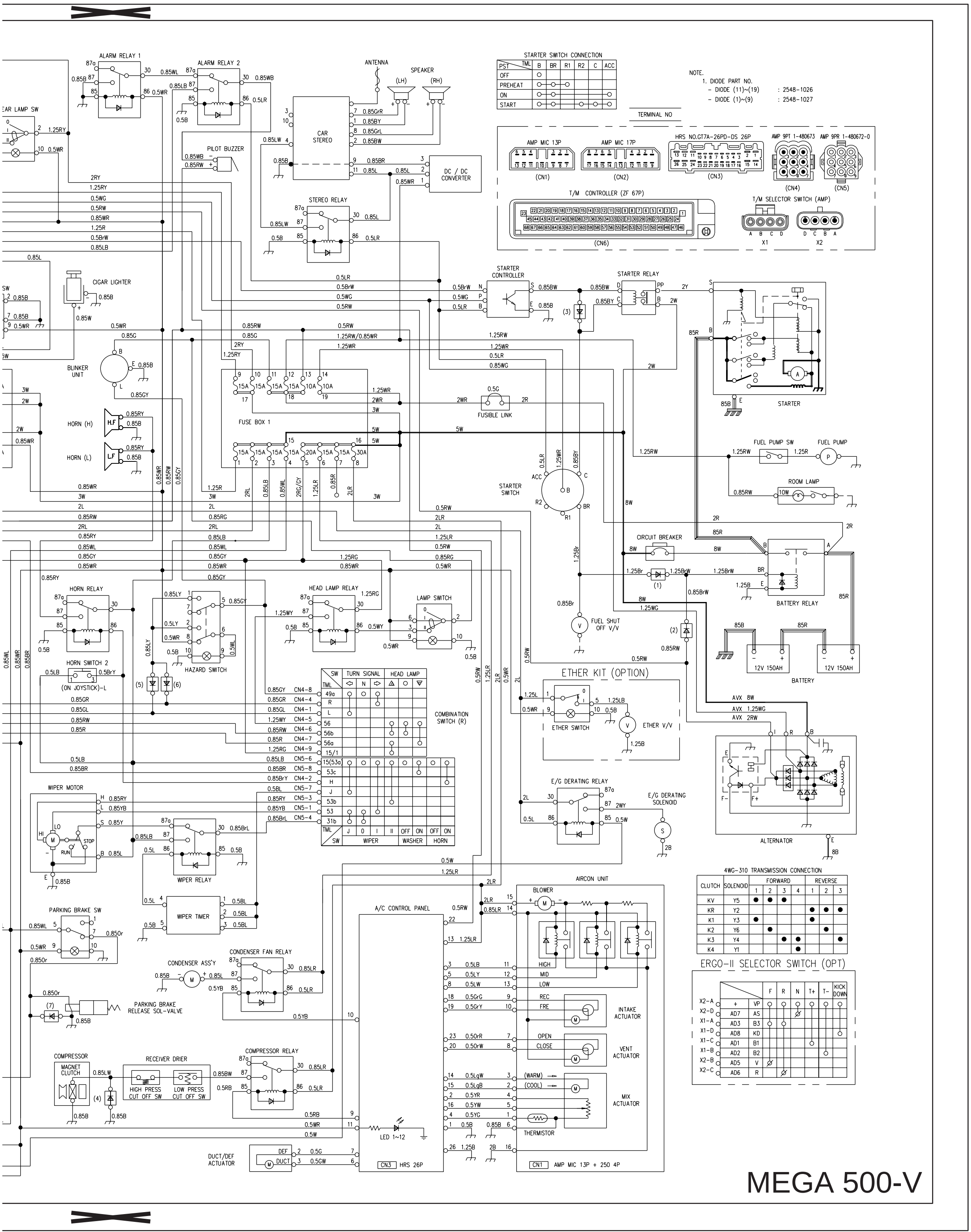


Figure 2


STARTER SWITCH CONNECTION
ALARM RELAY 1
ALARM RELAY 2
ANTENNA
SPEAKER
CAR STEREO
DC / DC CONVERTER
PILOT BUZZER
STEREO RELAY
CIGAR LIGHTER
BLINKER UNIT
HORN (H)
HORN (L)
FUSE BOX 1
FUSIBLE LINK
STARTER CONTROLLER
STARTER RELAY
STARTER
STARTER SWITCH
FUEL PUMP SW
FUEL PUMP
ROOM LAMP
CIRCUIT BREAKER
BATTERY RELAY
BATTERY
FUEL SHUT OFF V/V
HORN RELAY
HORN SWITCH 2
HAZARD SWITCH
HEAD LAMP RELAY
LAMP SWITCH
COMBINATION SWITCH (R)
ETHER KIT (OPTION)
ETHER SWITCH
ETHER V/V
E/G DERATING RELAY
E/G DERATING SOLENOID
ALTERNATOR
WIPER MOTOR
WIPER RELAY
WIPER TIMER
PARKING BRAKE SW
PARKING BRAKE RELEASE SOL-VALVE
CONDENSER ASS'Y
CONDENSER FAN RELAY
COMPRESSOR
RECEIVER DRIER
COMPRESSOR RELAY
A/C CONTROL PANEL
AIRCON UNIT
INTAKE ACTUATOR
VENT ACTUATOR
MIX ACTUATOR
THERMISTOR
DUCT/DEF ACTUATOR
4WG-310 TRANSMISSION CONNECTION
ERGO-II SELECTOR SWITCH (OPT)
MEGA 500-V

AHS3680L

ATTACHMENTS