THOMAS®

REPAIR MANUAL

173 HL"S" II SERIES

Publication# 043225

S/N LK000930 ONWARD

FOREWORD

This repair manual provides information for the proper servicing and overhaul of **Thomas** Model T173HLS II Compact Loaders.

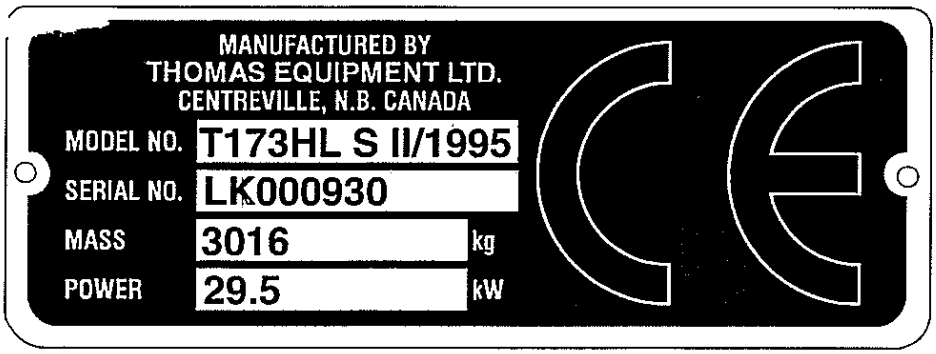
This manual covers units produced from 12/95 onward. Special service instructions are identified by loader serial number or applicable production dates throughout the text.

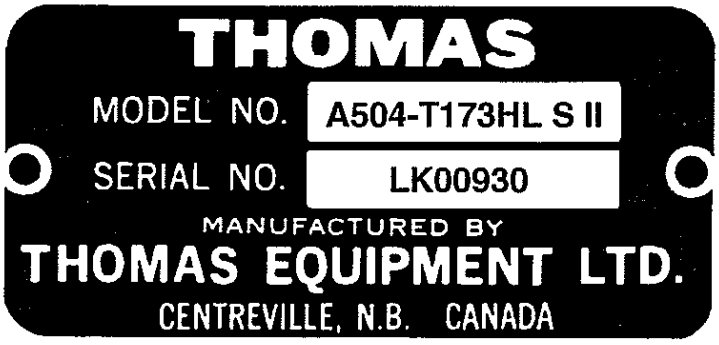
This manual is divided into 8 sections, each divided into subsections. Each subsection contains information on general operating principles, detailed inspection and overhaul and where applicable, troubleshooting, special tools and specifications.

The material contained in this manual was correct at the time of publication, however, **Thomas** policy is one of continuous improvement and the right to change prices, specifications, equipment or design at anytime without notice is reserved. All data in this manual is subject to production variations so overall dimensions and weights should be considered as approximate only and illustrations do not necessarily depict the unit to standard built specifications.

Thomas Equipment Ltd.

WARNING To avoid personal injury service repairs must be performed by an authorized Thomas Dealer.



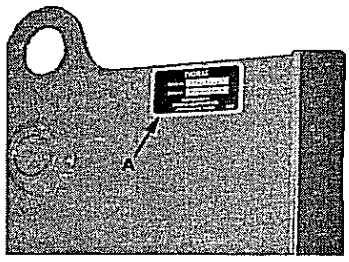


A vehicle identification plate is located on the inside of the hydraulic tank above the engine compartment cover at the rear of the machine. (Fig. 1 Item A)

Whenever effecting repair or overhaul of the **Thomas** Compact Loader, the relevant information should be noted and used when referring to service bulletins or ordering parts.

This plate is stamped with the following information:

Model Number _____
Serial Number _____



C-012 Fig.1

It is important when ordering replacement parts or making a service inquiry to provide both the model number and the serial number of your **Thomas** loader.

RH and LH, when mentioned in the manual, is defined as sitting in the drivers seat looking in a forward direction.

SAFETY PRECAUTIONS

Practically all Service work involves the need to drive the loader. The Operator's Manual, supplied with each loader, contains safety precautions relating to Driving, Operating and Servicing that loader. These precautions are as applicable to the service technician as they are to the operator and should be read, understood and practiced by all personnel.

Prior to undertaking any maintenance, repair, overhaul, dismantling or re-assembly operations, whether within the shop facility or "out in the field", consideration should be given to factors that may have an effect upon Safety, not only upon the mechanic carrying out the work but also upon bystanders.

PERSONAL CONSIDERATIONS

* *CLOTHING*
  The wrong clothing or carelessness in dress can cause accidents. Check to see that you are suitably clothed. Some jobs require special protective equipment.

* *SKIN PROTECTION*
  Used motor oil may cause skin cancer. Follow work practices that minimize the amount of skin exposed and length of time used oil stays on your skin.

* *EYE PROTECTION*
  The smallest eye injury may cause loss of vision. Injury can be avoided by wearing eye protection when engaged in chiseling, grinding, discing, welding, painting and any other task that involves foreign matter.

* *BREATHING PROTECTION*
  Fumes, dust and paint spray are unpleasant and harmful . These can be avoided by wearing respiratory protection.

* *HEARING PROTECTION*
  Loud noise may damage your hearing and the greater the exposure the worse the damage. If you feel the noise excessive, wear ear protection.

* *HAND PROTECTION*
  It is advisable to use a protective cream before work to prevent irritation and skin contamination.
  After work, clean your hands with soap and water. Solvents such as white spirit, paraffin, etc. may harm the skin.

* *FOOT PROTECTION*
  Substantial or protective footwear with reinforced toecaps will protect your feet from falling objects. Additional oil-resistant soles will help to avoid slipping.

* *SPECIAL CLOTHING*
  For certain work it may be necessary to wear flame or acid resistant clothing.

NOTE	Avoid injury through incorrect handling of components. Make sure you are capable of lifting the object. If in doubt get help.

EQUIPMENT CONSIDERATIONS

* *MACHINE GUARDS*
  Before using any machine, check to ensure that the machine guards are in position and serviceable. These guards not only prevent parts of the body or clothing coming in contact with the moving parts of the machine but also ward off objects that might fly off the machine and cause injury.

* *LIFTING APPLIANCES*
  Always ensure that lifting equipment, such as chains, slings, lifting brackets, hooks, and eyes are thoroughly checked before use. If in doubt select stronger equipment. Never stand under a suspended load or raised implement.

* *COMPRESSED AIR*
  The pressure from a compressed air line is often as high as 100 P.S.I. (6.9 bar) Any misuse may cause injury.

  Never use compressed air to blow dust, filing, dirt, etc. away from your work area unless the correct type of nozzle is fitted.

  Compressed air is not a cleaning agent. It will only move dust etc. from one place to another. Look around before using an air hose as bystanders may get grit into their eyes, ears and skin.

* *HAND TOOLS*

Many cuts, abrasions and injuries are caused by defective tools. Never use the wrong tool for the job as this generally leads either to some injury or to a poor job done.

Never use:

- A hammer with a loose or split handle.
- Spanners or wrenches with splayed or worn jaws.
- Wrenches or files as hammers; drills or clevis pins or bolts as punches.

For removing or replacing hardened pins use a copper or brass drift rather than a hammer.

For dismantling, overhaul and assembly of major and sub-components always use the Special Service Tools recommended. These will reduce the work effort, labour time and the repair cost.

Always keep tools clean and in good working order.

* *ELECTRICITY*

Electricity has become so familiar in day to day usage that it's potentially dangerous properties are often overlooked. Misuse of electrical equipment can endanger life.

Before using any electrical equipment, particularly portable appliances, make a visual check to make sure that the cable is not worn or frayed and that the plugs, sockets, etc. are intact. Make sure you know where the nearest isolating switch for your equipment is located.

GENERAL CONSIDERATIONS

* *SOLVENTS*

Use only cleaning fluids and solvents that are known to be safe. Certain types of fluids can cause damage to components such as seals etc. and can cause skin irritation. Solvents should be checked that they are suitable not only for the cleaning of components and individual parts but also that they do not affect the personal safety of the user.

* *HOUSEKEEPING*

Many injuries result from tripping or slipping over , or on, objects or materials left lying around by a careless worker.

Prevent these accidents from occuring. If you notice a hazard, don't ignore it, remove it.

A clean hazard free place of work improves the surroundings and daily environment for everybody.

* *FIRE*

Fire has no respect for persons or property. The destruction that a fire can cause is not always fully realized. Everyone must be constantly on guard.

- Extinguish matches,cigars, cigarettes etc. before throwing them away.
- Work cleanly, disposing of waste material into proper containers.
- Locate the fire extinguishers and ensure all personnel know how to operate them.
- Do not panic; warn those near and sound an alarm.
- Do not allow or use an open flame near the loader fuel tank, battery or component parts.

* *FIRST AID*

In the type of work that mechanics are engaged in, things such as dirt, grease, fine dust etc. all settle upon the skin and clothing. If a cut, abrasion or burn is disregarded it may be found that a septic condition has formed within a short time. What appears at first to be trivial could become painful and injurious. It ony takes a few minutes to have a fresh cut dressed but it will take longer if you neglect it.

* *CLEANLINESS*

Cleanliness of the loader hydraulic system is essential for optimum performance. When carrying out service and repairs, plug all hose ends and components before component connections to prevent dirt entry.

Clean the exterior of all components before carrying out any form of repair. Dirt and abrasive dust can reduce the efficiency and working life of a component and lead to costly replacememt. Use of a high pressure washer or steam cleaner is recommended.

OPERATIONAL CONSIDERATIONS

* Stop the engine, if at all possible, before performing any service.

* Place a warning sign on loaders which, due to service or overhaul, would be dangerous to start. Disconnect the battery leads if leaving such a unit unattended.

* Do not attempt to start the engine while standing beside the loader or attempt to by-pass the safety start system.

* Avoid prolonged running of the engine in a closed building or in an area with inadequate ventilation as exhaust fumes are highly toxic.

* Always turn the radiator cap to the first stop to allow pressure in the system to dissipate when the coolant is hot.

* Never work beneath a loader which is on soft ground. Always take the unit to an area which has a hard working surface, preferably concrete.

* If it is found necessary to raise the loader for ease of maintenance, make sure that safe and stable supports are installed beneath the main frame before commencing work.

* Use footsteps or working platforms when servicing those areas of the loader that are not within easy reach.

* Before loosening any hoses or tubes switch off the engine, remove all pressure in the lines by operating the foot pedals several times. This will remove the danger of personal injury by oil pressure.

* Prior to pressure testing make sure all the hoses and connectors on both the loader and on the test machine are in good condition and tightly sealed. Pressure readings must be taken with the gauges specified. The correct procedure should be rigidly observed to prevent damage to the system or the equipment and to eliminate the possibility of personal injury.

* Always lower equipment to the ground when leaving the loader.

If high lift attachments are installed on a loader beware of overhead power and telephone lines when travelling. Drop attachment near to ground level to increase stability and minimize risks.

* Do not park or attempt to service a loader on an incline. If unavoidable, take extra care and block the wheels.

* Escaping hydraulic / diesel fluid under pressure can penetrate the skin causing serious injury. Do not use your hand to check for leaks. Use a piece of cardboard or paper to search for leaks. Stop the engine and relieve pressure before connecting or disconnecting lines. Tighten all connections before starting the engine or pressurizing the lines. If any fluid is injected into the skin, obtain medical attention immediately.

* Prior to removing wheels and tires from a loader check to determine whether additional ballast (liquid or weights) has been added. Seek assistance and use suitable equipment to support the weight of the wheel assembly.

* When inflating tires beware of overinflation; constantly check the pressure. Over inflation can cause tires to burst and result in personal injury.

* Safety precautions are very seldom the figment of someone's imagination. They are the result of sad experience where most likely someone has paid dearly through personal injury.

* Heed these precautions and you will protect yourself accordingly. Disregard them and you may duplicate the sad experiences of others.

SERVICE TECHNIQUES

A. SERVICE SAFETY

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all motor vehicles as well as the personal safety of the individual doing the work. This shop manual provides general directions for accomplishing service and repair work with tested effective techniques. Following them will help assure reliability.

There are numerous variations in procedures, techniques tools and parts for servicing vehicles as well as in the skill of the individual doing the work. This manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in this manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

B. SERVICE TECHNIQUES

Clean the exterior of all components before carrying out any form of repair. Dirt and abrasive dust can reduce the efficient working life of a component and lead to costly replacement.

Use cleaning fluids which are known to be safe. Certain types of fluid can cause damage to O-rings and cause skin irritation. Solvents should be checked that they are suitable for the cleaning of components and also that they do not risk the personal safety of the user.

Time spent on the preparation and cleanliness of working surfaces will pay dividends in making the job easier and safer and will result in overhaul components being more reliable and efficient in operation.

Replace O-rings, seals or gaskets whenever they are disturbed. Never mix new and old seals and O-rings, regardless of condition. Always lubricate new seals and O-rings with hydraulic oil before installation.

When replacing component parts use the correct tool for the job.

HOSES AND TUBES

Always replace hoses and tubes if the end connections are damaged. Be sure any hose installed is not kinked or twisted.

When installing a new hose loosely connect each end and make sure the hose takes up the designed position before tightening the connection. Clamps should be tightened sufficiently to hold the hose without crushing and to prevent chafing.

The hoses are the arteries of the unit; be sure they are in good condition when carrying out repairs or maintenance otherwise the machines output and productivity will be affected.

After hose replacement to a moving component check that the hose does not foul by moving the component through the complete range of travel.

Hose connections which are damaged, dented, crushed or leaking, restrict oil flow and the productivity of the components being served. Connectors which show signs of movement from the original swaged position have failed and will ultimately separate completely.

A hose with a chafed outer cover will allow water entry. Concealed corrosion of the wire reinforement will subsequently occur along the hose length with resultant hose failure.

Ballooning of the hose indicates an internal leakage due to structural failure. This condition rapidly deteriorates and total hose failure soon occurs.

Kinked, crushed, stretched or deformed hoses generally suffer internal structural damage which can result in oil restriction, a reduction in the speed of operation and ultimate hose failure.

Free-moving, unsupported hoses must never be allowed to touch each other or related working surfaces. This causes chafing which reduces hose life.

PRESSURE TESTING

Prior to pressure testing be sure all hoses are in good condition and all connections tight. Pressure readings must be taken with gauges of specified pressure readings.

The correct procedure should be rigidly observed to prevent damage to the system or the equipment and to eliminate the possibilty of personal injury.

BEARINGS

Bearings which are considered suitable for further service should be cleaned in a suitable solvent and immersed in clean lubricating oil until required.

Installation of a bearing can be classified in two (2) ways :

press fit on rotating parts such as shafts and gears and

push fit into static locations such as reduction gear houses.

Where possible, always install the bearing onto the rotating component first.

Use the correct tools or a press to install a bearing or bushing. In the absence of the correct tools or press, heat the bearing and/or the casing in hot oil to assist the installation of the bearing.

When bearings or bushings are removed always carefully check that the bearing is free from discolouration and signs of overheating. Also check for mechanical damage such as excessive clearance, nicks and scuffing. If in doubt replace the bearings or bushings.

Bearings should never be removed unless absolutely necessary. Always use the recommended puller to reduce the risk of bearing or related component damage.

The reliability and durability of a unit depends on the effective operation of the many types of bearings and bushings which are incorporated in the complete assembly.

These bearings and bushings are subjected, in normal operation, to high working loads and adverse conditions.

Be sure during normal routine servicing, maintenance or repair that bearings are given the right attention and are installed with care.

BOOM SUPPORTS

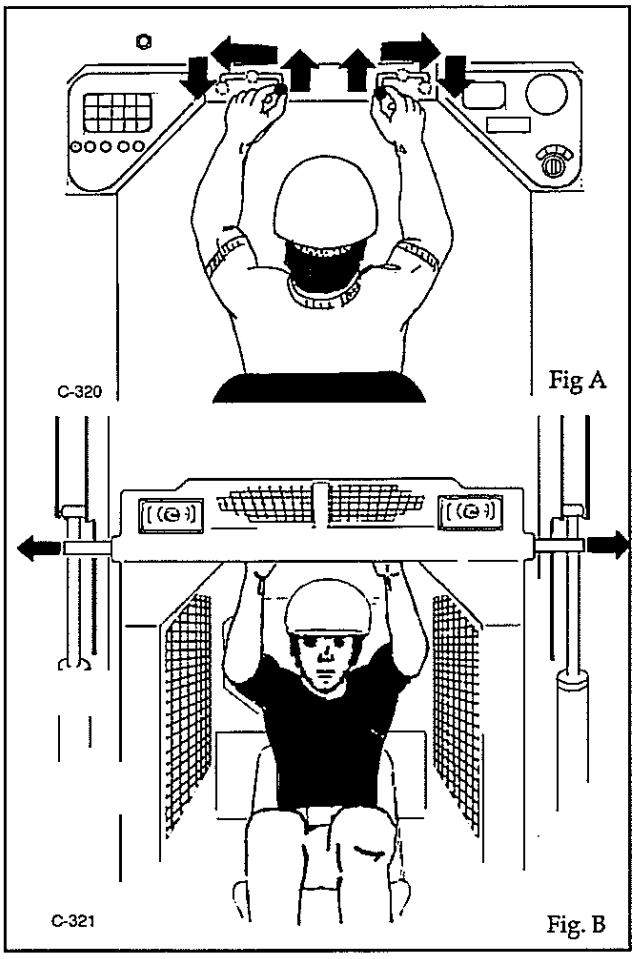
WARNING

To avoid personal injury service the loader with the boom arms down and the bucket or attachment on the ground. If it is necessary to service the loader with the boom arms raised be sure to engage the boom supports (Fig. A & B). Never work under or around a loader with raised boom arms without boom supports engaged.

For safety while performing regular service or maintenance work, the loader is equipped with boom supports.

The boom supports, when extended, prevent the boom arms from dropping if hydraulic pressure is relieved or the foot control pedals are accidentally cycled.

To operate the boom supports, first remove any bucket or attachment from the quick - tach; raise the boom arms to full height and shut off the engine. Raise the boom handles up and push out toward boom arms to extend the boom supports.



BOOM LOCKDOWNS

The boom lock down is intended to lock the loaders boom arms in the down position for safe entry and exit of the loader cab. To operate the boom lock down, lower the boom arms fully down and shut off the engine. Lower the bucket or attachment fully down on the ground and engage the parking brake. Engage the boom lock down by moving the boom lock down handle upwards to the lock position (Fig. 2).

Check to ensure the boom lock down is fully engaged at the loaders lift arm and that the foot pedals are locked before getting out of the loader.

The boom lock down must be engaged in the locked position when operating the loader with a backhoe or cold planer attachment. Boom lock down bars must also be used when operating the above attachments. Fig 3.

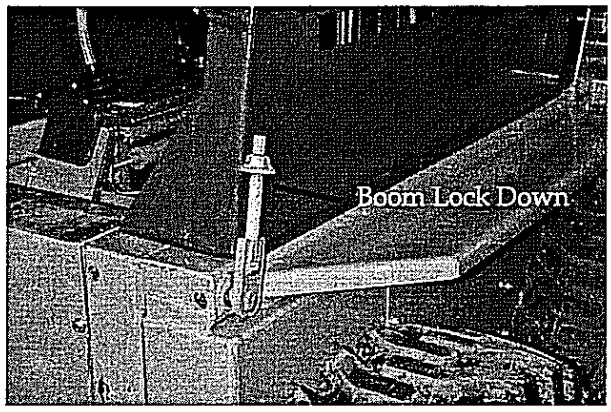


Fig. 2

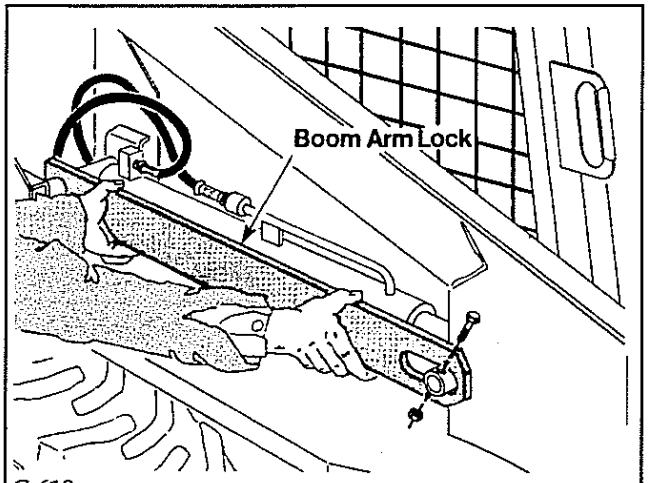


Fig. 3

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SECTION 1
Hydraulic System

7 GENERAL

7.1 Tire Pressure:
Check the pressure and if necessary inflate to the following pressure:
7.00 X 15 50 PSI (345 KPa)
10.00 X 16.5 30 - 35 PSI (207 - 241 KPa)
12.00 X 16.5 30 - 35 PSI (207 - 241 KPa)

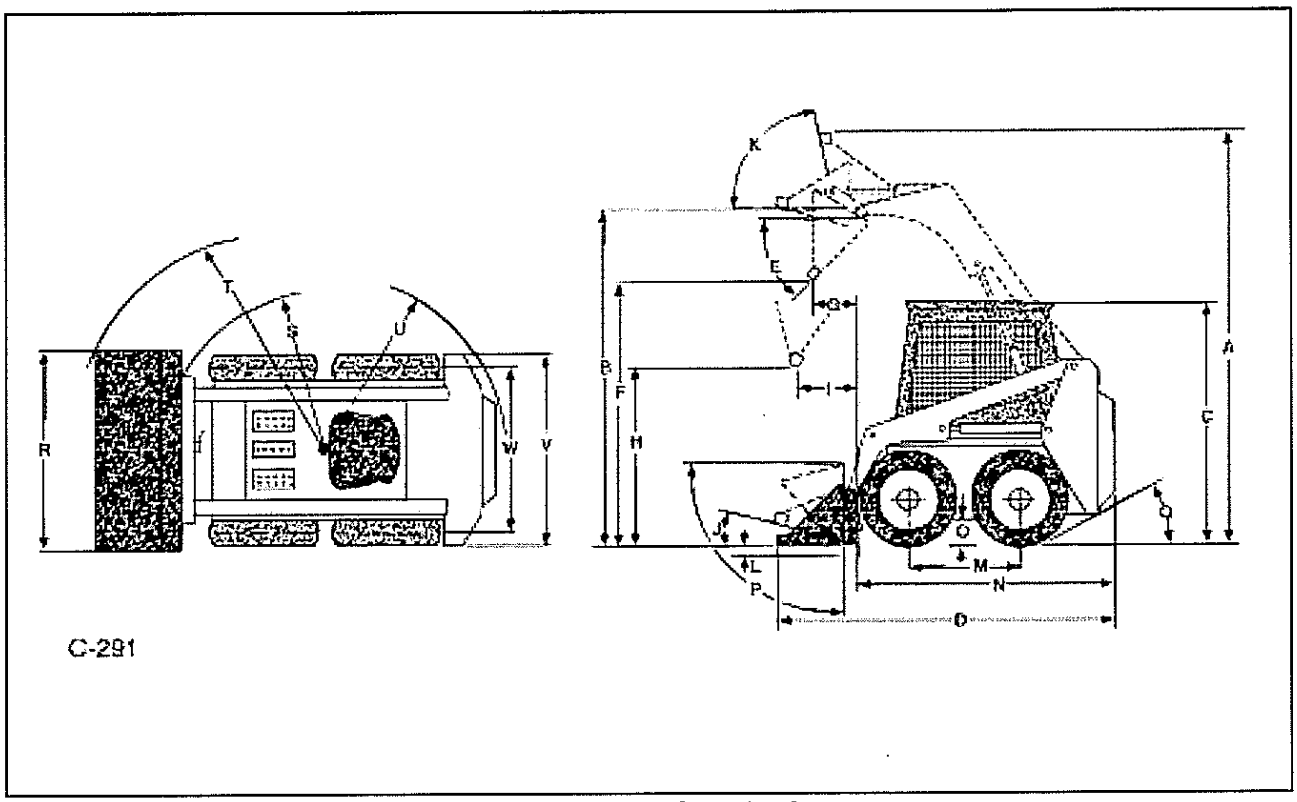
7.2 Wheel Nut Torque:
Check and torque wheel nuts to 100 - 110 ft. lbs. (136 - 149 N.M.)

7.3 Condition of Cab:
Inspect both the seat and seat belt. Ensure all safety and instruction decals are in place. Inspect sound insulation, side windows and door operation for machines equipped with cab enclosure kits.

7.4 Condition of Shields and Safety Equipment:
Inspect and ensure all shields are in place and securely fastened. Inspect and ensure all safety equipment is working properly. Ensure owners and operator manual, safety manual and all safety and instruction decals are in place. If necessary, replace. If the safety controls are malfunctioning or require adjustment, consult your Thomas Equipment Dealer for service.

7.5 General Condition:
Make a general inspection of the machine looking for loose or missing parts, oil leaks, etc.

8.3 LOADER SPECIFICATIONS



Dimensions (With Standard Tires and Dirt Bucket)

A.	Overal operating height	168" (4267mm)
B.	Height to hinge pin	132.8" (3373mm)
C.	Overall vehicle height	82" (2083 mm)
D.	Overall length with bucket	139.8" (3551 mm)
E.	Dump Angle	28°
F.	Dump height	106.8" (2814 mm)
G.	Reach - fully raised	18.8 " (478 mm)
H.	Height at 45° dump angle	72.6 " (1844 mm)
I.	Reach at 45° dump angle	27.5" (699 mm)
J.	Max. roll back at ground	26°
K.	Max. roll back fully raised	102°
M.	Wheel base	39.6" (1006 mm)
N.	Overall length less bucket	110.8" (2814 mm)
O.	Ground clearance	7.8" (198 mm)
P.	Max. grading angle - bucket	93°
Q.	Angle of departure	27°
R.	Bucket width	66" (1676 mm)
S.	Clearance circle front less bucket	53" (1346mm)
T.	Clearance circle front with bucket	81.8" (2078)
U.	Clearance circle rear	64.5" (1638 mm)
V.	Overall width less bucket	64.1" (1628 mm)

Operational:

Rated operating capacity		1700 lbs. (771 kg)
Operating weight		6650 lbs. (3016 kg)
Shipping weight		6050 lbs. (2744 kg)
Travel speed CE	2700 RPM	6.1 mph (9.8 km/hr)
Travel speed (STD)	2950 RPM	6.4 mph (10.3 km/hr)

Controls:

VEHICLE	Steering direction and speed controlled by two (2) hand operated control levers.
HYDRAULICS	Boom lift, bucket tilt and auxiliary hydraulic functions controlled by separate foot pedals.
ENGINE	Hand lever throttle, engine stop and key type ignition switch.

ENGINE

	T173HLS II
Make and Model	Kubota V2203
Cylinders	4
Cooling System	Liquid
Displacement	133.4 cu. in. (2186 cc)
Horsepower	52 (29.5 Kw)
Torque	115 ft. lbs. @ 1600 RPM
Fuel Type	Diesel No. 2
Air Cleaner	Replaceable Dry Cartridge w/ indicator
Maximum governed RPM (no load) CE	2800 RPM
Standard	2950 RPM

HYDRAULIC SYSTEM

Pump type	Gear
Pump Capacity CE	15.8 GPM 2800 RPM
Standard	16.6 GPM 2950 RPM
Control valve	Series type with float on lift and detent on auxiliary
System Relief valve, zero flow	2400 PSI (165.5 Bar)
Filtration	10 micron
Hydraulic fluid	10W30 API Class SE/CD

	T173 HLS II	
Cylinders (double acting)	Lift	Tilt
Bore Diameter	2.5 in.	2.5 & 3 in.
Rod Diameter	1.5 in.	1.5 in.

HYDROSTATIC TRANSMISSION/FINAL DRIVE

Pump type	Two (2) in line, axial piston
Pump displacement	2.5 cu. in. (40.96 cm^3)
Motor type	Geroler, torque motor
System relief setting	4500 PSI (310.3 Bar)
Final drive	No. 100 roller chain running in an oil bath

ELECTRICAL

Alternator	40 amp
Battery	12V
Type	34/78
Cranking amps	730
Reserve capacity	125
Starter	12V

TIRES

Standard	10.00 X 16.5, 6 ply 30 - 35 PSI (207 - 241 KPa)

FLUID CAPACITIES

Fuel tank	18 gal. (68 l)
Final drive transmission	5.9 gal (26.5 l)
Hydraulic reservoir	14.5 gal (101.3 l)
Engine cooling system	3.2 gal (14.5 l)
Engine oil	9.0 qt (8.5 l)

8.4 TORQUE SPECIFICATIONS

LOADER

Wheel nuts (32)	100 - 110 lbs. ft. (136 - 149 N.M.)
Hydrostatic pump mtg. bolts (4)	80 - 85 lbs. ft. (109-115 N.M.)
Hydrostatic pump mtg. bolts(4)	80 - 85 lbs. ft. (109 - 115 N.M.)
Engine Mount	55 to 60 ft.lbs. (75-81 N.M.)
ROPs Isolator	55 to 60 ft. lbs. (75-81 N.M.)

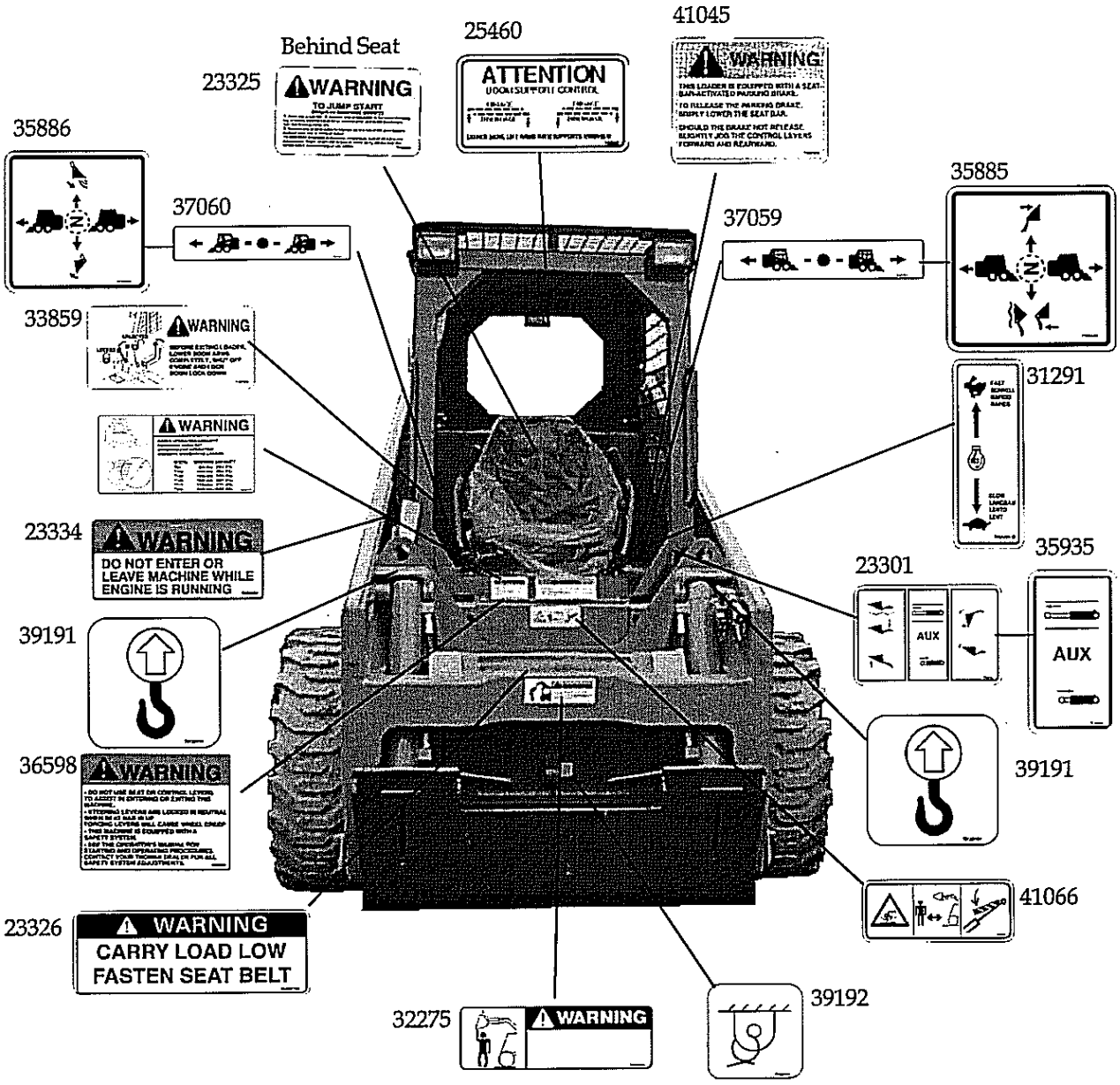
HYDRAULIC / HYDROSTATIC

Gear pump section bolts	25-28 ft. lbs. (34-38 N.M.)
Piston pump section bolts	27-31 lbs. ft. (37-42 N.M.)
Torque motor section bolts	70 lbs. ft. (94 N.M.)
Hydraulic filter, case	30 lbs. ft. (41 N.M.)

Bolts and Nuts	Torque lbs. ft. (N.M.)
1/4 - 20	5-7 (6.7-9.5)
5/16 - 18	12-15 (16-20)
5/16 - 24	12-15 (16-20)
3/8 -16	17-22 (23-30)
3/8-24	22-27 (30-37)
7/16-14	30-35 (41-47)
7/16-20	40-45 (54-61)
1/2-13	45-50 (61-68)
1/2-20	50-60 (68-81)
9/16-12	60-70 (81-95)
9/16-18	65-75 (88-102)
5/8-18	100-110 (136-139)

8.5 SOUND POWER LEVEL SPECIFICATION

LPA Sound level at operators ear	85 dB(A)
LWA adjusted sound level	103 dB(A)


Behind Seat
23325
WARNING
TO JUMP START
25460
ATTENTION
41045
WARNING
35886
37060
37059
35885
33859
WARNING
31291
WARNING
23334
WARNING
DO NOT ENTER OR LEAVE MACHINE WHILE ENGINE IS RUNNING
23301
35935
AUX
AUX
39191
39191
36598
WARNING
41066
23326
WARNING
CARRY LOAD LOW
FASTEN SEAT BELT
32275
WARNING
39192

1.1 HYDRAULIC CIRCUITS

1.1.1 SPECIFICATIONS

Pump Type.....Gear
Capacity (at rated RPM
and Pressure)...CE.....15.2 GPM (57.5 L/M)
Rated RPM.....2700
Capacity (at rated RPM
and pressure).....16.6 GPM (62.8 L/M)
Rated RPM.....2950
Rated Pressure.....2450 PSI (1655 BAR)
Reservoir Capacity.....18 gals (68 L)
Fluid Type.....10W30 API class SE, CD Oil
Filtration.....10 micron
Filtration, Reservoir.....One, 100 micron elements
Control Valve, type.....series type with float on
lift and detent on auxiliary
Oil Cooler.....440 BTU (116 KCAL)

Cylinders	LIFT	TILT
Type	Double Acting	Double Acting
Qty. per machine	2	2
Bore Dia	2.5	3 / 2.5
Rod Dia	1.5	1.5
Stroke	27.75	15.5

1.1.2 GENERAL INFORMATION - HYDRAULIC SYSTEM

Operation
(Refer to Illustration 1.1.2) Page 13.

Oil flows from the hydraulic reservoir through a 100 micron element located in the reservoir to the hydraulic pump.

The hydraulic pump is a gear type pump which is driven by a shaft through the hydrostatic drive pumps at engine speed. The hydraulic pump capacity is directly related to engine speed. Oil goes from the hydraulic pump to the hydraulic control valve.
The hydraulic control valve is equipped with an adjustable relief valve which is set at 2450 PSI (165.5 BAR). The hydraulic control valve is a three (3) spool sectional series type valve. The first spool provides hydraulic flow to the two (2) boom lift cylinders. The lift section spool is equipped with a float position. The centre spool provides flow to the auxiliary hydraulic circuit allowing operation of hydraulic attachments and tools. The centre spool is equipped with a detent position to allow constant flow to the auxiliary hydraulic circuit. The third spool provides hydraulic flow to the two (2) bucket cylinders.

Oil flows from the control valve to the hydraulic filter. The hydraulic filter has a replaceable 10 micron element with a built in by-pass valve to allow the hydraulic fluid to flow if the element is plugged.

Oil flows from the hydraulic filter through a check valve which in turn supplies charge pressure to the tandem pump and from the diverter valve, built into the filter, on through the hydraulic oil cooler. Oil flows from the hydraulic oil cooler to the hydraulic reservoir. All hydraulic oil flowing to the hydrostatic drive pumps passes first through the 10 micron hydraulic filter.

WARNING

To prevent personal injury do not service the loader without instruction or taking the necessary safety precautions. Before working on the loader, see the warnings and instructions at the beginning of the service manual.

1.1.3 Control Functions

Operation of the loader hydraulic functions are controlled by three (3) foot pedals. (Fig. 1.1.3a)

Boom Lift - The LH pedal is the boom lift control (Fig. 1.1.3a). To raise the boom press on the heel (2) of the pedal. To lower the boom press on the toe (1) of the pedal. Firm pressure on the toe (1) of the pedal will lock the boom in float position. This allows the bucket to follow the ground as the loader moves backward.

Auxiliary Hydraulics - The centre pedal is used to engage the auxiliary hydraulic circuit to power an attachment such as a backhoe. Pressing on the toe (3) of the pedal provides hydraulic pressure to the female quick connect coupling located at the front of the boom arms. Firm pressure on the toe (3) of the pedal places the valve in detent position providing a continous flow of hydraulic flow of hydraulic oil to the attachment. Pressing on the heel of the pedal (4) provides hydraulic pressure to the male quick connect coupling reversing the flow of hydraulic oil. When the auxiliary circuit is not in use return the foot pedal to neutral position otherwise starting the loader may be difficult or impossible and damage to the starter may occur.

WARNING

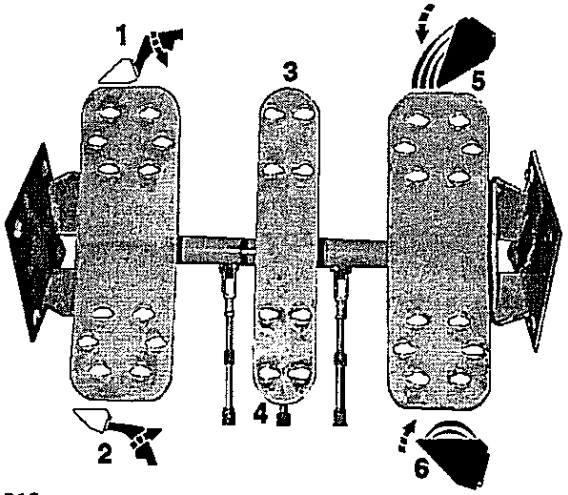
To prevent personal injury do not start the engine unless you are in the seat with the seatbelt fastened around you.

IMPORTANT

Return auxiliary hydraulic foot pedals to neutral position when not in use.

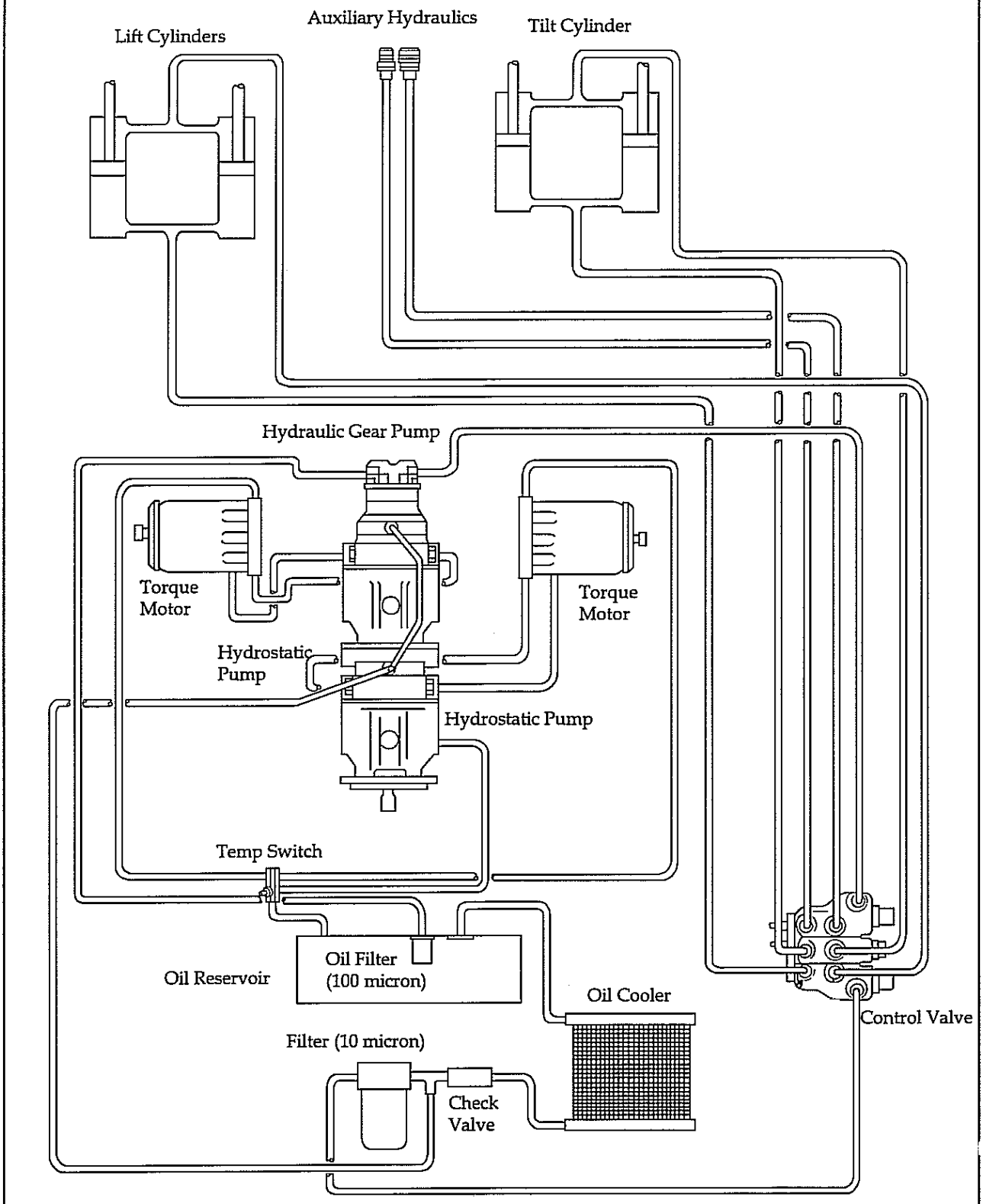
WARNING

To prevent personal injury always keep feet on the foot pedal controls while operating the loader



C-318

Fig. 1.1.3a


Lift Cylinders
Auxiliary Hydraulics
Tilt Cylinder
Hydraulic Gear Pump
Torque Motor
Torque Motor
Hydrostatic Pump
Hydrostatic Pump
Temp Switch
Oil Reservoir
Oil Filter (100 micron)
Oil Cooler
Control Valve
Filter (10 micron)
Check Valve

C-322

Fig. 1.1.2

Bucket Tilt - the RH pedal is the bucket tilt (dump) control. Pressing on the toe (5) of the pedal will dump the bucket. Pressing on the heel (6) of the pedal will roll the bucket back.

1.1.4 HAND CONTROLS

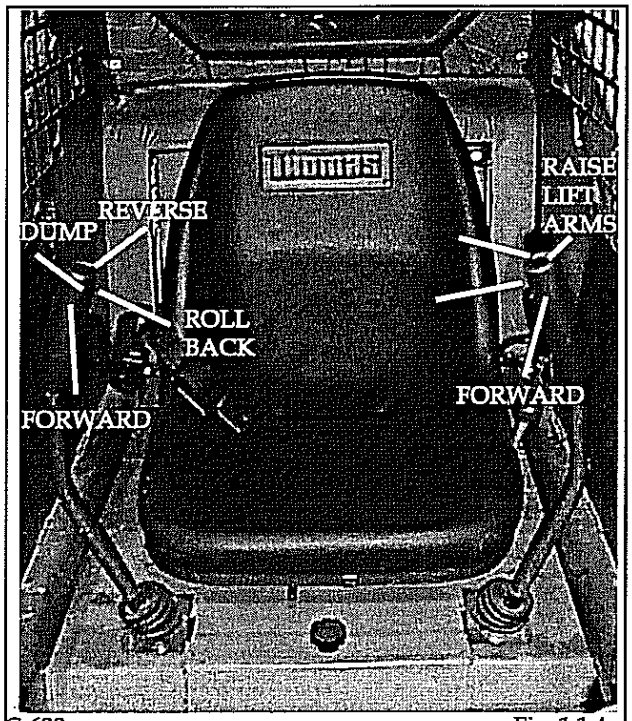
Hand controls to operate the loaders boom and bucket hydraulic system as well as the loaders travel speed and direction are available as a factory installed option.

Bucket Control - The right hand lever controls the bucket tilt cylinders. Moving the left lever to the left will cause the boom cylinders to extend, raising the loaders boom arms. Moving the control lever to the right causes the boom cylinders to retract, lowering the boom. Moving the control lever to the extreme right will place the boom in the float position. This allows the the bucket to follow the contour of the ground as the loader moves backward.

When the control levers are released they will automatically return to the neutral position stopping all hydraulic movement and travel speed. Before exiting the loader, shut off the engine and lower the boom completely down to the frame and ground the attachment. Raise the seat bar to the lock position. Move both control levers forward and backward to ensure the steering controls are locked and move both levers to the left and right to ensure the hydraulic controls are locked before you get out of the loader.

Auxiliary Hydraulics - The foot pedal is used to engage the loaders auxiliary hydraulic circuit to power an attachment such as a post hole auger. Pressing on the toe of the pedal provides hydraulic flow to the female quick connect coupling located at front of the boom arms. Firm pressure on the toe of the pedal will lock it into detent position providing a continous flow of hydraulic oil to the attachment. Pressing on the heel of the pedal provides hydraulic flow to the quick connect coupling reversing the flow of hydraulic oil. If not locked in detent position, releasing the pedal will cause it to return to the neutral position stopping all hydraulic flow. Once the pedal is locked in detent it can be returned to neutral by tapping the heel of the pedal.

When the auxiliary hydraulic system is not in use return the pedal to neutral position otherwise starting the loader may be difficult or impossible and damage to starter may occur.



C-633 Fig. 1.1.4

1.1.5 MAINTENANCE SCHEDULE

	First (Hrs).	Every (Hrs)
Oil Level, check	8	8
Oil Filter, change	50	150
Oil Cooler, clean	8	8
General System check		
(Leaks, tension, torques	8	8
Cylinders, Lubricate	8	8
Resevoir Filters, change	1000	1000
Hydraulic Oil, change	1000	1000

1.2 GEAR PUMP

1.2.1 SPECIFICATIONS

Pump, Type.....Gear
Displacement.....1.30 cu. in (21.3)
Capacity (at rated speed
and pressure).....15.2 GPM (57.5L/M)
Rated Speed (RPM).....2800
Capacity (at rated speed
and pressure).....16.6 GPM (62.8 L/M)
Rated Speed (RPM).....2950
Rated Pressure.....2400 PSI (165.5 bar)
Rotation.....RH Viewed from shaft end)
Tie Bolt Torque.....25 - 28 ft. lbs. (34 - 38 N.M.)

1.2.2 GENERAL INFORMATION

The hydraulic gear pump (Fig. 1.2.2) is mounted at the end of the two (2) hydrostatic piston drive pumps. The splined shaft of the hydraulic gear pump is driven by the internal splined shaft of the front hydrostatic pump at engine crankshaft speed. The output flow of the hydraulic gear pump is directly related to engine speed. Maximum output will be at full rated engine RPM.

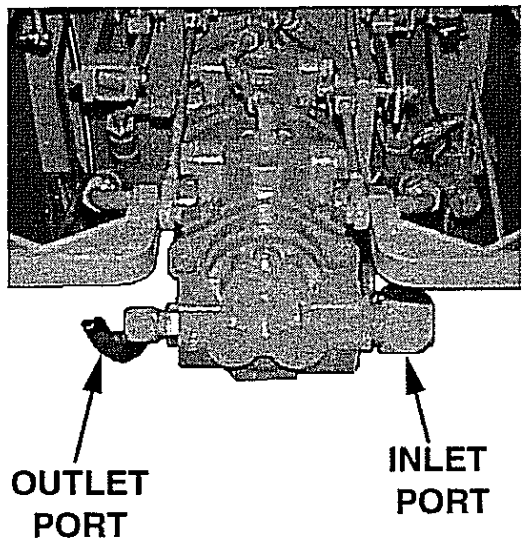
Oil is drawn from the hydraulic oil reservoir and enters the hydraulic gear pump at the inlet port. The oil is pressurized and is directly through the outlet port to the hydraulic control valve for boom, bucket and auxiliary hydraulic functions.

1.2.3 HYDRAULIC PRESSURE TESTING (Sect. 1.9)

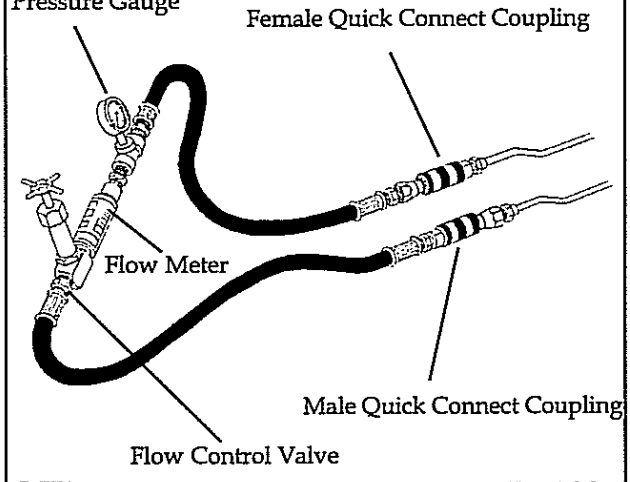
Use test equipment which will meet the following performance figures when performing the test:

Hose Assembly : Capable of a minumum burst pressure of 3000 PSI.

Flow Meter: Capable of reading up to 30 GPM (114 l/m) and equipped with a flow control valve. (Fig. 1.2.3).



C-327 Fig. 1.2.2



C-571 Fig. 1.2.3

Shut off Valve : Capable of minumum 3000 PSI burst pressure.

Pressure Gauge : Capable of reading up to 3000 PSI (206.9 bar).

WARNING To prevent personal injury never repair or tighten hydraulic hoses or fittings with the engine running or the system under pressure.

IMPORTANT When making repairs to the hydraulic system, keep all parts clean and remove dirt from the work area. Use caps and plugs on all lines and openings.

IMPORTANT There is no relief valve protecting the pump when the tester is connected between the pump and just before the valve. To prevent pump damage do not close the valve on the tester all the way or exceed 2450 PSI (165.5 bar).

1.2.4 GEAR PUMP REMOVAL AND REPLACEMENT

1. Remove attachment, raise the boom arms and engage boom supports.
2. Disconnect the line between the hydraulic oil reservoir (Fig. 1.2.4a) and the hydraulic gear pump at the gear pump inlet port. Plug the hose with a 1 in. JIC cap to prevent loss of hydraulic oil or you may also create a vacumn in the hyd. reservoir with a shop vac to prevent oil loss.
3. Disconnect the line between the hydraulic gear pump and hydraulic control valve (Fig. 1.2.4a).
4. Remove the two (2) bolts which hold the hydraulic gear pump to the hydrostatic pump (Fig. 1.2.4b).

WARNING To prevent personal injury do not work on a loader with the boom arms in a raised position unless the boom supports are engaged.

5. Remove the hydraulic gear pump from the hydrostatic pump (Fig. 1.2.4b).
6. Check the drive coupler.

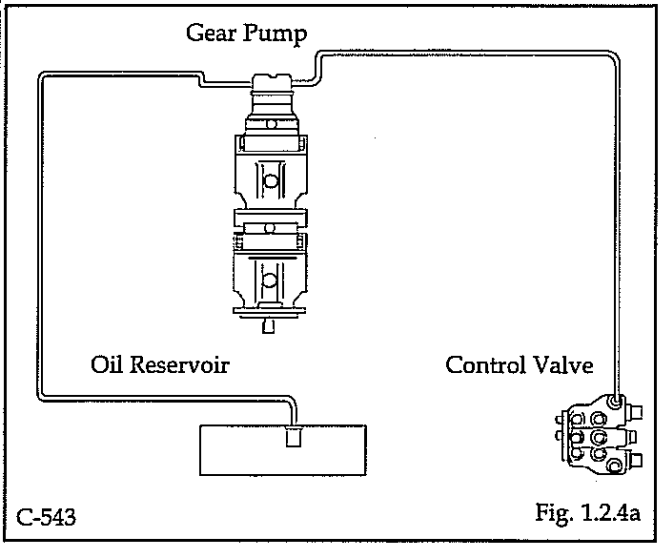


Fig. 1.2.4a

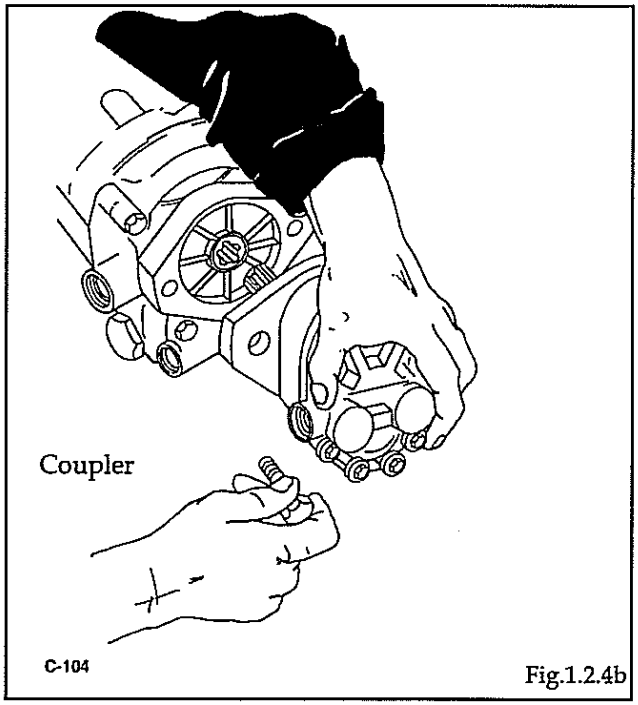


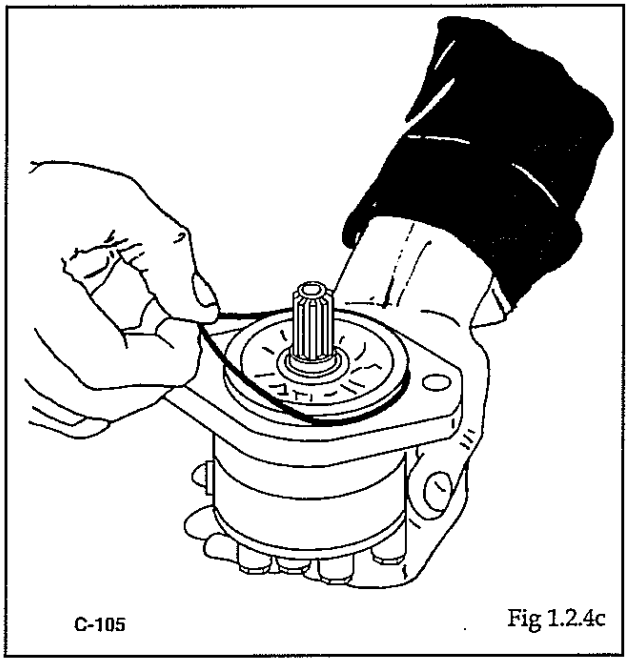
Fig.1.2.4b

Reassembly :

1. Install a new O ring on the mounting flange of the hydraulic gear pump. (Fig. 1.2.4c).

2. Install the drive coupler.

3. Install the hydraulic gear pump on the hydrostatic pump.



C-105

Fig 1.2.4c

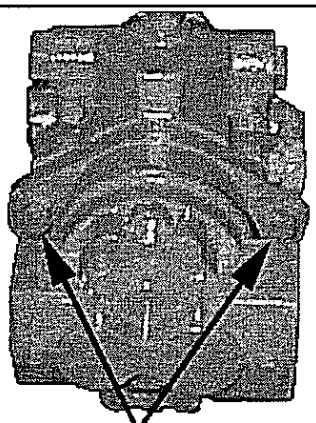
4. Install the two (2) mounting bolts and torque to 27 - 31 ft. lbs. (36.6 - 42 N.M.) Fig. 1.2.4d.

5. Install the hydraulic fittings.

6. Install the hydraulic line between the gear pump and hydraulic control valve. Torque the fittings and the hose ends.

7. Install the hydraulic hose from the oil reservoir at the rear of the pump inlet. Torque the fittings and hose end.

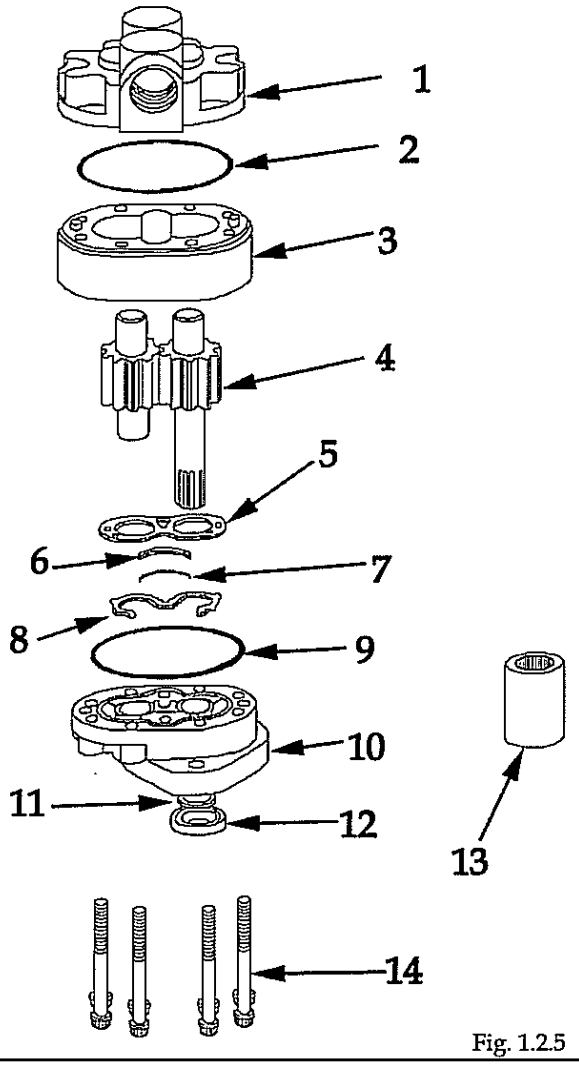
7. Replace the seat and plate assembly. See the start up after repair. Check for leaks



C-328

Fig. 1.2.4d

1. Back Plate
2. O-Ring
3. Body
4. Drive Gear
5. Wear Plate
6. Seal Bearing
7. Moulded Seal
8. Back Up Gasket
9. O - Ring
10. Front Plate
11. Washer
12. Shaft Seals
13. Coupler
14. Tie Bolts



C-473

Fig. 1.2.5

1.2.5 DISASSEMBLY AND INSPECTION

Before disassembling the pump, clean the body with a suitable solvent and dry with compressed air. Ensure all openings are plugged to prevent solvent entering the pump. Mark the pump across the front plate, body and back plate to assist reassembly.

IMPORTANT

To prevent damage after removal or repair of hydraulic components refer to start up procedure section 1.2.6

Disassembly : (Fig. 1.2.5)

1. Remove the eight (8) tie bolts.

2. Hold the pump in both hands and tap the driveshaft with a rubber hammer to separate the front plate from the back plate. The body will remain with either the front plate or the back plate.

3. To separate the body from the section it remains with, place the drive gear in the body and tap the protruding end of the gearshaft with a plastic mallet.

4. Remove the O-ring from the back plate and discard.

5. Remove the wear plate from the front plate.

6. Remove and discard the bearing seal, molded seal and the backup gasket from the front plate.

7. Remove and discard the shaft seal from the front plate.

Inspection :

1. Thoroughly clean and dry all parts.

2. Inspect the shaft and gear assemblies for roughness or excessive wear at the bearing and seal areas.

3. Inspect the gear faces for any scoring which would render it unserviceable. Carefully remove any sharp areas on the gear teeth with emery cloth.

4. Inspect the bearings in the front and back plate. The bearings are an integral part of the front and back plate and are not serviced separately. The complete plate should be changed if the following conditions are not met:

   a. The bearings in the front plate should be flush with the face of the front plate.
   b. The oil grooves in the bearings should line up with the dowl pin holes and be 180 degrees apart for both front and back plates.
   c. The inside diameter of each bearing should not exceed .879 in. (22.33 mm).

5. Inspect the gear pockets of the body and wear plate for excessive scoring or wear. Replace if wear exceeds .0015 in. (.038 mm).

6. Check body inside gear pockets for excessive scoring or wear.

7. Replace body if I.D. of gear pockets exceeds 2.108 in. (53.54mm).

Reassembly :

Replace all gaskets, seals, wear plates and molded O-rings.

1. Using a dull tool, fit the backup gasket groove in the front plate.

2. Install the backup gasket in the front plate.

3. Place molded O-ring in the front plate. Place the bearing seal over the molded O-ring.

4. Place the pump body onto the front plate.

5. Place wear plate on top of backup gasket with bronze facing up.

6. Lubricate and slip gear assemblies into gear pockets.

7. Install the adapter plate.

8. Install the rear body and wear plate.

9. Slide the back plate over the gear shafts until the dowel pins are engaged.

10. Install and evenly tighten the eight (8) tie bolts. Torque to 25 - 28 ft. lbs. (34 - 38 N.M.).

11. Dip the shaft seal in system fluid and install it on the driveshaft, being careful not to cut the rubber sealing lip. Fully seat the seal into the recessed bore in the front plate.

12. Rotate the pump shaft by hand. A small amount of resistance should be felt, however, the pump should turn freely after a short period of use.

IMPORTANT

To prevent damage after removal or repair of hydraulic components refer to the start up procedure. Section 1.2.6

1.2.6 START UP AFTER REPAIR

After draining the hydraulic oil reservoir or replacing major hydraulic or hydrostatic components, the following procedure must be followed to prevent damage on startup.

1. Fill the hydraulic oil reservoir to the correct level with 10W30 API classification SE/CD oil. Refer to section 1.7.3 for procedure and capacities.

2. On diesel engines with the throttle lever set in the off position, intermittently turn the engine over with the starter motor for approximately two (2) minutes. This allows both the gear pump and hydrostatic drive pump to draw oil from the reservoir ensuring the system is full on startup. DO NOT START THE ENGINE.

3. Start the engine and run it at half throttle with no hydraulics engaged for several minutes.

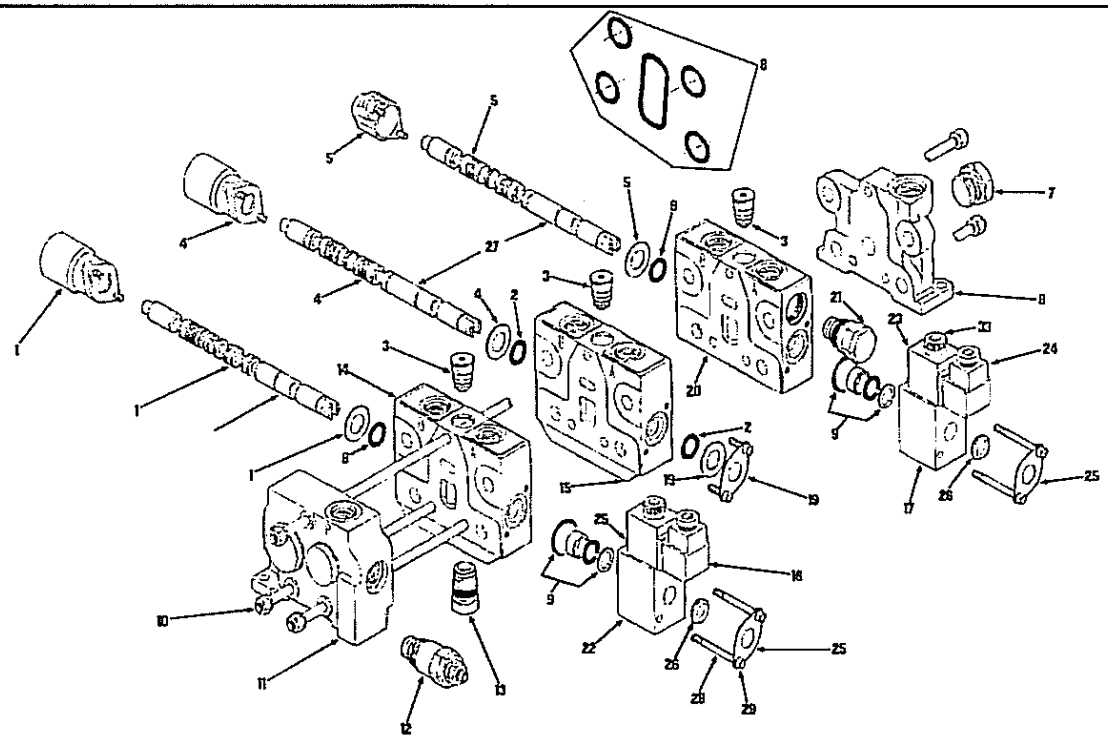
4. With the engine running at half throttle, operate the hydraulic control valve to build up pressure at three (3) second intervals for approximately three (3) minutes.

5. Increase the engine speed to full throttle, operate the hydraulic control valve to build up pressure at three (3) second intervals for approximately three (3) minutes.

6. Idle the engine and check for leaks.

1.3 CONTROL VALVE

DIAGRAM LEGEND
1. Float Spool
2. Spool O ring Kit
3. Check Valve
4. Double Acting Spool
5. Spring Centre
6. Outlet Section SAE 12
7. Plug, Outlet Side
8. O ring Kit Sections
9. O ring Kit
10. Tie Rod Kit
11. Inlet Section SAE 10
12. Main Relief Valve
13. Special Check Valve
14. Series Section SAE 10A/B
15. Auxiliary Section
16. Connection Solenoid



C-845

Fig. 3.1

17. Block for Spool Lock
19. Dust Cover
20. Handle Section SAE 10
21. Anticavitation Valve
22. Spool Locking Device
23. Solenoid 12V
24. Bushing
25. Shim
26. Scraper
27. Spool End
28. SHC Screw
29. Spring Washer
30. O ring
31. Spacer
32. O ring
33. Nut
34. Seal Kit

1.3.1 SPECIFICATIONS

Model.....VD08A
Valve Type .....3 spool, sectional series type with float on boom and aux. detent
Flow Capacity.....20 GPM
Main Relief, Type.....Adjustable
Main Relief, Setting .....2450 PSI (165.5 bar)
Load, Check.....1 per valve circuit

1.3.2 GENERAL INFORMATION

Loader Control Valve
The loader hydraulic control valve is a series of parallel type, sectional valve. The valve contains three (3) spools which control loader bucket, auxiliary hydraulic and boom operations.

When the spools are in neutral, oil flows from the hydraulic gear pump, through the control valve and returns to the hydraulic reservoir. As a spool is moved, oil is directed to one end of the cylinders. Oil returning from the cylinders is ported to the next valve circuit which allows operation of more than one (1) function at the same time.

Each spool end contains a centering spring which returns the spool to the neutral position if the foot pedal control is released. The auxiliary section contains a detent mechanism to hold the spool in position, providing constant flow to the auxiliary hydraulic circuit when required.

The boom section has a detent mechanism to hold the spool in position, when float is desired. Port 'A' to slow the boom down cycle time.

System Relief Valve Operation

The system relief valve (Fig. 1.3.2a) is located at the rear of the valve near the inlet port between the high pressure passage and the low pressure passage.

When the spool is moved, oil is directed to one end of the cylinders. If the cylinders are restricted or reach the limit of their travel, oil pressure builds up in the system. To protect against the pressure increase, the relief valve opens and allows high pressure oil to return to the reservoir. The system relief valve is adjustable, refer to section 1.3.3. The relief valve is preset at 2450 PSI (165.5 bar).

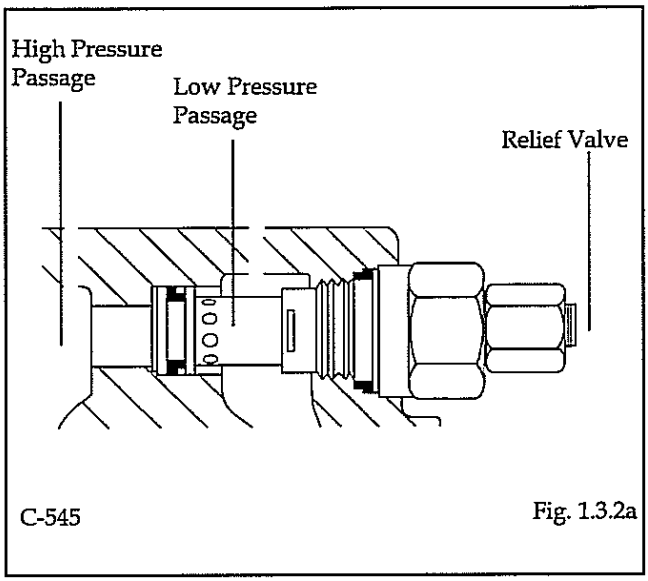
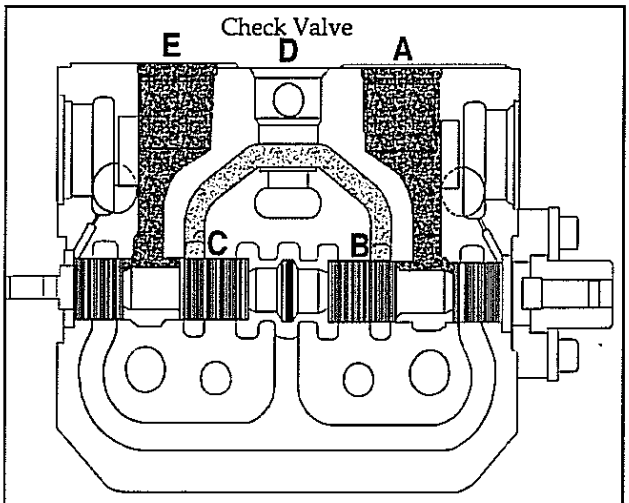


Fig. 1.3.2a

Load Check Valve Operation

Load check valves are located between the ports of each spool circuit. The function of the check valve is to hold the boom arms or bucket in position during spool movement.

In operation, the check valve (Fig. 1.3.2b) is retained on it's seat by spring force. At initial spool movement, the natural tendency is for oil, which is being pressurized by the closing of the open centre passage to flow to an area of lower pressure. As the open centre passage is being blocked, the oil would then attempt to flow past the open spool. This oil is held at the check valve until the pumped oil overcomes the force holding the check valve on it's seat. As the pressure increases, the oil pressure unseats the check valve and pressurized oil flows to the cylinder.



C-421

Fig. 1.3.2b

Operation Spool -In

Fig. 1.3.2c illustrates the foot movement required to send oil flow through the valve to the cylinder hose ports. Pushing the spool in causes the boom to lower in the boom spool section, the bucket to dump in the bucket spool section and oil to flow to the female quick connect coupling on the auxiliary hydraulic spool section.

Oil enters the inlet section (Fig. 1.3.2b), at A and B. The spool land blocks the oil from flowing to port C. All pumped oil is directed through passage A, the pressure increases until the load check valve D is unseated. Oil passes by the load check valve and out hose port E to one end of the cylinders.

Oil forced out of the cylinders by the piston enter the valve through hose port and flows to the reservoir.

The auxiliary hydraulic spool has a detent mechanism to hold the spool in this position if a constant flow of oil to the auxiliary circuit is required.

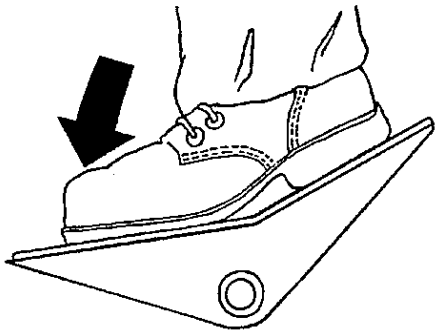

C-626

Fig. 1.3.2c

1. This test must be performed with the engine running and hydraulic oil at working temperature of approximately 160 °F.

2. Connect the hydraulic tester between the male and female quick couplers on the boom. The inlet hose from the tester connects to the outlet port of the quick coupler and the outlet hose from the tester connects to the return port of the quick coupler.

3. Restrict flow to 2 GPM until you reach 160°F.

4. Increase engine speed to full operating RPM gradually turn the flow control clockwise . Decreasing the flow, carefully watch the pressure gauge as it rises. If the pressure reaches 2450 PSI and flow remains, pressure is set too high and must be adjusted down at the relief valve.

5. Open the flow control valve to full flow. Loosen the jam nut (Fig. 1.3.3b) on the relief valve adjusting screw and turn the screw clockwise, counting the turns until it bottoms out.

⚠ WARNING To prevent injury or damage to the loader do not run the engine while adjusting the relief valve.

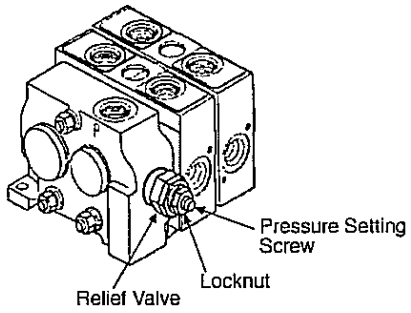
6. Gradually turn the adjusting screw out more or less than the turns required to bottom it. To increase the pressure turn the screw out less than what you counted. To decrease the pressure turn the screw out more than you counted (Fig 1.3.3c).

7. Gradually stop flow completely. Read the pressure at no flow. It should be 2450 PSI +/- 100 PSI. Remember the relief valve adjustment is very sensitive and will require only a 1/8 turn to affect pressure. Do not exceed the above mentioned pressures.

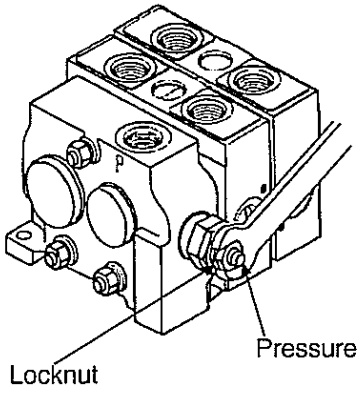
IMPORTANT Do not set the relief pressure above 2450 PSI (169 Bar) to prevent damage to the hydraulic components.

⚠ WARNING To prevent personal injury do not work a loader with the boom arms in a raised position unless the boom supports are engaged.

⚠ WARNING To prevent personal injury do not start the engine unless you are in the seat with the seat belt fstened around you.



C-353 Fig. 1.3.3b



C-354 Fig 1.3.3c

1.3.4 *CONTROL VALVE REMOVAL AND REPLACEMENT*

Removal

1. Remove any attachment. Shut off the engine.

2. Disconnect the control cables and solenoid electrical wires.

3. Disconnect the line from the control valve outlet port (Fig. 1.3.4b). Cap the hydraulic line and plug the control valve outlet port.(1 1/16 JIC Male)

4. Disconnect the line between the hydraulic gear pump outlet and the control valve inlet. (Fig. 1.3.4a).

5. Disconnect all six (6) lines going to bucket, boom and auxiliary hydraulic circuits at the control valve (Fig. 1.3.4c). Cap all six (6) hydraulic lines and hose ports on the control valve.

6. Remove the three (3) nuts which secure the hydraulic control valve mount and remove the hydraulic control valve.

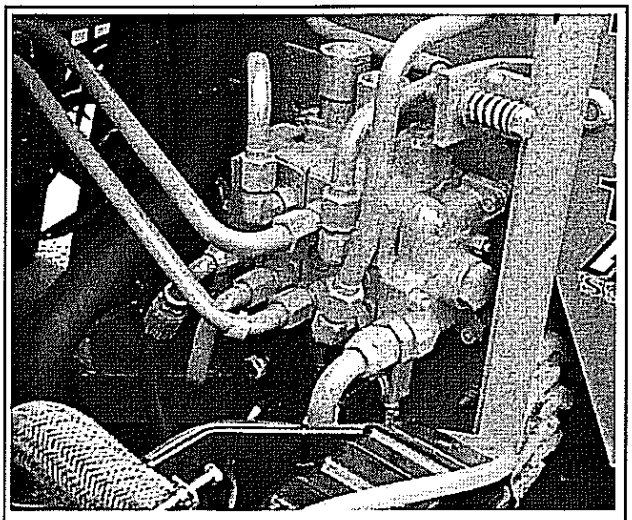
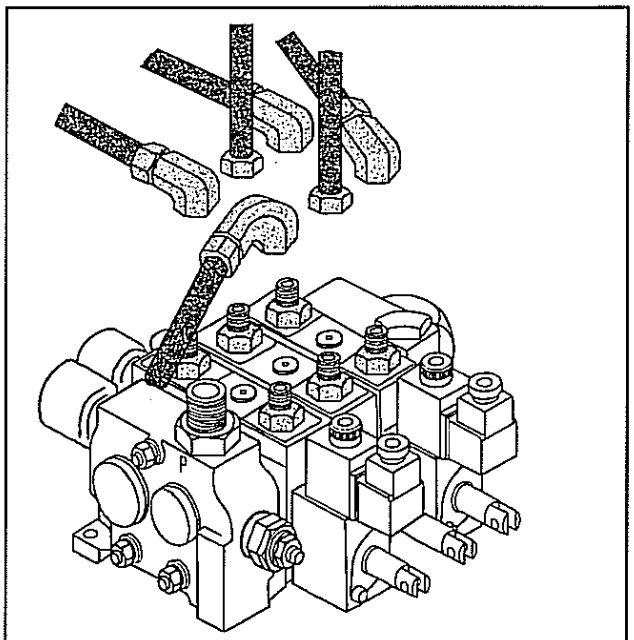


Fig 1.3.4a



C-422

Fig. 1.3.4b

IMPORTANT

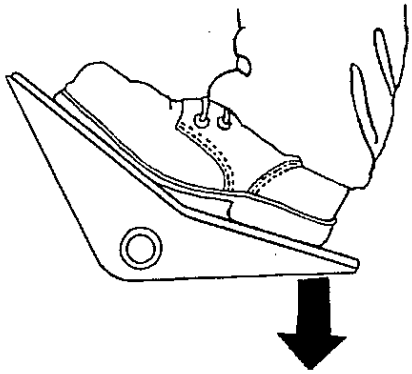
When making repairs to the hydraulic system, keep all moving parts clean and remove all dirt from the work area. Use caps and plugs on all lines and openings.

⚠ WARNING

To prevent personal injury do not work on a loader with the boom in a raise position unless the boom supports are engaged.

Operation Spool -Out

Fig. 1.3.2d illustrates the position of the foot pedal to show oil flow through the valve to the cylinder hose ports when the spools are out. Pulling the spool out in the boom section causes the boom to raise, in the bucket section the bucket to roll back and in the auxiliary section oil to flow to the male quick connect coupling.



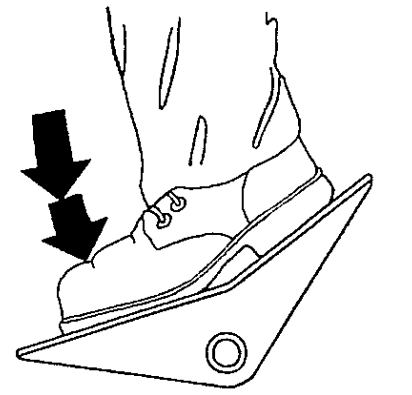
C-627 Fig. 1.3.2d

Oil enters the inlet valve (Fig. 1.3.2b) section at A and B. The spool land blocks the oil from flowing to passage C. All pumped oil is directed through passage A where it is blocked by the load check D. The pressure increases until it overcomes the force holding the check valve in it's seat. The oil pressure unseats check valve D and flows out hose port E to one end of the cylinder.

Oil forced out of the cylinders by the pistons enters the valve through the hose and flows to the reservoir.

Operation Boom Float Position

Incorporated at the end of the boom spool is a detent locking device that holds the spool in float position. With the spool in this position, oil is permitted to flow freely between the rod and piston end of the boom cylinders.This is accomplished in the illustration by forcing down on the toe of the pedal as in Fig. 1.3.2e. As the working surface varies the boom arms float with the ground contour.



C-628 Fig 1.3.2e

Oil travels through passages A and B to passage D which is connected to the reservoir and to passages G and H.

Oil being displaced or forced out of one cylinder end circulates to the other cylinder end through hose port, depending on whether raising or lowering conditions occur.

The load check valve C will not unseat as the passage is blocked by the spool land.

1.3.3 *TESTING AND ADJUSTING THE RELIEF VALVE*

Testing System Relief Valve

Use a pressure gauge capable of reading up to 3000 PSI. (206.6 bar) and hose and fittings capable of 3000 PSI (206.6 bar) continous pressure when performing the test.

1. Operate the loader until the hydraulic oil is approximately 160 °F. Shut off the engine.

2. This test must be performed with the engine running. Before performing the test remove any attachment and block the loader securely with all four (4) wheels clear of the ground.

3. Connect a pressure gauge in the female quick connect coupling on the auxiliary hydraulic circuit located at the front of the boom arm (Fig.1.3.3a).

4. Start the engine.

5. Press the toe of the hydraulic (centre) pedal to activate the auxiliary hydraulic circuit.

6. Pressure must be 2450 PSI (165.5 bar).

7. Shut off the engine and cycle the foot pedal to relieve pressure at the gauge.

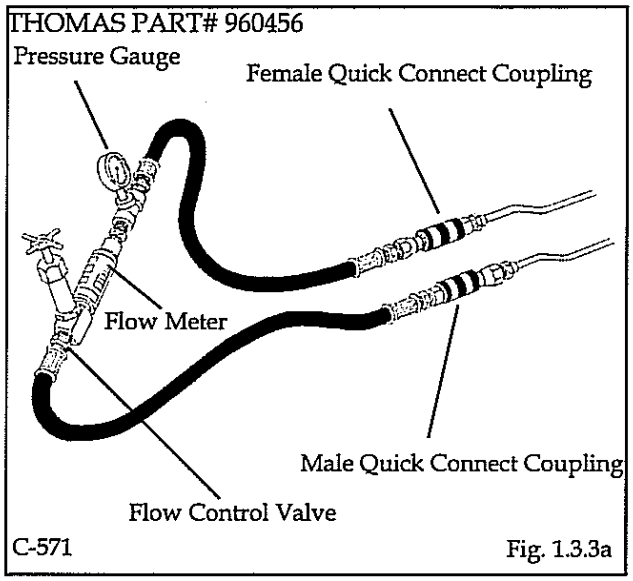


Fig. 1.3.3a

Adjustment System Relief Valve

Flow Meter - Capable of reading up to 30 GPM (114 l/m).

Pressure Gauge - Liquid filled gauge capable of reading to 3000 PSI (206.8 bar).

CAUTION	Should you adjust relief valve pressure too high, serious damage to the gear pump could occur.

Replacement

1. Install the valve and secure with three (3) nuts. Lock washer torque is 15 ft. lbs.

2. Connect the six (6) hydraulic lines going to the bucket, boom and auxiliary hydraulic circuits at the control valve.

3. Connect the hydraulic pipe going to the hydraulic gear pump at the hydraulic control valve inlet port.

4. Connect the hydraulic hose going to the oil filter at the hydraulic control valve outlet port.

5. Connect the foot pedal cables to the hydraulic control valve spools.Connect the solenoid electrical if so equipped.

6. Fill the hydraulic reservoir to the correct level with 10W30 API Classification SE/CD. Refer to section 1.7.3 for procedure and capacities.

7. Before startup refer to section 1.2.6 for correct procedure to prevent damage to the hydraulic system components.

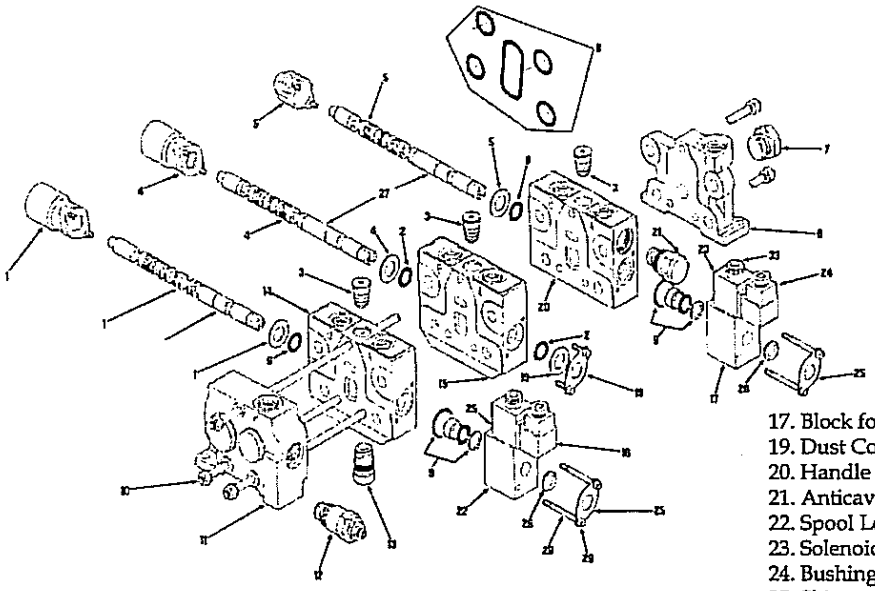


DIAGRAM LEGEND
1. Float Spool
2. Spool O ring Kit
3. Check Valve
4. Double Acting Spool
5. Spring Centre
6. Outlet Section SAE 12
7. Plug, Outlet Side
8. O ring Kit Sections
9. O ring Kit
10. Tie Rod Kit
11. Inlet Section SAE 10
12. Main Relief Valve
13. Special Check Valve
14. Series Section SAE 10A/B
15. Auxiliary Section
16. Connection Solenoid
17. Block for Spool Lock
19. Dust Cover
20. Handle Section SAE 10
21. Anticavitation Valve
22. Spool Locking Device
23. Solenoid 12V
24. Bushing
25. Shim
26. Scraper
27. Spool End
28. SHC Screw
29. Spring Washer
30. O ring
31. Spacer
32. O ring
33. Nut
34. Seal Kit

C-845

Fig. 1.3.5a

1.3.5 CONTROL VALVE DIASSEMBLY AND INSPECTION

Disassembly

Before disassembling the hydraulic control valve, clean the body with a suitable solvent and dry with compressed air.

WARNING To avoid eye injury use safety goggles when cleaning with compressed air.

Ensure all openings are plugged to prevent solvent from entering the valve. Refer to Fig. 1.3.5a to assist in diassembly.

1. Remove the pressure relief valve. Discard O-rings and back up washers.

2. Remove three (3) tie bolts holding the valve assembly together.

3. Remove the solenoid lock assembly.

4. Remove the spool end caps.

5. Remove the spring spacer, spring and return washer.

6. Remove the detent springs, detent balls and bucket spool from the spool end cap.

7. Remove the two (2) end cap screws from the auxiliary spool end cap. Remove the end cap.

8. Remove the detent spool. spring spacer, spring and return washer from the auxiliary spool . Remove the auxiliary spool.

9. Remove the two (2) detent plugs, detent springs and detent balls from the boom spool end cap.

10. Remove the two (2) end cap screws from the boom spool end cap. Remove the boom spool end cap.

11. Remove the detent spool, spring washer, spring and return washer from the boom spool. Remove the boom spool.

12. Remove and discard the six (6) spool O-rings. Be careful not to scratch the spool bores.

Inspection

1. Thoroughly clean and dry all parts.

2. Inspect the load check valve springs (3) for breakage or loss of tension. Inspect the load check poppets (4) for scoring or wear. 1.3.5b) To remove the load check poppets, simply remove the top tie rod from the valve assembly. The poppets can then be removed as illustrated above (see item 3). When reassembling, do not overtorque approximately 15 ft. lbs.

3. Inspect the check valve seats inside the valve body for scoring. Scoring on the check valve seat will allow leakage and may result in the boom or bucket being unable to hold their position when the spools are in neutral or initial spool movement.

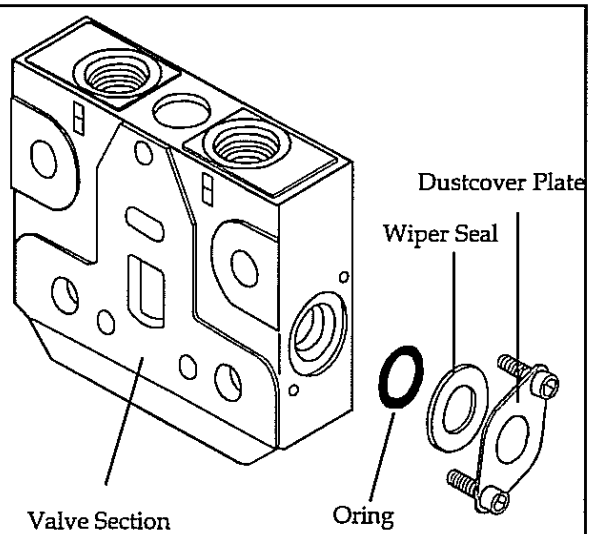
4. Check the spools for scoring or wear.

5. Inspect the spool bores in the control valve body for scoring or wear.

6. Inspect the return washers, return springs, spring spacers and the detent spools for damage or wear.

IMPORTANT

When making repairs to the hydraulic system, keep all moving parts clean and remove all dirt from the work area. Use caps and plugs on all lines and openings.



C-565 Fig. 1.3.5b

7. Check the relief valve and relief valve seat in the control valve housing for score or wear.

Assembly

1. Install the three (3) load check poppets, poppet springs and load check plug in the control valve housing (Fig. 1.3.5c). Install a new O-ring on the load check plug and backup washers before assembly.

2. Install the relief valve in the control valve housing. Install new O-rings and backup washers on the relief valve before assembly.

3. Carefully insert each spool into its proper bore from the back of the valve housing. Rotate the spools as they pass through the front of the valve body. Pull the spools out of the front of the valve body until the back edge of the spool is in line with the back edge of the valve housing.

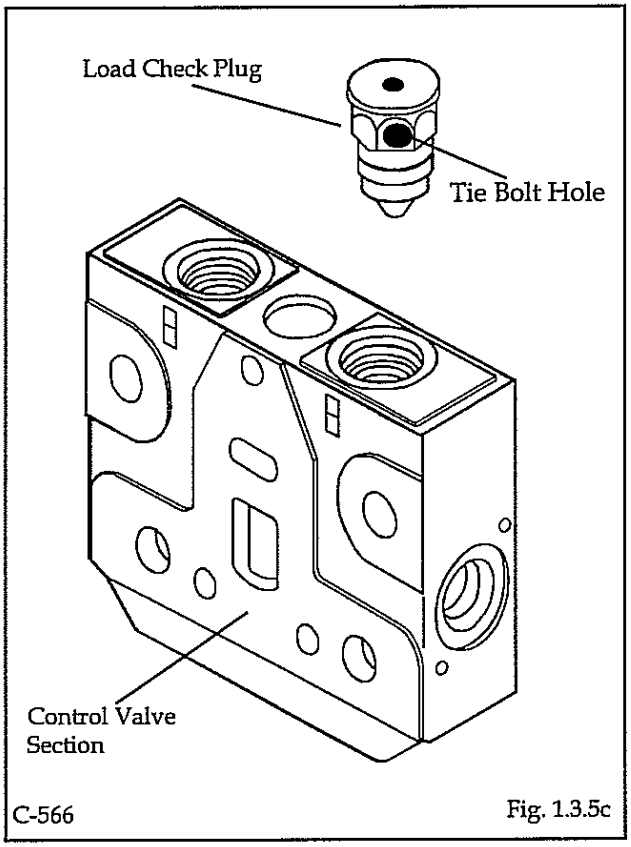
4. Lubricate with system oil, three (3) spool O-rings and install them.

5. Install the return washer, spring, spring washer on the end of the bucket spool and secure in place with the lockwasher and screw. Torque to 2 -3 ft. lbs. (2.7 - 4 N.M.).

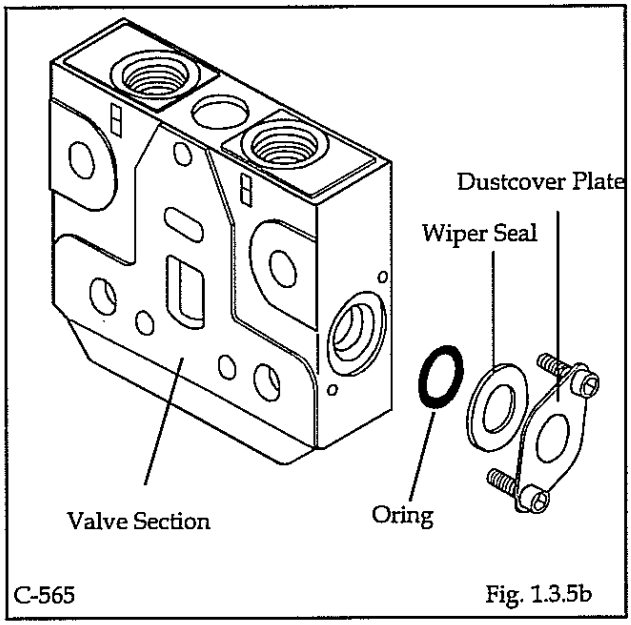
6. Install the bucket spool end cap and secure with two (2) end cap screws. Torque the end cap screws to 2 - 3 ft. lbs. (2.7 - 4 N.M.).

7. Install the return washers, springs and spring spacer on the ends of both the auxiliary and boom spools.

8. Install the auxiliary and boom spool end caps and secure with end cap screws. Torque the end cap screws 2 - 3 ft. lbs. (2.7 - 4 N.M.).



C-566 Fig. 1.3.5c



C-565 Fig. 1.3.5b

1.3.6 SPOOL SEAL REPLACEMENT

It is not necessary to remove the hydraulic control valve from the loader or to remove the spools from the valve body to replace the spool seals.

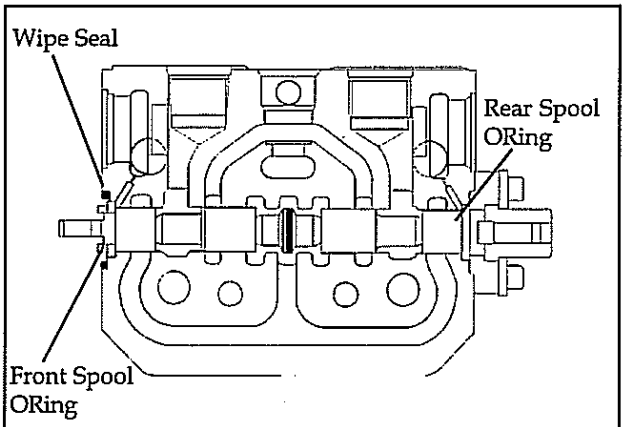
The spool is sealed on both ends with an O-ring (Fig. 1.3.6a).

The following instructions refer to replacement of the spool seals on the boom lift spool.

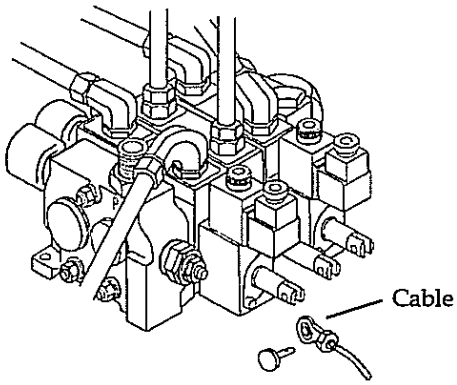
The procedure on the other two (2) spools will be the same with the exception of removing the spring mechanism on the bucket spool.

Refer to section 1.3.5 for additional information:

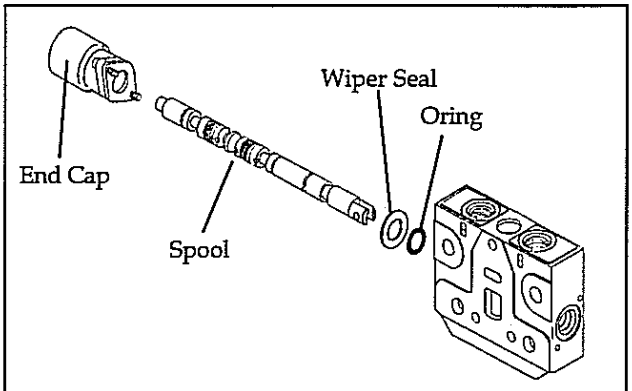
1. Ground the attachment and lower the boom arms. Shut off the engine.
2. Disconnect the cable at the control valve spool (Fig. 1.3.6b).
3. Remove the end cap (Fig. 1.3.6c).
4. Remove the detent spool, spring spacer, spring and return washer from the end of the spool (Fig. 1.3.6c).
5. Remove and discard the old O-rings.
6. Carefully replace with new O-ring. Lubricate thoroughly with system oil.
7. Remove the lock mechanism and old O-ring.
8. Lubricate and install the new O-ring.
9. Replace spool lock mechanism. Tighten each bolt evenly to prevent binding the lock.
10. Install the end cap and spring return parts in the reverse order of disassembly. Torque the end cap screws 2 - 3 ft. lbs. (2.7 - 4 N.M.).
11. Reconnect the foot pedal linkage.
12. Start the engine and check for leaks.



C-559 Fig. 1.3.6a



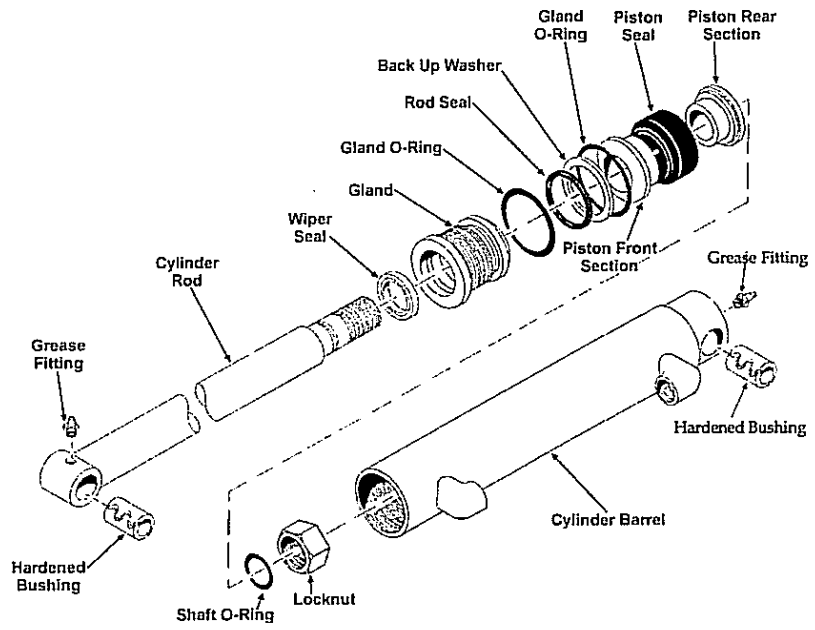
C-356 Fig. 1.3.6b



C-560 Auxiliary Section Fig. 1.3.6c

IMPORTANT Do not intermix parts from one spool with another. Keep spool parts separate.

IMPORTANT When making repairs to the hydraulic system, keep all parts clean and remove dirt from the work area. Use caps and plugs on all lines and openings.



C-020

Fig. 1.4

1.4.1 SPECIFICATIONS

	BOOM	BUCKET
Type.....Double Acting		Double Acting
Qty. per Model	2	2
Rod Diameter	1.5 in.	1.5 in.
Bore Diameter	2.5 in.	2.5 and 3 in.
Stroke	27.75 in.	15.5 in.

1.4.2 GENERAL INFORMATION

All cylinders are double acting being designed to both extend and retract under hydraulic pressure.

The piston rods, which are made of high strength distortion free material, are precision ground and hard chrome plated. The cylinder barrels are microhoned to close tolerance, straightnesss and smooth finish for long piston packing life.

All cylinders have a two (2) piece piston assembly made of ductile iron and a polypac seal arrangement consisting of a piston seal and two (2) wear rings.

The gland rod seal consists of a U cup which faces the pressurized oil. The rod wiper keeps foreign matter from entering the cylinder by wiping the rod clean as the cylinder retracts.

Two (2) types of outer gland seals are used. One type consists of an O-ring with a teflon backup washer installed on the low pressure side of the O-ring. The other type consists of an O-ring which seals between the gland and the end of the cylinder barrel. The seal kit contains seals to service both types of glands.

1.4.3 TESTING THE PISTON SEALS

If the boom or bucket cylinders drift down with the control valve in neutral position and with no external leaks in the hydraulic system, the following test will indicate if oil is leaking by the cylinder piston seal. With the fluid at operating temperature and a fully loaded attachment, check that the lift arm cylinder does not drop more than *1.5 in. per minute.* Before performing the test ensure the foot pedals are not binding and the hydraulic control valve spools are centering in the neutral position.

Boom Cylinders

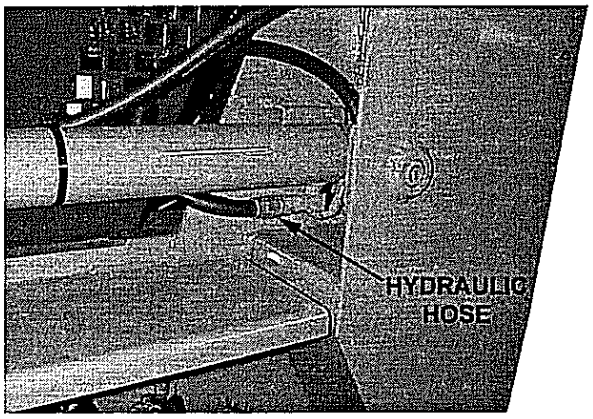
1. This test must be performed with the engine running. Remove any attachment and block the loader securely with all four (4) wheels clear off the ground.

2. Lower the lift arms completely down. Shut off the engine and cycle the foot pedals to release hydraulic pressure.

3. Disconnect the hydraulic hose from the boom cylinder rear port (Fig. 1.4.3a). Cap the hose.

4. Start the engine. Push down on the toe of the boom foot control pedal (do not put in float position).

IMPORTANT When making repairs to the hydraulic system, keep all parts clean and remove all dirt from the work area. Use caps and plugs on all lines and openings.



C-011 Fig. 1.4.3a

5. If oil leaks from the rear boom cylinder port, remove the cylinder or cylinders and make repairs as needed (see Section 1.4.4 and 1.4.5).There should be no leakage coming from the rear boom cylinder. If there is no leakage from the rear boom cylinder port check for internal leakage at the control valve. (See Section 1.3.5, Inspection).

6. Connect the hydraulic hose to the rear port of the boom cylinder (Fig. 1.4.3a).

Bucket Cylinders

1. This test must be performed with the engine running. Remove any attachment and block the loader securely with all four (4) wheels off the ground.

2. Retract the bucket cylinders fully (rollback) and stop the engine. Cycle the foot pedals to release hydraulic pressure.

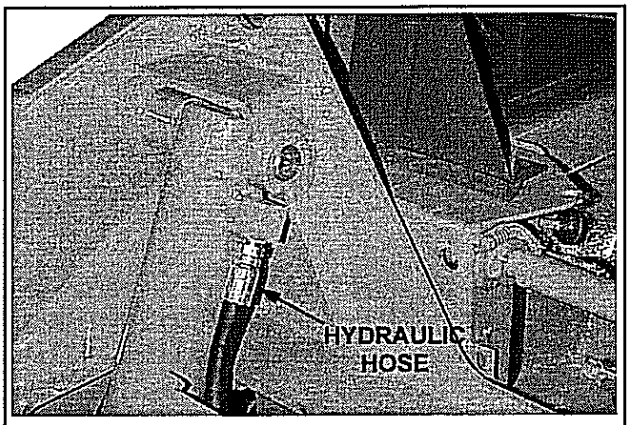
3. Disconnect the hydraulic hose from the bucket cylinder rear port (Fig. 1.4.3b). Cap the hose.

4. Start the engine. Push down on the heel of the bucket foot control pedal.

⚠ WARNING To prevent personal injury never repair or tighten hydraulic hoses or fittings with the engine running or the system under pressure.

5. If oil leaks from the rear bucket cylinder port, remove the cylinder or cylinders and make repairs as needed (see Section 1.4.4 and 1.4.5).There should be no leakage coming from the rear boom cylinder. If there is no leakage from the rear of the bucket cylinder port check for internal leakage at the control.

6. Connect the hydraulic hose to the rear port of the bucket cylinder (Fig.1.4.3b).



C-110 Fig. 1.4.3b

1.4.4 *CYLINDER REMOVAL*

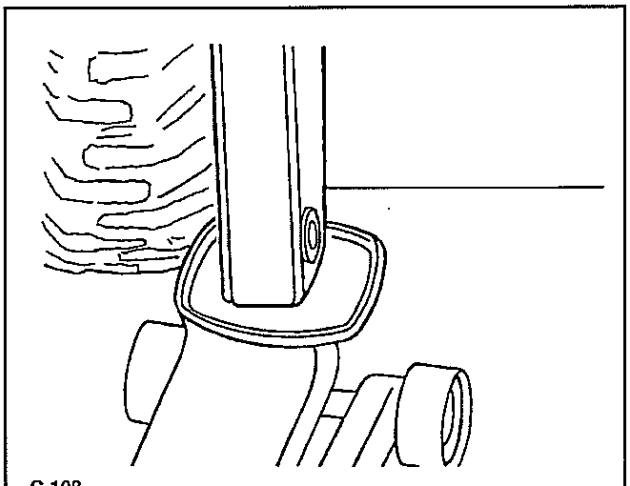
Boom Cylinder - Removal

1. Stop the engine and cycle the foot pedals to relieve any hydraulic pressure in the system.

2. Put a floor jack under the boom arms (Fig. 1.4.4a).

3. Lock the boom lift foot pedal in float position by pushing firmly down on the toe of the pedal (see Section 4.2.1).

4. Raise the boom arms with the floor jack until the pivot pins in the rod end of the boom cylinders can be removed.


C-108 Fig. 1.4.4a

5. Remove the locknut, washer and bolt from the pivot pin at the rod end of the boom cylinders. (Fig. 1.4.4b).

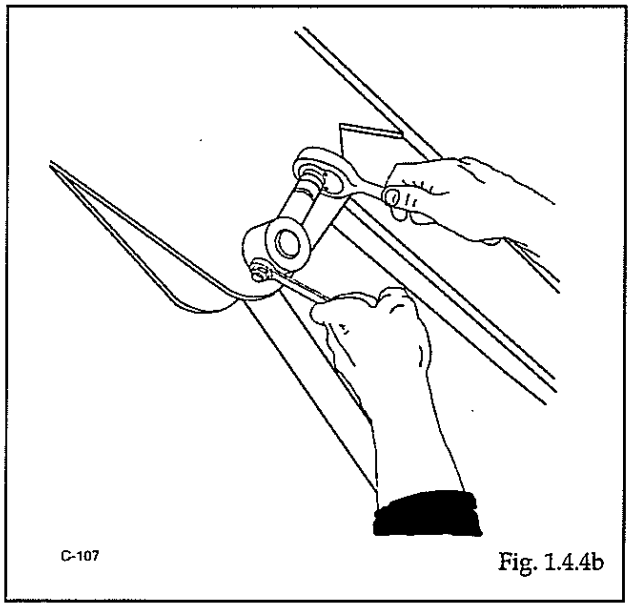


Fig. 1.4.4b

6. Remove the pivot pins (Fig. 1.4.4c). Place a support under the boom cylinder to prevent the cylinder from falling when the pivot pin is removed.

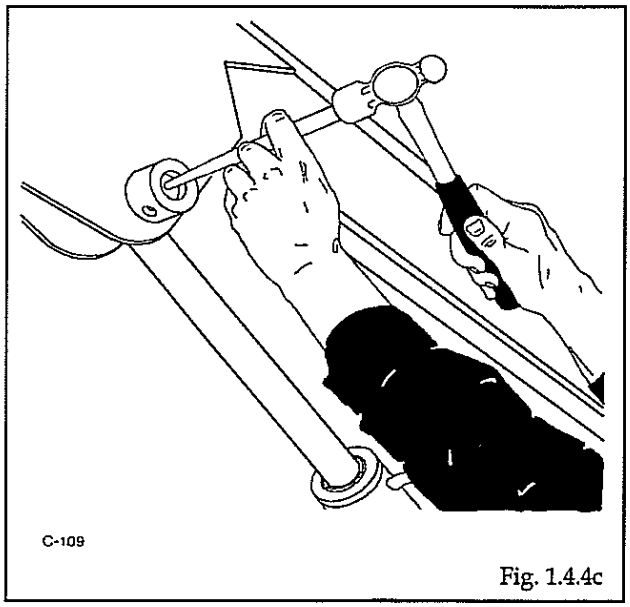
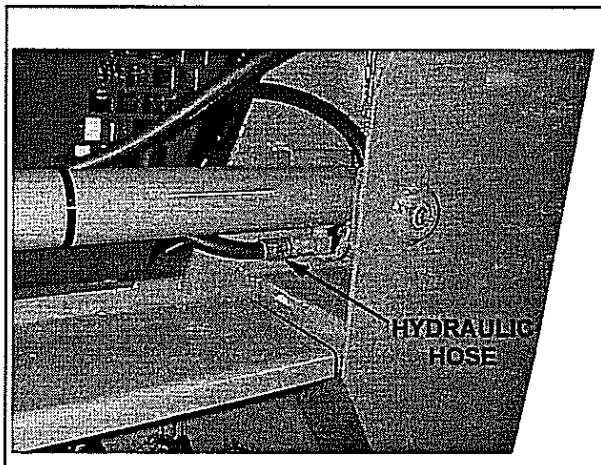


Fig. 1.4.4c

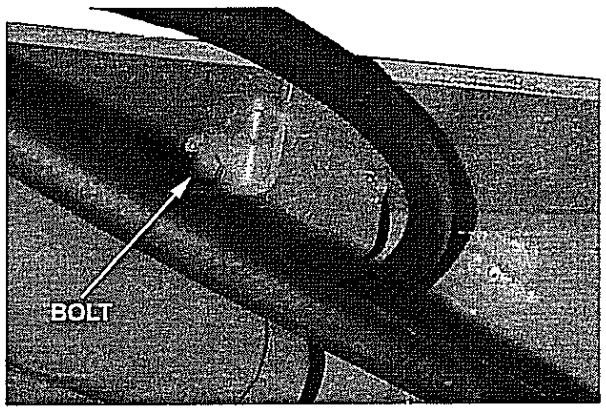
7. Remove the hydraulic hose from the front and rear ports on the boom cylinder (Fig. 1.4.4d). Cap cylinder ports and hoses.



C-011

Fig. 1.4.4d

8. Remove the locknut, washer and bolt at the base of the cylinder (Fig.1.4.4e).



C-611 Fig. 1.4.4e

9. Remove the pivot pins (Fig.1.4.4f).

10. Remove the boom cylinder from the loader.

IMPORTANT When making repairs to the hydraulic system, keep all parts clean and remove the dirt from the work area. Use caps and plugs on all lines and openings.

11. Lower the boom arms and remove the floor jack.

⚠ WARNING To prevent personal injury do not work on a loader with the boom in a raise position unless the boom supports are engaged.

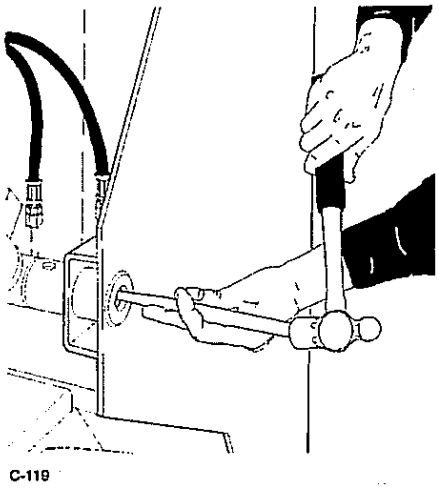


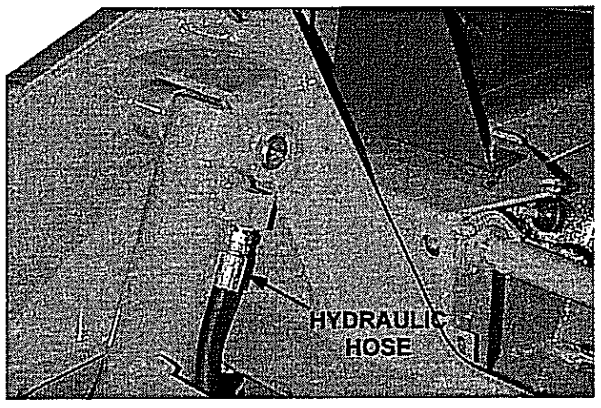
Fig. 1.4.4f

Bucket Cylinder - Removal

1. Lower the boom arm, remove any attachment and extend the bucket cylinders (dump). Shut off the engine. Cycle the hydraulic pedals to release pressure.

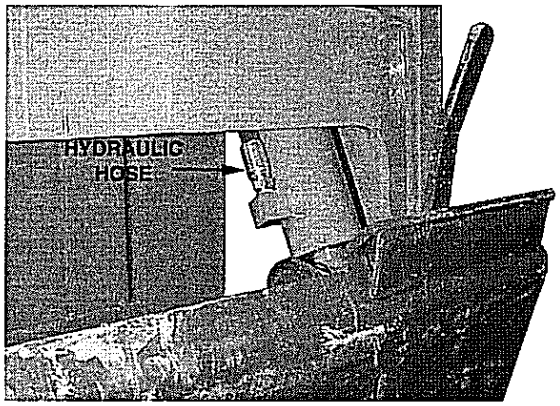
2. Remove the hydraulic hose from the rear port of the bucket cylinder (Fig. 1.4.4g). Plug the cylinder port and cap the hydraulic hose.

⚠ WARNING To prevent personal injury never repair or tighten hydraulic hoses or fittings with the engine running or the system under pressure.



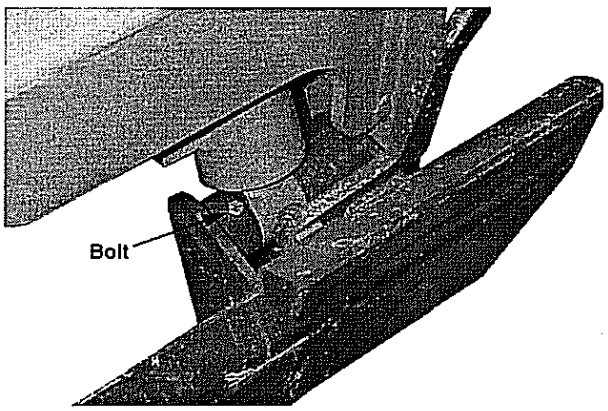
C-009 Fig. 1.4.4g

3. Remove the hydraulic hose from the rod end port of the bucket cylinder (Fig. 1.4.4h). Plug the cylinder port and cap the hydraulic hose.



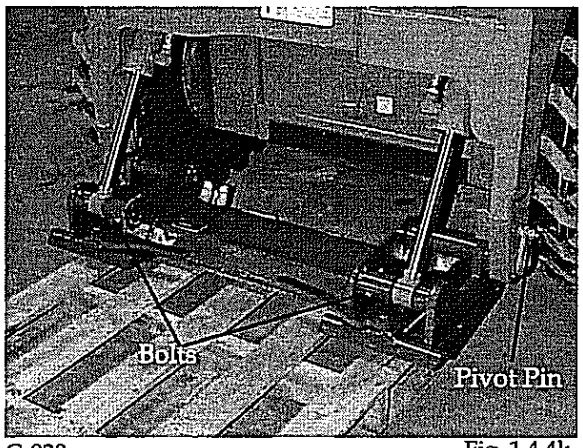
C-018 Fig. 1.4.4h

4. Remove the locknut, washer and bolt at the rod end of the cylinder (Fig. 1.4.4j).



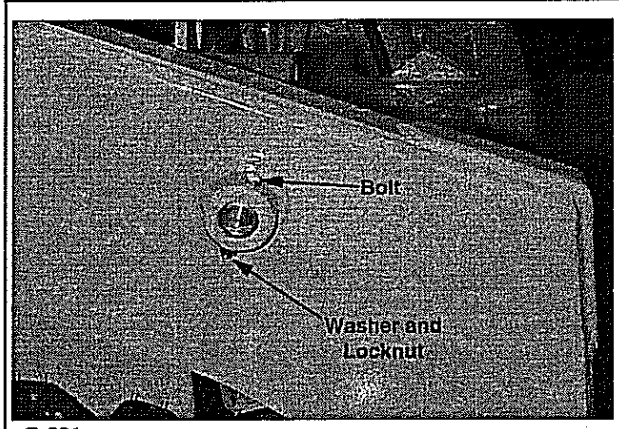
C-019 Fig. 1.4.4j

5. Remove the pivot pins (Fig. 1.4.4k).



C-020 Fig. 1.4.4k

6. Remove the locknut, washer and bolt at the rear of the bucket cylinder (Fig. 1.4.4l).

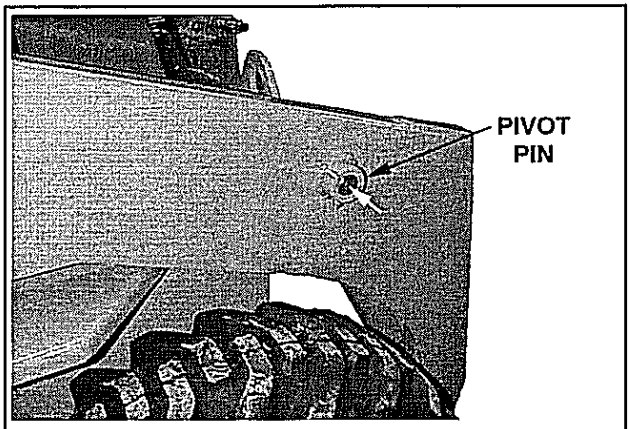


C-021

Fig. 1.4.4l

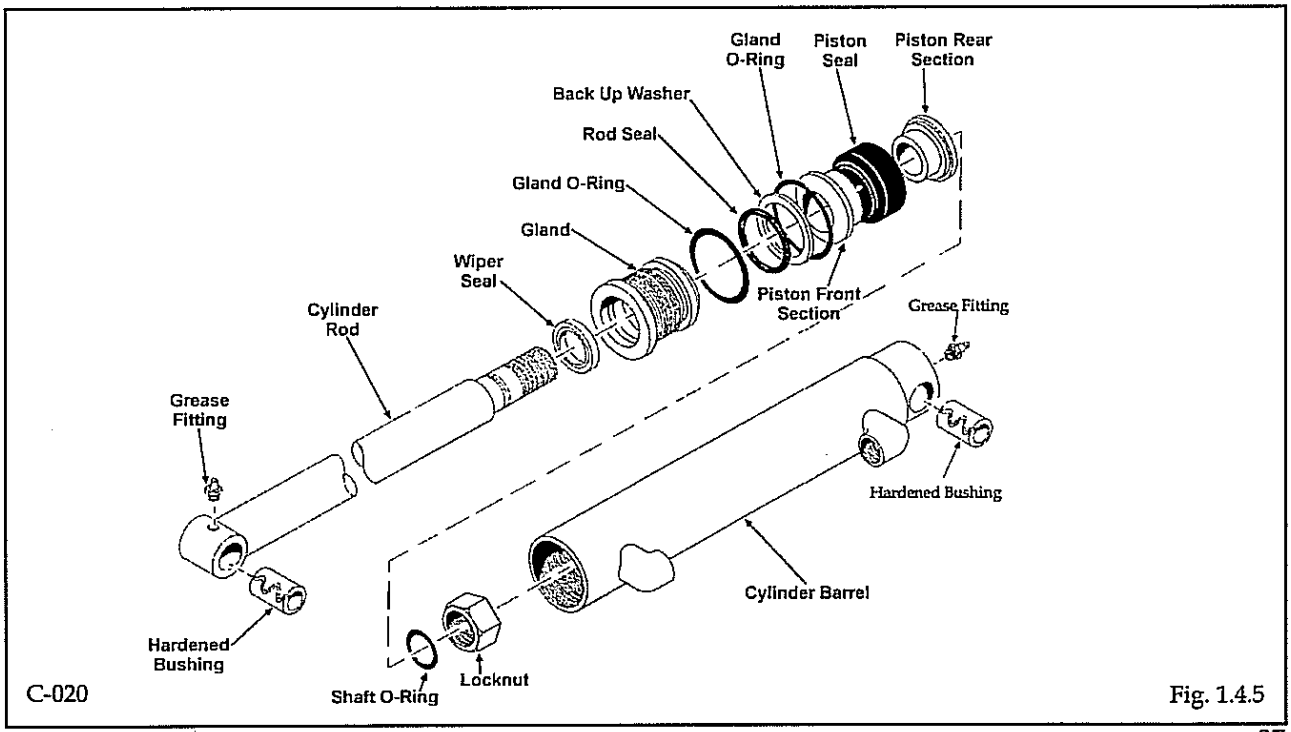
7. Remove the pivot pin (Fig. 1.4.4m). A hole is located on the boom arm side plate to allow driving out the pivot pin.

8. Remove the cylinder from the loader.



C-124

Fig. 1.4.4m



C-020

Fig. 1.4.5

1.4.5 CYLINDER DISASSEMBLY AND INSPECTION

Before disassembling the hydraulic cylinder, clean the body with a suitable solvent. Ensure all openings are plugged to prevent solvent entering the cylinder.

IMPORTANT When making repairs to the hydraulic system, keep all parts clean and remove all dirt from the work area. Use caps and plugs on all lines and openings.

Disassembly

1. Place the base end of the cylinder in a vice and support the front end of the body (Fig. 1.4.5a). Remove the plugs from the hose ports. Using a torch, heat the end of the shaft to aid in loosening the Loctite that is added to the threads.

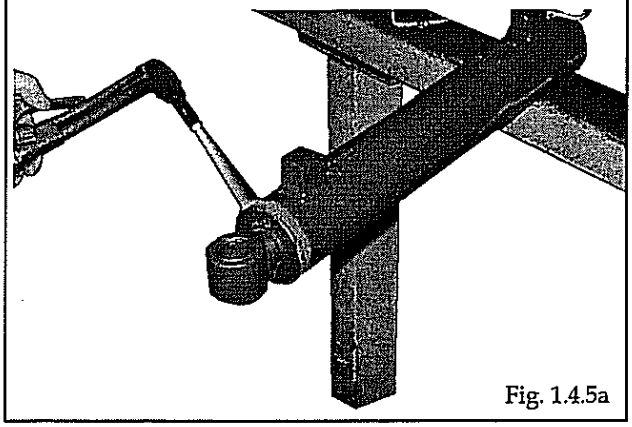


Fig. 1.4.5a

2. Using a spanner wrench, unscrew the gland from the cylinder barrel. (Fig. 1.4.5b).

3. Remove the rod, gland and piston assembly from the cylinder barrel.

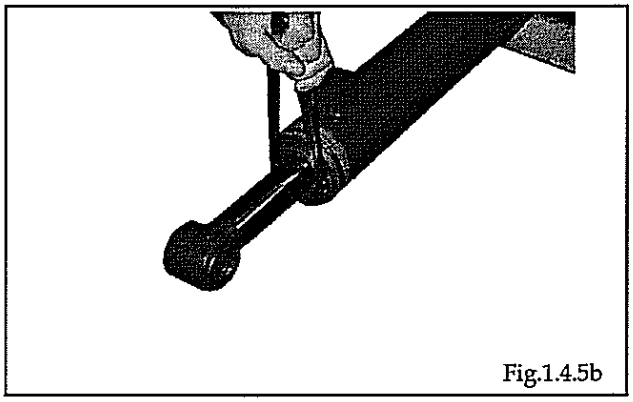


Fig.1.4.5b

4. Place the rod end in a vice and remove the nut (Fig. 1.4.5c).

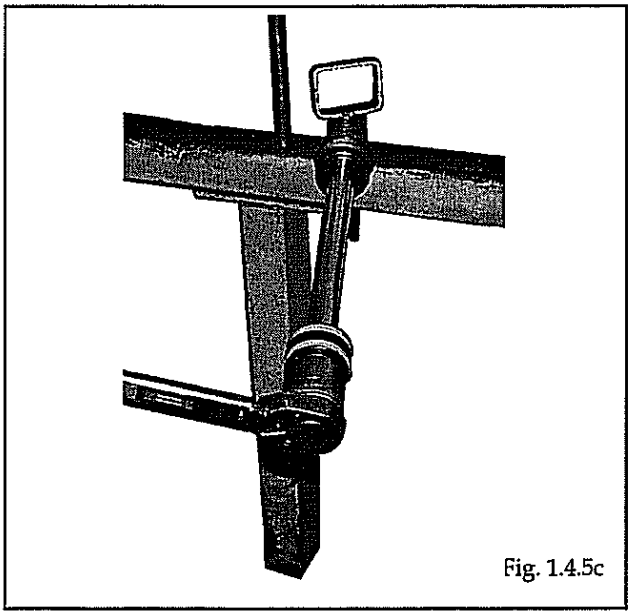


Fig. 1.4.5c

5. Remove the two (2) piece piston assembly from the cylinder rod (Fig. 1.4.5d).

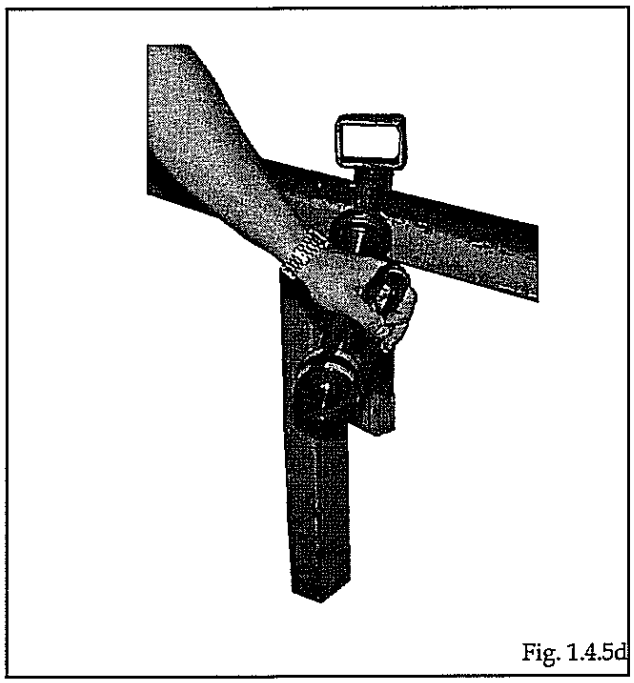


Fig. 1.4.5d

6. Depending on what design of cylinder you are working on, remove and discard the O-ring from the end of the cylinder rod (Fig. 1.4.5e).

   (Up to LK001464 have the O-ring)

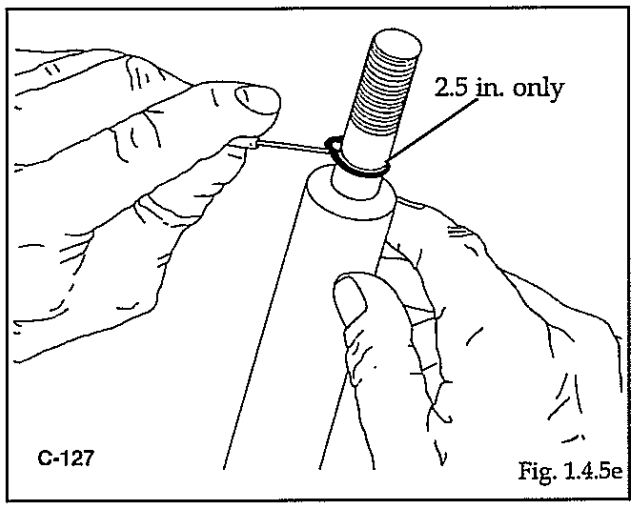


Fig. 1.4.5e

7. Remove the gland assembly from the cylinder rod (Fig. 1.4.5f).

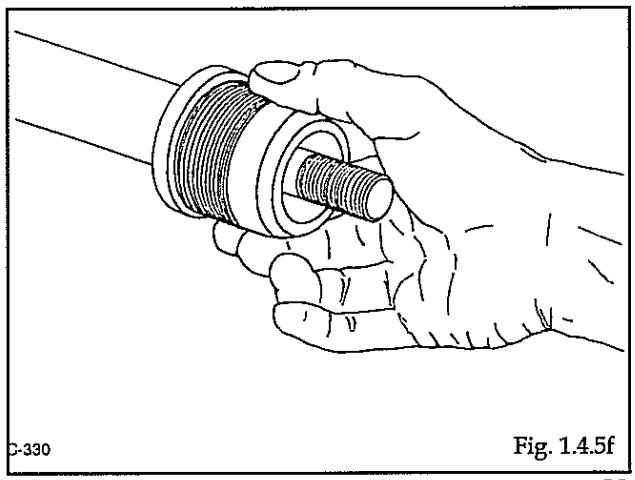


Fig. 1.4.5f

8. Remove and discard the wiper seal, rod seal and O-rings and teflon backup washer from the gland assembly (Fig. 1.4.5g.).

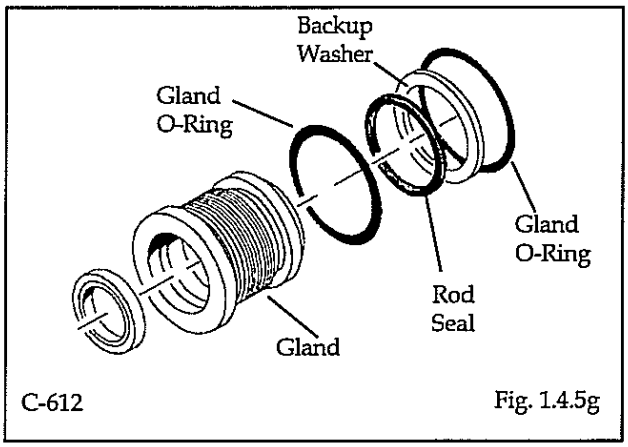


Fig. 1.4.5g

9. Remove and discard the wear rings and piston seal from the piston assembly (Fig. 1.4.5h).

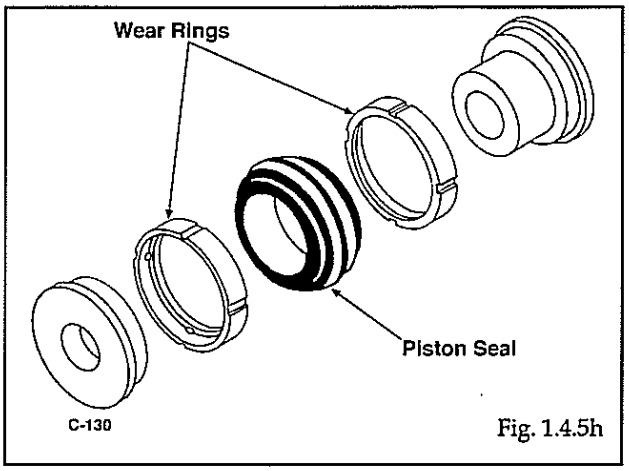


Fig. 1.4.5h

Inspection

1. Inspect the cylinder rod for scratches, dents and other damage. Minor rod damage may be repaired using a fine abrasive. Major scratches or dents are not repairable and the rod should be replaced. The chrome surface must be intact to provide a rust-resistant surface. Blemishes on the rod will damage the rod seal and wiper and will cause leaking after a short period of use.

2. Inspect the cylinder rod threads. The threads must be in good condition because of the high torque required to secure the piston assembly.

3. Inspect the gland for nicks, burrs or other damage. Minor damage can be repaired using a fine abrasive. Smooth down any sharp edges that could damage seals and cause leakage.

4. Inspect the gland threads for damage.

5. Inspect the piston assembly for damage. Remove minor scratches or damage with a fine abrasive.

6. Using a suitable light inspect the cylinder bore for scratches, dents, burrs or other damage. Install a new cylinder barrel if there is any evidence of damage.

7. Inspect the cylinder barrel threads for damage. The threads must be in good condition because of the high torque required to secure the gland assembly.

Assembly

1. Install a new gland rod seal by forming the seal into a U shape, seating it in it's groove and straightening the seal back into it's original shape (Fig.1.4.5j).

2. Install a new wiper seal in the gland (Fig. 1.4.5j).

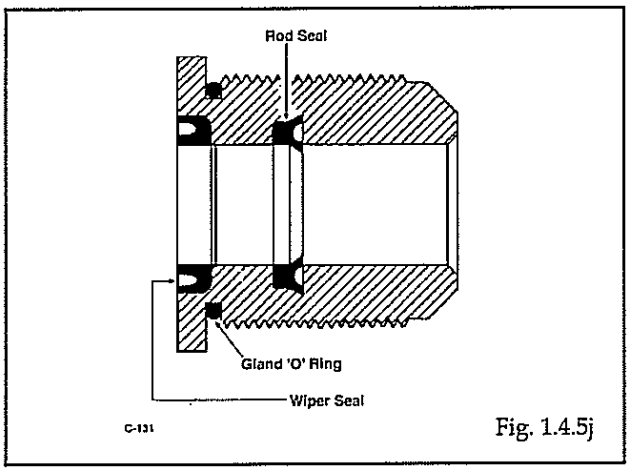


Fig. 1.4.5j

3. The gland sealing arrangements have been used on the boom lift and bucket tilt cylinders (Fig. 1.4.5k).

4. Install a new gland O-ring (Fig. 1.4.5k).

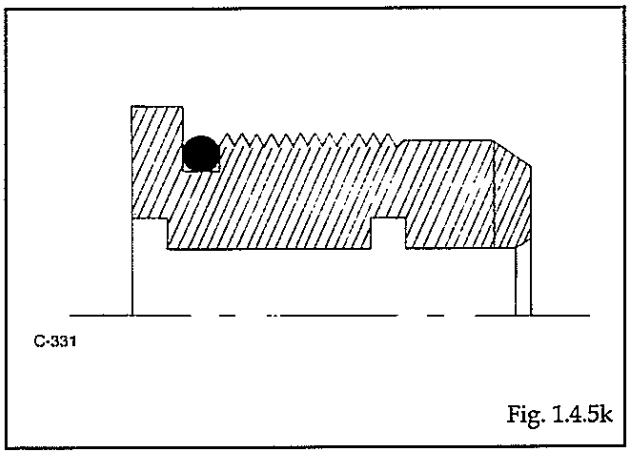


Fig. 1.4.5k

5. Coat the cylinder rod with light oil and assemble the gland assembly (Fig. 1.4.5l) on the rod.

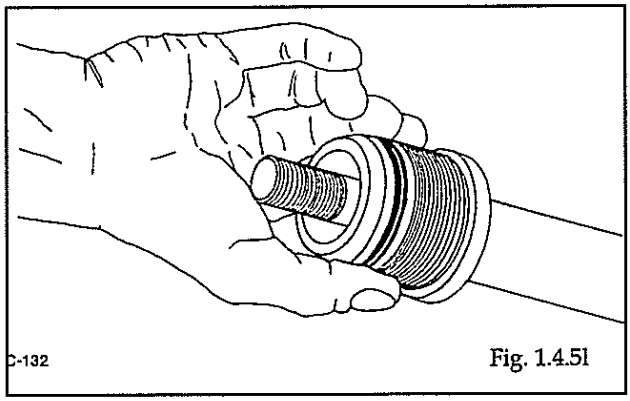


Fig. 1.4.5l

6. Install a new Oring On the cylinder rod (Fig. 1.4.5m)

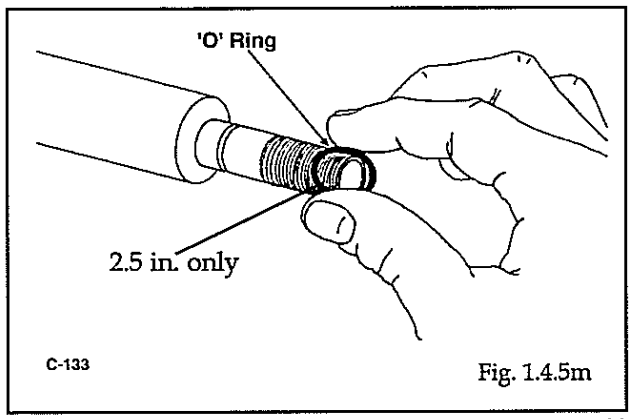


Fig. 1.4.5m

7. Install new wear rings and piston seals on the two (2) piece piston assembly (Fig. 1.4.5n).

8. When installing the shaft back into the tube, lubricate the piston, clean inside of the tube. Add loctite 242 to the threads and tighten as much as possible using a spanner wrench.

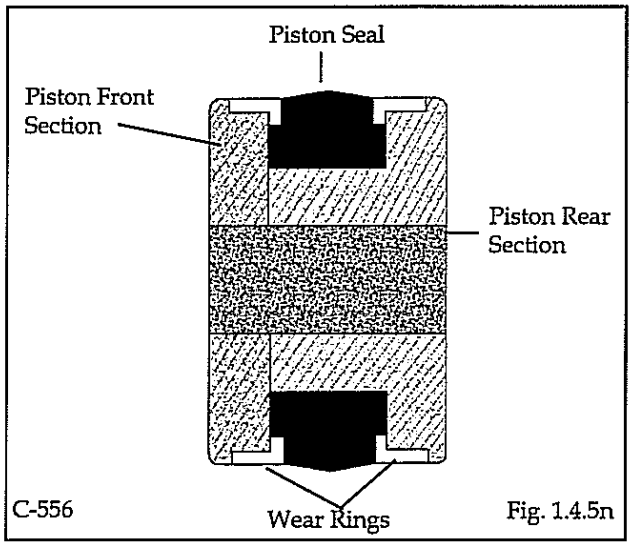


Fig. 1.4.5n

1.5 HYDRAULIC OIL FILTER

1.5.1 *Specifications*

The hydraulic oil filter (Fig. 1.5) is located on the left hand (LH) side of the machine inside the engine compartment.

1.5.2 *General Information*

The 10 micron replaceable element, filters all oil returning from the control valve before it enters the hydrostatic drive system charge pump.

The filter material is a resin impregnated cellulose which features an accordian pleated design to provide maximum filtering area.

A bypass relief valve built into the replaceable element diverts oil from the filter when more than 25 PSI. (1.7 bar) differential pressure is required to force oil through the element.

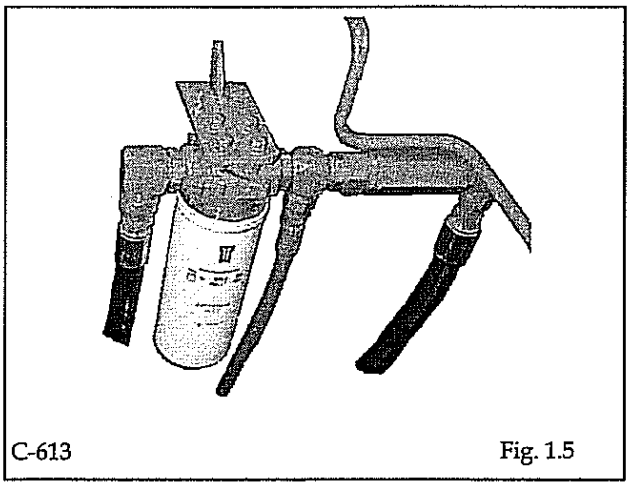


Fig. 1.5

1.5.3 *Filter Replacement*

The hydraulic filter must be changed after the first 50 hours of operation and every 150 hours therafter.

1. Shut off the engine, lower the boom arms, ground any attachment and set the parking brake.

⚠ WARNING To prevent personal injury never repair or tighten hydraulic hoses or fittings with the engine running or the system under pressure.

2. Open the rear door. Turn the filter cartridge counterclockwise to remove.

3. Lubricate the new filter gasket with system fluid.

4. Turn the cartridge clockwise until snug against the sealing gasket.

1.6 OIL COOLER

1.6.1 Specifications

Rating BTU per min.....440
Rating BTU per min (High Flow Oil Cooler).....725

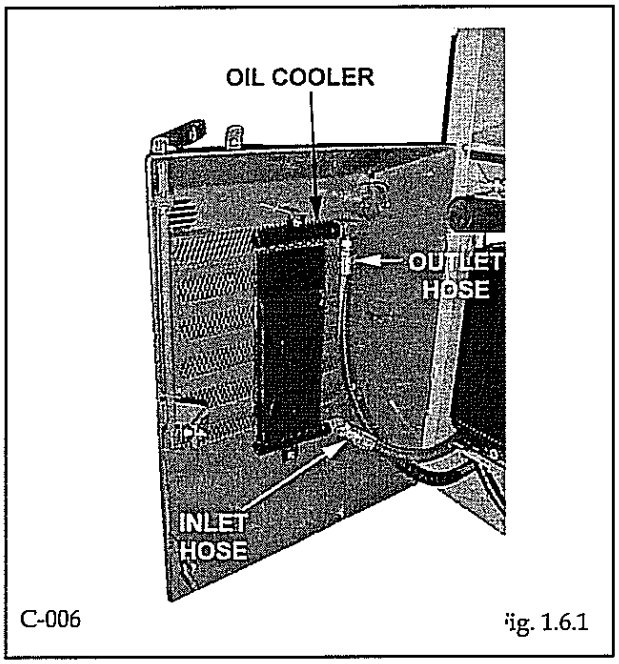
1.6.2 General Information

The hydraulic oil cooler (Fig. 1.6.1) is mounted on the inside of the rear door.

All hydraulic oil returning from the hydraulic control valve circulates through the cooler before returning to the hydraulic reservoir or entering the hydrostatic drive system charge pump. Air forced through the oil cooler fins by the engine fan cools the oil.

1.6.3 Oil Cooler Service

The hydraulic oil cooler should be checked daily for dirt buildup on the cooling fins. If the air flow through the cooling fins is blocked or restricted overheating of the hydraulic system will occur. Clean any dirt buildup on the cooling fins with compressed air.



C-006 Fig. 1.6.1

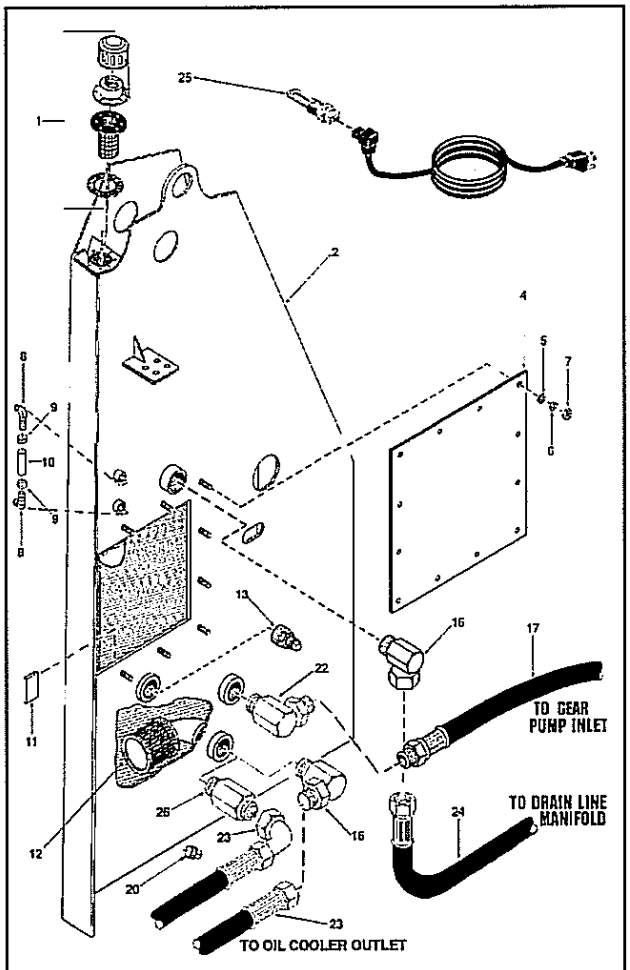
1.7 OIL RESERVOIR

1.7.1 Specifications

Reservoir Capacity.....14.5 Gals(101 l)
No. of Suction Filters.....1
Suction Filter Rating.....100 micron
Breather Cap Filter.....10 micron
Filler Inlet Screen.....30 mesh
Change Oil Every.....1000 Hrs.
Change Suction Filters Every.....1000 Hrs.
Clean Magnet in Tank Bottom.....Whenever .....tank is open or 1000 hrs

1.7.2 General Information

The hydraulic oil reservoir is located at the rear of the loader on the left side (Fig. 1.7). The reservoir is completely separate from all chain and gear drives to eliminate contamination. A magnetic drain plug is installed in the bottom of the reservoir to assist in removing metal particles from the oil.



C-090 Fig. 1.7

The breather filler cap is located at the top of the tank and has a built in 10 micron filter to reduce contaminated air entering the reservoir as it breathes.

The filter is also equipped with a 30 mesh suction element (screen). Oil flowing to the hydraulic gear pump or returning to the reservoir from the oil cooler pass through one 100 micron suction filter located inside the hydraulic reservoir (Fig. 1.7).

Oil level is checked through a sight gauge which indicates both maximum and minimum oil levels. To assist in cleaning or service work inside the reservoir there is a bolt on inspection cover. For cold weather operation an optional hydraulic oil heater is available.

1.7.3 Checking and Adding Oil

Oil Level Check

The oil level should be checked daily.

1. Check the oil level with the machine on level ground.

> **⚠ WARNING** To avoid personal injury do not service the loader with the engine running.

2. Lower the boom arms, retract cylinders and engage the parking brake, shut off the engine.

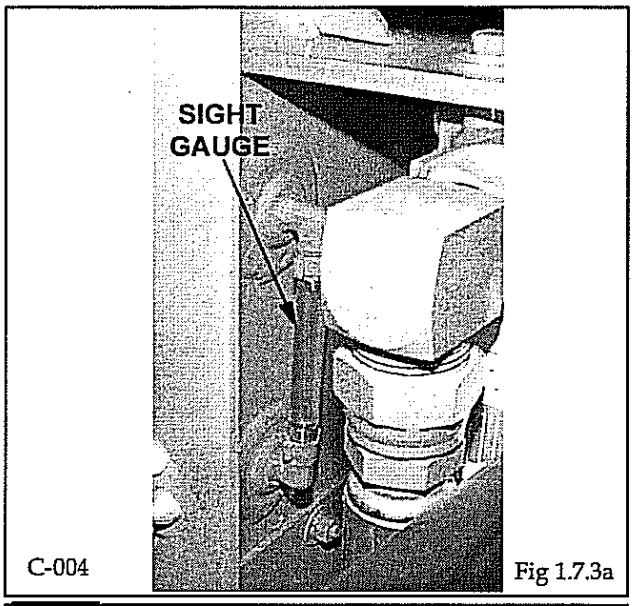
3. Open the rear door.

4. Check the level of oil in the sight gauge (Fig. 1.7.3a).

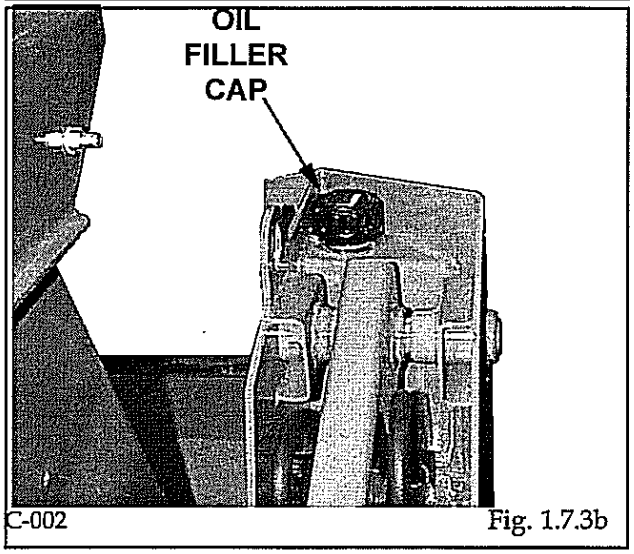
5. If oil is visible approximately mid-way in the gauge, the level is correct.

Adding Oil

1. Remove the bolt on the filler cap.
2. Open the oil filler cap (Fig.1.7.3b).



C-004 Fig 1.7.3a



C-002 Fig. 1.7.3b

2. Inspect the filler screen in the filler neck for damage. If the filler screen is damaged, replace it.

3. Using a clean container add 10W30 API Classification SE/CD oil. Total reservoir capacity is 14.5 gals. (68 l).

4. Replace the oil filler cap.

NOTE If the reservoir has been completely drained refer to the start up procedure Section 1.2.6 to prevent damage to the hydraulic components.

Draining the Oil Reservoir

Change the hydraulic oil and clean the magnet in the tank bottom after 1000 operating hours or if the oil has become contaminated or after any major hydrostatic drive system repair.

1. Remove any attachment. Shut off the engine and engage the parking brake.

2. To drain; remove the drain plug located at the bottom of the hydraulic oil reservoir (Fig. 1.7.3d).

When refilling, add proper rated oil. Total reservoir capacity is 14.5 Gals. (101.3 l).

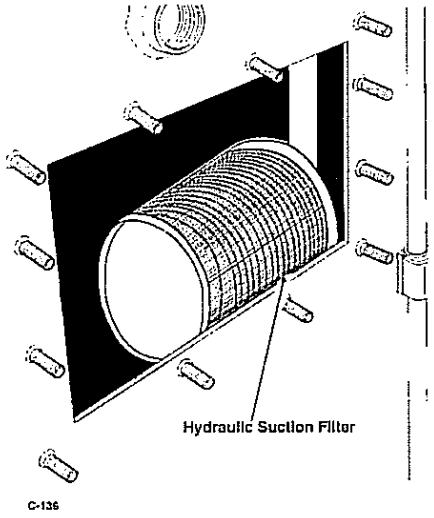
NOTE If the reservoir has been completely drained refer to the start up procedure Section 1.2.6 to prevent damage to the hydraulic components.

⚠ WARNING To avoid personal injury do not service the loader with the engine running.

1.7.4 Filter Replacement

The 100 micron suction filters, located inside the oil reservoir, should be changed every 1000 Hrs. or if the oil becomes contaminated or after a major hydrostatic drive system repair.

1. Drain the oil from the hydraulic oil reservoir (refer to Section 1.7.3).



C-136 Fig. 1.7.4

2. Open the rear door and clean the area around the oil reservoir inspection cover.

3. Remove the inspection cover. Clean off silicone and clean any contaminants from the bottom of the tank.

4. Remove the 100 micron suction filter (Fig. 1.7.4).

5. Install new suction filter elements.

6. Install the coverplate. Seal with silicone.

7. Refill the oil reservoir using 10W30 API Classification SE/CD oil. Total reservoir capacity is 14.5 Gals. (68 l).

1.9 HYDRAULIC PRESSURES

Fig 1 shows the Hi - Flow installed

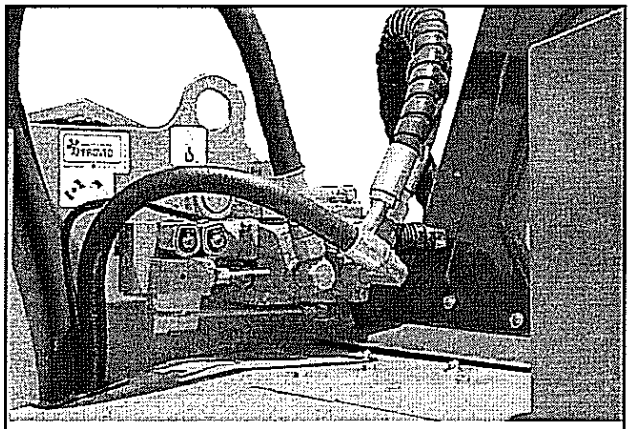


Fig 1

Fig. 2 shows the connections mounted on the lift arms.

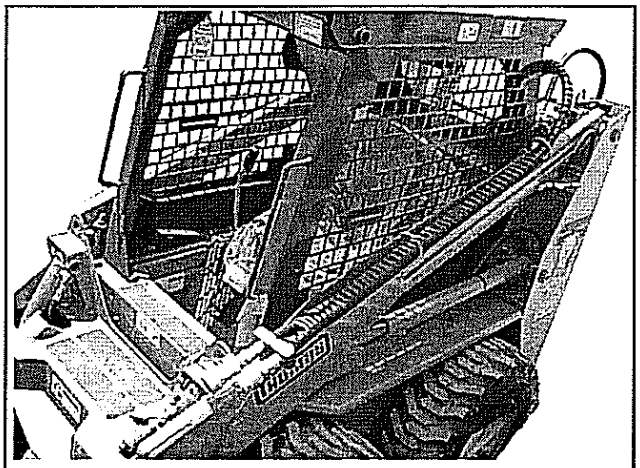


Fig 2

Fig. 3 shows the proper hookup of a flowmeter.

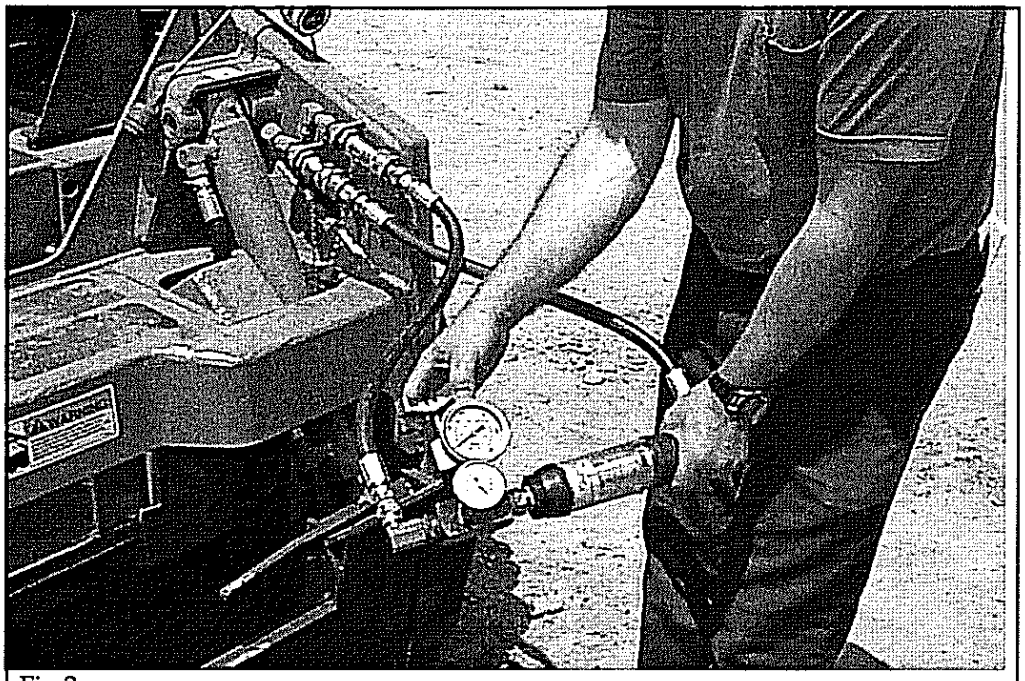
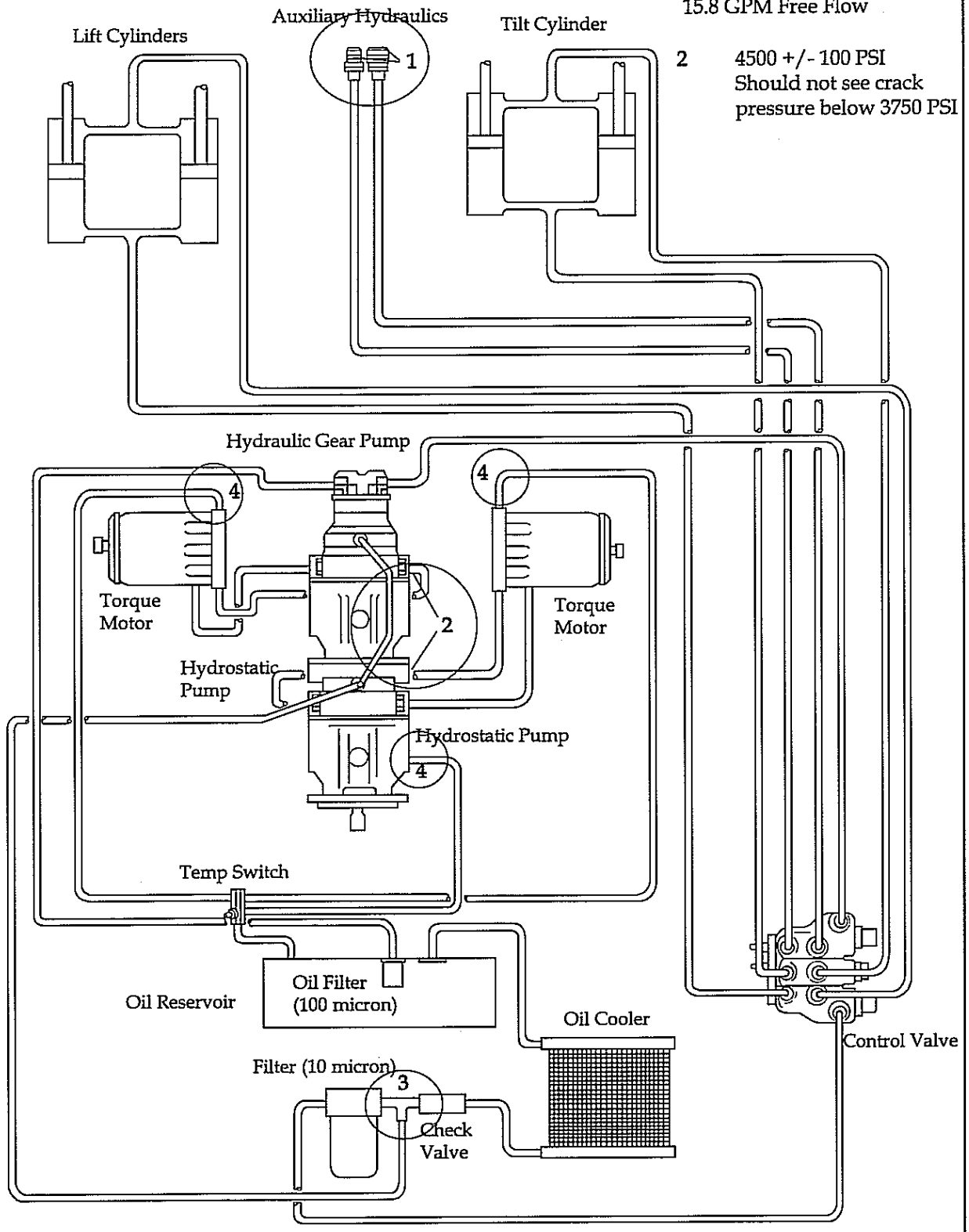


Fig 3

1.9 HYDRAULIC PRESSURES

1 Control Valve Relief Check
2450 PSI +/- 100 PSI
15.8 GPM Free Flow

2 4500 +/- 100 PSI
Should not see crack pressure below 3750 PSI



3 Charge Pressure 60 lbs./sq. in. Min.
150 lbs./sq. in. Max

4 Case Drain 25 PSI Max
3 1/2 gal/min. under max load

C-322

Fig. 1.1.2

1.10 TROUBLESHOOTING - HYDRAULIC SYSTEM

PROBLEM	CAUSE	CORRECTIVE ACTION	SECTION
Loss of hydraulic power (no flow from the gear pump)	Reservoir low on oil	Check for leaks. Fill reservoir with 10W30 or 20W50 API, SE/CD oil	1.7.3
	Universal joint between engine and pump failure	Inspect and replace damaged parts. Check for misalignment	
	Gear pump not functioning	Inspect and replace damaged parts	1.2.4 1.2.5
	Spline coupling between front and rear hydrostatic pump failure	Inspect and replace damaged parts	2.2.6
Loss of hydraulic power (full flow from gear pump)	Auxiliary foot pedal engaged or switched on	Disengage	
	Foot pedal linkage disconnected or binding	Inspect and adjust or repair	4.2
	Relief valve failure or out of adjustment	Check pressure and adjust or repair	1.3.3
Hydraulic action jerky	Reservoir low on oil	Check for leaks. Fill with 10W30 or 20W50 API SE/CD oil	1.7.3
	Foot pedal linkage worn or loose	Inspect and adjust or replace damaged parts	4.2
	Air in hydraulic system	Check for leaks between oil reservoir and pump. Bleed system by extending and retracting boom cylinders several times	
	Load check valve not functioning	Inspect and replace damaged parts	1.3.5
	Control valve spool spring return mechanism not functioning	Inspect and adjust or replace damaged parts	1.3.5
	Solenoid Lock still engaged	Inspect and repair	

1.10 TROUBLESHOOTING - HYDRAULIC SYSTEM

PROBLEM	CAUSE	CORRECTIVE ACTION	SECTION
Boom raises slowly at full RPM	Reservoir low on oil	Check for leaks. Fill reservoir with 10W30 API, SE/CD oil	1.7.3
	Foot pedal linkage binding	Inspect and adjust	4.2
	Auxiliary foot pedal engaged	Disengage	
	Attempting to lift more than rated capacity	Reduce load	
	Engine RPM too slow	Check engine RPM and reset	
	Relief valve failure or out of adjustment	Check pressure and adjust or repair	1.3.3
	Oil bypassing one or both boom cylinders	Check piston seals for leakage and repair	1.4.3
	Internal leakage in gear pump	Test gear pump flow and repair	1.2.3 1.2.5
	Internal leakage in control valve	Inspect control valve and repair	1.3.5
Bucket or boom cylinders will not support a load (leak down)	External leak between control valve and cylinders	Inspect and repair	
	Control valve spool not centering	Check foot pedals for binding repair	
		Check for damaged spring return mechanism on control valve spool	1.3.5
	Oil bypassing one or both cylinder piston seals	Check piston seals for leakage and repair	1.3.5
	Internal leakage in control valve	Inspect control valve and repair	1.3.5

1.10 TROUBLESHOOTING - HYDRAULIC SYSTEM

PROBLEM	CAUSE	CORRECTIVE ACTION	SECTION
Hydraulic oil overheating	Reservoir low on oil	Check for leaks and fill with 10W30 API SE/CD oil	1.7.3
	Oil cooler plugged or dirty (also check engine radiator)	Clean the cooling fins	1.6.3
	Auxiliary foot pedal engaged	Disengage	
	Engine RPM too slow	Check engine RPM and reset	
	Engine cooling fan reversed	Check fan and install correctly	
	Relief valve failure or out of adjustment	Check pressure and adjust	1.3.3
	Temperature sender defective	Replace	
	Wrong type of fluid	Replace	1.7.3

1.11 HYDRAULIC FITTING TORQUE

All Torques are in Ft. Lbs.

Steel in Steel

NOTE: JIC Fittings 37′ and SAE 45′

Size (hose)	Torque
1/4	9 to 10
5/16	15 to 16
3/8	20 to 22
1/2	30 to 33
5/8	40 to 44
3/4	70 to 77
7/8	82 to 90
1	55 to 60
1 1/4	120 to 132
1 1/2	131 to 144
2	300 to 330

Steel in Steel

NOTE: ORB Fittings

Size (hose)	Torque
1/4	14 to 16
5/16	18 to 20
3/8	24 to 26
1/2	50 to 60
5/8	72 to 80
3/4	125 to 135
7/8	160 to 180
1	200 to 220
1 1/4	210 to 280
1 1/2	270 to 360

Steel in Aluminum

NOTE: ORB Fittings

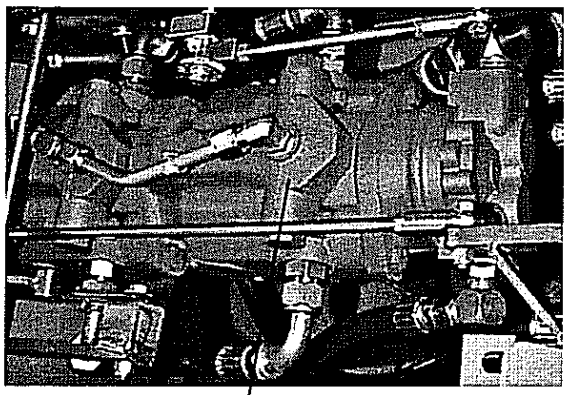
Size (hose)	Torque	Size (hose)	Torque
1/4	5 to 7	3/4	40 to 45
5/16	8 to 10	7/8	50 to 55
3/8	10 to 12	1	90 to 99
1/2	21 to 24	1 1/4	80 to 90
5/8	27 to 30		

SECTION 2
Hydrostatic Drive System

2.1 *HYDROSTATIC DRIVE CIRCUIT*

2.1.1 SPECIFICATIONS

Pump Type.....Hydrostatic, Variable Displacement, reversable piston
No. of Drives.....2
Mounting.....Tandem
Rotation (viewed from rear).....R.H.
Operating Speed.....2950 RPM
..... CE.....2800 RPM
No. of Relief Valves per Pump.....2
Max. Allowable Case Pressure.....25 PSI
Motor Type.....Geroler, Torque Motor
Filtration.....10 Micron
Reservoir Filtration.....One, 100 micron elements



Tandem Pump

C-532 Fig. 2.1.1

2.1.2 GENERAL INFORMATION - HYDROSTATIC DRIVE CIRCUIT

The hydrostatic drive system consists of two (2) hydrostatic variable displacement piston pumps, mounted in tandem and connected through high pressure lines to two (2) fixed displacement torque motors. Hydrostatic pumps and the RH torque motor provide power through a chain drive to the wheels on the RH side of the loader. The rear pump and torque motor provide drive power to the LH wheels.

The hydrostatic pumps are connected directly to the engine through a double universal joint located between the rear pump input shaft and the engine flywheel.

The steering levers, which control both the loaders speed and direction, are connected through a mechanical linkage to the two (2) hydrostatic pump camplate shafts which control the flow of oil from both pumps. As the steering levers are moved, oil is pumped from the hydrostatic pumps to the torque motor which in turn drive the loader wheels. Drive speed is controlled by the amount the steering levers are moved which controls the volume of oil pumped from the variable displacement pumps to the fixed displacement torque motors.

The oil pumped under pressure from the hydrostatic pumps returns from the torque motors back to the hydrostatic pumps where it is pressurized. This creates a closed loop circuit. Each pump has two (2) relief valves set at 4500 PSI. (258.5 bar).

A certain amount of leakage oil occurs internally within the pumps and motors for lubrication as well as to remove some of the warm working oil from the closed loop circuit. This oil enters the pump and motor housings where it is drained through lines back to the oil reservoir.

To replenish the leakage oil from the closed loop circuits a flow diverter valve has been placed just after the return filter. This valve allows return filtered oil to flow directly to the charge pump to maintain the charge pressure between 60 to 120 PSI.

2.1.3 CONTROL FUNCTIONS

Refer to section 1.1.3 to for control lever fuction.

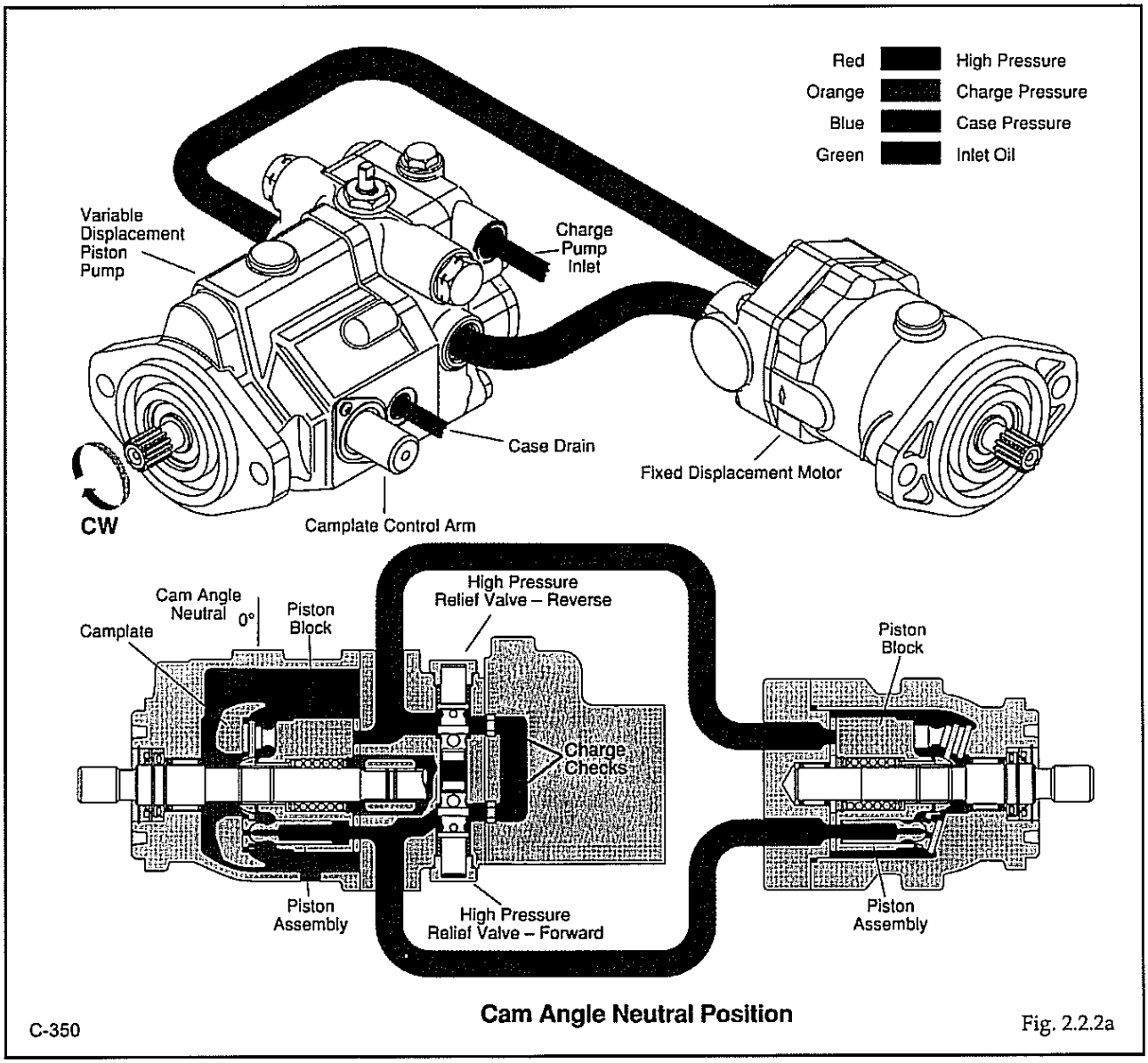


Fig. 2.2.2a

2.2 *HYDROSTATIC PUMPS*

2.2.1 *SPECIFICATIONS*

Pump Type.....Hydrostatic, Variable Displacement, Reversal Piston

NO. of Drive Pumps.....2
Mounting.....Tandem
Rotation (viewed from shaft end).....R.H.
Displacement.....2.48 cu.in. (40.96 cm^3)
Operating Speed.....2950 RPM
Relief Valve Setting.....4500 PSI (310.3 Bar)
NO. of Relief Valve per Pump.....2
Max. Allowable Case Pressure.....25 PSI. (1.7 bar)

2.2.2 *GENERAL INFORMATION*

The driveshaft of the piston pump is rotated by the engine. The piston block which is splined to the driveshaft also turns. The piston block contains nine (9) piston assemblies which have free swivelling shoes swagged on the ball end of the piston assembly. The shoe end of the piston rides against the smooth surface of the camplate. With the camplate in the neutral or 0° position (Fig. 2.2.2a) the piston assemblies do not reciprocate in the piston block, but only rotate. No oil is drawn into or discharged from the pump. The pump is in a zero displacement position and the loader remains stationary.

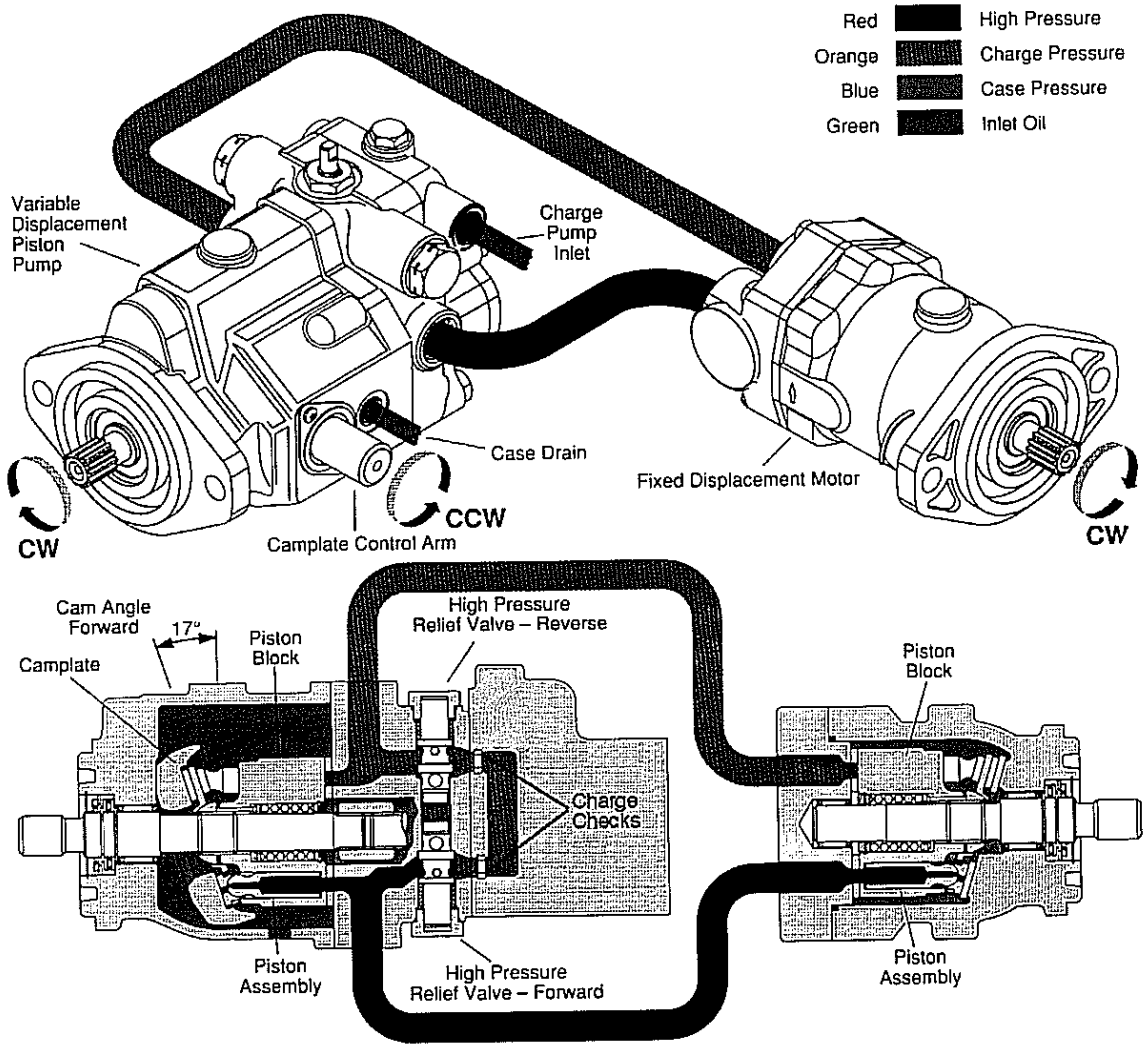


figure 2 — Cam Angle Forward Position

C-351

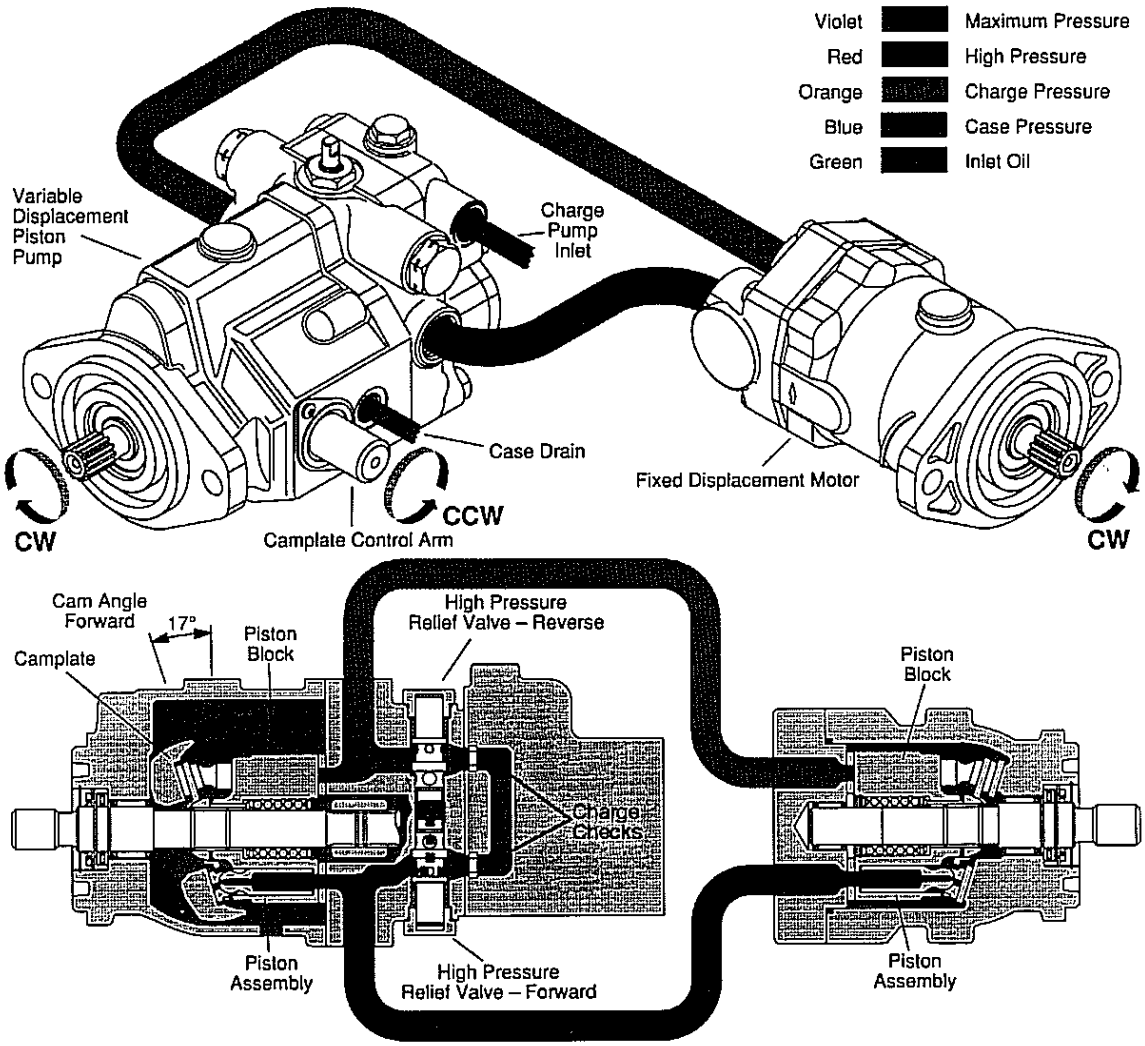
Fig. 2.2.2b

which also achieves maximum volume of oil being discharged from the pump.With the camplate in the 0° or neutral position the pressure of the charge oil, which ranges from 60 to 120 PSI (3.0 to 10.3 BAR) is able to unseat both charge check valves and supply oil to both sides of the pump because of the balance in pressure. There is very little internal leakage while the camplate is in the 0° position so the excess charge oil is bypassed and is recirculate back into the reservoir.

The oil that leaks internally in the pump and motor collects in their body housings and is returned to the reservoir by the case drains in each pump and motor housing. This leakage oil is the only oil returning to the reservoir in a closed loop system.

As the steering lever is moved forward the loader starts a forward movement (Fig. 2.2.2b). As the camplate begins to move, the piston assemblies start to reciprocate in the piston block. As the steering lever continues a forward movement the cam angle increases, the pistons reciprocate further, more oil is being pumped and the speed of the loader is increased. The steering lever can be moved forward until a full cam angle of 17 ° has been reached, which also achieves maximum volume of oil being discharged from the pump.

When the camplate begins to move the charge check on the discharge or pressure side seats because of the higher pressure differential. The other charge check remains open on the intake or low pressure side to continue supplying the closed loop system with a charge of oil.



C-352 **Cam Angle Forward Position with Relief Valve Cross Relieving** Fig. 2.2.2c

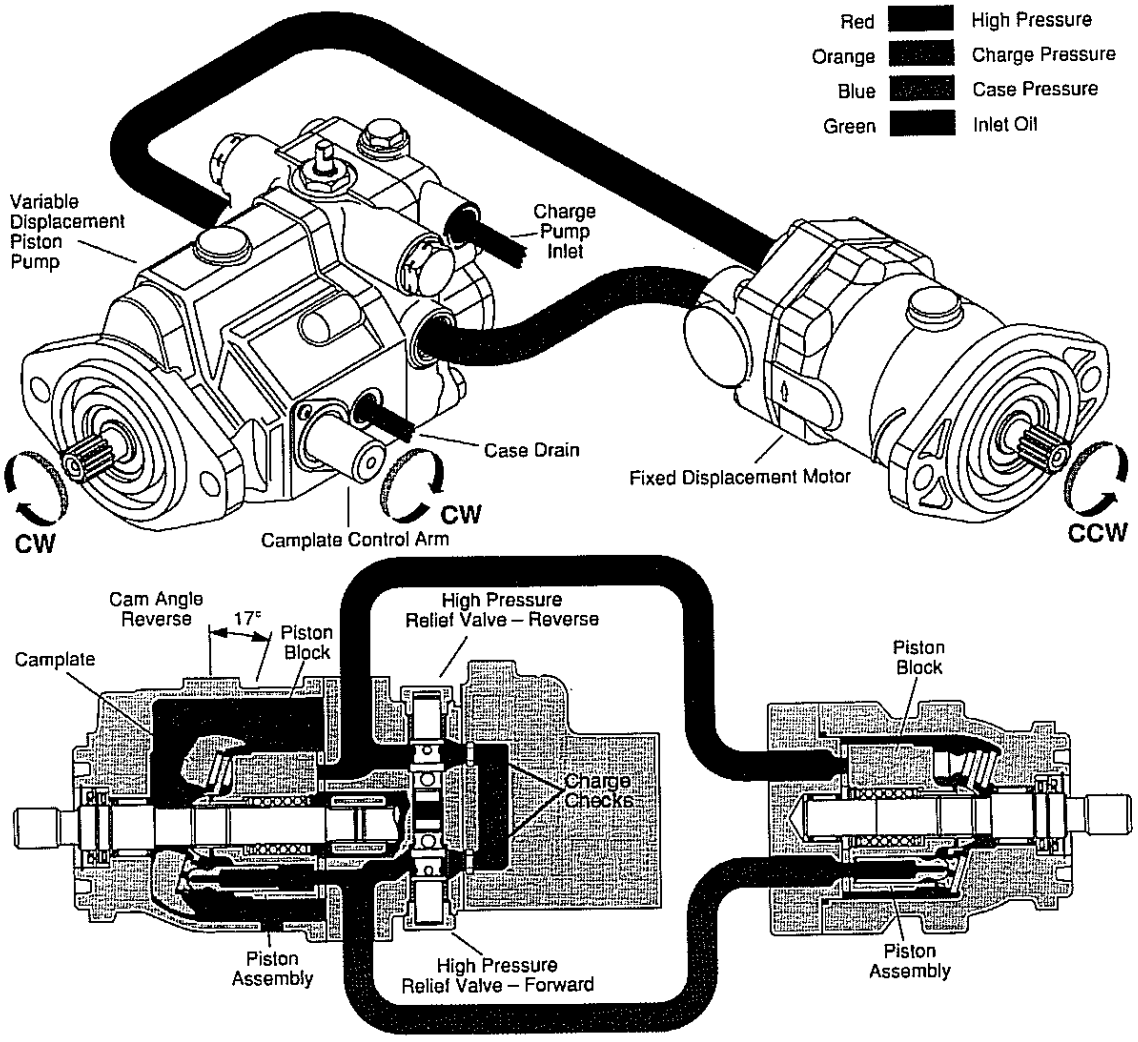
The motor, which is a fixed displacement type, delivers a constant output torque for a given pressure throughout the speed range of the motor.

The movement of the pump camplate from 0° to 17 ° in either forward or reverse position controls the direction of rotation of the motor.

Fig. 2.2.2c shows the camplate in the full 17 ° forward position with the relief valve cross relieving. The function of the system relief valve is to relieve the pressure side of the system of excessive high pressure when the loader encounters a heavy load or stalls out.

The high pressure surrounding the relief valve enters the relief valve body cavity through a drilled orifice in the cartridge. This pressurized oil that enters the relief valve starts to push on a spool, which is seated by spring tension and moves it forward, exposing the cross holes drilled in the end of the spool. A small volume of oil starts to flow across to the other relief valve. This relief valve is exposed to the low pressure on the intake side of the pump and is seated by the spring tension within the relief valve body.

The pressure of the small volume of oil being bypassed is enough to unseat the relief valve and let it recirculate back into the intake side of the pump. As the pressure continues to build on the pressure side, a larger volume of oil flows and at a greater speed through the drilled orifice in the relief valve cartrige, causing a pressure drop inside the relief valve. The surrounding pressure is now able to unseat the relief valve and bypass maximum volume of oil. The system relief valve functions the same for both sides of the system.



C-348

Cam Angle Reverse Position

Fig. 2.2.2d

When the steering lever is slowly moved to the reverse position, the vehicle starts a reverse movement (Fig. 2.2.2d). As the camplate begins to move, the piston assemblies start to reciprocate in the piston block.

As the lever continues a reverse movement the cam angle increases, the piston reciprocates further, more oil is being pumped and the speed of the vehicle is increased.

The steering lever can be moved in reverse until a full cam angle of 17 ° has been reached, which also achieves maximum volume of oil being discharged from the pump. When the camplate begins to move the charge check on the discharge or pressure side seats because of the higher pressure differential. The other charge check remains open on the intake or low pressure side to continue supplying the closed loop system with a charge of oil.

In the reverse position the pump shaft still rotates in the same direction, but the discharge of oil from the pump is reversed, thus reversing the rotation of the motor.

WARNING

To prevent personal injury never repair or tighten hydraulic hoses with the engine running or the system under pressure.

WARNING

To prevent personal injury do not work on a loader with the boom arms in a raised position unless the boom supports are engaged.

2.2.3 *HYDROSTATIC PUMP, REMOVAL*

1. Remove any attachment, raise the boom arms and engage the boom supports. Shut off the engine.

2. Drain the hydraulic oil from the hydraulic oil reservoir. Refer to section 1.7.3 for the procedure.

3. Remove the seat and hydrostatic shield.

4. Disconnect the hydraulic lines from the hydraulic gear pump and remove the gear pump from the loader (Fig. 2.2.3a). Refer to section 1.2.4 for the procedure.

IMPORTANT

When making repairs to the hydraulic system, keep all parts clean and remove dirt from the work area. Use caps and plugs on all lines and openings.

5. Plug all openings in the gear pump and control valve and cap all hydraulic lines.

6. Disconnect the control linkage rod at the pump end. (Fig. 2.2.3b).

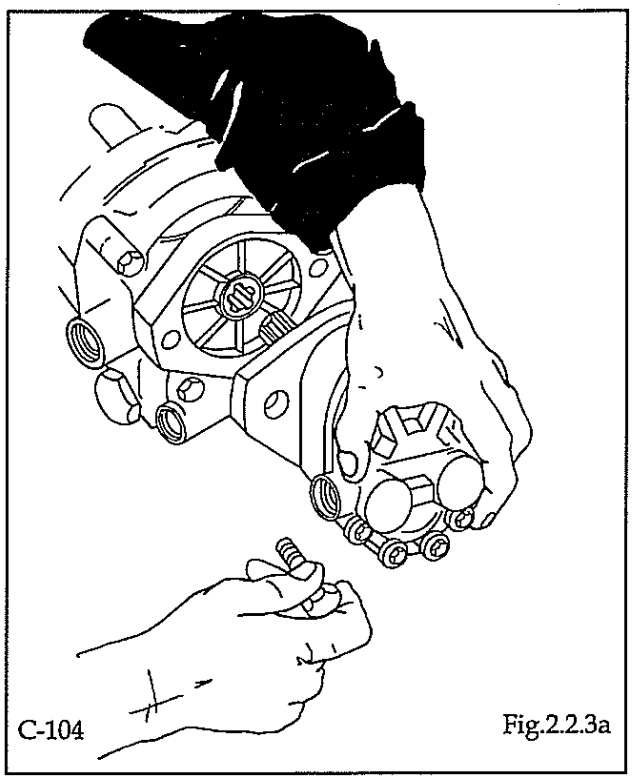


Fig.2.2.3a

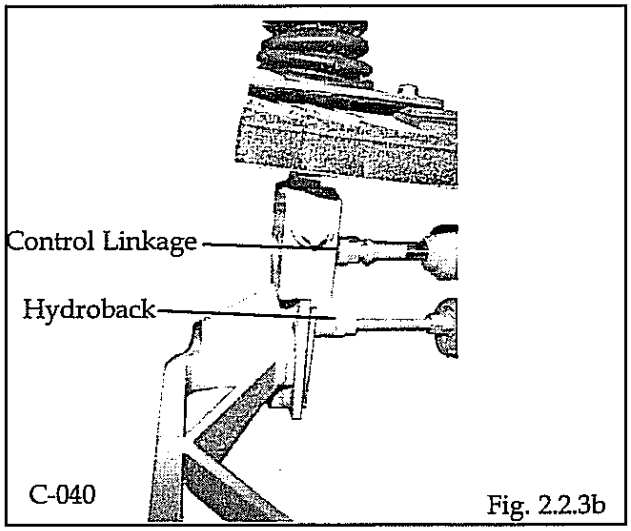


Fig. 2.2.3b

8. Remove the hydraulic hose from the inlet port (Fig. 2.2.3d). Plug the inlet port and cap the hydraulic line.

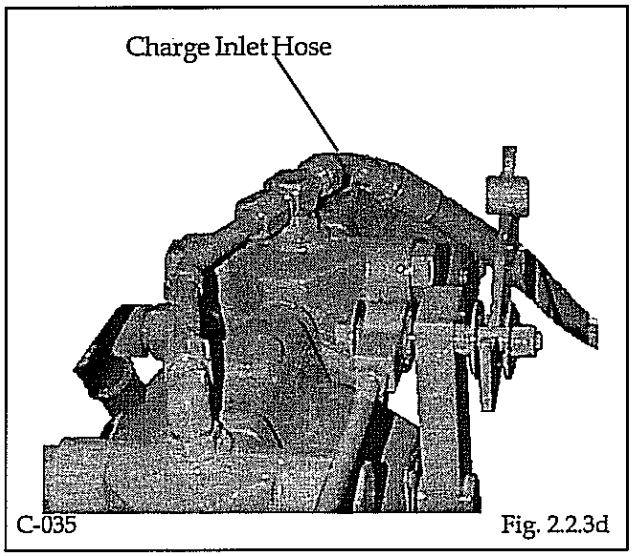


Fig. 2.2.3d

9. Disconnect and remove the transfer line between the front and rear hydrostatic pump (Fig. 2.2.3e). Cap the line and plug both transfer ports, unless you remove the whole unit.

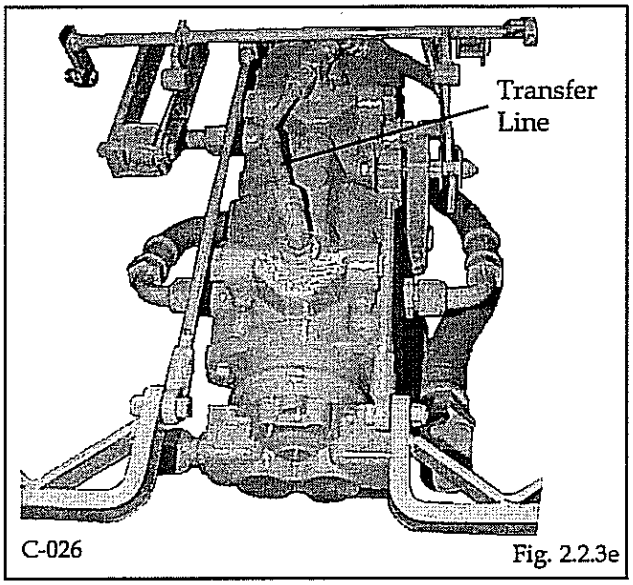


Fig. 2.2.3e

10. Disconnect the rear pump drain lines from the pump (Fig. 2.2.3f). Cap the drain line and plug the pump drain line ports.

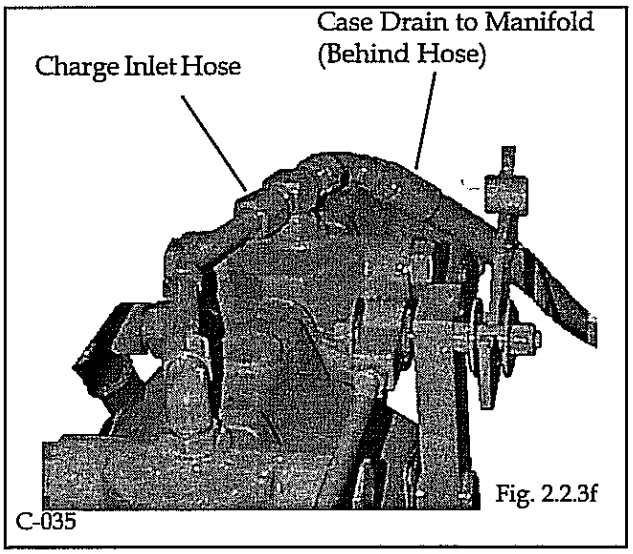
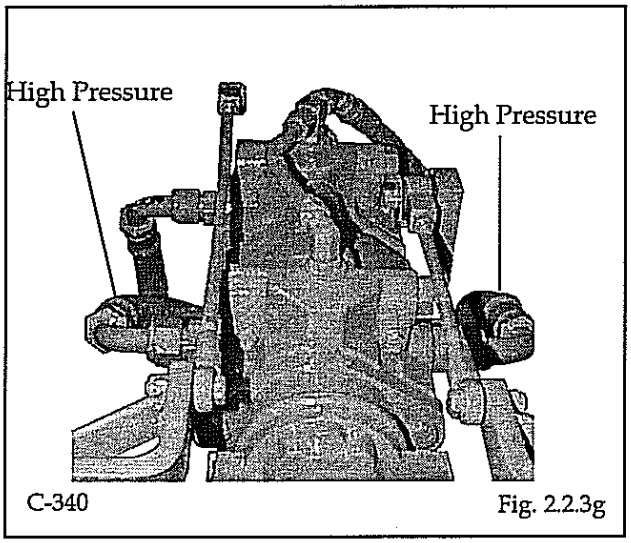


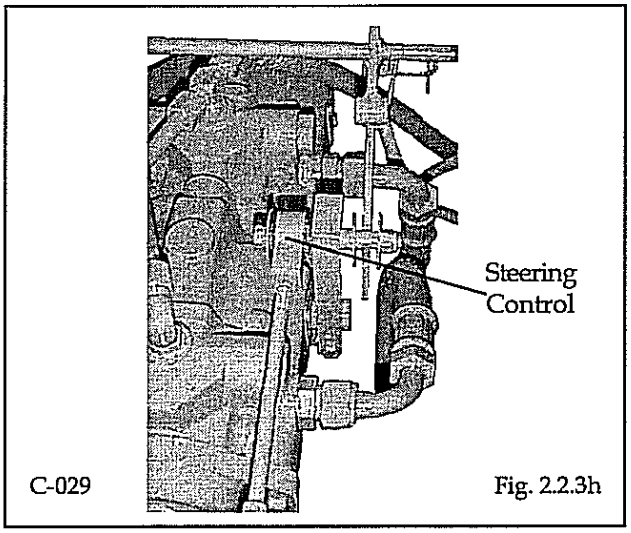
Fig. 2.2.3f

11. Disconnect and remove the high pressure hose between the front pump and the torque motor (Fig. 2.2.3g). If the rear pump is to be removed, disconnect the rear pump high pressure hoses. Plug the pump and motor ports and cap both ends of the high pressure hoses.



C-340 Fig. 2.2.3g

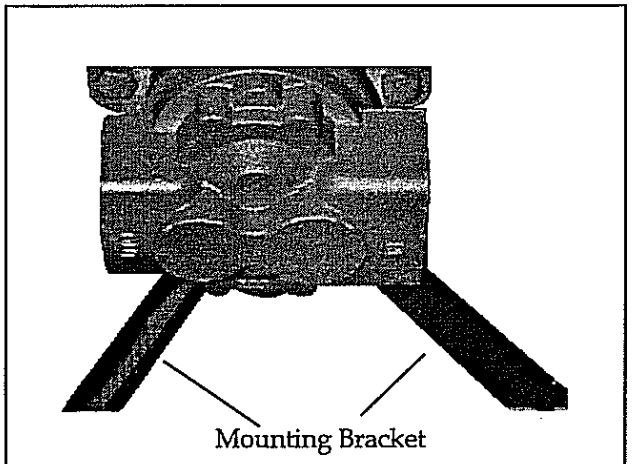
12. Disconnect the steering control linkages from the front pump pintle lever (Fig. 2.2.3h). If the rear pump is to be removed, disconnect the steering linkage from the rear pump pintle lever.



C-029 Fig. 2.2.3h

13. Disconnect the front pump mounting bracket (Fig. 2.2.3i).

WARNING To avoid back injury, do not attempt to lift heavy objects without assistance.



C-061 Fig. 2.2.3i

14. Remove the mounting bolts which secure the front pump to the rear pump (Fig. 2.2.3j).

15. Remove the front pump from the loader.

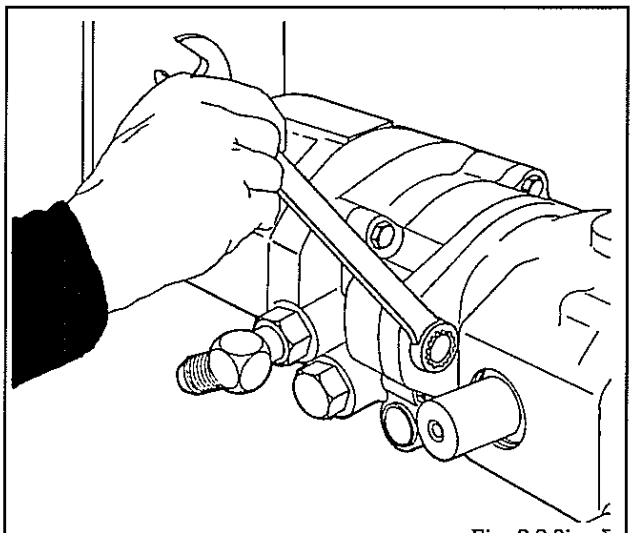
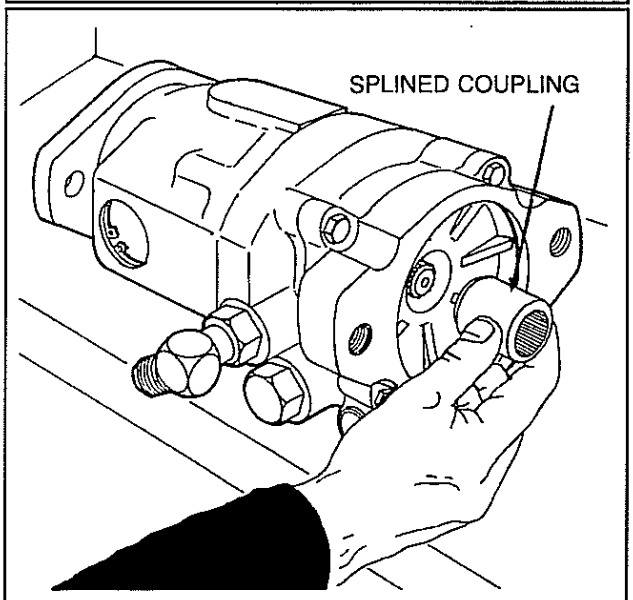

C-335

Fig. 2.2.3j

16. Remove the splined drive coupling from the rear pump (Fig. 2.2.3k).

17. Remove the mounting bolts which secure the rear pump to the bulkhead.

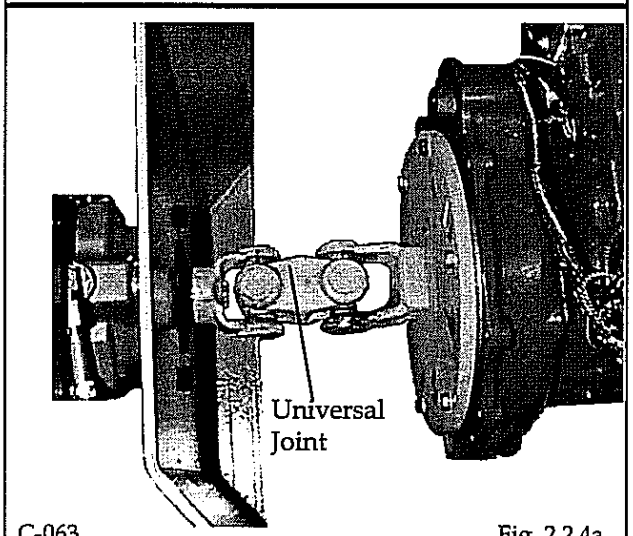


C-334
C-334

Fig. 2.2.3k

2.2.4 *HYDROSTATIC PUMP REPLACEMENT*

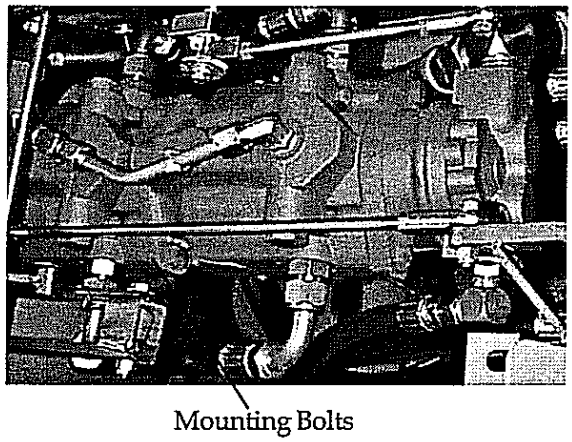
1. Line up the universal joint with the splines on the rear pump in the loader (Fig. 2.2.4a). Install the rear pump mounting bolts which fasten the pump to the bulkhead.



C-063

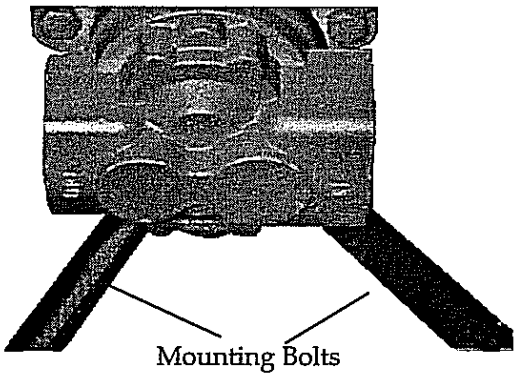
Fig. 2.2.4a

2. Install the front pump in the machine (Fig.2.2.4b). Tighten the mounting bolts which fasten in the front pump to the rear pump to the following torque: 55 - 60 ft. lbs. (3.8 - 4.1 bar).



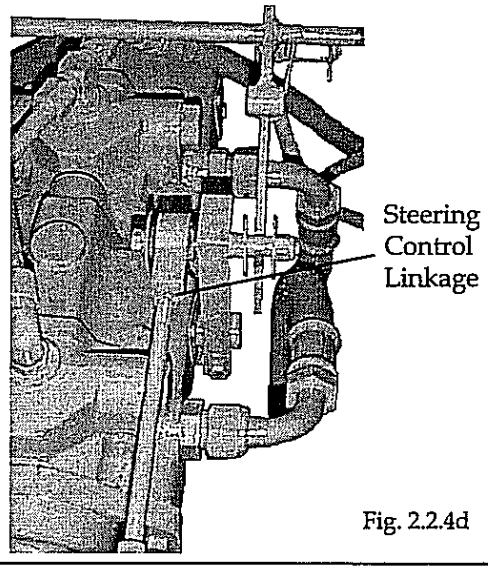
C-532 Fig. 2.2.4b

3. Install the front pump mounting bracket (Fig. 2.2.4c).



C-061 Fig. 2.2.4c

4. Reconnect the steering lever control linkages to the front and rear pump pintle levers (Fig. 2.2.4d). On start up it may be necessary to adjust the steering linkage. Refer to section 4.1.



C-029 Fig. 2.2.4d

5. Install the four (4) high pressure hoses between the pumps and motor (Fig. 2.2.4e).

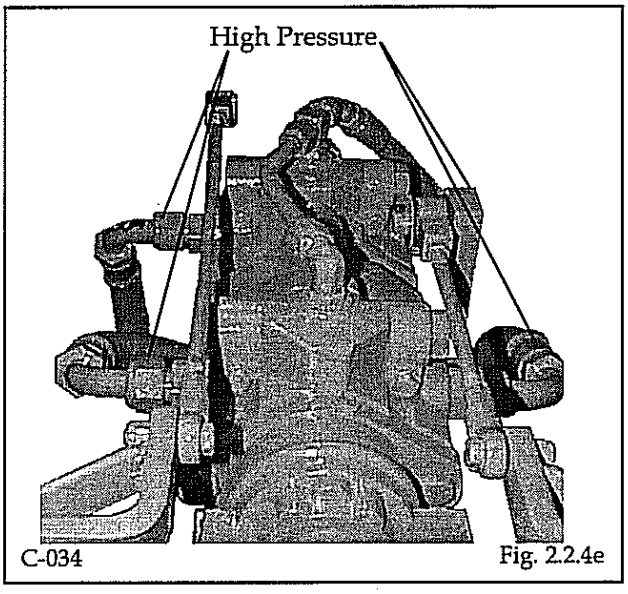


Fig. 2.2.4e

6. Install the case drain line. (Fig. 2.2.4f).

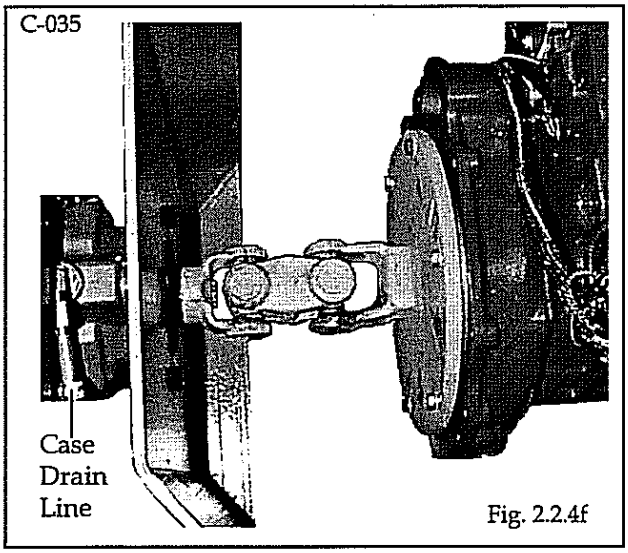


Fig. 2.2.4f

7. Install the charge transfer line between the front and rear pump (Fig. 2.2.4g).

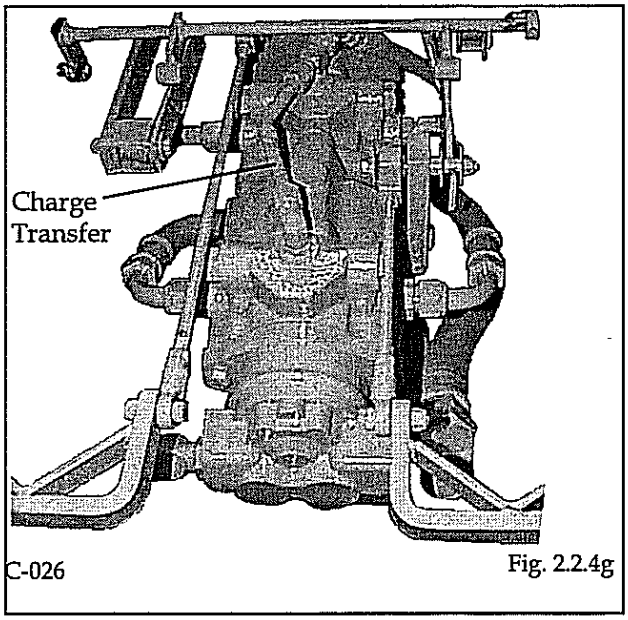
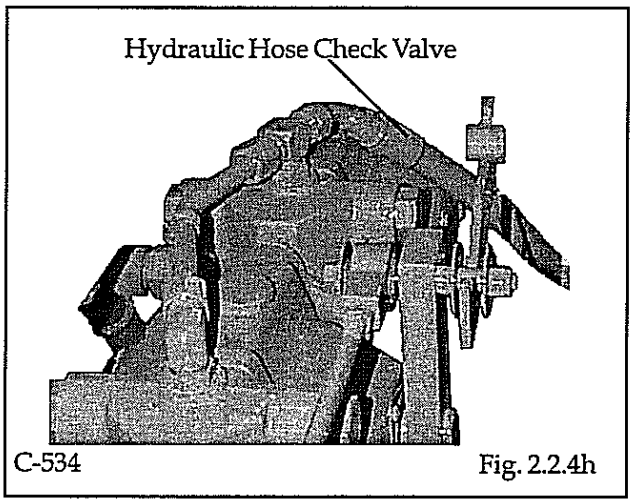


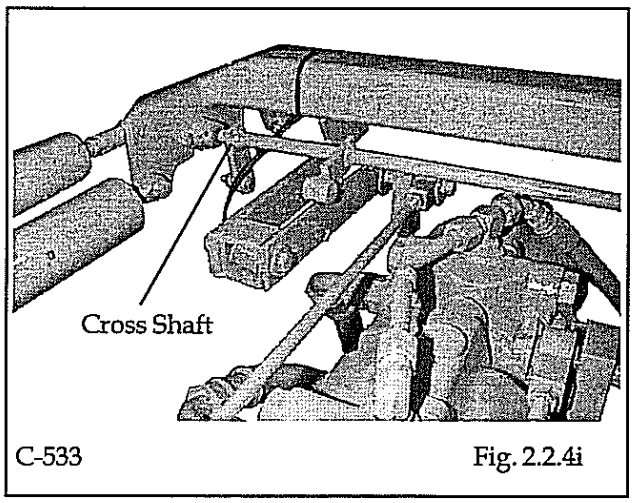
Fig. 2.2.4g

8. Install the hydraulic hose from the check valve at the filter, to the inlet port (Fig. 2.2.4h).



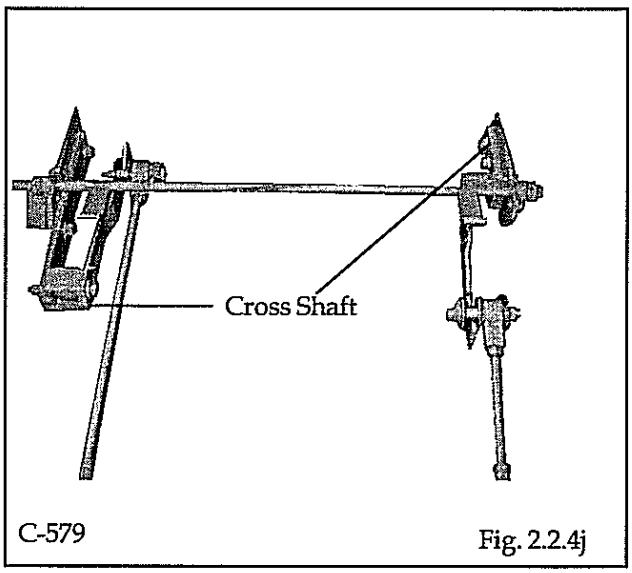
C-534 Fig. 2.2.4h

9. Raise the steering lock cross shaft up into place and install the bearing mounting bolts (Fig. 2.2.4i).



C-533 Fig. 2.2.4i

10. Install the lock guides on the steering lock cross shaft (Fig. 2.2.4j).



C-579 Fig. 2.2.4j

11. Install the hydraulic gear pump on the hydrostatic pump and reconnect the gear pump inlet hose and the hydraulic line between the gear pump and control valve (Fig. 2.2.4). Refer to section 1.2.4 for procedure. Tighten the hydraulic gear pump mounting bolts 27 - 31 ft. lbs. (36.6 - 42 N.M.).

12. Refill the hydraulic reservoir to the proper level.

13. Before starting the loader refer to the start up procedure in section 1.2.6 to prevent damage to the hydraulic or hydrostatic components.

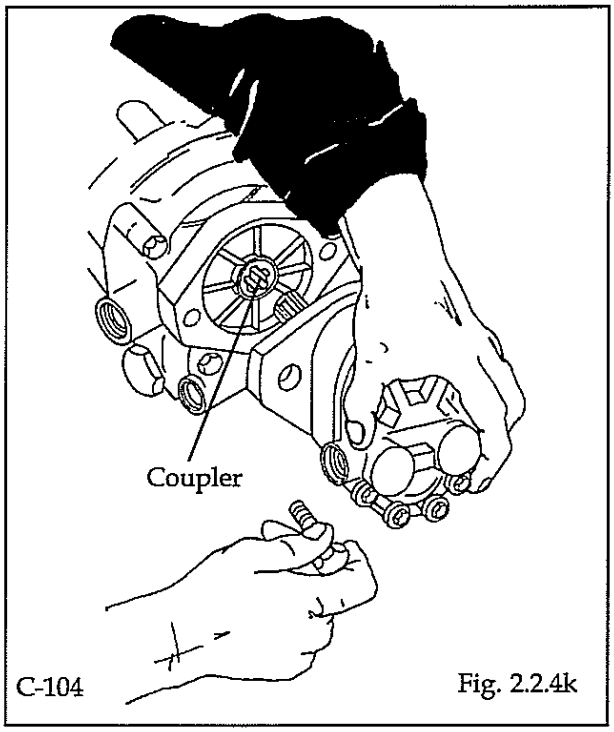


Fig. 2.2.4k

IMPORTANT	To prevent damage after removal or repair of hydraulic components refer to startup procedure section 1.2.6

2.2.5 HYDROSTATIC PUMP - DISASSEMBLY

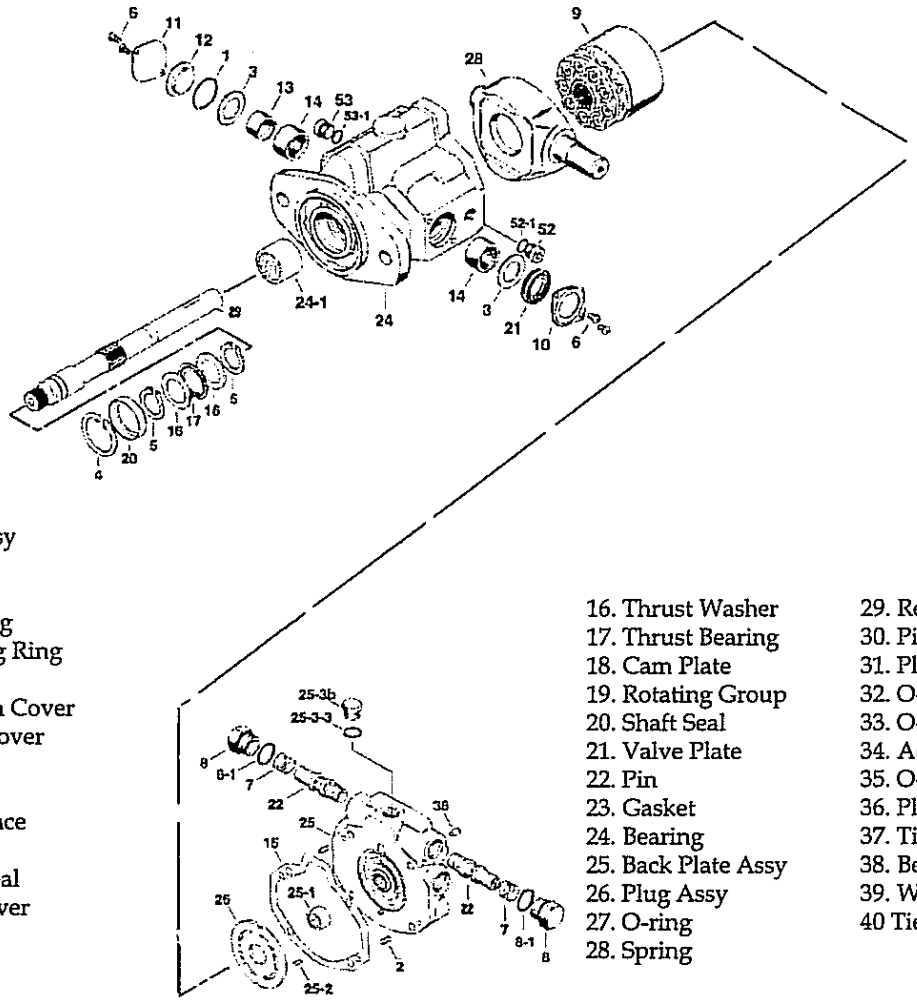
Before diassembling the pump, clean the body with a suitable solvent and dry with compressed air. Be sure all openings are plugged to prevent solvent entering the pump.

Disassembly instructions are given for the front pump. Disassembly of the rear pump is identical unless otherwise noted.

⚠ WARNING	To avoid eye injury use safety goggles when cleaning with compressed air.

IMPORTANT	When making repairs to the hydrostatic system, keep all parts clean and remove dirt from the work area. Use caps and plugs on all lines and openings.

IMPORTANT	Do not intermix parts from one pump with another. Keep all pump parts separate.



1. Shaft Assy
2. Bearing
3. Housing
4. Snap Ring
5. Retaining Ring
6. Screw
7. Trunnion Cover
8. O-ring Cover
9. O-ring
10. Washer
11. Inner Face
12. Bearing
13. Shaft Seal
14. Seal Cover
16. Thrust Washer
17. Thrust Bearing
18. Cam Plate
19. Rotating Group
20. Shaft Seal
21. Valve Plate
22. Pin
23. Gasket
24. Bearing
25. Back Plate Assy
26. Plug Assy
27. O-ring
28. Spring
29. Relief Valve
30. Pin
31. Plug
32. O-ring
33. O-ring
34. Adaptor Plate
35. O-ring
36. Plug
37. Tie Bolt
38. Bearing
39. Washer
40 Tie Bolt

C-478

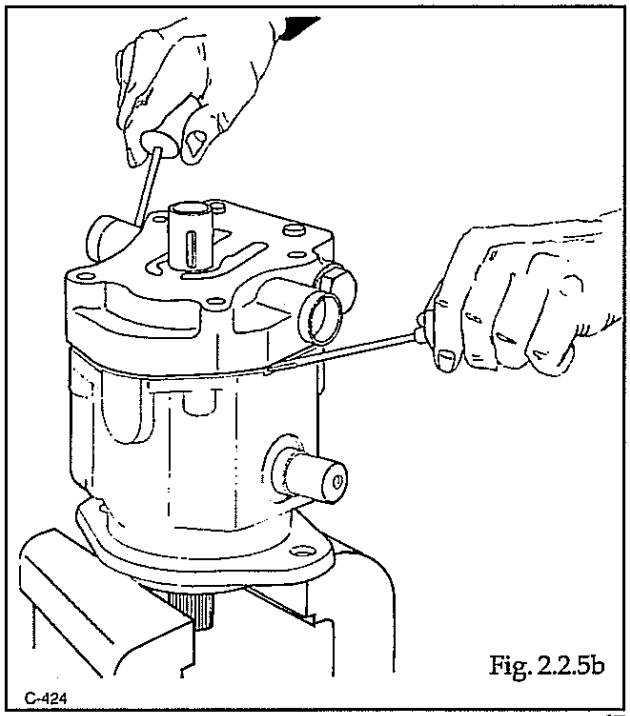
Fig. 2.2.5a

1. From the backplate, remove the plugs and relief valve assemblies.

NOTE Mark the relief valve in relationship to the cavity it was removed from, for reassembly purposes. Check the bearing (pressfit) in backplate. If needles remain in cage, and move freely, removal is not required (Fig. 2.2.5a).

2. Remove housing gasket from housing.

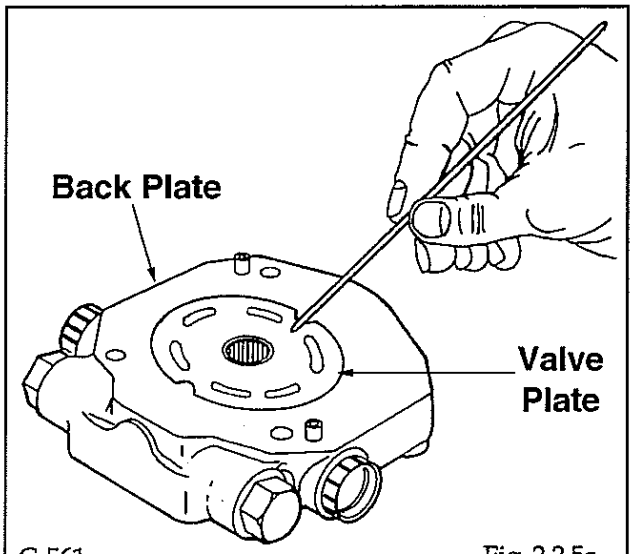
3. Remove rotating kit assembly from housing, by turning housing up and allowing rotating kit to slide down (Fig. 2.2.5b).



C-424

Fig. 2.2.5b

4. The piston block assembly does not require to be disassembled unless the pins or springs are damaged (Fig. 2.2.5c).



C-561 Fig. 2.2.5c

5. If the piston block spring needs to be removed use the following procedure (Fig. 2.2.5d & e).

   a. Place a 5/16 in. flat washer over the 5/16 X 2 7/8 in. cap screw and insert the screw through the centre of the piston block.

   b. Place a 5/16 in. flat washer over the end of the cap screw and screw on the 5/16 in. UNC nut.

   c. Tighten the nut and compress the spring.

   d. Remove the retaining ring.

   e. Slowly back off the 5/16 in. nut relieving the compression on the spring.

   f. Remove the two (2) washers, spring and three (3) pins from the piston block.

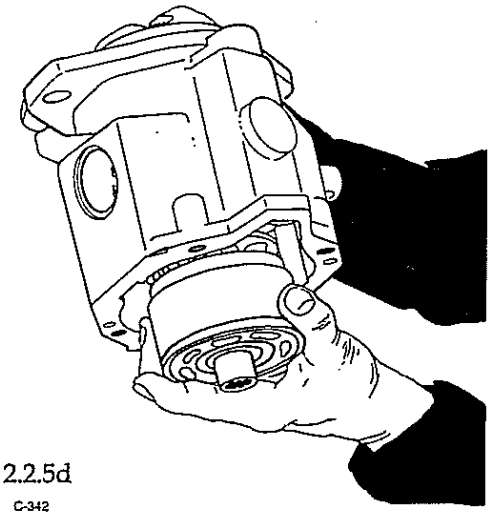
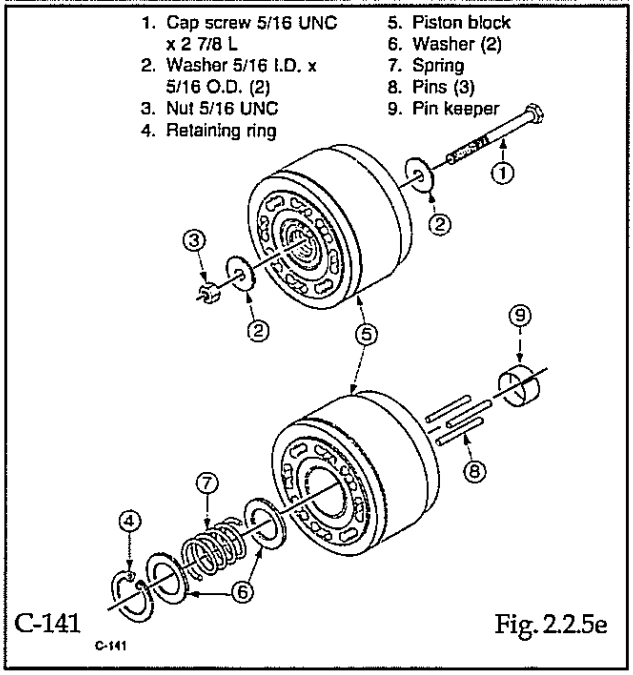


Fig. 2.2.5d
C-342



C-141 Fig. 2.2.5e
C-141

g. Remove the retaining ring from the housing (Fig. 2.2.5f).

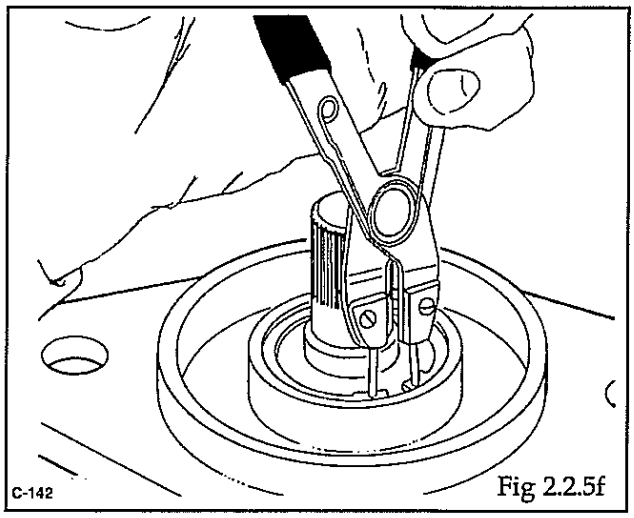


Fig 2.2.5f

6. Tap the end of the shaft against a wooden block to remove the shaft, seal and bearing assembly from the housing (Fig. 2.2.5g).

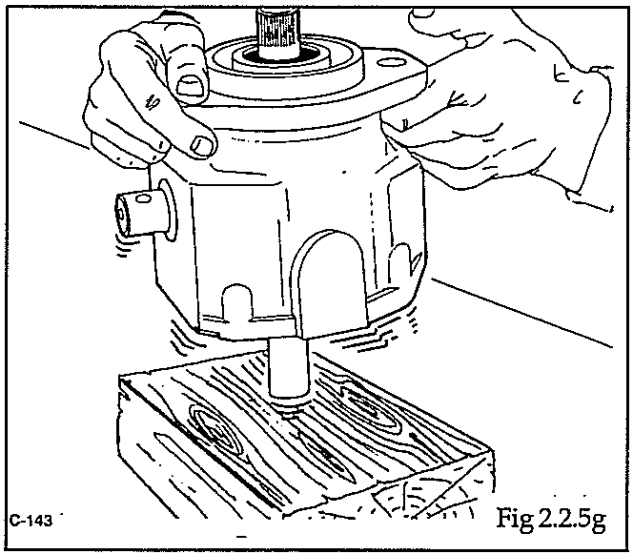


Fig 2.2.5g

7. Remove the seal, spacer, retaining ring, thrust bearing and races from the pump shaft (Fig. 2.2.5h).

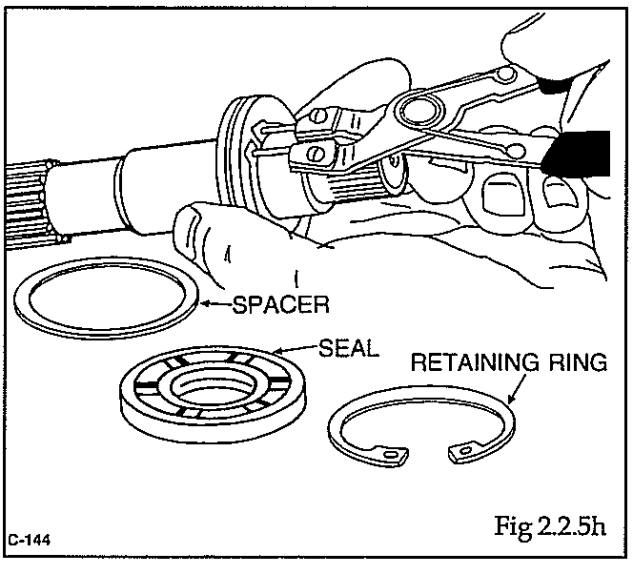
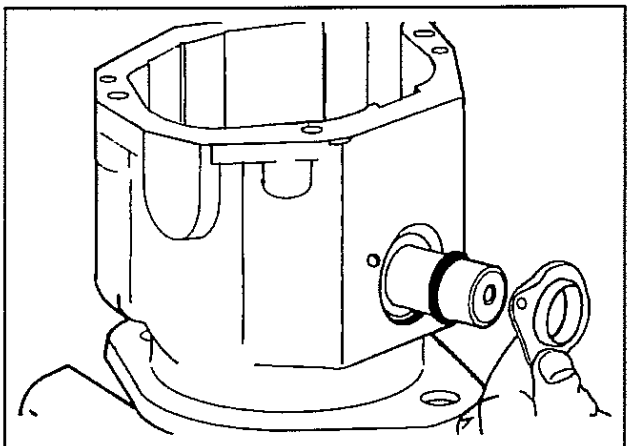


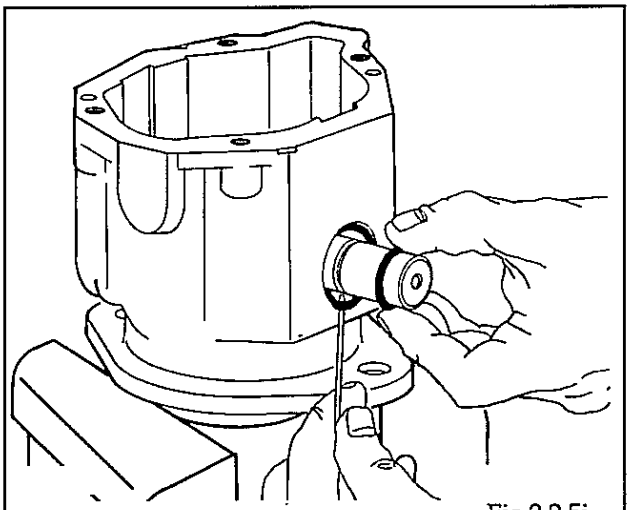
Fig 2.2.5h

8. Remove the retaining screw and the camplate cover (Fig. 2.2.5i).



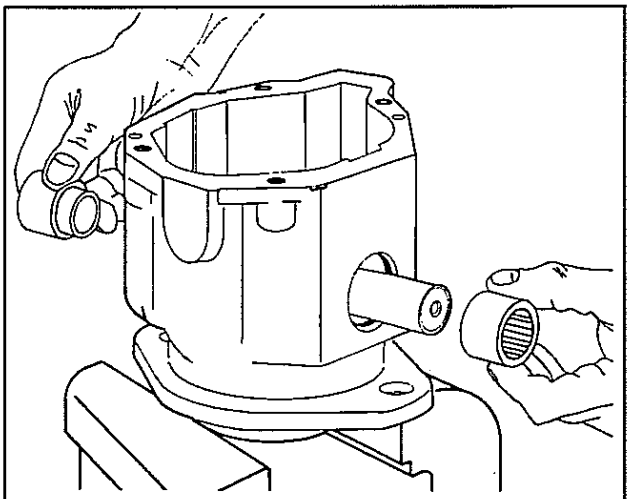
C-562 Fig 2.2.5i

9. Remove the camplate cover plate O-ring.



C-563 Fig 2.2.5i

10. Remove the retaining ring, camplate cover and seal from the opposite side of the pump housing (Fig. 2.2.5j).



C-343

Fig. 2.2.5j

11. Remove the camplate from the housings (Fig. 2.2.5k).

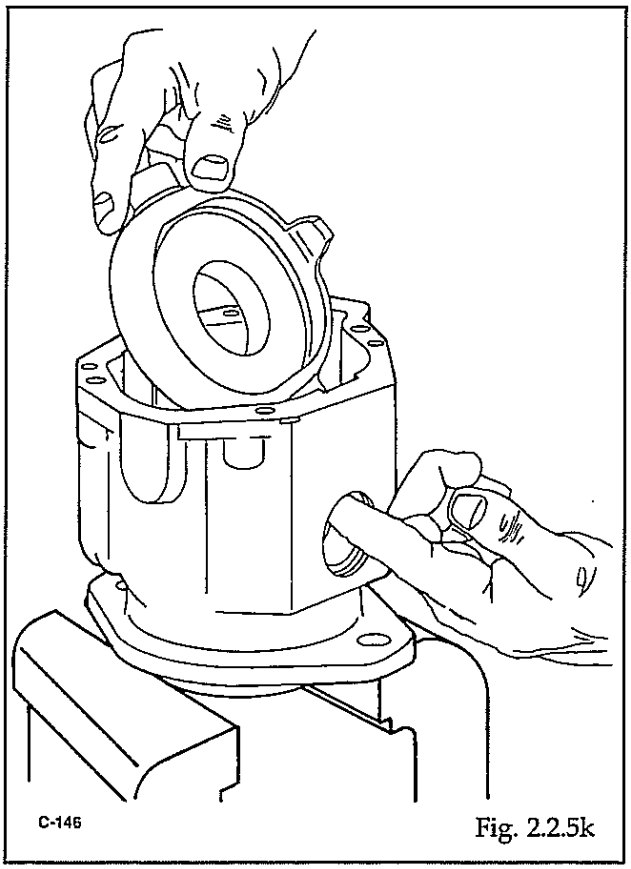


Fig. 2.2.5k

2.2.6 HYDROSTATIC PUMP, INSPECTION

1. Inspect the needle bearing inside the adaptor housing. If the needles are free from excessive play and remain in the bearing cage there is no need to replace the bearing.

2. Inspect the face of the wear washer for scoring or wear. The washer should be smooth and free of grooves. If not, replace (Fig. 2.2.6a).

IMPORTANT Do not intermix parts from one pump with another. Keep all pump parts separate.

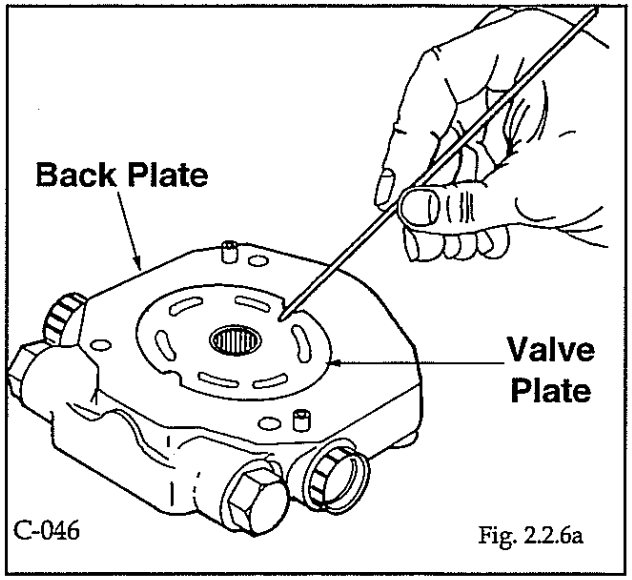


Fig. 2.2.6a

3. Inspect the face of the valve plate for score or wear. The plate should be smooth and free of grooves (Fig. 2.2.6b).

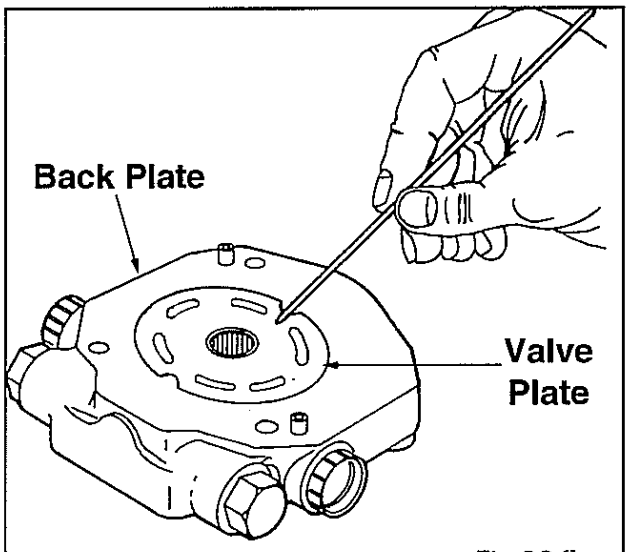


Fig. 2.2.6b

4. Inspect the piston block (Fig. 2.2.6c). The face that contacts the back plate should be smooth and free from grooves.

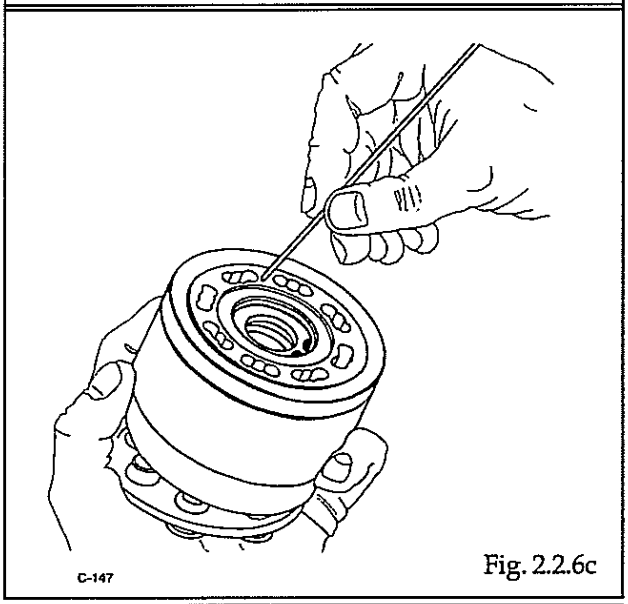


Fig. 2.2.6c

WARNING The piston block spring is highly compressed and the retaining ring should not be removed without first compressing the spring.

5. Inspect the piston block spring and the three (3) pins for damage (Fig. 2.2.6d).

6. Check that the pistons move freely in the piston block bore. If they are sticky in the bore, check the bore for scoring or contamination.

7. Inspect the piston shoes. The flat surface of the shoe should be flat and smooth. The corners of the piston shoe should be square and not rounded.

8. Inspect the finish on the outside diameter of the pistons. The surface should be free from scratches or wear.

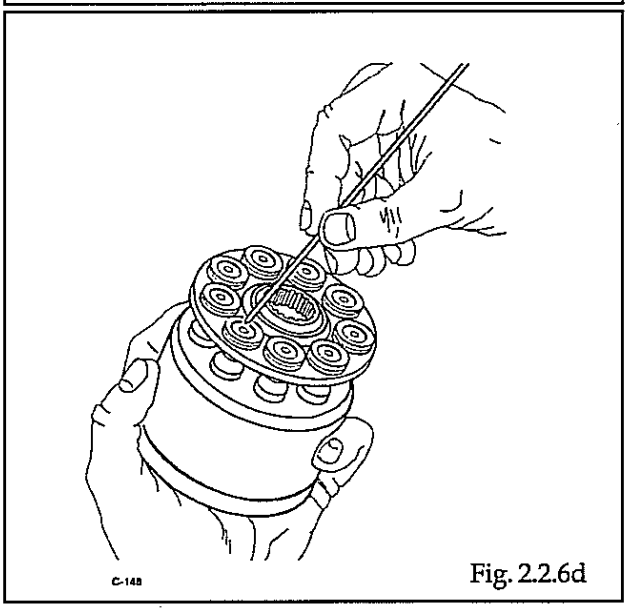


Fig. 2.2.6d

9. Inspect the spider pivot (Fig. 2.2.6e). It should be smooth and shows no signs of wear.

10. Inspect the spider. It should be flat with no cracks or any signs of wear in the pivot area.

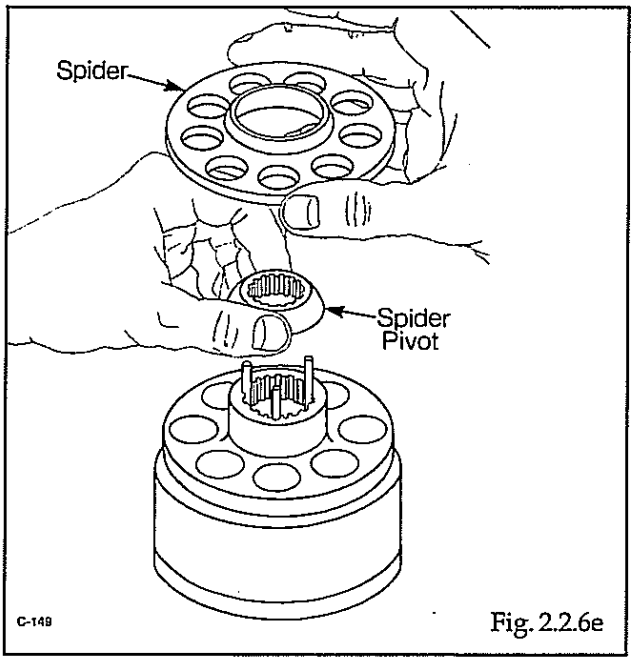


Fig. 2.2.6e

11. Inspect the polished surface of the camplate for scoring (Fig. 2.2.6f).

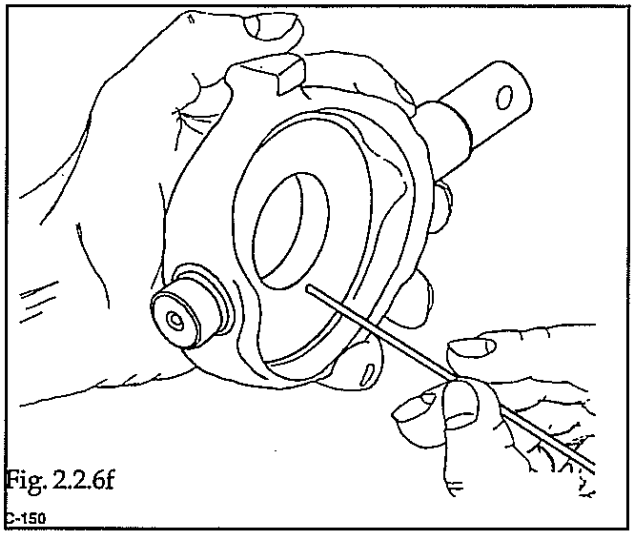


Fig. 2.2.6f

IMPORTANT Do not intermix parts from one pump with another. Keep all pump parts separate.

12. Inspect the pump driveshaft bearing surfaces and splines for signs of scoring, wear or any damage (Fig. 2.2.6g).

13. Inspect the thrust bearing and washers for wear.

14. Inspect the needle bearing in the housing assembly.

    If the needles are free of excessive play and remain in the bearing cage there is no need to replace the bearing.

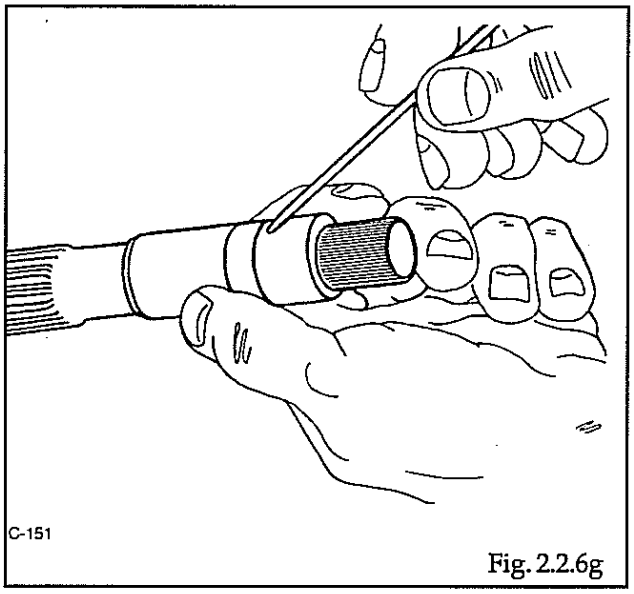


Fig. 2.2.6g

2.2.7 *HYDROSTATIC PUMP - REASSEMBLY*

Discard all old gaskets, seals and O-rings and replace with new ones on reassembly.

Clean all parts in a suitable solvent and lubricate with system oil before assembly.

1. Install the camplate in the pump housing (Fig. 2.2.7a).

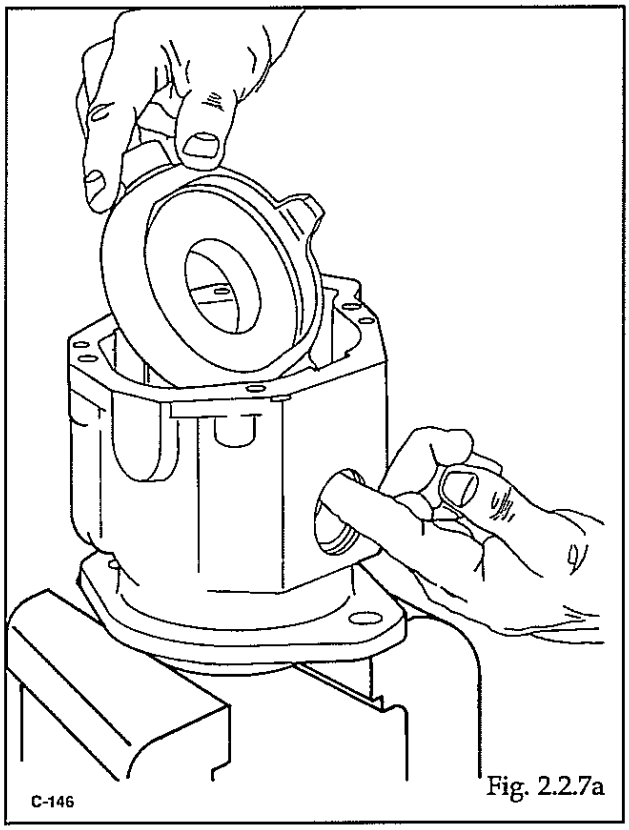


Fig. 2.2.7a

2. Install the needle bearings and inner races over the camplate shafts and slide them into the housing (Fig. 2.2.7b). The numbered end of both bearings and races should face outward and the chamfered I.D. of the races should face inward.

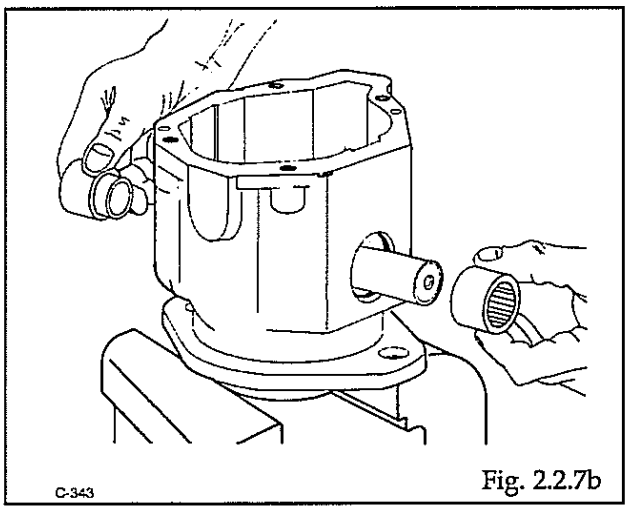


Fig. 2.2.7b

3. Install the washer and new shaft seal on the camplate (Fig. 2.2.7c).

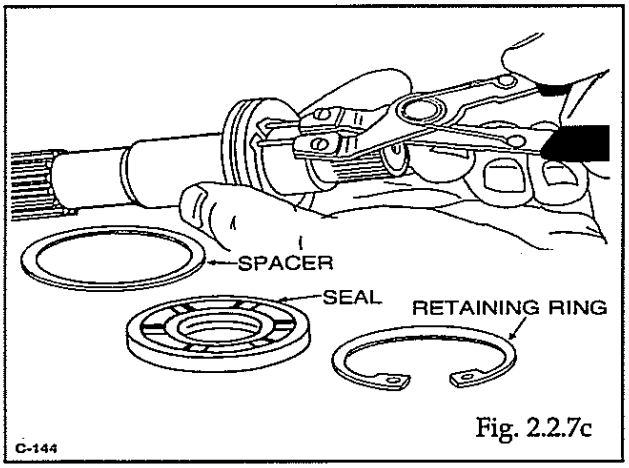
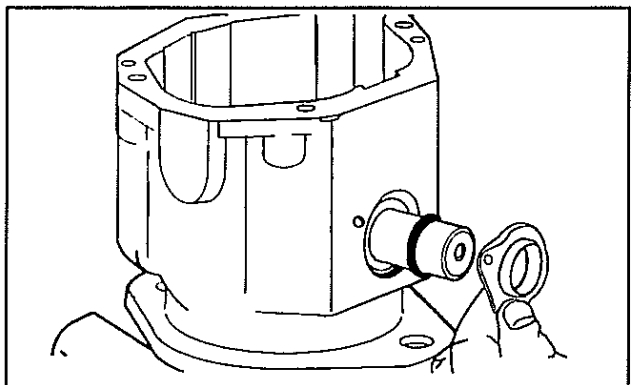


Fig. 2.2.7c

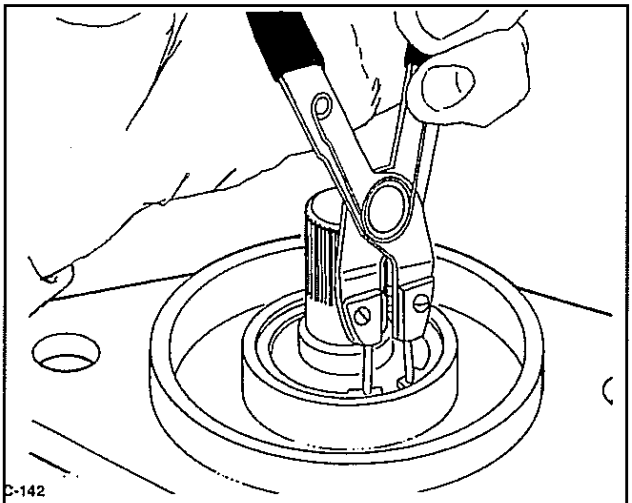
4. Install the seal cover (Fig.2.2.7d).



C-562 Fig.2.2.7d

5. Install the washer, new O-ring, O-ring cover and trunnion cover on the opposite side of the pump housing. Torque the screws 3 to 4 ft. lbs. (4 - 5 N.M.).

6. If the piston has been diassembled, install the three (3) pins, washers and springs. Compress the spring and install the retaining ring (Fig. 2.2.7e).



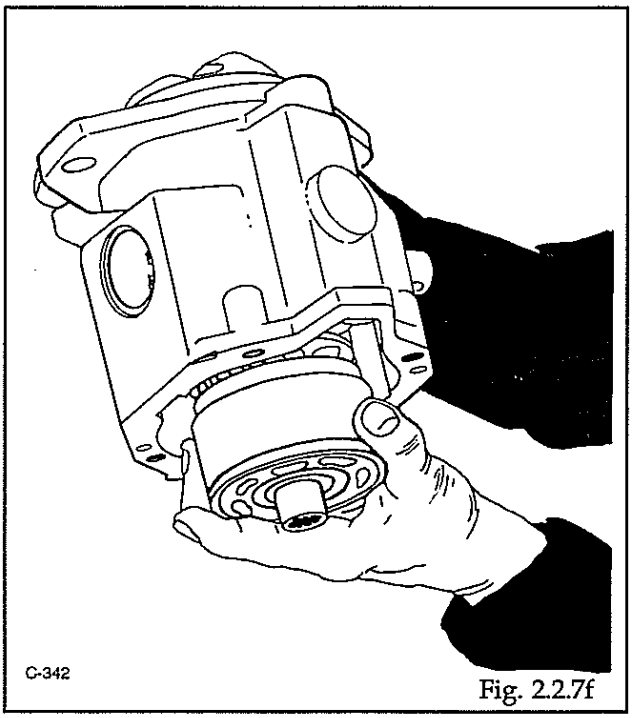
C-142 Fig. 2.2.7e

7. Install the spider pivot, spider and nine pistons in the piston block. Install the piston block in the housing (Fig. 2.2.7f). Line up the spline on the piston block with the spline on the pump shaft.

8. Ensure the piston shoes come in contact with the camplate. The piston block will extend slightly beyond the housing when installed.

9. Install a new gasket on the housing.

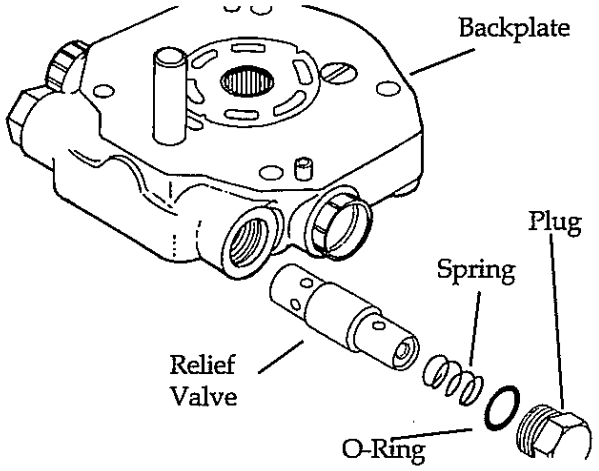
⚠ WARNING The piston block spring is highly compressed and the retaining ring should not be removed without first compressing the spring.



C-342 Fig. 2.2.7f

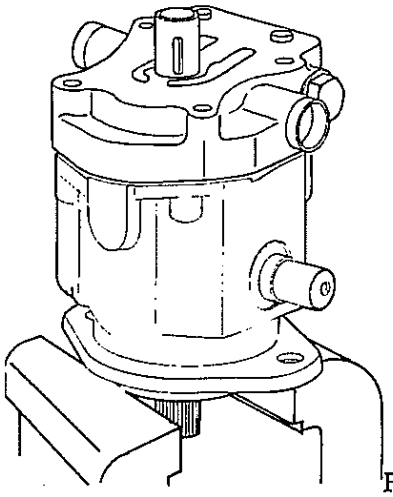
10. Install the two (2) relief valves and springs into the back plate assembly (Fig. 2.2.7g). Place a new O-ring on the plugs and torque them to 55 - 60 ft. lbs. (75 - 81.3 N.M.)

NOTE: Valve plate has two unique sides; make sure the brass side faces out, bearing flush with the top of the plate.



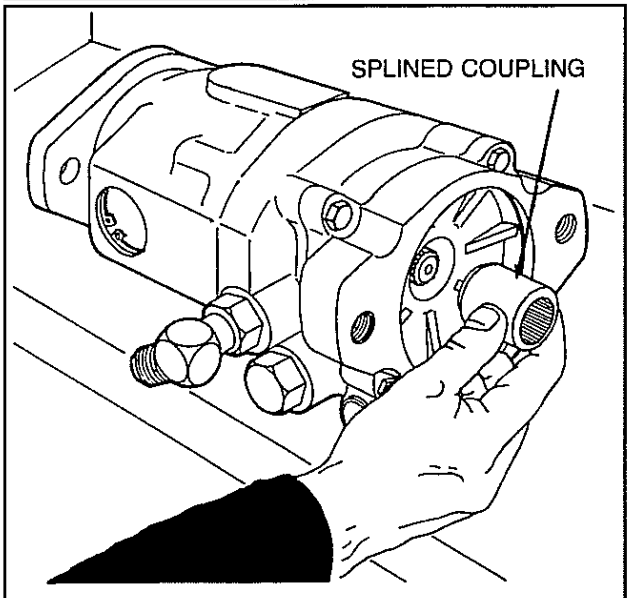
C-054 Fig. 2.2.7g

11. Install the back plate on the housing being careful not to damage the gasket (Fig. 2.2.7h). When installed there will be a slight gap between the back plate and housing.



C-596 Fig. 2.2.7i

12. Install the splined drive coupler in the rear piston pump (Fig. 2.2.7j).



C-334 Fig. 2.2.7j

2.2.8 CHARGE PRESSURE VALVE

Thomas S series loaders are now equipped with a charge pressure check valve located just after the hydrostatic oil filter. The valve is pre-set and will divert charge oil to the hydrostatic pumps. Charge pressure may be checked at the valve or at the transfer line between the two (2) pumps. Charge pressure should be approximately 60 to 120 PSI.

2.2.9 CAMPLATE SEAL REPLACEMENT

The hydrostatic pump camplate seals can be replaced without removing the hydrostatic pump from the loader.

Discard all seals and replace with new ones on assembly.

1. Remove any attachment, raise the boom arms and engage the boom supports. Shut off the engine.

2. Remove the seat and hydraulic shield.

3. Disconnect the steering control linkage and the shock absorber from the pump pintle lever (Fig. 2.2.9a).

4. Remove the clamp bolt from the bottom of the pintle lever (Fig. 2.2.9b).

IMPORTANT

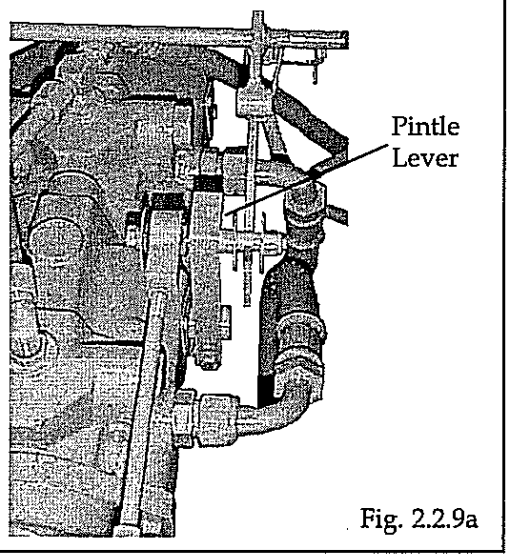
When making repairs to the hydrostatic system, keep all parts clean and remove dirt from the work area. Use caps and plugs on all lines and openings.

⚠ WARNING

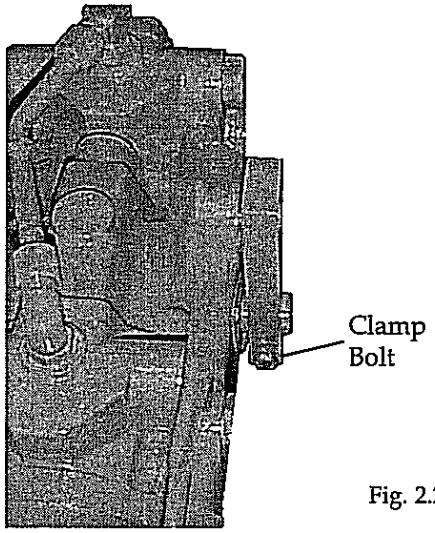
To prevent personal injury never repair or tighten hydraulic hoses with the engine running or the system under pressure.

⚠ WARNING

To prevent personal injury do not work on a loader with the boom arms in a raised position unless the boom supports are engaged.

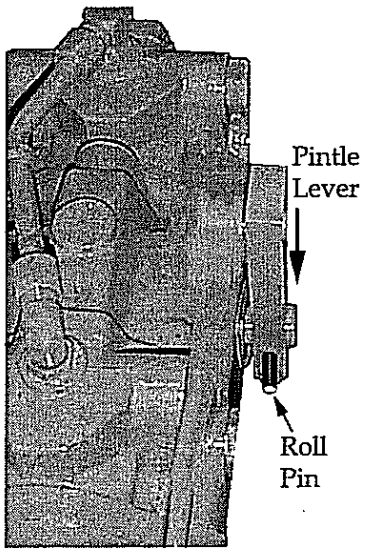


C-029 Fig. 2.2.9a



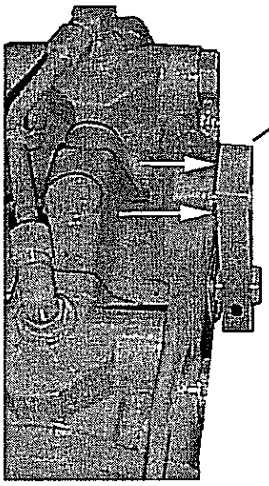
C-041 Fig. 2.2.9b

5. Remove the roll pin from the pintle lever (Fig. 2.2.9c).



C-042 Fig. 2.2.9c

6. Remove the pintle lever from the camplate shaft (Fig. 2.2.9d).



C-043 Fig. 2.2.9d

7. Remove the two (2) screws holding the seal cover in place and remove the seal cover (Fig. 2.2.9e). On reassembly torque the screws 3 to 4 ft. lbs. (4 - 5 N.M.).

8. Remove the shaft seal. On reassembly, install a new shaft seal.

9. Remove the two (2) screws, trunnion cover, O-ring cover and O-ring from the opposite side of the pump housing. On ressembly torque screws 3 to 4 ft. lbs. (4 - 5 N.M.). On reassembly, install a new O-ring.

C-575

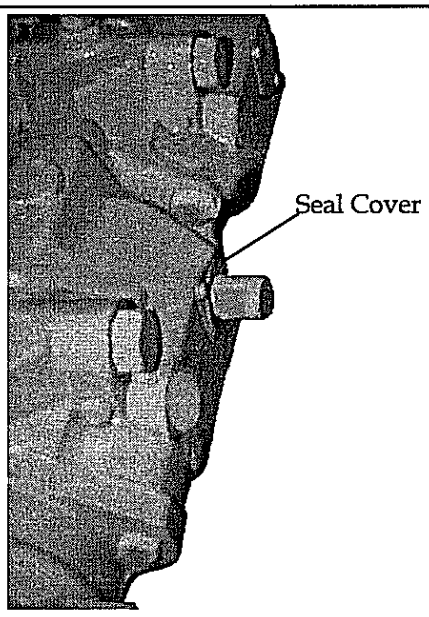


Fig. 2.2.9e

2.2.10 REAR PUMP - SHAFT SEAL REPLACEMENT

1. Drain the hydraulic reservoir or by using a vacumn create suction to prevent oil from leaking out.

2. Disconnect the universal joint. (Fig. 2.2.10a).

3. Remove the high pressure, case drain and charge pressure lines.

4. Disconnect the control rod linkage.

5. Remove the pump from the loader and place on a work bench.

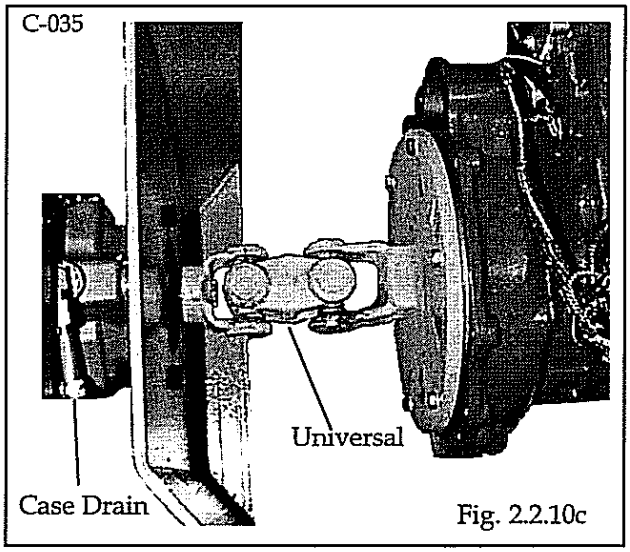


Fig. 2.2.10c

5. Remove the retaining ring from the hydrostatic pump (Fig. 2.2.10d & e).

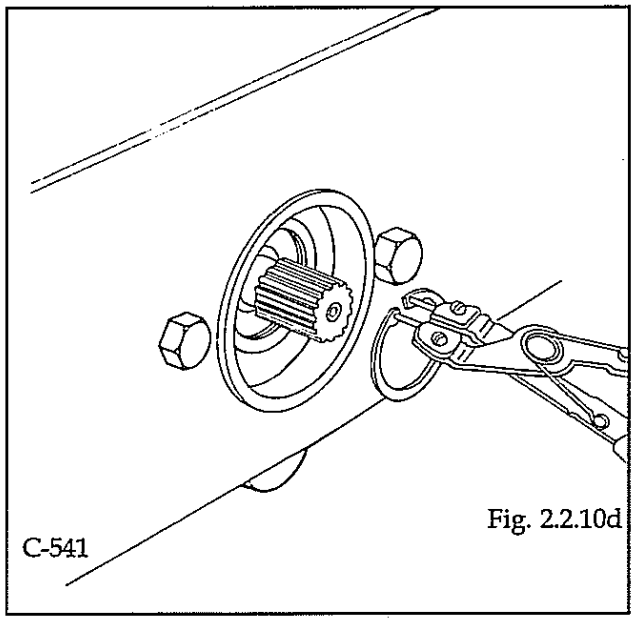


Fig. 2.2.10d

6. Remove the pump shaft seal (Fig. 2.2.10e).

NOTE: The back up washer may come out when the shaft seal is removed. Ensure the washer is reinstalled before installing a new pump shaft seal.

7. Lubricate a new pump shaft seal with system fluid and reinstall it in the pump.

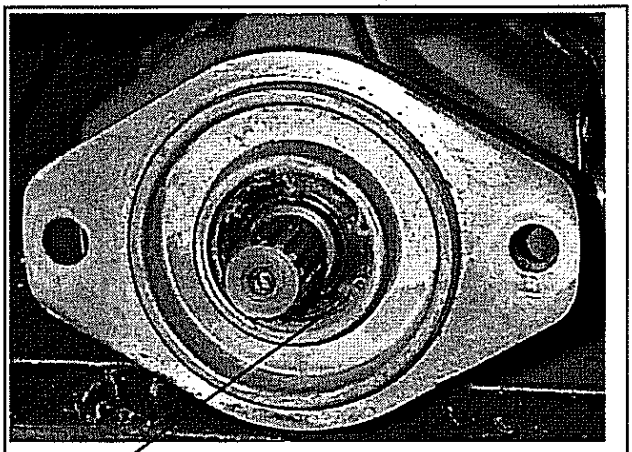


Fig. 2.2.10e

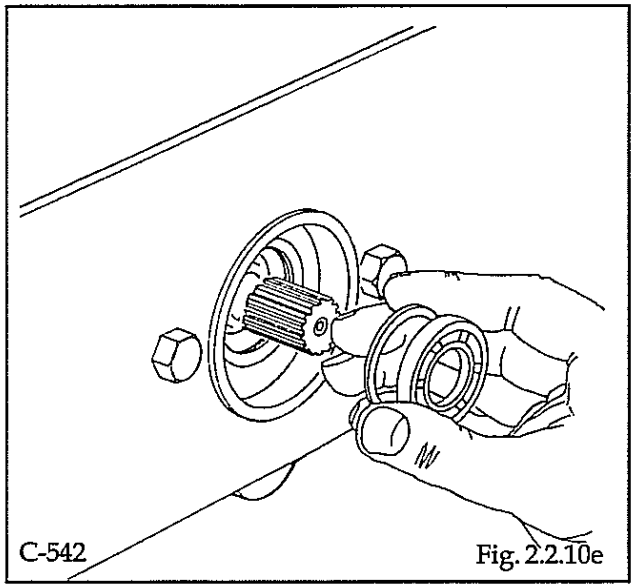


Fig. 2.2.10e

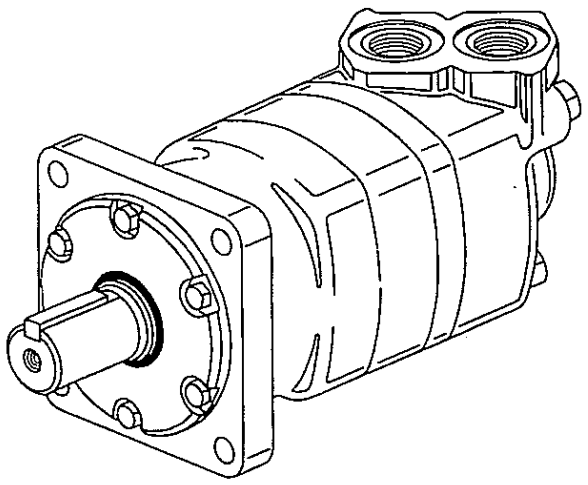
2.3 *TORQUE MOTOR*

2.3.1 *SPECIFICATIONS*

Motor Type.....Geroler
Displacement.....11.9 or 15 cu. in. (245 cm^3)
Rotation.....Dual
Section Bolt Torque.....62.5 ft. lbs. (84.7 N.M.)
Retainer Cover Bolt Torque.....25 ft.lbs. (33.9 N.M.)
Mounting Nut Torque 80 ft.lbs.
(to frame).....(136 - 149 N.M.)
Sprocket Nut Torque.....350 ft. lbs. (475 N.M.)

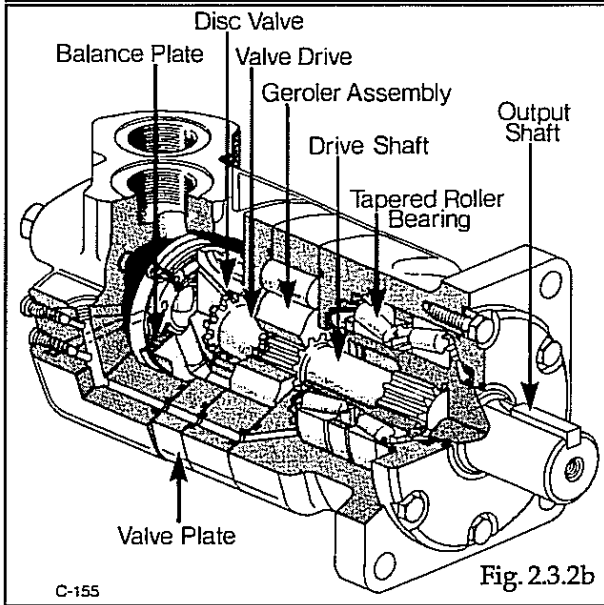
2.3.2 *GENERAL INFORMATION*

The basic geroler design uses a combination of mechanical and hydraulic principles that are utilized in the high torque, low speeds. (Fig 2.3.2a & b)



C-152

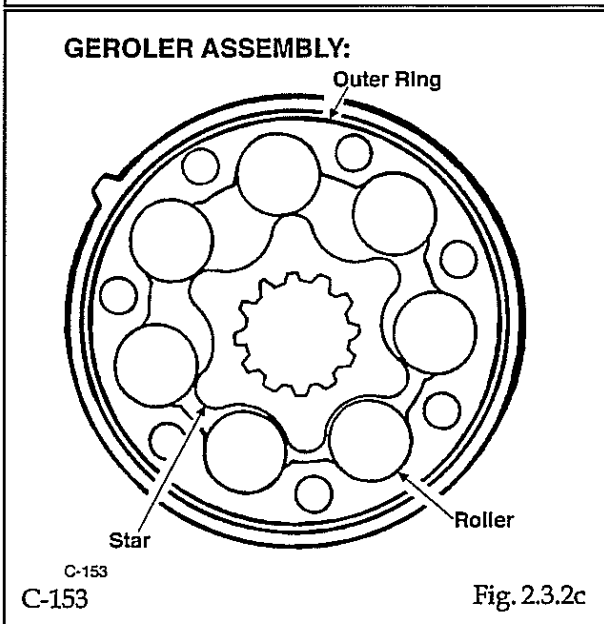
Fig. 2.3.2a



C-155

Fig. 2.3.2b

The outer ring (Fig. 2.3.2c) of the geroler assembly is similar to an internal gear that is held in a fixed position by securing it to the motor housing. The rotating inner gear, called a star orbits inside the secured outer ring.



C-153

C-153

Fig. 2.3.2c

Because of the different number of teeth on the star and outer ring, the star rotates in an eccentric circular orbiting motion from the housing centre line (Fig. 2.3.2d).

A driveshaft is used to transmit the rotation of the star to the output shaft. The driveshaft has crowned external splines to match the internal splines in the star and output shaft. This type of drive is used because the star centreline continously changes during rotation.

As the star orbits, it causes a continous opening and closing of the outer ring fluid pockets. Half of these fluid pockets are subject to fluid pressure, causing star rotation and the opposing half are connected to a return line.

When pressure is introduced into the fluid pockets on the right side of the star (Fig. 2.3.2e) the output rotation will be counterclockwise. When the fluid pockets on the left side of the star are pressurized the output rotation will be clockwise.

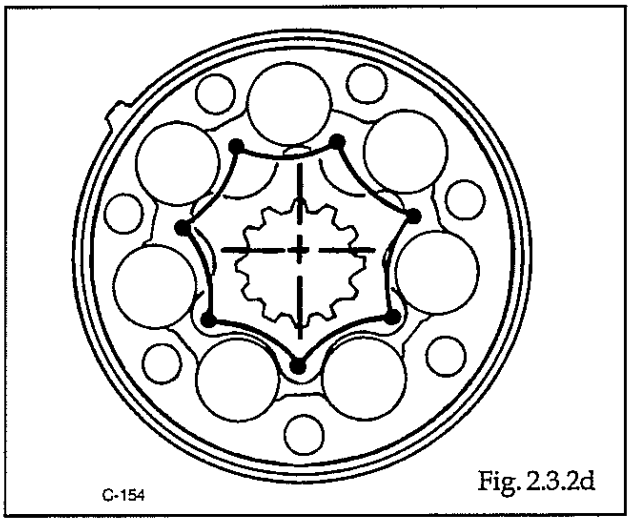


Fig. 2.3.2d

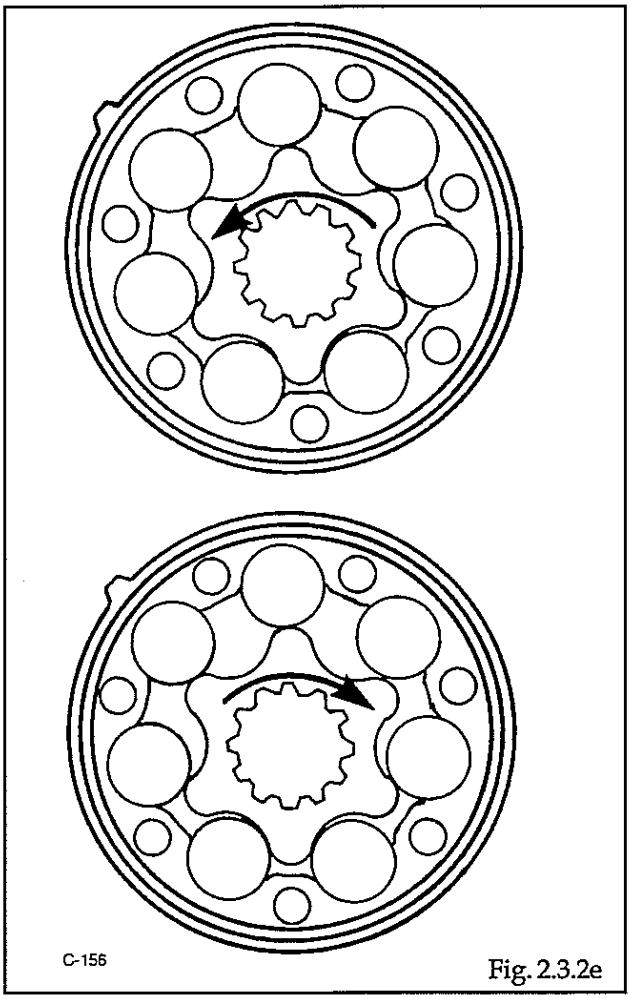


Fig. 2.3.2e

To seal the fluid pockets the torque motor incorporates a rotating roller type seal (Fig.2.3.2f). This type of a rolling seal reduces friction at the star points providing increased efficiency and reduced component wear.

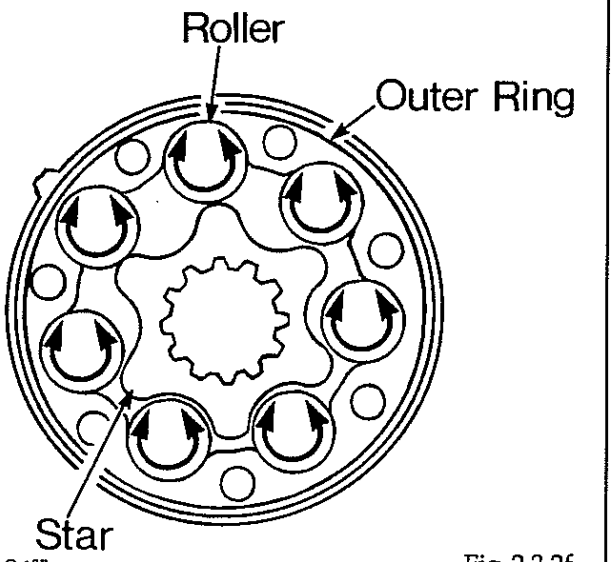


Fig. 2.3.2f

The geroler (Fig. 2.3.2g), is both a fluid displacement motor and a gear reducer. It provides six (6) times (the number of star points) greater power per revolution than a gear, vane or piston type motor. This means that six (6) times greater torque can be delivered at one sixth the speed without further gear reduction.

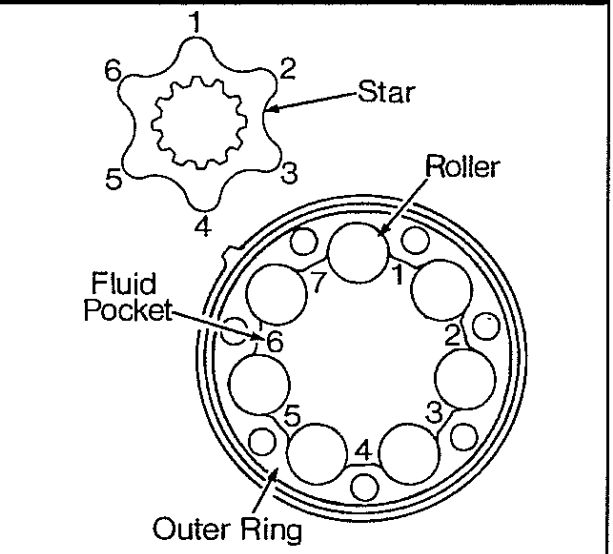


Fig. 2.3.2g

Shown in figure 2.3.2h is one complete star orbit, or one sixth of the output shaft rotation. The star must travel through six (6) complete orbits for each single reduction of six to one (6 to 1).

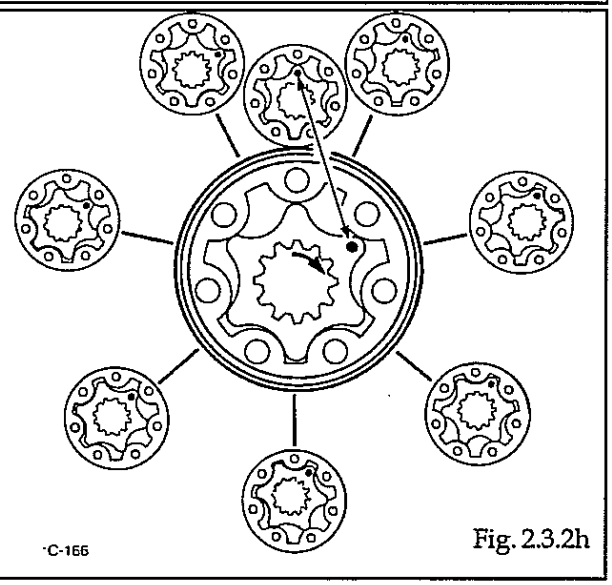


Fig. 2.3.2h

The use of seven (7) fluid power pockets with the six to 1 (6 to 1) ratio provides forty two (42) fluid power cycles per each complete shaft totation.

For smooth and continous motor output rotation, the torque motor utilizes a disc valve which operates in synchronization with the geroler star. The disc valve arrangement consists of a stationary balance plate, rotating disc valve and a stationary valve plate (Fig. 2.3.2i).

The disc valve contains an inlet fluid passage port for each star valley and a return fluid passage point.

A separate crowned driveshaft is used to synchronize the disc valve and geroler star so that they turn as one. To accept fluid from the disc valve, the valve plate also contains internal porting passages to each outer ring pocket area.

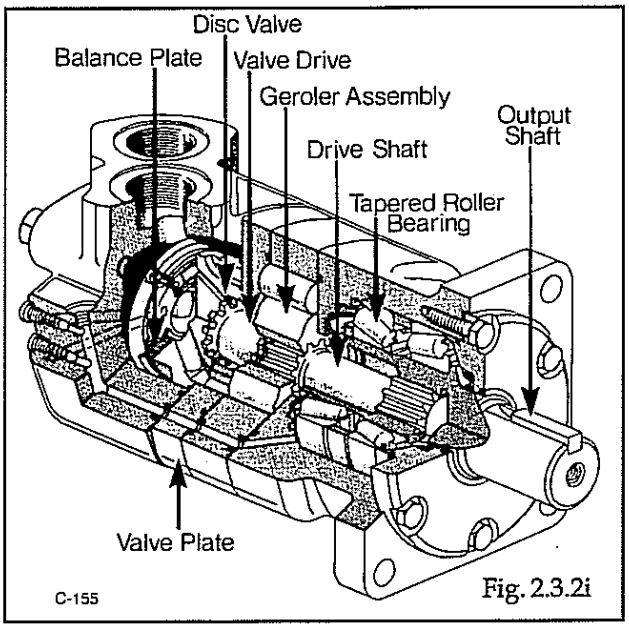


Fig. 2.3.2i

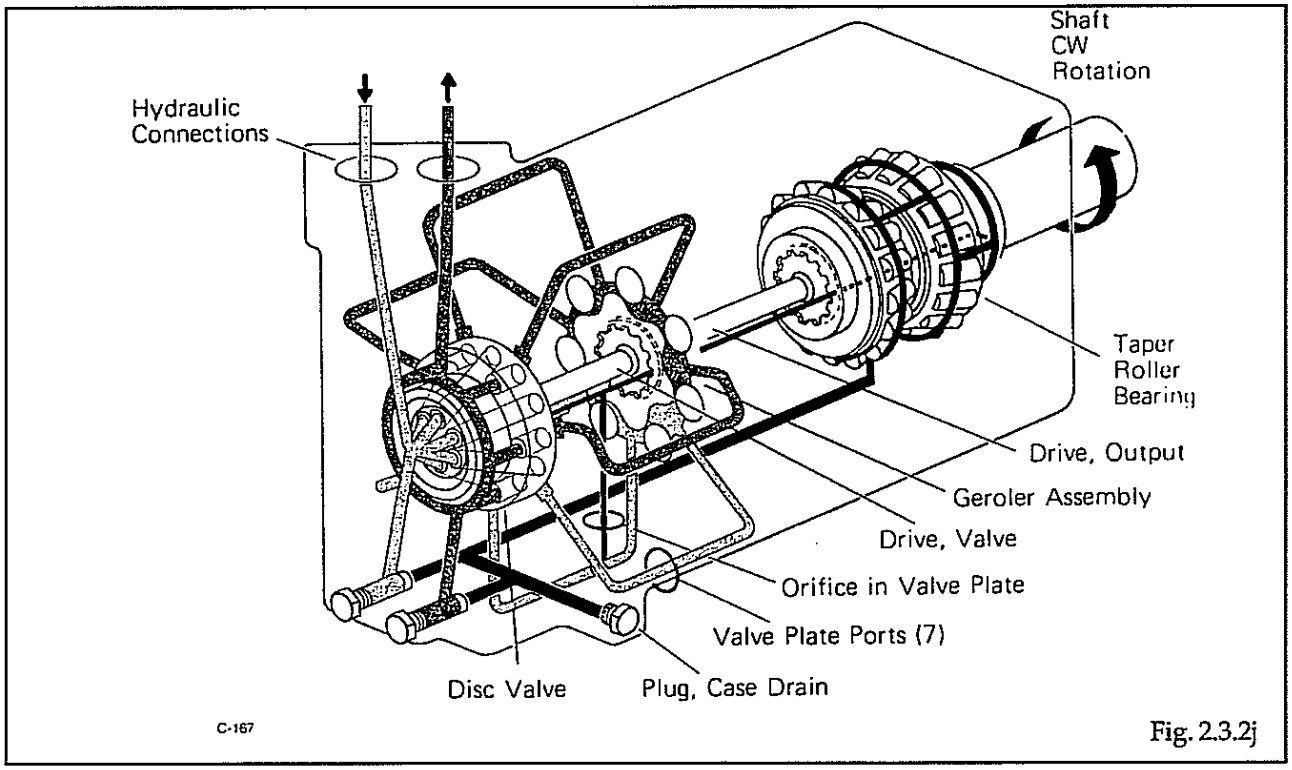


Fig. 2.3.2j

Fig. 2.3.2i illustrates the fluid flow through the torque motor for clockwise rotation.

Fluid enters the housing through the inlet port and is directed to the balance plate. The balance plate contains an inner and an outer seal to separate the high and low pressure fluid passages. Fluid passes through the stationary balance plate to the rotating disc valve. The rotating disc valve ports the fluid to the stationary valve plate and proper side of the geroler pockets causing the rotor star to turn.

As the rotor star rotates and each fluid pocket reaches its full open position, the return porting in the rotating disc valve opens to allow the fluid in the pocket area to pass back through the valve plate, disc valve, balance plate and out through the housing return port, as the pocket closes.

The disc valve is timed to the geroler rotor star to govern the inlet fluid flow to output shaft rotation. If the timing of the disc valve to geroler star is off one tooth, the relationship of input fluid to output motor shaft rotation will be reversed.

2.3.3 *TORQUE MOTOR REMOVAL*

1. Remove any attachment, raise the boom arms and engage the boom supports. Shut off the engine.

2. Block the loader securely with all four (4) wheels clear of the ground.

3. Remove the wheels on the side of the machine that the torque motor is to be removed.

4. Drain the lubricating oil from the final drive housing. (Refer to section 3.1.3 for procedure).

5. Remove the bolt end of threaded rod assembly from brake lever on caliper external linkage (Fig. 2.3.3b).

6. Remove the final drive inspection plate cover (Fig. 2.3.3a) located between the axles on the final drive housing.

7. Loosen the brake caliper assembly.

8. Remove the stainless steel "z" pin and hex washers from torque motor sprocket.

9. Spread the brake pads apart to allow removal of the brake disc.

10. Remove the primary chain. Refer to section 3.2.2. for procedure.

11. Using a proper gear puller, remove the sprocket and key from the torque motor shaft.

NOTE: The torque motor can be removed from the final drive housing with the sprocket mounted on the motor shaft.

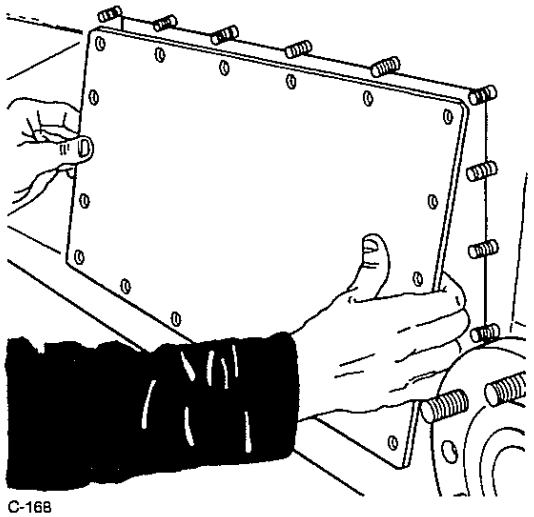
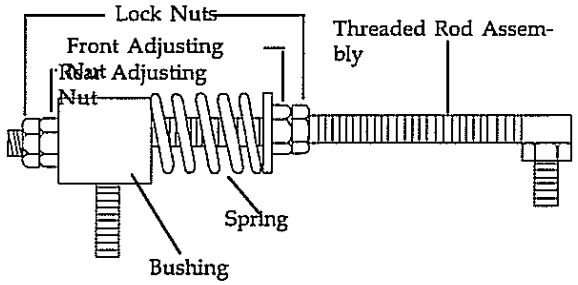


Fig. 2.3.3a



C-057

Fig. 2.3.3b

14. Disconnect and remove the two (2) high pressure hoses between the pump and motor (Fig. 2.3.3d).

NOTE: Cap the lines and plug the pump and torque motor port openings.

15. Disconnect and remove the drain line from the torque motor (Fig. 2.3.3d). Cap the line and plug the motor drain port.

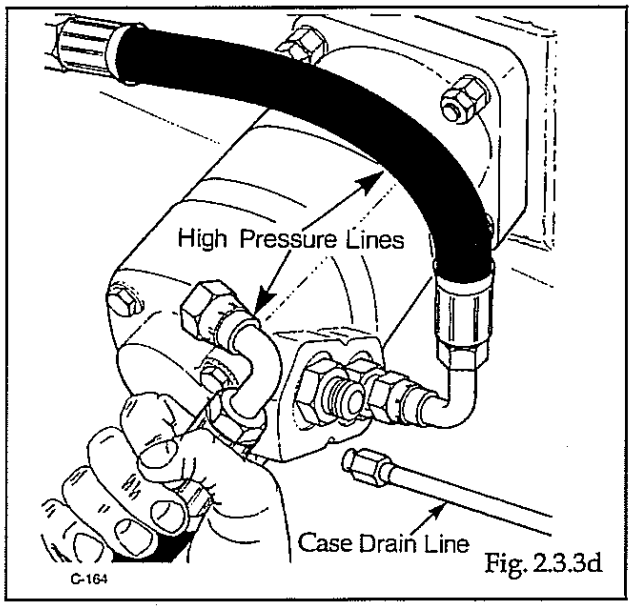


Fig. 2.3.3d

IMPORTANT

When making repairs to the hydrostatic system, keep all parts clean and remove dirt from the work area. Use caps and plugs on all lines and openings.

16. Remove the nylock mounting nuts from the torque motor (Fig.2.3.3f).

On reassembly torque the mounting nuts 80 ft. lbs.(108.8 N.M.).

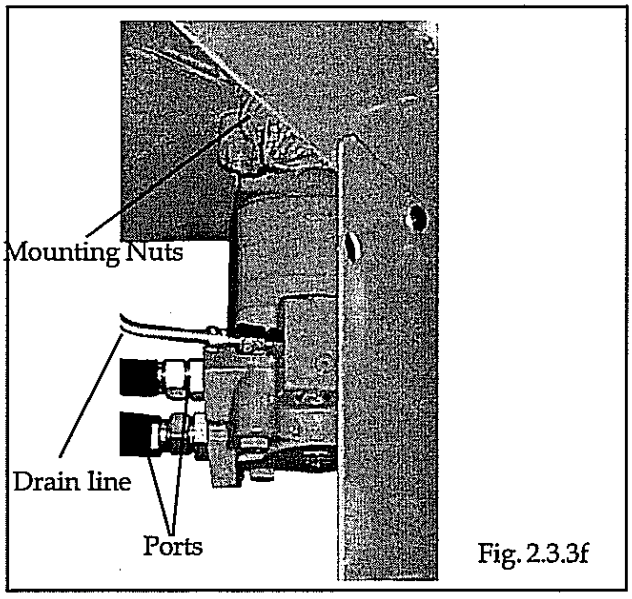


Fig. 2.3.3f

18. Remove the torque motor from the final drive housing (Fig. 2.3.3n).

REASSEMBLY - Torque mounting studs to 40 ft. lbs. and the mounting nuts to 80 ft. lbs.

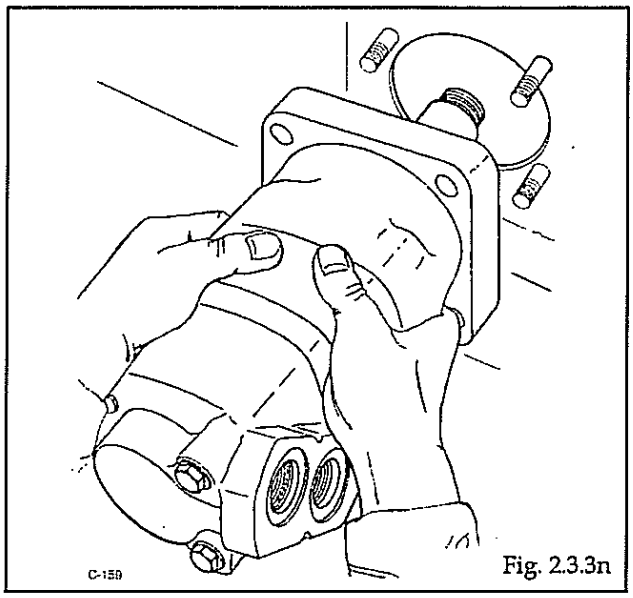


Fig. 2.3.3n

2.3.4 *TORQUE MOTOR REPLACEMENT*

1. Clean the area thoroughly before applying silicone sealant around the torque motor flange (Fig. 2.3.4a) to prevent oil leakage from the final drive housing.

NOTE: Sprocket must be mounted and torqued before assembly.

2. Install the torque motor mounting nuts from inside the final drive housing (Fig. 2.3.4b).

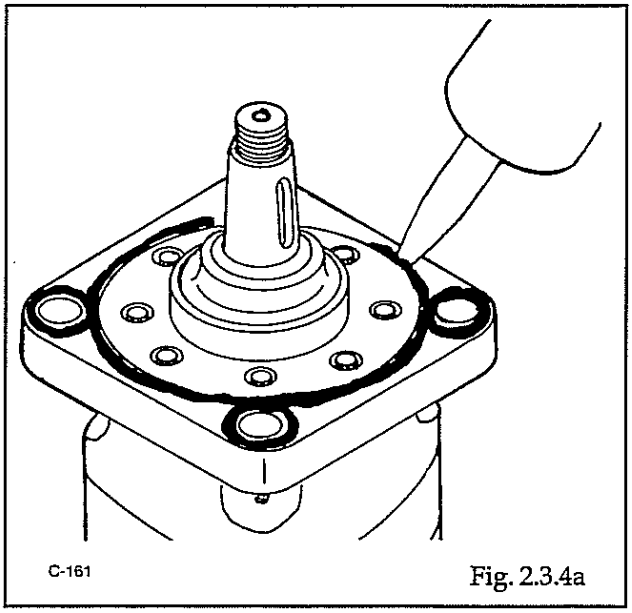


Fig. 2.3.4a

3. Install the sprocket on the torque motor (350 ft. lbs.) before installing the torque motor in the final drive housing (Fig. 2.3.4c).

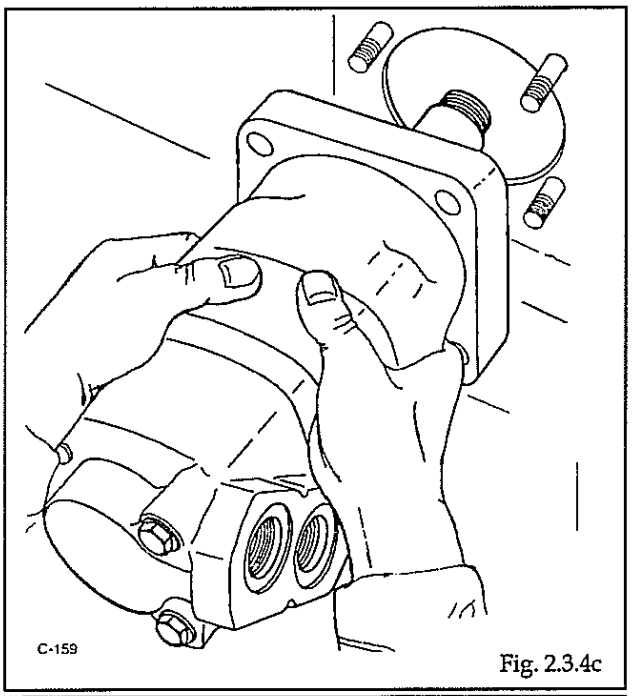


Fig. 2.3.4c

4. Install the mounting nuts and which secure the motor to the housing (Fig. 2.3.4d).

   Torque the mounting nuts 80 ft. lbs. (108.8 N.M.).

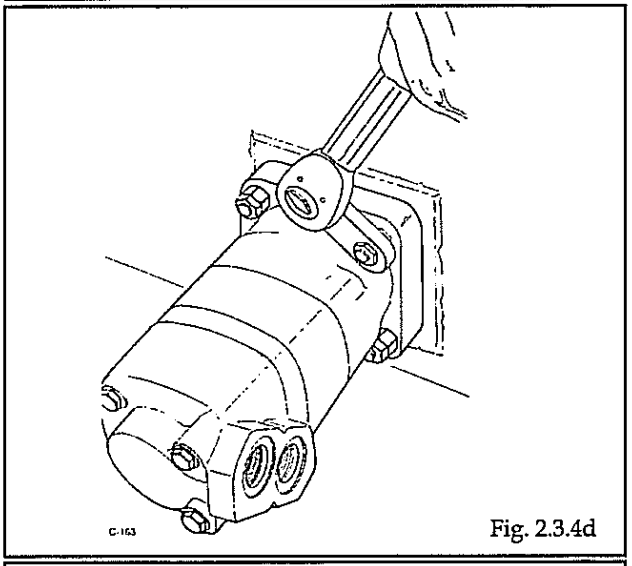
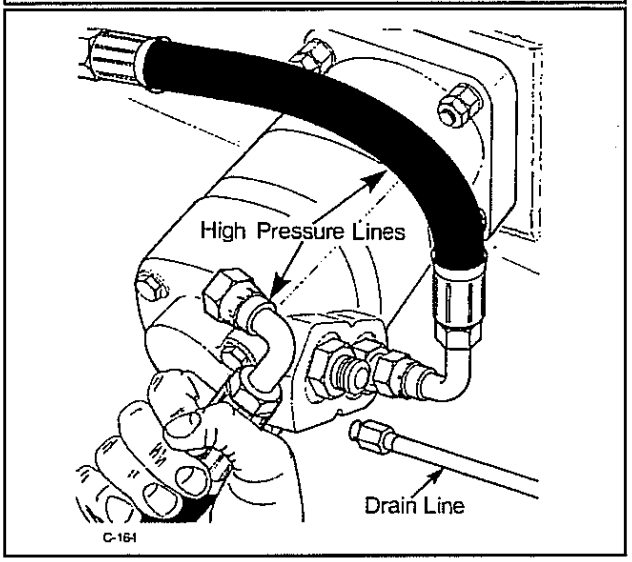


Fig. 2.3.4d

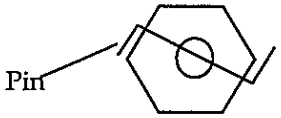
5. Install the two (2) high pressure lines between the hydrostatic pump and torque motor.

   Install the torque motor drain line (Fig. 2.3.4e).



6. Install the brake disc. Make sure the brake caliper lever is in correct slot so lever does not run out of engagement travel.

7. Install 3 hex washers . Bend new stainless 1/8 in. rod to make the pin into a "z". See pic.



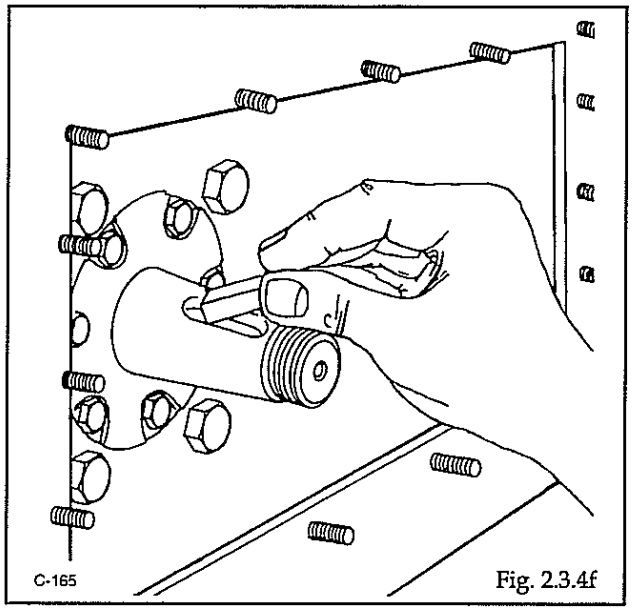


Fig. 2.3.4f

11. Tighten the brake caliper assembly and reinstall threaded rod assembly (Fig. 2.3.4g). Apply silicone behind head of caliper washers.

12. Fill the final drive housing to the correct level with 10W30 API SE/CD oil. Refer to section 3.1.5 for details. Capacity is 5 gal. (23l).

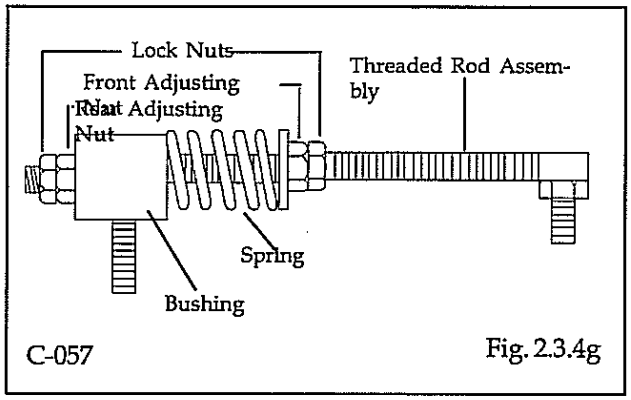


Fig. 2.3.4g

13. Apply silicone to the inspection cover and install the inspection cover on the final drive housing. (Fig. 2.3.4h). Do not exceed 11 ft. lbs. torque or shearing of the studs could happen.

14. Install the wheels. Torque the wheel nuts100 - 110 ft. lbs. (135 - 149 N.M.).

IMPORTANT	To prevent damage after removal or repair of hydraulic components refer to start up procedure Section 1.2.6

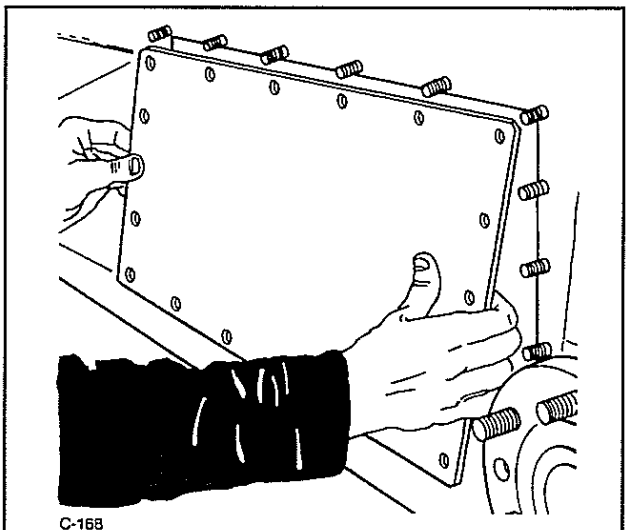


Fig. 2.3.4h

2.3.5 TORQUE MOTOR DISASSEMBLY

Fig. 2.3.5

1. Nut
2. Seal Kit
3. Retainer Plate
4. Bolt
5. Shaft/Bearing Assy
6. Key
7. Bearing Housing
8. Drive Shaft
9. Geroler
10. Valve Plate
11. Drive, Valve
12. Valve
13. Balance Ring
14. Ring, Spring
15. Housing
16. Plug
17. Bolt
18. Bolt
20. Plug
21. Sleeve
22. Spring
23. Poppet
24. Piston
25. Plug
26. Inner Face Seal
27. Outer Face Seal

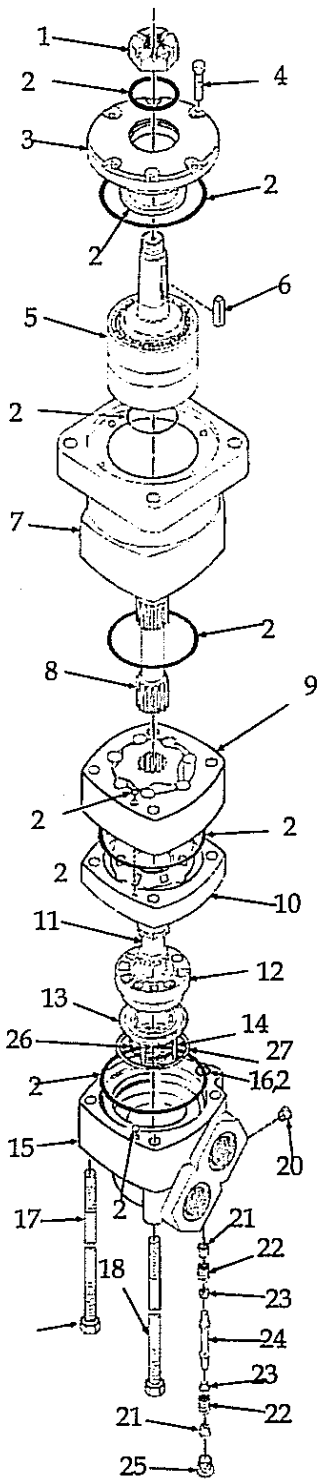
NOTE: Before disassembling the torque motor clean the body with a suitable solvent and dry with compressed air. Be sure all openings are plugged to prevent solvent entering the torque motor.

IMPORTANT

When making repairs to the torque motors, keep all parts clean and remove dirt from the work area. Use caps and plugs on all lines and openings.

⚠ WARNING

To avoid eye injury use safety goggles when cleaning with compressed air.



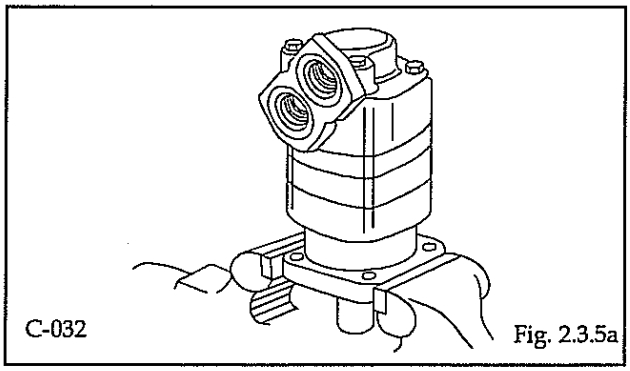
C-045

Fig. 2.3.5

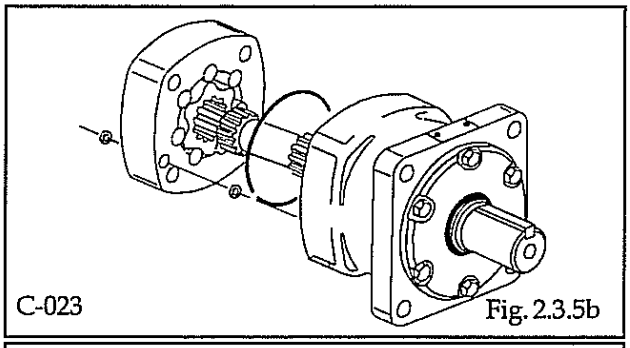
Discard all old seals and on reassembly replace with new seals.

1. Place the motor in a vice with the output shaft facing down (Fig. 2.3.5a). Do not clamp the motor on the housing as excessive pressure will cause distortion.

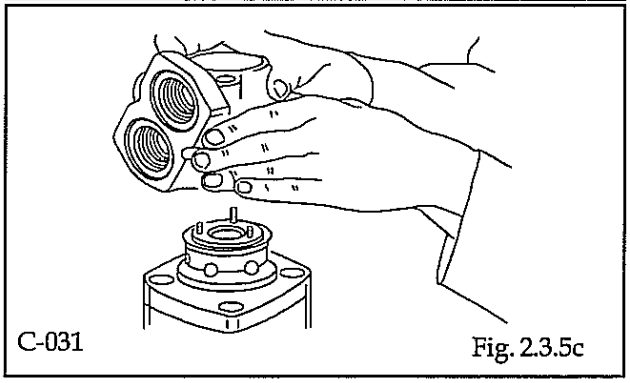
   Mark the body sections to assist in reassembly.


C-032 Fig. 2.3.5a

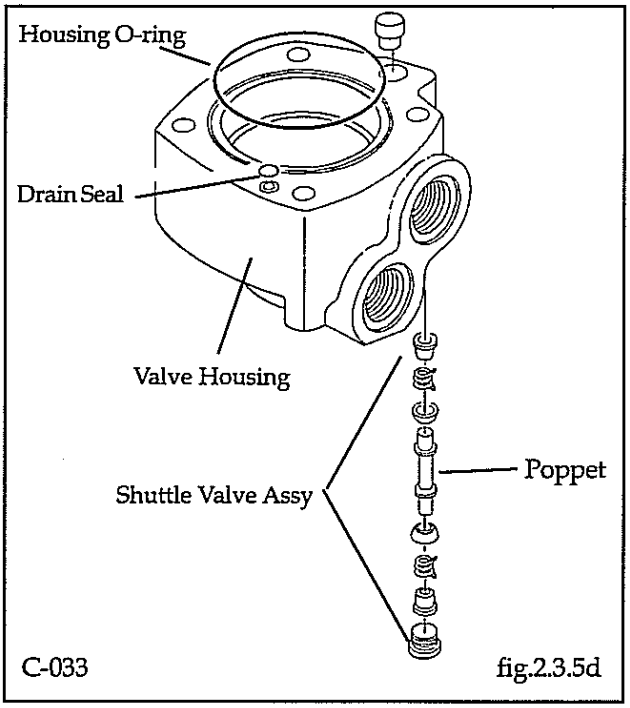
2. Remove the four (4) bolts from the motor valve housing (Fig. 2.3.5b). On reassembly, torque the mounting bolts to 62.5 ft. lbs. (84.7 N.M.). Follow the torque procedure outlined in section 2.3.7, para 7.


C-023 Fig. 2.3.5b

3. Carefully lift the valve housing straight up (Fig. 2.3.5c). The balance ring subassembly and springs should remain on the valve.

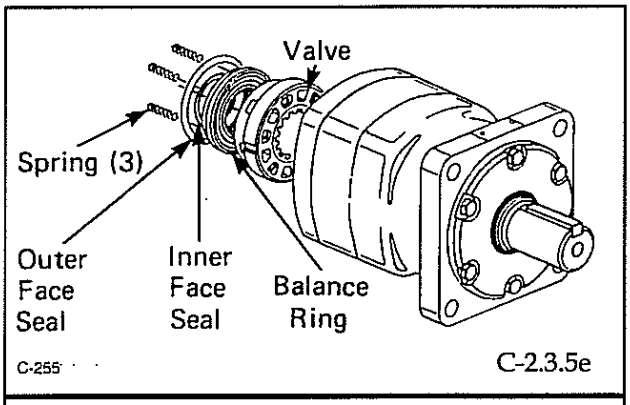

C-031 Fig. 2.3.5c

4. Remove the following parts from the valve housing (Fig. 2.3.5d).
   a. housing seal
   b. drain seal
   c. shuttle valve assembly



C-033 fig.2.3.5d

5. Remove the three (3) balance springs, balance ring and valve (Fig. 2.3.5e). remove both the inner and outer face seal from the balance ring.



C-2.3.5e

6. Remove the valve plate, seal and valve drive (Fig. 2.3.5f).

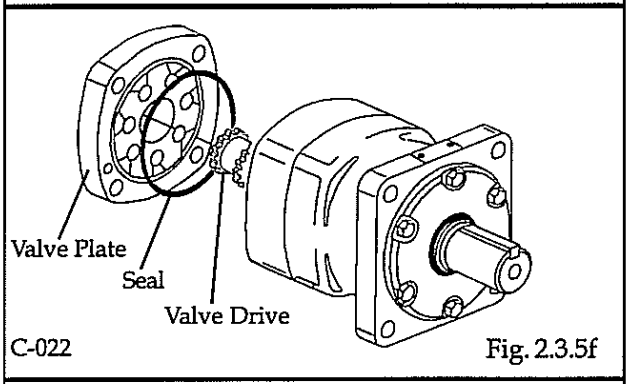


Fig. 2.3.5f

7. Remove the geroler assembly (Fig. 2.3.5g). Keep the rollers and the inner geroler in the outer geroler ring.

8. Remove the two (2) drain seals from each side of the geroler ring.

9. Remove the geroler drive and the seal from the bearing housing.

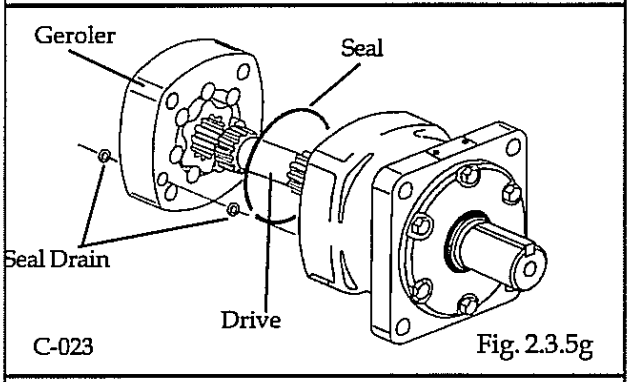


Fig. 2.3.5g

10. Turn the bearing housing over in the vice and remove the six (6) retainer plate bolts (Fig. 2.3.5h).

    On reassembly, torque the retainer plate bolts to 25 ft. lbs. (33.8 N.M.). Follow the torque sequence as outlined in section 2.3.7, para 7.

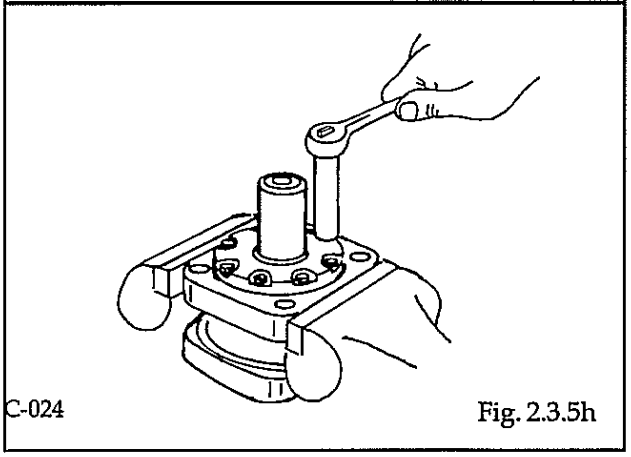
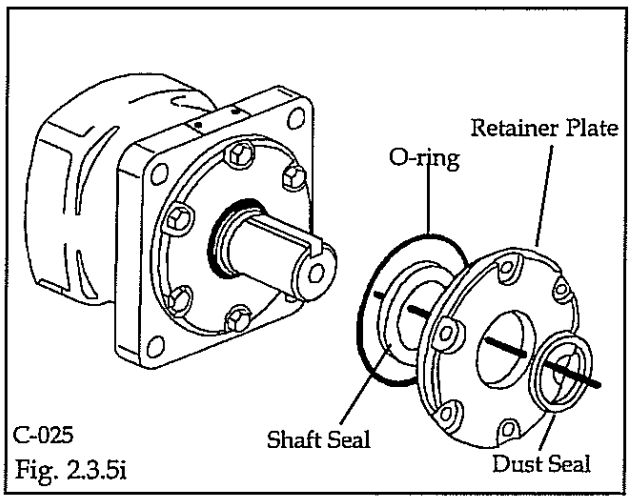


Fig. 2.3.5h

11. Remove the retainer plate from the bearing housing (Fig. 2.3.5i). The retainer plate may have to be pried free. Be careful not to damage the bearing housing or the retainer plate.

12. Remove the dust seal, shaft seal and O-ring from the retainer plate (Fig. 2.3.5i).

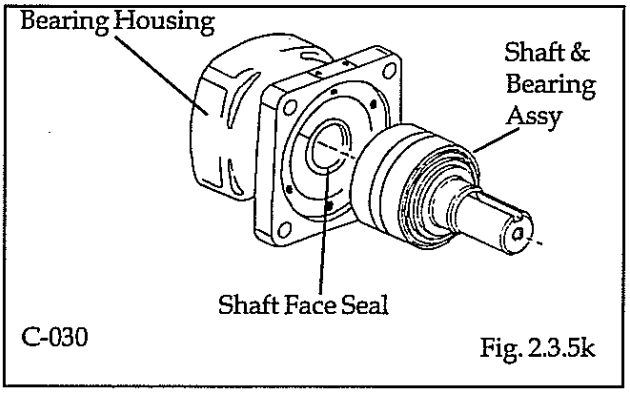


C-025
Fig. 2.3.5i

13. Remove the shaft and bearing assembly from the bearing housing (Fig. 2.3.5j). The shaft may need to be pressed out.

14. Remove the shaft face seal from the bore of the bearing housing. Be careful not to damage the bore of the bearing housing.

NOTE: Individual parts are not sold or serviced separately. Therefore care must be taken with all parts or replacement of the complete unit will be necessary.



C-030
Fig. 2.3.5k

2.3.6 *DRIVE MOTOR SPROCKET*

SPROCKET REMOVAL

NOTE: The torque motor can be removed from the final drive housing with the sprocket installed on the motor shaft.

1. Remove any attachments, raise the boom arms and engage the boom supports. Shut off the engine.

> **WARNING** To prevent personal injury do not work on a loader with the boom arms in a raised position unless the boom supports are engaged.

2. Block the loader securely with all four (4) wheels clear of the ground.

3. Remove the wheels on the side of the loader that the drive motor sprocket is to be removed from.

   On reassembly torque the wheel nuts 100 - 110 ft. lbs. (135 - 149 N.M.).

4. Drain the lubricating oil from the final drive housing. Total housing capacity is 5 gals or 23l.

5. Remove the final drive inspection cover plate (Fig. 2.3.6a) located between the axles on the final drive housing.

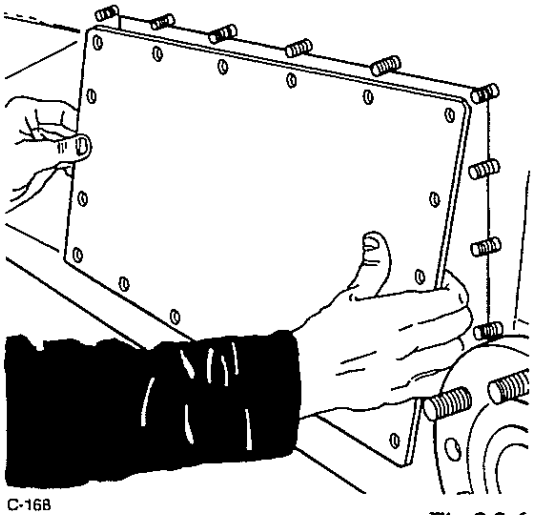


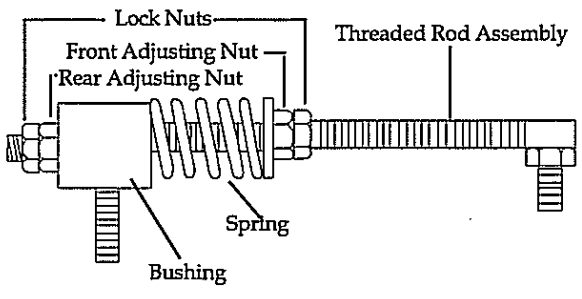
Fig.2.3.6a

6. Remove the bolt end of threaded rod assembly from the brake lever of caliper (Fig. 2.3.6b).

7. Loosen the brake caliper assembly.

8. Remove the stainless steel "z" pin and hex washers from the torque motor sprocket.

9. Spread the brake pads apart to allow removal of the brake disc.



C-057

Fig. 2.3.6b

10. Remove the primary chain (refer to section 3.2.2 for procedure).

11. Remove the castle nut.

12. Remove the complete Torque Motor Assembly.

13. Using a proper gear puller, remove the sprocket and key from the torque motor shaft.

SPROCKET INSTALLATION

1. Install the key on the torque motor shaft (Fig. 3.5.2a).

2. Line up the sprocket with the key and install the sprocket on the torque motor shaft.

3. Install the sprocket nut. Torque the nut to 350 ft. lbs. (474.5 N.M.). Then keep tightening to line up the hole with the castle nut. Assemble torque motor to the frame.

4. Install the primary chain (see section 3.2.2 for the procedure).

5. Install the brake disc, hex washers and stainless steel pin.

6. Bend both ends of the pin to make a"z".

7. Tighten the brake caliper assembly and reinstall the threaded rod assembly (Fig. 3.5.2b).

8. Fill the final drive housing to the correct level with 10W30 API SE/CD oil (refer to section 3.1.5 for details). Capacity is 23 l.

9. Apply silicone to the inspection cover and install the inspection cover on the final drive housing.

10. Install the wheels. Torque the wheel nuts 100 - 110 ft. lbs. (135 - 149 N.M.).

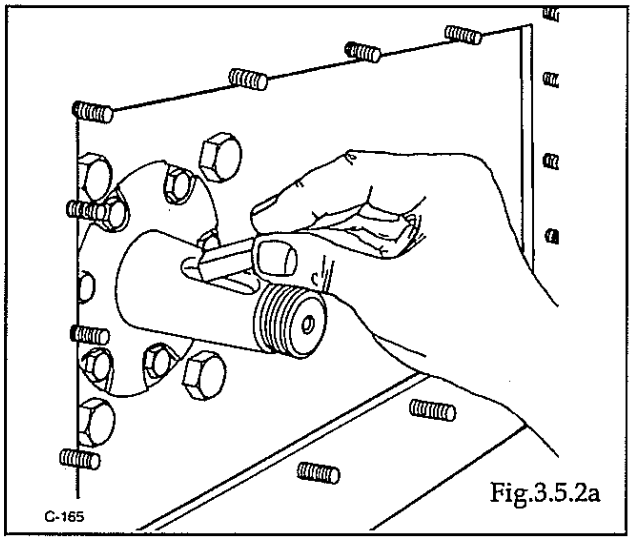
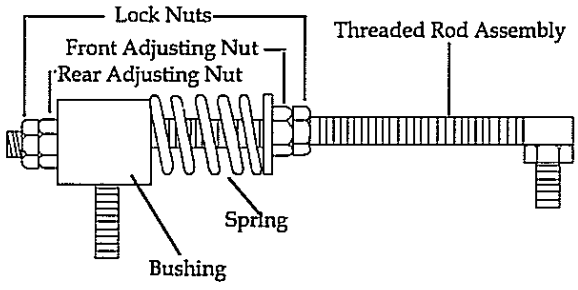


Fig.3.5.2a



C-057

Fig. 3.5.2b

IMPORTANT

To prevent damage after removal or repair of hydraulic components refer to start up procedure Section 1.2.6.

2.3.7 *TORQUE MOTOR - INSPECTION*

Clean all parts in a suitable solvent and blow dry with air. **Do not wipe clean with cloth or paper towels.**

> **WARNING** To avoid eye injury use safety goggles when cleaning with compressed air.

Do not use coarse grit or attempt to file or grind motor parts. Replace any parts that are scratched or have burrs that could cause leakage.

1. Inspect the geroler star (Fig. 2.3.7a) for wear or damage.

2. Inspect the geroler rollers (Fig. 2.3.7b) for wear or damage.

3. Inspect the valve plate (Fig. 2.3.7c & d) for scratches or wear.

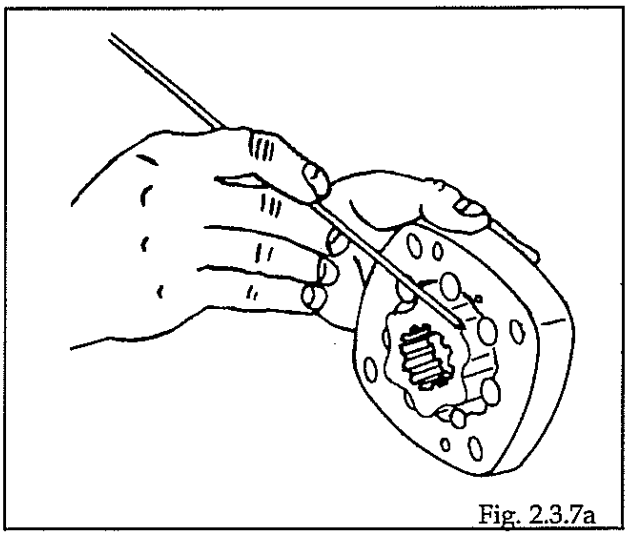


Fig. 2.3.7a

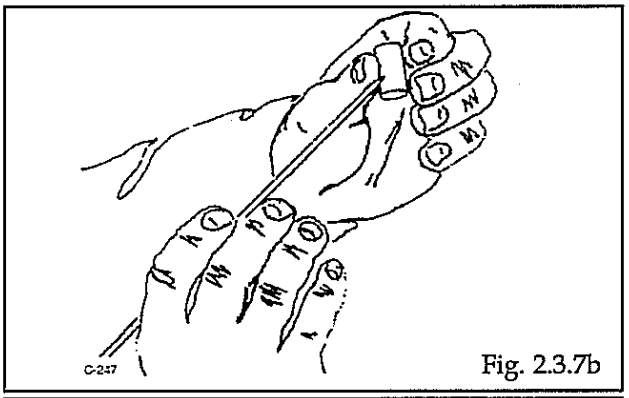


Fig. 2.3.7b

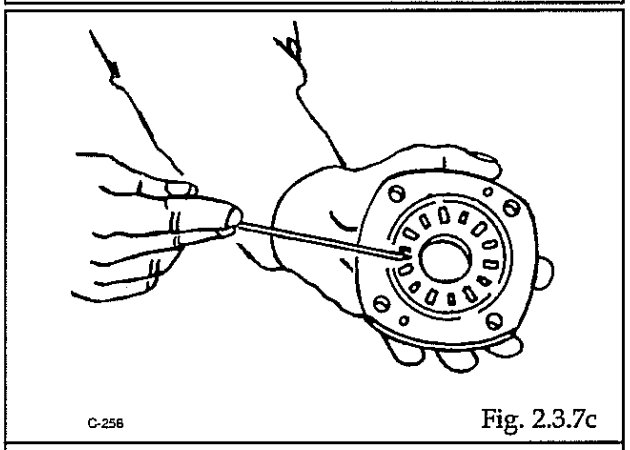


Fig. 2.3.7c

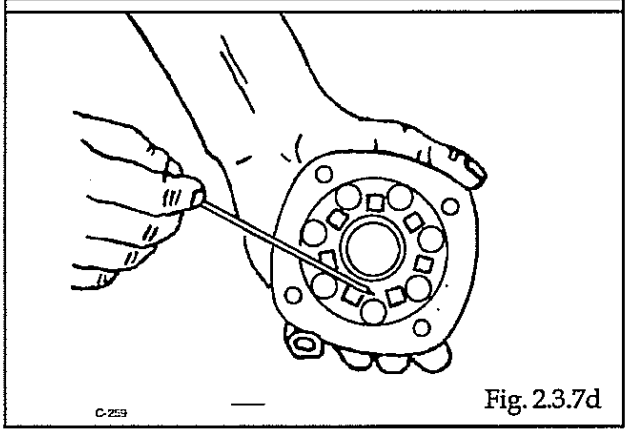


Fig. 2.3.7d

4. Inspect the balance plate for scratches or wear (Fig. 2.3.7e).

   Inspect the splines on the valve drive and geroler drive for wear.

   Inspect the keyway and chamfers on the output shaft for sharp edges or burrs which could damage the shaft seal.

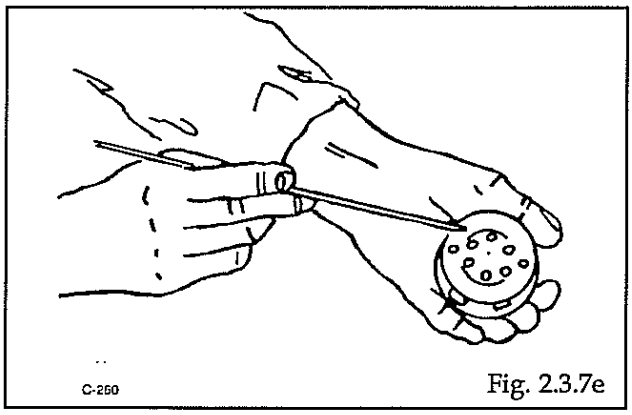


Fig. 2.3.7e

5. Inspect the valve (Fig. 2.3.7f & g) for scratches or wear.

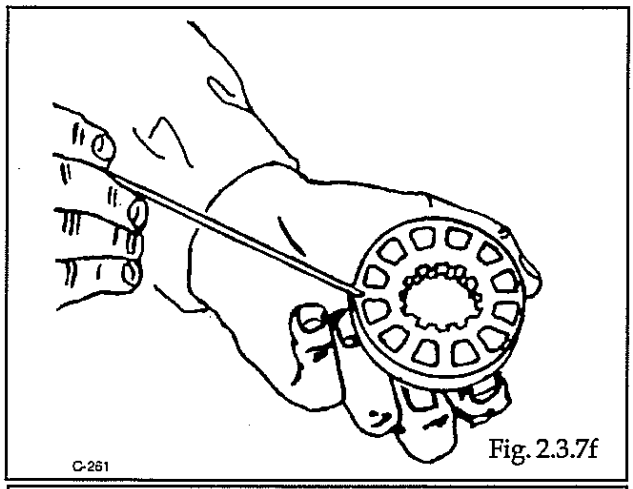


Fig. 2.3.7f

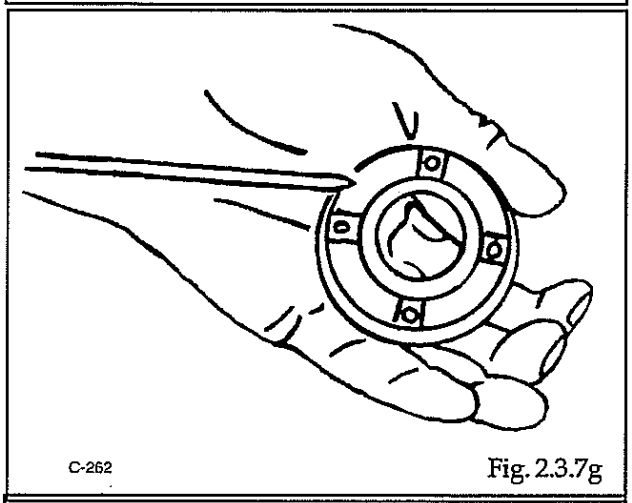


Fig. 2.3.7g

6. Inspect the face of the bearing housing (Fig. 2.3.7h) for scratches or wear.

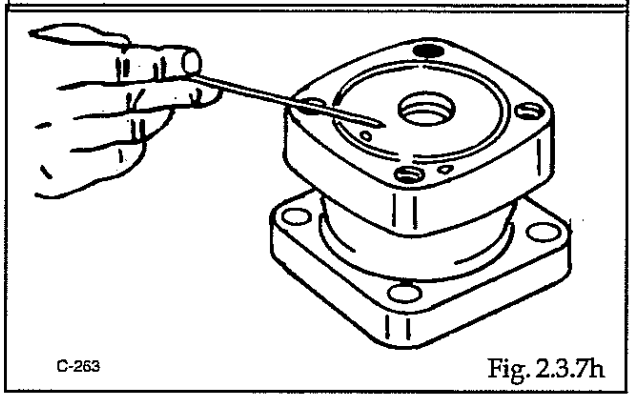


Fig. 2.3.7h

2.3.8 *TORQUE MOTOR ASSEMBLY*

Install new seals when reassembling the torque motor.

Lubricate all seals with petroleum jelly such as vaseline prior to assembly.

1. Install the shaft face seal in the bearing housing using a suitable tool to seat the seal.

   Place the bearing housing on a smooth, flat surface with the largest open end of the housing facing upward.

   Align the small I.D. end of the seal installation tube with the seal seat in the housing (Fig. 2.3.8a).
   Apply petroleum jelly to the shaft seal.

   Install the seal in the bore of the installation tube as shown in Fig. 2.3.8a.

   Insert the seal driver in the tube and push the shaft face seal with a rotating action until it is seated.

   Check for correct installation. A damaged shaft face seal will cause loss of internal lubrication and result in parts wear.

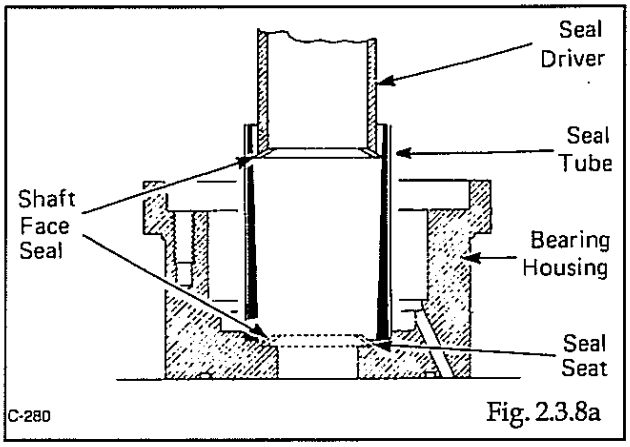


Fig. 2.3.8a

2. Install the shaft and bearing assembly in the housing (Fig. 2.3.8b). A press may be required to install the shaft and bearing assembly.

   Do not damage the shaft seal in the bore of the housing.

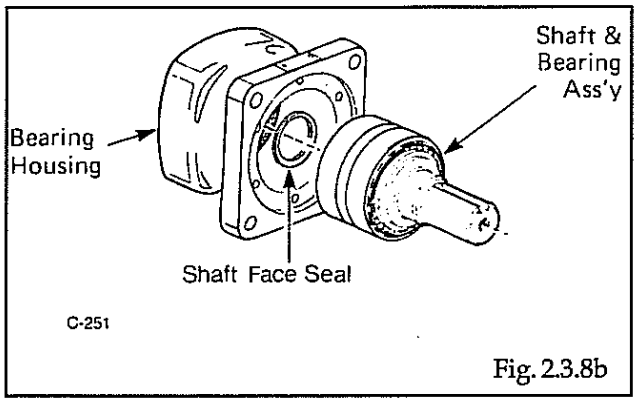


Fig. 2.3.8b

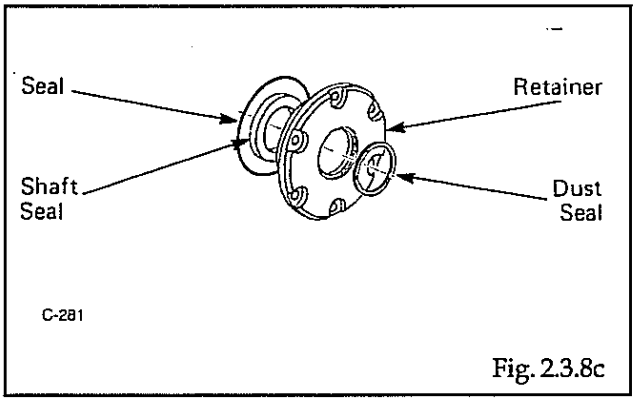


Fig. 2.3.8c

3. Install the dust seal in the retainer plate (Fig. 2.3.8c). The metal side of the dust seal must face upward.

4. Install the retainer seal in the shaft seal (Fig.2.3.8c). The smooth or flat side of the shaft seal must face toward the retainer (Fig. 2.3.8d).

5. Apply petroleum jelly to the inside diameter of both the dust seal and shaft seal.

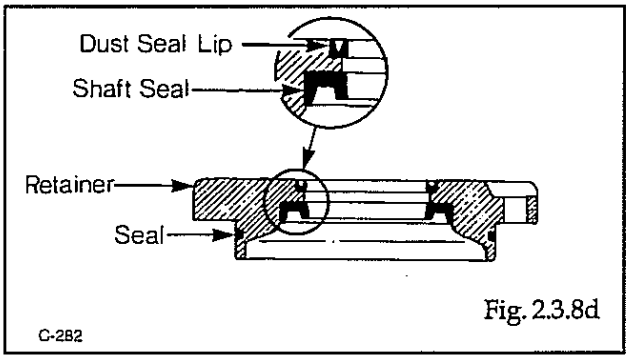


Fig. 2.3.8d

6. Install the retainer cover over the shaft with a twisting motion (Fig. 2.3.8e). Be careful not to distort or damage the shaft seal during assembly. Damage to the shaft seal will cause external leakage.

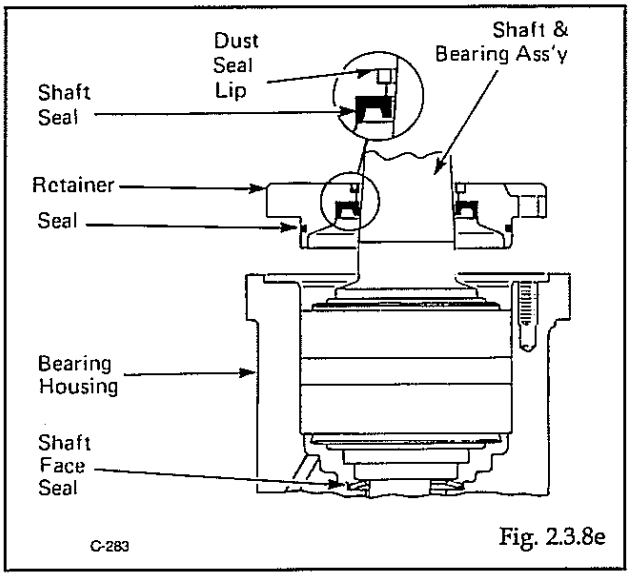


Fig. 2.3.8e

7. Lubricate the threads of the six (6) retainer cover bolts and turn them finger tight. Torque the bolts in sequence (Fig.2.3.8f) initially to 4 ft. lbs. (5.4 N.M.). Finally, torque the six (6) bolts in sequence to 25 ft. lbs. (33.9 N.M.).

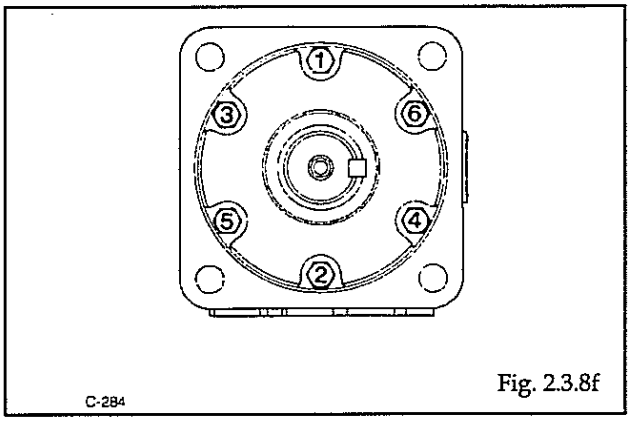


Fig. 2.3.8f

8. Reposition the bearing housing in a vice (Fig. 2.3.8g) clamping across the edge of the flange.

9. Pour a small amount of system oil inside the output shaft.

10. If available, install two (2) studs in the housing to assist in alignment of parts during assembly.

11. Apply a light film of petroleum jelly on the housing seal and install in the bearing housing.

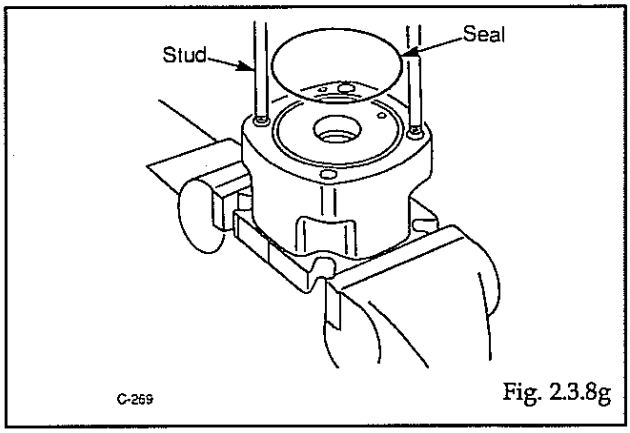


Fig. 2.3.8g

12. Install the geroler drive in the bearing housing (Fig. 2.3.8h). Install the longer splined end of the shaft into the bearing housing.

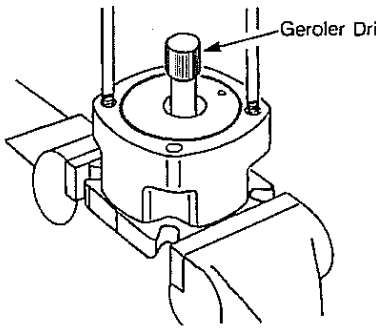


Fig. 2.3.8h

13. Apply petroleum jelly to the two (2) case drain seals and install them on both sides of the geroler assembly (Fig. 2.3.8i) in the case drain hole grooves.

14. Align the case drain hole and pressure relief valve in the geroler assembly with the case drain hole and pressure relief valve hole in the bearing housing. Install the geroler assembly on the bearing housing.

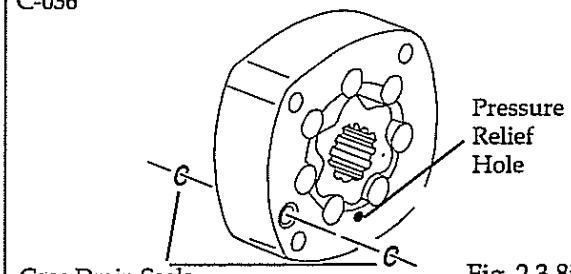


Fig. 2.3.8i

15. *Timing Step No. 1*
Locate the largest open pocket in the geroler (Fig. 2.3.8j). Mark the location of the pocket on the outside edge of the geroler.

16. Install the valve drive in the geroler.

17. Apply a light film of petroleum jelly on the valve plate seal. Install the valve plate seal in the valve plate.

18. Align the case drain hole in the valve plate with the case drain hole in the geroler. Install the valve plate (seal side toward geroler) on the geroler assembly.

19. *Timing Step No. 2*
Locate the slot opening in the valve plate which is in line with the largest open pocket of the geroler (Fig. 2.3.8j).

20. *Timing Step No. 3*
Install the valve on the valve plate. Locate any one of the side openings of the valve that goes through to the face of the valve (Fig. 2.3.8j). Line up this side opening with the open slot of the valve plate that is in line with the largest open pocket of the generator.

Rotate the valve clockwise (1/2 spline tooth) to engage the spline teeth of the valve drive.

IMPORTANT To ensure the correct shaft rotation the torque motor must be timed. Refer to instructions.

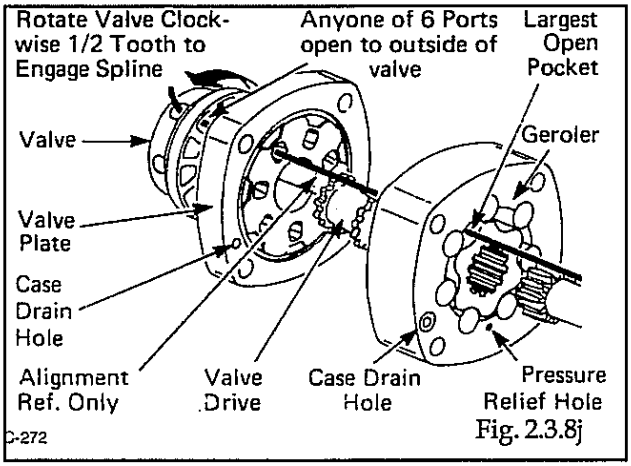


Fig. 2.3.8j

When timed correctly the motor will rotate when pressurized as shown in Fig. 2.3.8k.

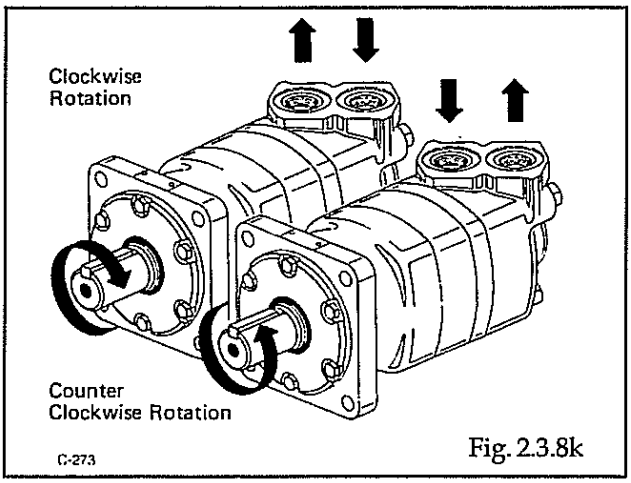


Fig. 2.3.8k

21. Apply clean grease on the three (3) balance ring assembly springs. Install the three (3) springs in the holes located inside the bore of the valve housing (Fig. 2.3.8l).

22. Apply a light film of petroleum jelly on the case drain seal. Install the seal in the in the case drain seal groove on the valve housing.

23. Apply a light film of petroleum jelly on the valve housing seal. Install the seal in groove on the valve housing.

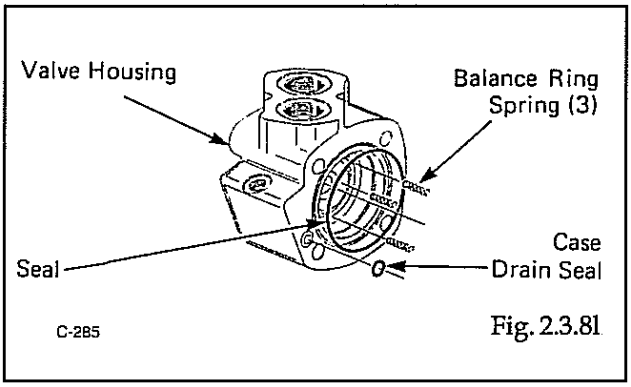


Fig. 2.3.8l

24. Apply petroleum jelly to both the outer and inner face seals. Install the face seals on the balance ring (Fig. 2.3.8m).

IMPORTANT The face seals must be installed as shown on Fig.2.3.8m or the motor will not operate.

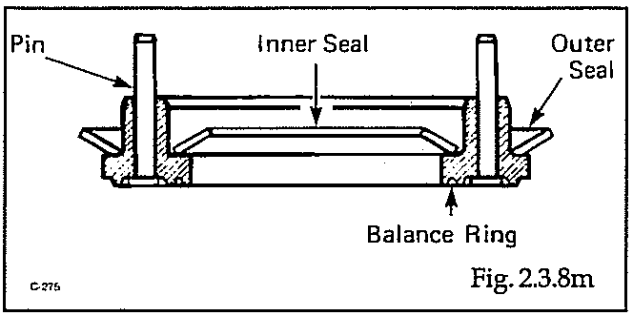


Fig. 2.3.8m

25. Align the balance ring pins with the two (2) holes in the valve housing. Install the balance ring in the valve housing.

26. Insert your finger through the port of the valve housing (Fig. 2.3.8n). Apply pressure to the side of the balance ring assembly to hold it in place while the valve housing is being installed

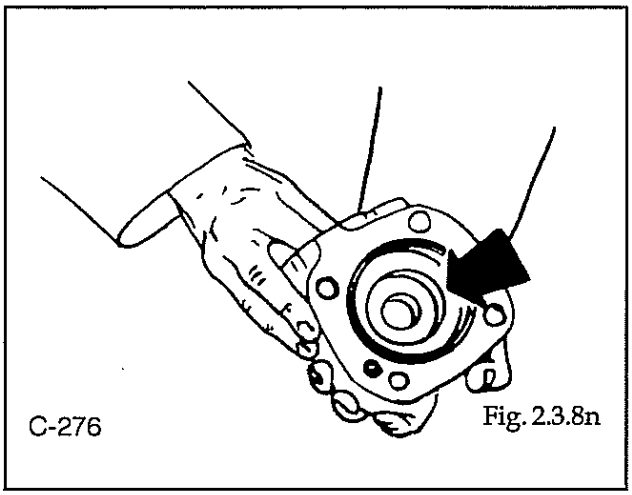


Fig. 2.3.8n

27. Align the case drain hole in the valve housing with the case drain hole in the valve plate (Fig. 2.3.8o). Install the valve housing on the valve plate.

IMPORTANT After installing the valve housing check between the body parts for unseated seals.

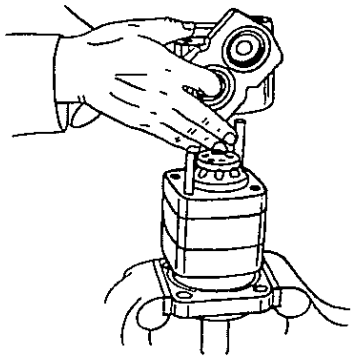


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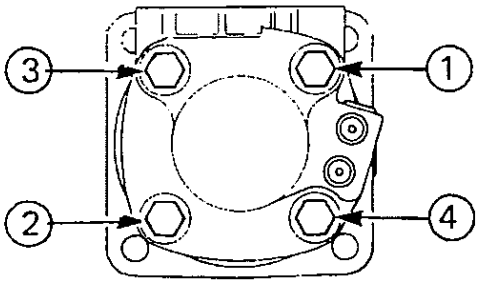
Fig. 2.3.8o

28. Install the four (4) bolts and tighten finger tight. Torque the bolts in sequence(Fig. 2.3.8p) to 62.5 ft. lbs. (84.7 N.M.).

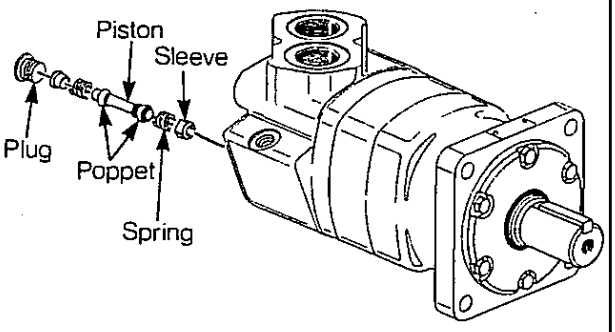


C-286

Fig. 2.3.8p

29. Install the shuttle valve assembly in the valve housing (Fig. 2.3.8q).

IMPORTANT For correct motor operation the shuttle valve must be installed in the correct sequence.



C-279

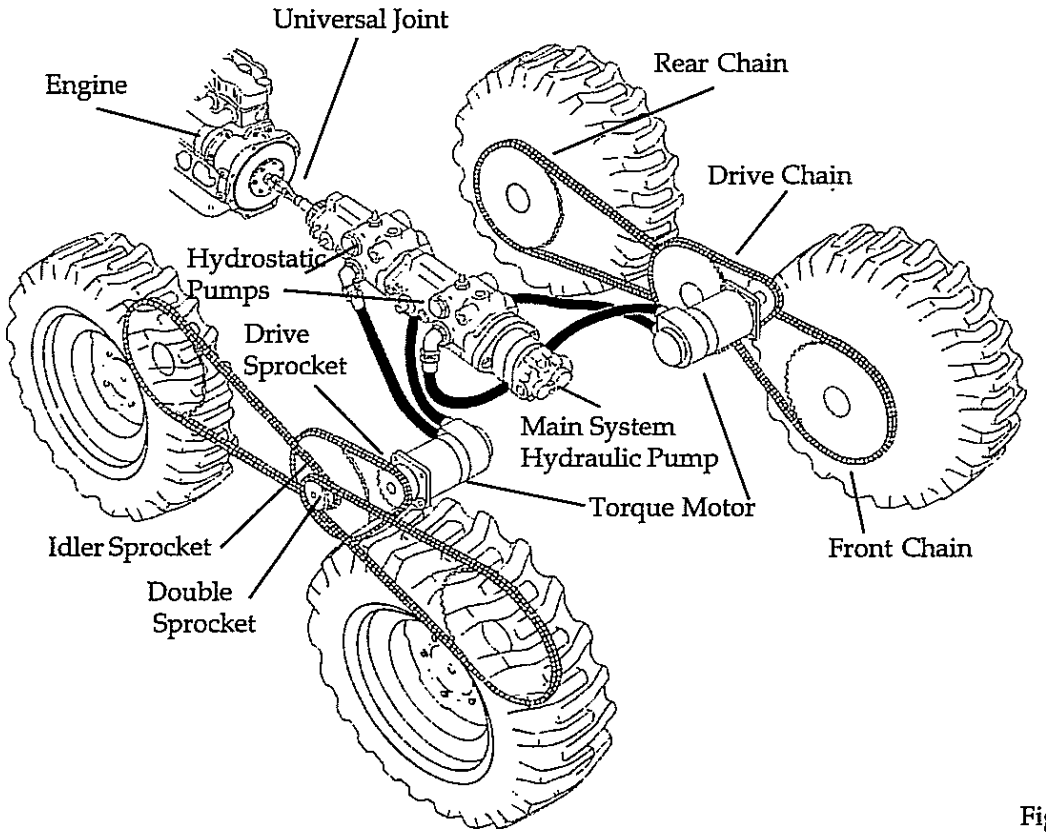
Fig. 2.3.8q

2.4 TROUBLESHOOTING - HYDROSTATIC DRIVE SYSTEM

PROBLEM	CAUSE	CORRECTIVE ACTION	SECTION
Loss of drive power on one side - both directions	Reservoir low on oil	Check for leaks. Fill reservoir with 10W30 API, SE/CD oil	1.7.3
	Disconnected steering control linkage	Reconnect and adjust steering control linkage	4.1
	Groove pin sheared on pump pintle lever	Replace. Check pintle lever for loose bolt or excessive play	4.1
	High pressure line failure	Replace line. Check motor and pump mounting bolts	2.3
	Drive chain failure	Inspect chain and connection link. Replace damaged parts.	3
	Drive motor shaft failure and/or coupler	Inspect and repair defective parts. Check motor mounting bolts	2.3.5
	Charge pump failure	Inspect and repair defective parts. Drive may Intially appear to be lost on one side only but after a few moments running will be lost on both sides.	2.2.8
	Excessive internal leakage or damage in pump and/or drive motor	Inspect and repair defective unit. Flush all lines and reservoir. Replace filter. Check on type of fluid used and engine RPM	2.2.7 2.3.5
Loss of drive power on one side - one direction only	Defective pump relief valve	Replace defective relief valve	2.2.5
	Damaged pump ball check	Disassemble pump and repair	2.2.6
Loss of drive power - both sides (also loss of hydraulic power)	Reservoir low on fluid	Check for leaks. Fill the reservoir with 10W30 API SE/CD oil	1.7.3
	Gear Pump failure or Coupler Relief Defective	Inspect and repair defective parts.	
	Input Shaft (U-Joint) Failure	Inspect and replace defective parts.	

SECTION 3
Final Drive

3.1 FINAL DRIVE



C-059

Fig. 3.1

3.1.1 SPECIFICATIONS

		T173 HLSII
Chain size	primary	ASA 80
	front axle	ASA 100
	rear axle	ASA 100
Lubricating Oil		10W30 API SE/CD
Capacity (per housing)		5.06 gals (23l)
Approved Chain Manufacturer		TSUBAKI

Torque Specifications

Hydrostatic Motor
Mounting Nuts.....80 - 85 ft. lbs. (109 - 115 N.M.)
Idler Flange Nuts.....40 - 45 ft. lbs. (54 - 61 N.M.)
Wheel Nuts.....100 - 110 ft. lbs. (136 - 149 N.M.)
Mounting Studs.....40 ft. lbs. (54 N.M.)
Tire Pressure

10.00 X 16.5	30 - 35 PSI (207 - 241 KPa)
12.00 X 16.5	30 - 35 PSI (207 - 241 KPa)

3.1.2 MAINTENANCE SCHEDULE

	Initial Check (Hours)	Check Every (Hours)
Tire Pressure	8	8
Wheel Nut Torque	8	8
Lubricating Oil	50	150 (1)
Chain Tension	50	150
Axle Bearing Preload	50	150
Motor Mounting Nuts	50	150
Idler Flange Nuts	50	

3.1.3 *LUBRICATING OIL - LEVEL CHECK*

The loader has two (2) independent final drive housings. Check the lubricating oil level with the loader on a level surface. Remove the check plug (Fig. 3.1.3a) located between the two (2) tires to determine the oil level. The oil level should be checked after 50 operating hours and every 150 hours thereafter. It is recommended the oil be changed after 1000 operating hours of if it shows signs of contamination, or if any major components have been repaired.To drain the final drive lubricating oil place the loader on a level surface. Remove the oil drain plug (Fig.3.1.4a) located between the two (2) tires. Remove the filler cap. Fill with 10W30 API SE/CD Classification engine oil up to the oil check plug level.

Total Capacity per final drive housing: 5.06 gals/23 l

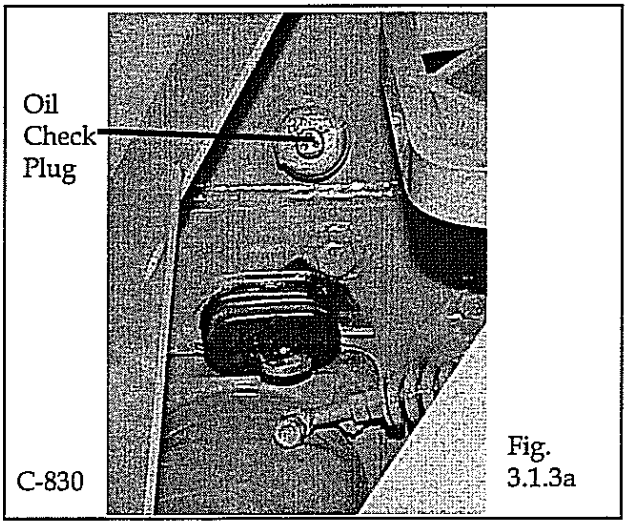


Fig. 3.1.3a

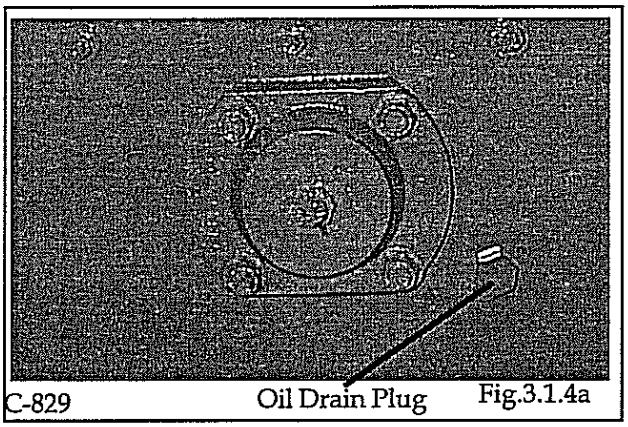


Fig.3.1.4a

3.2 *DRIVE CHAIN*

3.2.1 *CHAIN INSPECTION*

The drive chains should be inspected for wear or damage after the first 50 hours of operation and every 150 hours thereafter or at any time the final drive inspection cover is removed. If the chain shows any sign of wear or damage replace it. Inspect as follows:

1. Inspect the chain for excessive roller wear.

2. Inspect the chain for excessive wear on the link plates

3. Inspect the connection link cotter pins for wear or damage caused by interference.

4. Check the sprockets for excessive wear or damage.

Damage - broken teeth, sharp or rounded teeth, out of round center holes caused by loose or broken bearings

5. If the chain has been removed from the loader check for stiffness caused by wear between the pins and bushings.

6. If the chain is removed from the loader check that when laid out it runs straight and not to one side indicating misalignment.

3.2.2 *PRIMARY CHAIN - REPLACEMENT*

Removal

1. Block the loader securely with the wheels clear of the ground.

2. Remove the wheels. On reassembly torque the wheel nuts 100 - 110 ft. lbs. (136 - 149 N.M.).

3. Remove the inspection cover and cover plate from the final drive housing.

4. With the throttle control lever in the OFF position and the steering control lever in full forward position, turn the engine over with the starter motor revolving the chain until the primary connection link is visible (Fig. 3.2.2).

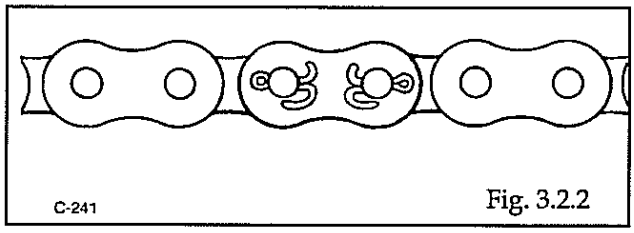


Fig. 3.2.2

WARNING Keep hands and clothing clear of the chain.

5. Remove brake threaded rod assembly from brake caliper lever.

See Section 4.5 for replacement and adjustment.

6. Loosen the brake caliper assembly.

7. Remove the "z" pin from the end of the torque motor shaft.

8. Remove the three (3) hex washers and brake disc.

9. Disconnect the connection link and remove the primary chain.

   On reassembly use a new connection link and cotter pins.

Replacement

1. Using a piece of wire attached to the chain as a guide, install the primary chain around the idle sprocket.

2. Install the chain around the drive sprocket.

3. Install a new connection link with the cotter pins on the back side of the chain toward the small inspection cover.

4. Replace the brake disc.

See Section 4.5 for replacement and adjustment.

3.2.3 *FRONT AXLE CHAIN - REPLACEMENT*

Removal

1. By turning the axle, revolve the chain until the connection link is visible.

2. Remove the connection link and front axle chain from the final drive housing.

   On reassembly install a new connector link and cotter pins.

Replacement

1. Using a piece of wire attached to the chain as a guide, feed the front axle chain over the top of the axle sprocket and under the idler sprocket (Fig. 3.2.3a).

   NOTE: The front chain must be installed to the front side of the final drive housing towards the inspection cover.

2. Install a new connection link and cotter pins.

   Install the connection link with the cotter pins facing the outside or inspection cover side of the chain.

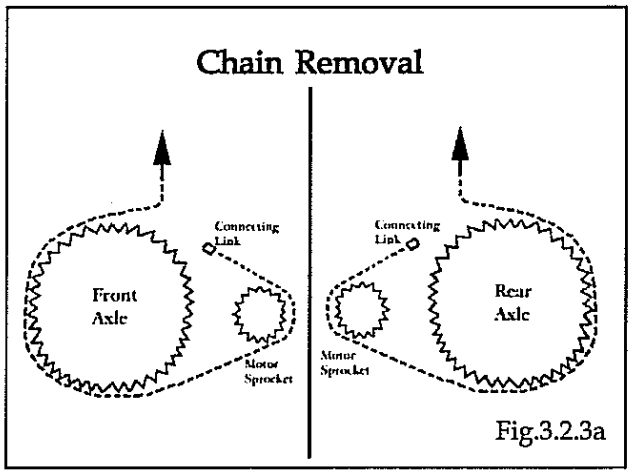


Fig.3.2.3a

3.2.4 *REAR AXLE CHAIN - REPLACEMENT*

Removal

1. By turning the axle, revolve the chain until the connection link is visible.

2. Remove the connection link and the rear axle chain from the final drive housing.

   On reassembly install a new connection link and cotter pins.

Replacement

1. Using a piece of wire attached to the chain as a guide, feed the chain over the top of the rear axle sprocket and under the idler sprocket (Fig. 3.2.4a).

NOTE: The rear chain must be mounted on the centre idler sprocket between the front and primary sprockets

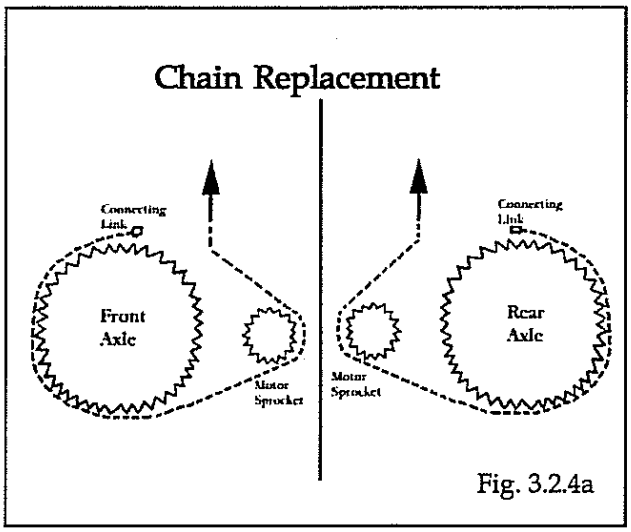
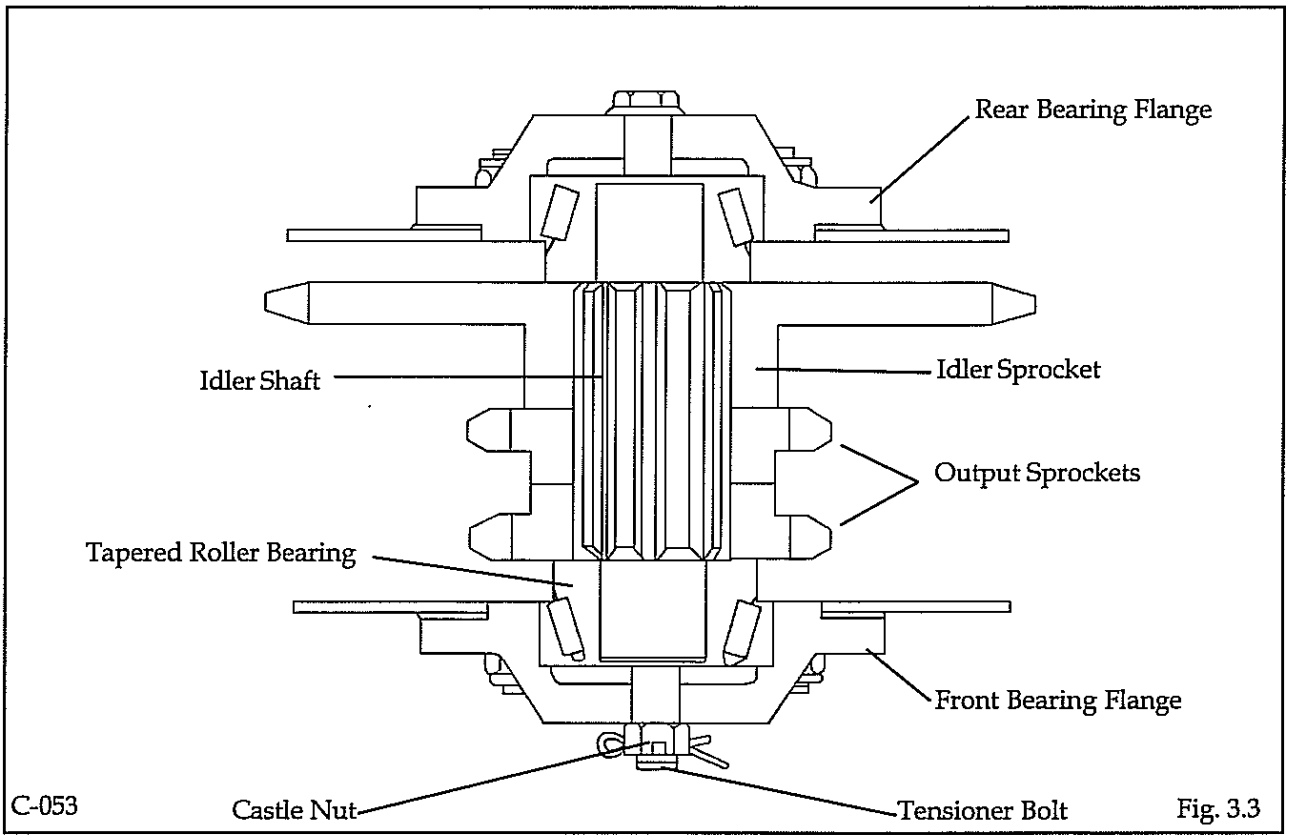


Fig. 3.2.4a

2. Install a new connection link and cotter pins. Install the connector link so the cotter pins are on the backside of the chain.

3.3 *IDLER SPROCKET AND SHAFT*



3.3.1 *BEARING PRELOAD - ADJUSTMENT*

1. Block the loader securely with the wheels clear of the ground.

2. Remove the wheels. On reassembly torque the wheel nuts 100 - 110 ft. lbs. (136 - 149 N.M.).

3. Remove the final drive coverplate located between the two (2) axles.

   On reassembly apply silicone sealer to the inspection cover to prevent leakage.

4. Rock the idler sprocket to determine if there is any play in the idler shaft (Fig. 3.3).

5. If play is detected, remove the cotter pin from the castle nut on the end of the tensioner bolt. (Fig. 3.3).

6. Place a screwdriver in the slot on the end of the tensioner bolt (3.3) and tighten the castle nut until there is no play in the idler sprocket shaft.

⚠ CAUTION

The idler sprocket will slide back and forth approx. a 16th in. on the idler shaft and should not be confused with idler shaft play.

7. Install a new cotter pin on the castle nut.

3.3.2 *IDLER SPROCKET AND SHAFT - REMOVAL*

1. Remove any attachment, raise the boom arms and engage the boom supports. Shut off the engine.

> **WARNING** Do not work on a loader with the boom arms raised unless the boom supports are engaged.

2. Block the loader securely with the wheels clear of the ground.

3. Remove the wheels. On reassembly torque the wheel nuts 100 - 110 ft. lbs. (136 - 149 N.M.).

4. Remove the final drive coverplate located between the two (2) axles.

   On reassembly apply silicone sealer to the inspection cover to prevent leakage.

5. Drain the lubricating oil from the final drive housing (see section 3.1.4).

6. Remove the primary chain (refer to section 3.2.3).

7. Remove the cotter pin, castle nut and tensioner bolt (Fig. 3.3.2a).

8. Remove the front and rear flanges from the housing (fig. 3.3.2a).

9. Using a brass drift, drive the splined output shaft through the idler sprocket and double axle sprocket.

   Remove the splined shaft as it is driven out the back side of the final drive housing (Fig. 3.3.2b).

NOTE: The rear bearing will remain with the splined output sprocket during removal.

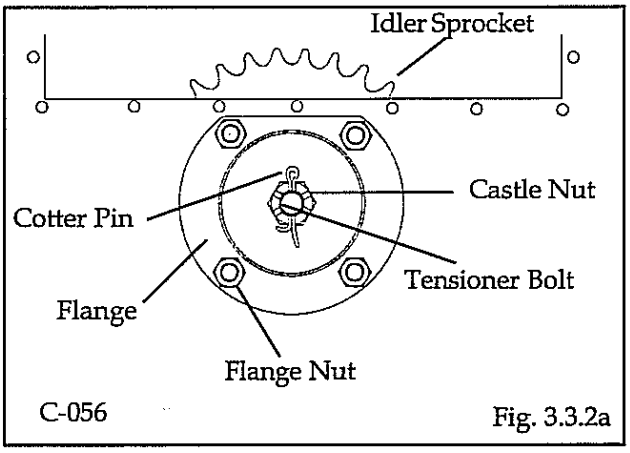


Fig. 3.3.2a

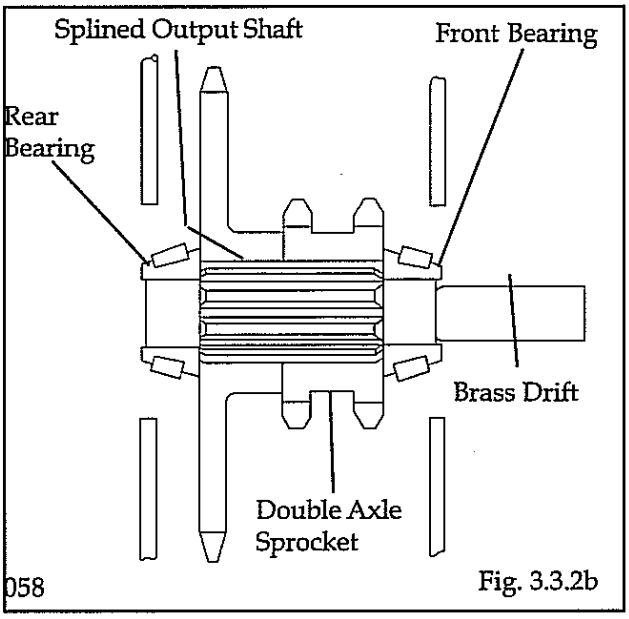
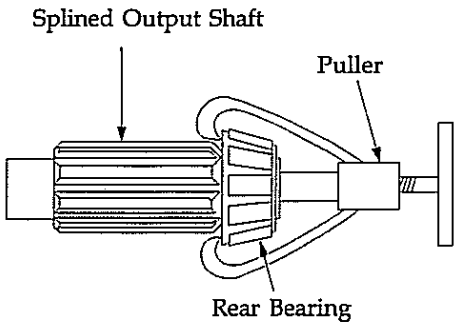


Fig. 3.3.2b

10. Disconnect the front and rear axle drive chains, remove the double axle sprocket and front bearing from the final drive housing.

11. Remove the idler sprocket from the final drive housing.

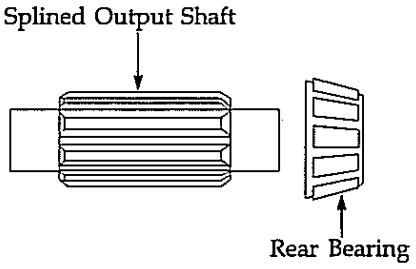
12. Using a proper puller, remove the rear bearing from the splined output shaft (Fig. 3.3.2c).



C-051 Fig. 3.3.2c

3.3.3 *IDLER SPROCKET AND SHAFT - INSTALLATION*

1. Using a suitable driver install the rear bearing on bearing surface of the splined output shaft (Fig. 3.3.3a).



C-052 Fig. 3.3.3a

2. Lubricate the parts and mount the double axle sprocket and idler on the splined output shaft (Fig. 3.3.3b).

3. Install the rear flange and torque the mounting nuts 45 - 55 ft. lbs. (61 - 75 N.M.).

   Apply silicone sealant to the rear flange to prevent leakage.

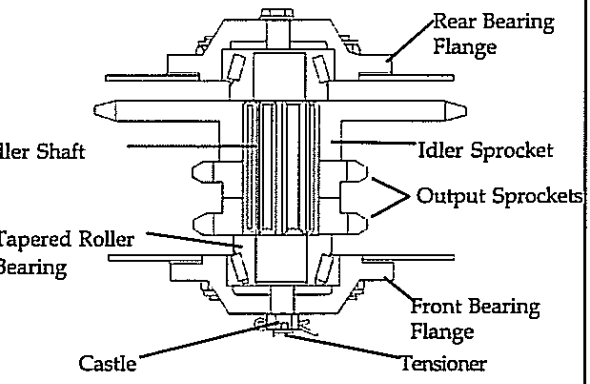
   Install new nylock nuts on the flange during assembly.

4. Using a suitable driver install the front bearing on the splined shaft.

5. Install the front flange on the final drive housing.

   Apply silicone sealant to the flange to prevent leakage.

   Install new nylock nuts to the flange studs. Start but do not tighten the flanged nuts until the axle drive chains are connected.



C-053 Fig. 3.3.3b

6. Reconnect the axle drive chain on the double axle sprocket (refer to section 3.2.4 and 3.2.5).

7. Reconnect the primary chain (see section 3.2.3).

8. Torque the flanged nuts 45 - 55 ft. lbs. (61 - 75 N.M.).

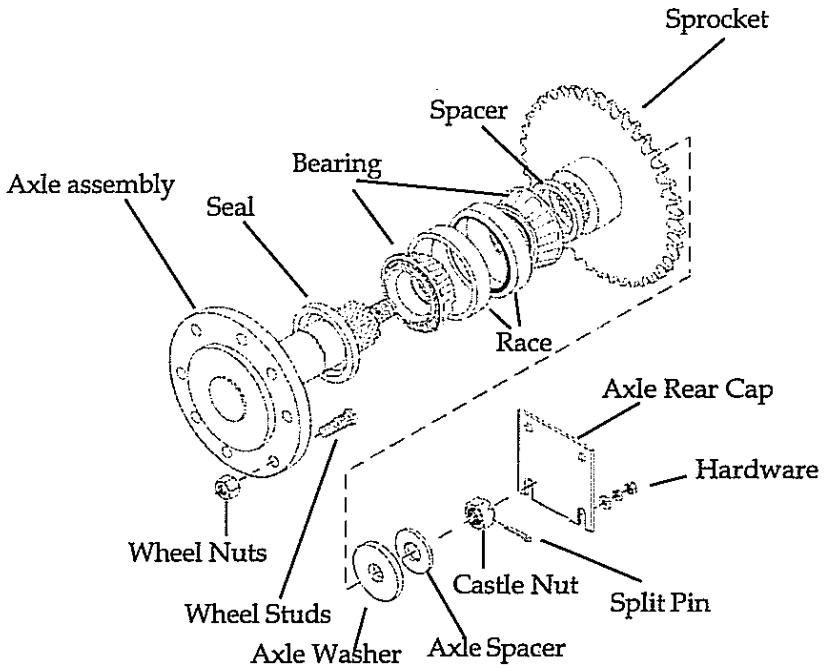
9. Install the tensioner bolt and castle nut and preload the bearing to remove all end play (refer to section 3.3.1).

10. Install a new cotter pin on the castle nut.

11. Refill the final drive housing with lubricating oil (see section 3.1.5) and reinstall the coverplate.

12. Apply silicone sealant to he coverplate to prevent leakage.

3.4 *AXLE ASSEMBLY*



C-048

Fig. 3.4

3.4.1 AXLE REMOVAL

1. Remove any attachment, raise the boom arms and engage the boom supports. Shut off the engine.

WARNING Do not work on a loader with the boom arms raised unless the boom supports are engaged.

2. Block the loader securely with all four (4) wheels clear of the ground.

3. Remove the wheels on the side of the loader that the axle is to be removed from.

   On reassembly torque the wheel nuts to 100 - 110 ft. lbs. (135 - 149 N.M.).

4. Drain the lubricating oil from the final drive housing (see section 3.1.4). Total housing capacity is 23 l.

5. Remove the final drive inspection cover located between the two (2) axles.

6. Remove the drive chain from the final drive housing (refer to section 3.2.4).

7. Remove the axle cover plate (Fig. 3.4.1a) from the inside of the final drive housing.

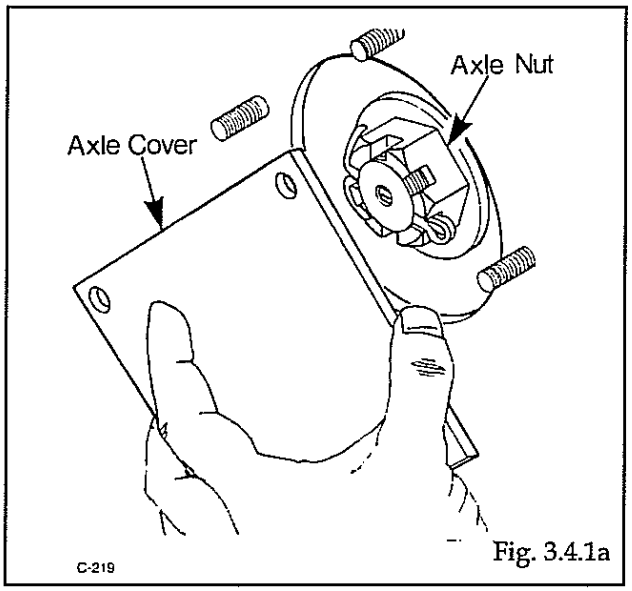


Fig. 3.4.1a

8. Remove the cotter pin from the castle nut on the end of the axle (Fig. 3.4.1b).

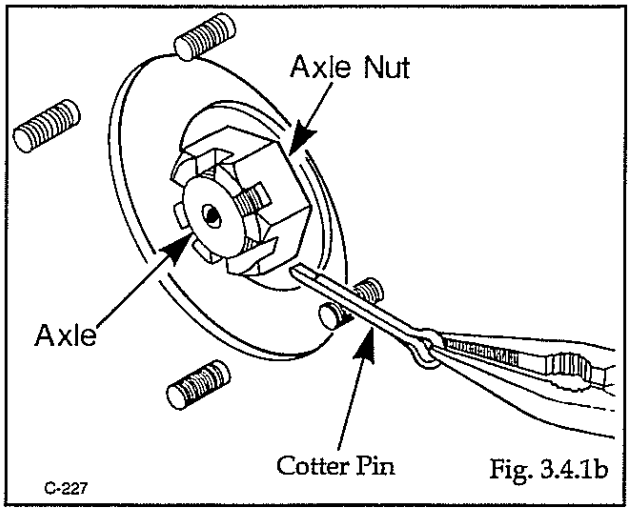


Fig. 3.4.1b

9. Remove the rear castle nut, axle washers and spacer (Fig. 3.4.1c).

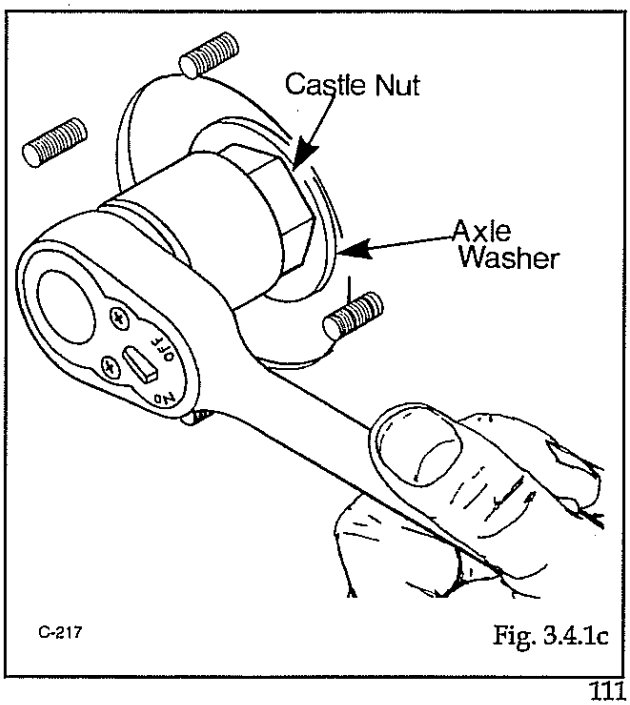


Fig. 3.4.1c

10. Attach the special tool TH957372 to the axle flange (Fig. 3.4.1d).

11. Using the special axle puller tool (sliding hammer) remove the rear bearing from the end of the axle. The rear bearing and axle sprocket will remain inside the final drive housing.

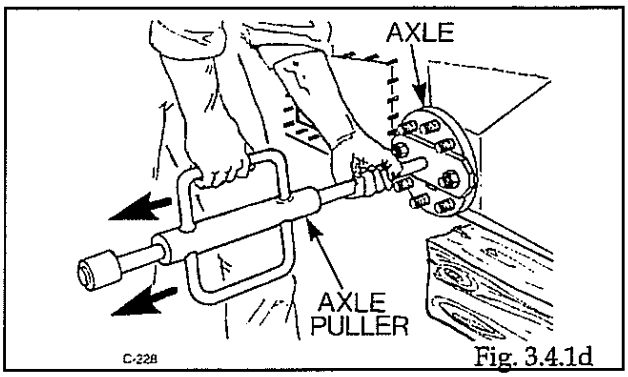


Fig. 3.4.1d

12. Remove the axle assembly from the final drive housing (Fig. 3.4.1e).

13. Remove the axle sprocket and rear bearing from the final drive housing through the inspection cover.

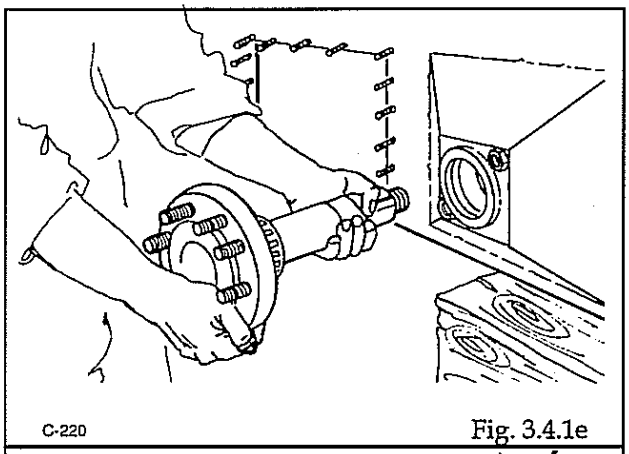


Fig. 3.4.1e

14. Using a bearing puller remove the axle bearing (Fig. 3.4.1f) from the axle.

15. Remove and discard the axle oil seal.

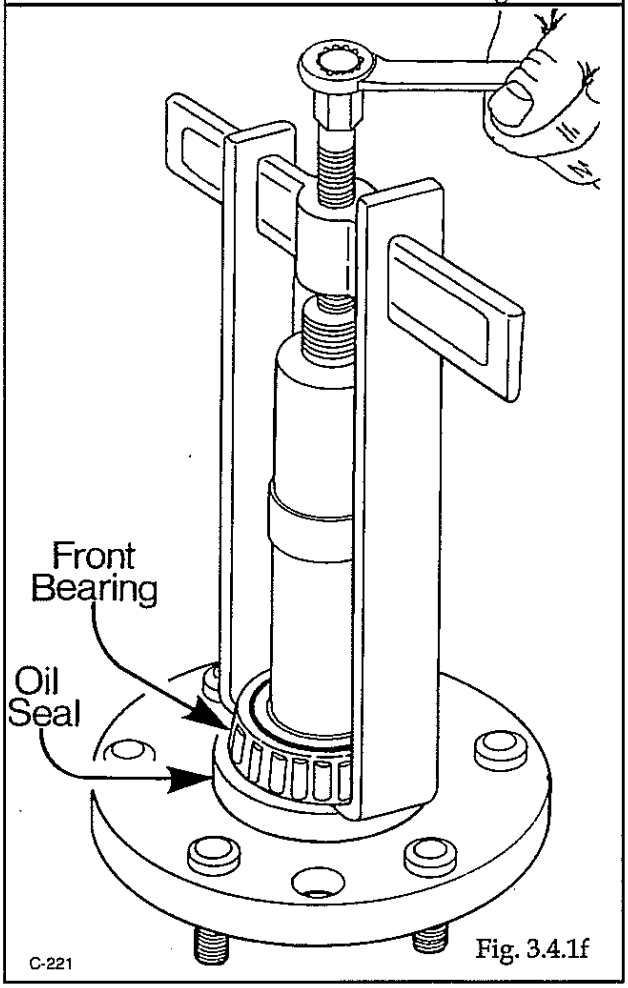


Fig. 3.4.1f

3.4.2 *AXLE INSTALLATION*

1. Lubricate the axle oil seal and install it on the seal surface of the axle. The seal part number stamped on the face of the seal must face the flange end of the axle (Fig. 3.4.2a).

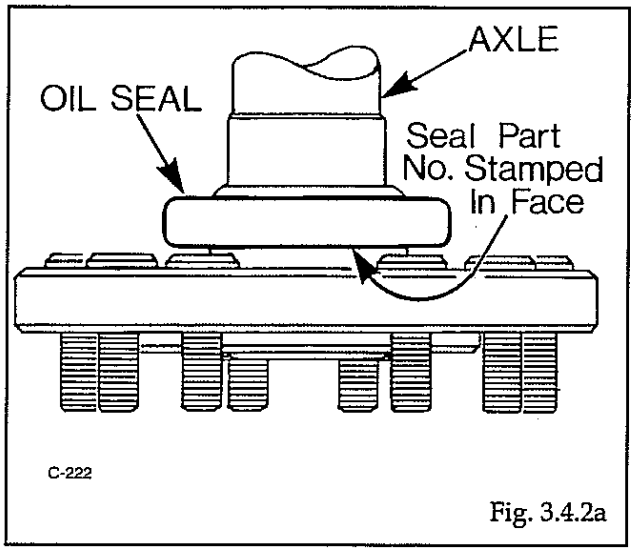


Fig. 3.4.2a

2. Using a bearing heater, heat the front axle bearing and press it on the axle (Fig. 3.4.2b). Be sure the bearing is seated.

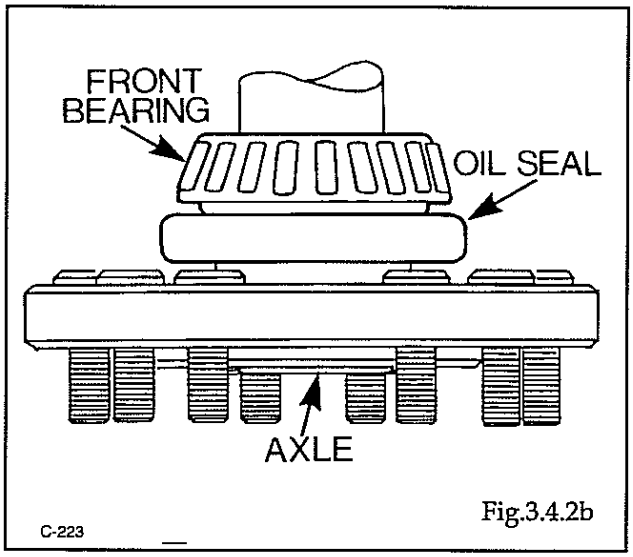


Fig.3.4.2b

3. Place two (2) seal installation tools (special tools TH957189) on the axle flange (Fig. 3.4.2c).

   The seal installation tools will properly seat the axle seal in the final drive housing as the axle is installed.

4. Apply gasket shelac to seal housing area. Do not get any around the bearing surface.

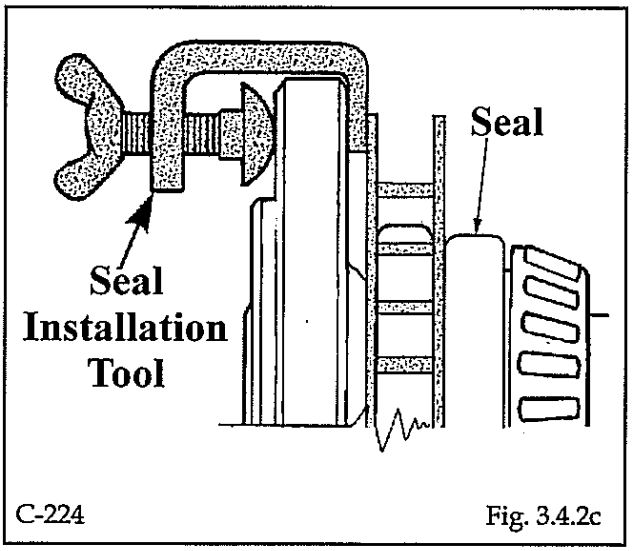


Fig. 3.4.2c

5. Install the axle in the final drive housing (Fig. 3.4.2d).

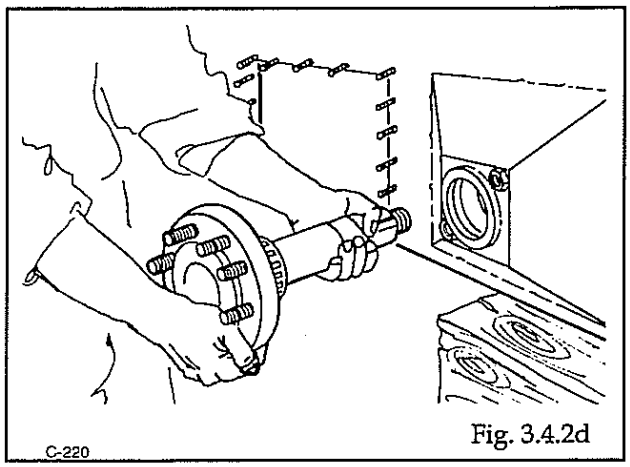


Fig. 3.4.2d

6. Reach in through the inspection opening and install the rear axle bearing on the axle (Fig. 3.4.2e). Line the bearing up with the bearing seat on the axle.

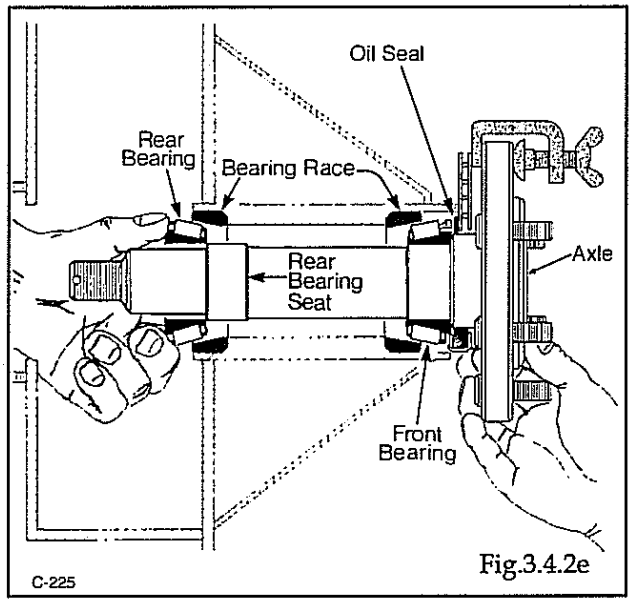
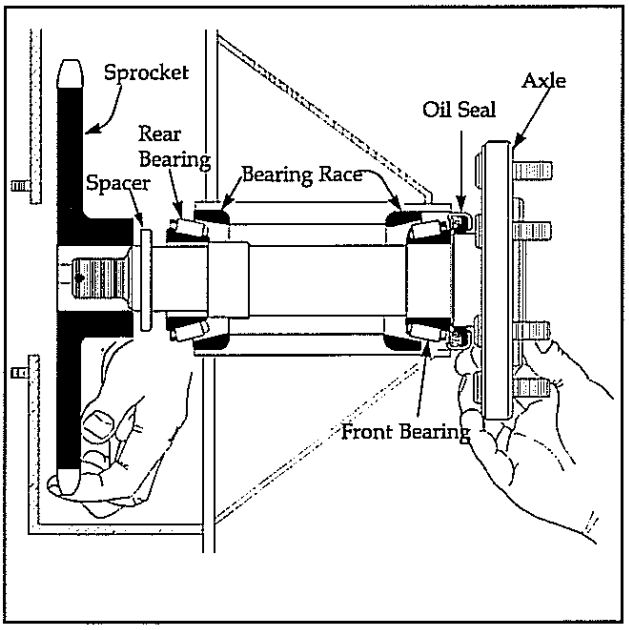


Fig.3.4.2e

7. Reach in through the inspection opening and install the axle sprocket on the axle (Fig. 3.4.2f). Make sure the sprocket starts on the axle. The hub end of the sprocket must face the flanged end of the axle.



3.4.2 *AXLE INSTALLATION*

1. Lubricate the axle oil seal and install it on the seal surface of the axle. The seal part number stamped on the face of the seal must face the flange end of the axle (Fig. 3.4.2a).

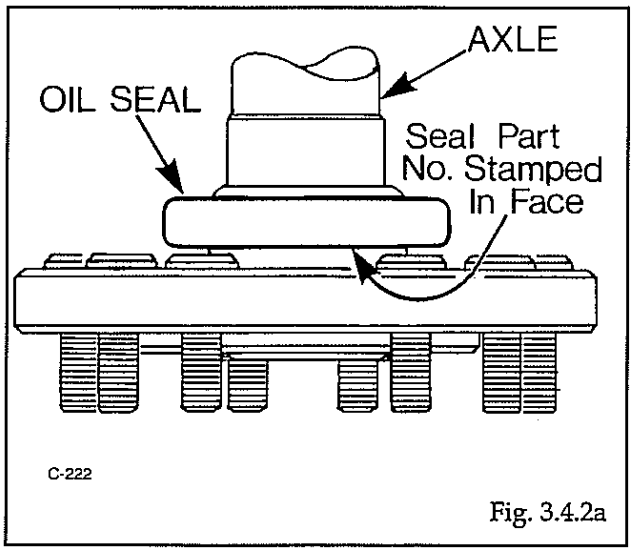


Fig. 3.4.2a

2. Using a bearing heater, heat the front axle bearing and press it on the axle (Fig. 3.4.2b). Be sure the bearing is seated.

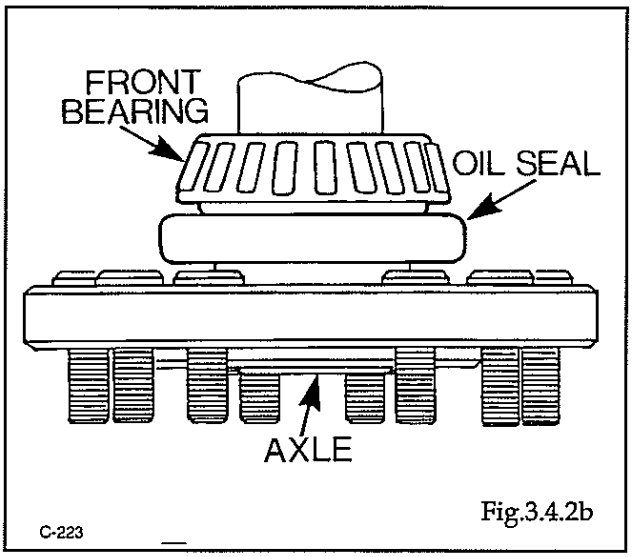


Fig.3.4.2b

3. Place two (2) seal installation tools (special tools TH957189) on the axle flange (Fig. 3.4.2c).

   The seal installation tools will properly seat the axle seal in the final drive housing as the axle is installed.

4. Apply gasket shelac to seal housing area. Do not get any around the bearing surface.

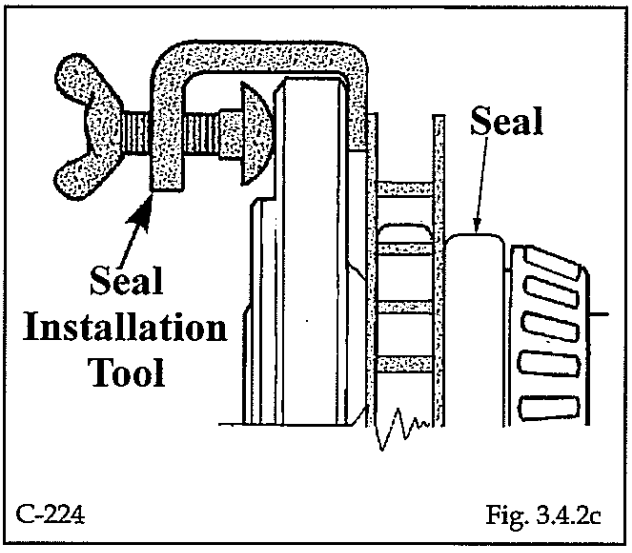


Fig. 3.4.2c

8. Install the axle spacer and castle nut (Fig. 3.4.2g).

9. While tapping in on the axle tighten the castle nut until the installation tools are touching the front of the housing.

10. Remove the seal installation tools from the axle.

    The axle seal should be flush with the final drive housing.

11. Install the axle spacer, axle washers as required and castle nut and preload the axle bearings to zero (0) end play (Fig. 3.4.2g). Keep tightening until you can hardly turn the axle with one hand

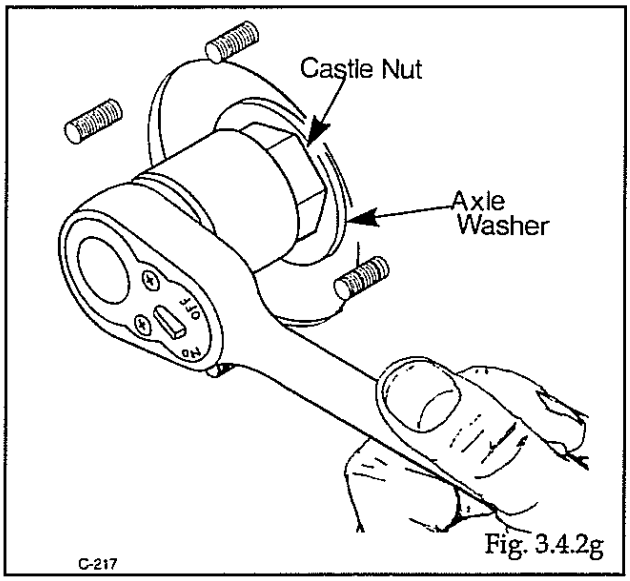


Fig. 3.4.2g

12. Install the cotter pin through the castle nut (Fig. 3.4.2i).

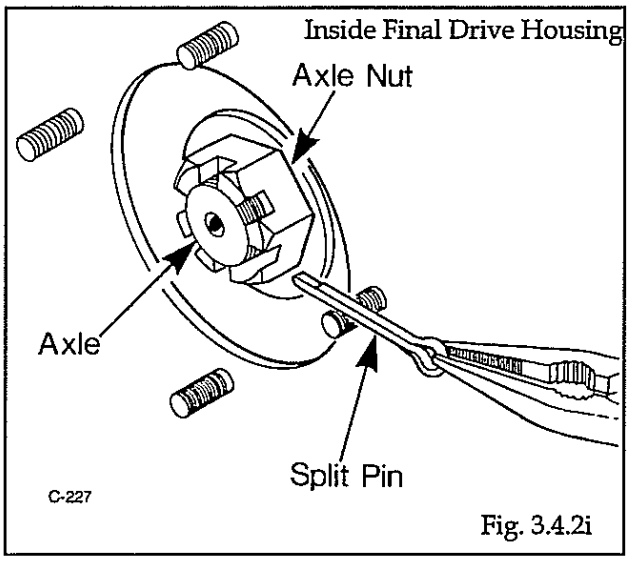


Fig. 3.4.2i

5. Install the axle in the final drive housing (Fig. 3.4.2d).

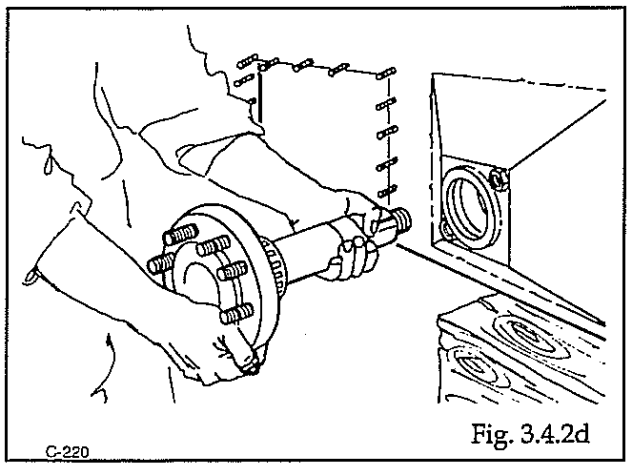


Fig. 3.4.2d

6. Reach in through the inspection opening and install the rear axle bearing on the axle (Fig. 3.4.2e). Line the bearing up with the bearing seat on the axle.

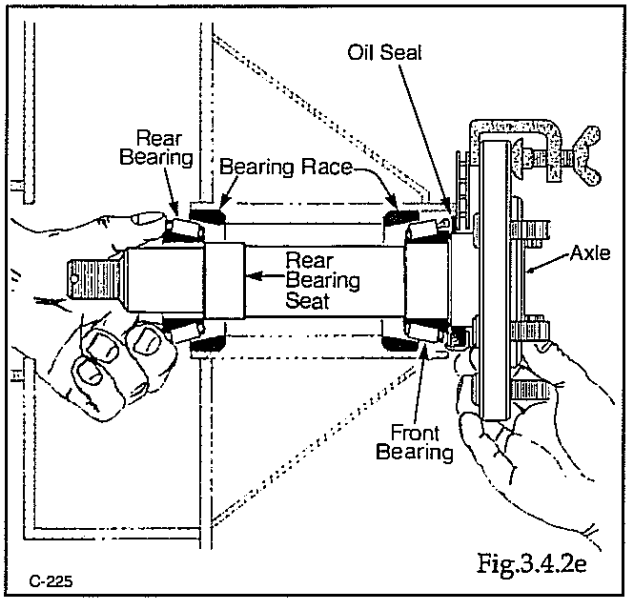
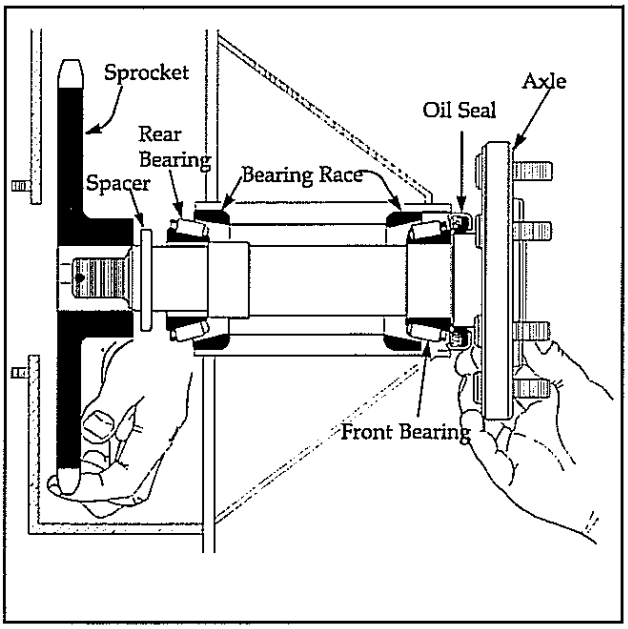


Fig.3.4.2e

7. Reach in through the inspection opening and install the axle sprocket on the axle (Fig. 3.4.2f). Make sure the sprocket starts on the axle. The hub end of the sprocket must face the flanged end of the axle.



13. Install the axle cover and seal with silicone (Fig. 3.4.2j).

14. Install the drive chain and parking brake assembly (refer to section 3.2.4 and 5).

15. Fill the final drive housing to the correct level with 10W30 API SE/CD oil (see section 3.1.3 for procedure). Total capacity per housing is 5 gals or 23 l.

16. Install the final drive inspection cover.

17. Install the wheels. Torque the wheel nuts 100 - 110 ft. lbs. (135 - 149 N.M.)

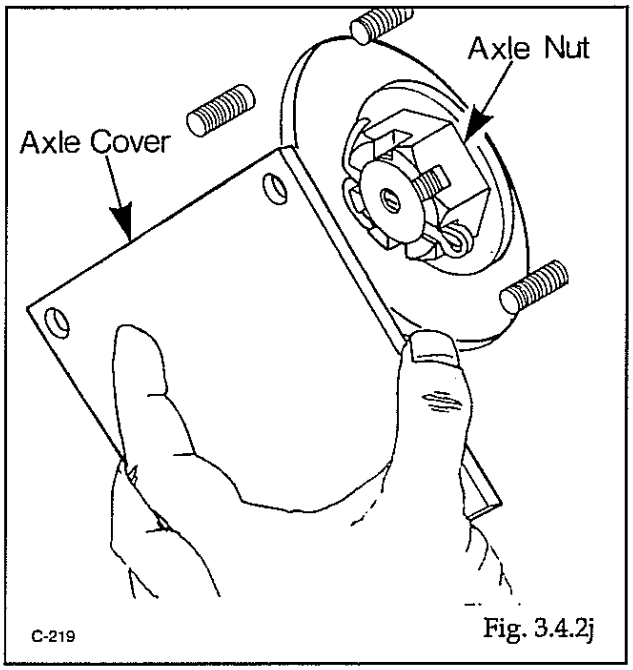


Fig. 3.4.2j

3.4.3 *AXLE STUD REPLACEMENT*

IMPORTANT Check wheel nut torque daily to prevent stud and / or rim damage.

1. Lower the boom arms. Shut off the engine.

⚠ WARNING To prevent personal injury do not work on a loader with the boom arms in a raised position unless the boom supports are engaged.

2. Raise and block the loader securely with the wheels on the side of the loader that the stud is to be replaced, clear of the ground.

3. Remove the wheel. On reassembly torque the wheel nuts 100 - 110 ft. lbs. (135 - 149 N.M.).

4. Remove the damaged or broken stud (Fig. 3.4.3a).

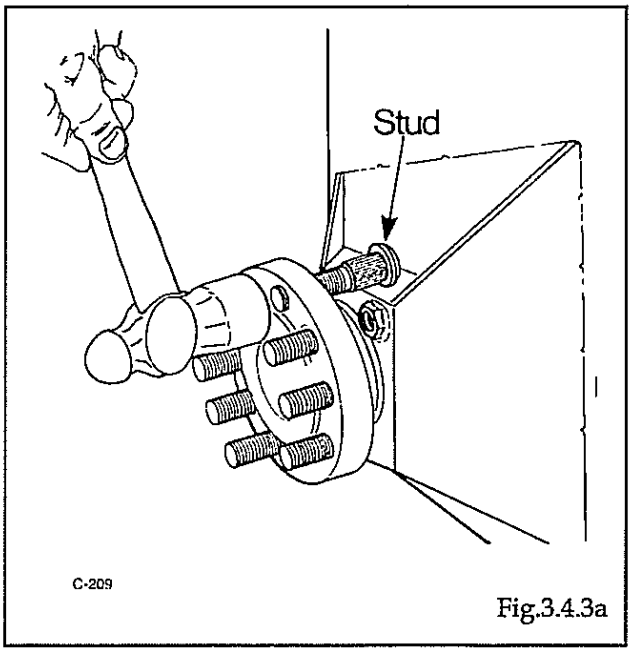


Fig.3.4.3a

5. Install a new stud from the back of the axle flange (Fig. 3.4.3b). Line up the splines on the stud with the splines cut into the axle flange.

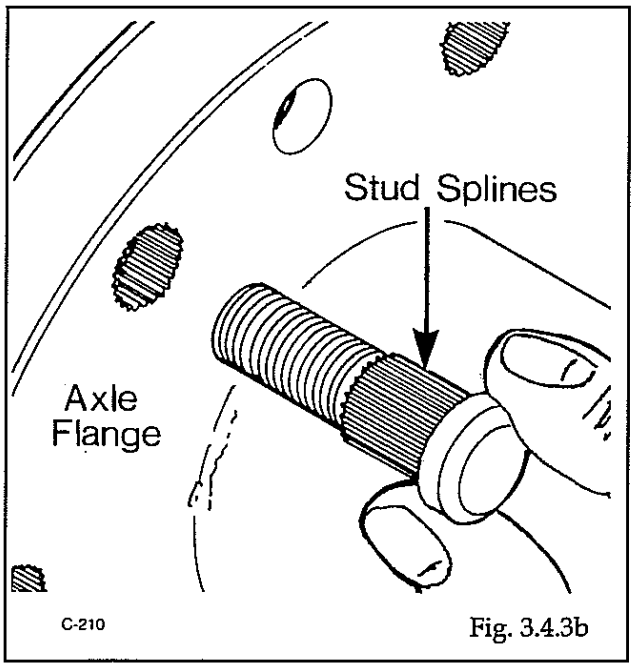


Fig. 3.4.3b

6. Place a nut on the stud and tighten it to draw the stud into the axle flange (Fig. 3.4.3c).

7. Replace the wheel and torque the wheel nuts 100 - 110 ft. lbs. (135 - 149 N.M.).

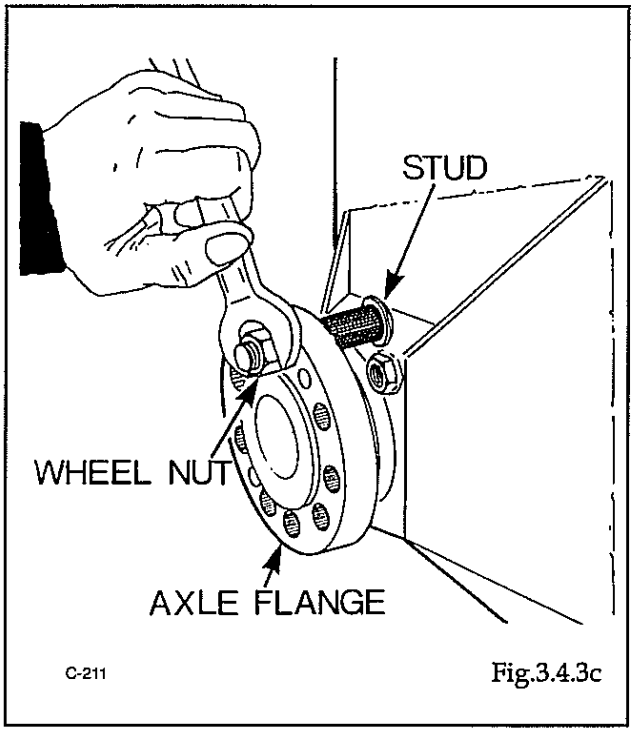


Fig.3.4.3c

3.5 *TROUBLESHOOTING - FINAL DRIVE*

PROBLEM	CAUSE	CORRECTIVE ACTION	SECTION
Final drive noisy	No lubricating oil	Check oil level. Add 10W30 API, SECD oil to correct level. Check for leaks	3.1.3
	Chain loose	Replace chain. Check tension every 150 hours.	3.2
	Axles have too much end play	Preload axle bearings removing all end play	3.3.1
	Parking brake engaged, damaged or out of adjustment	Inspect and adjust or replace damaged parts.	4.5
No drive on one side.	Drive chain failure	Inspect chain and connection link. Replace damaged parts. Check chain tension every 150 hours.	3.2
	Drive motor shaft failure	Inspect and replace damaged parts.	2.3
	Hydrostatic drive system failure	Refer to hydrostatic drive system	2.4
Lubricating oil leaking through the filter, breather cap	Lubricating oil level too high	Check oil level and drain excessive	3.1.3
	Drive motor shaft seal leaking	Inspect and repair damaged parts	2.3
Wheel stud shearing	Wheel nuts loose	Check wheel nut torque every 8 hours. Torque to 100 - 110 ft. lbs. (135 - 149 N.M.)	3.4.3
Wheel stud threads shearing	Wheel nuts over torqued	Check wheel nut torque every 8 hours. Torque to 100 - 110 ft. lbs. (135 - 149 N.M.)	3.4.3

SECTION 4
Controls

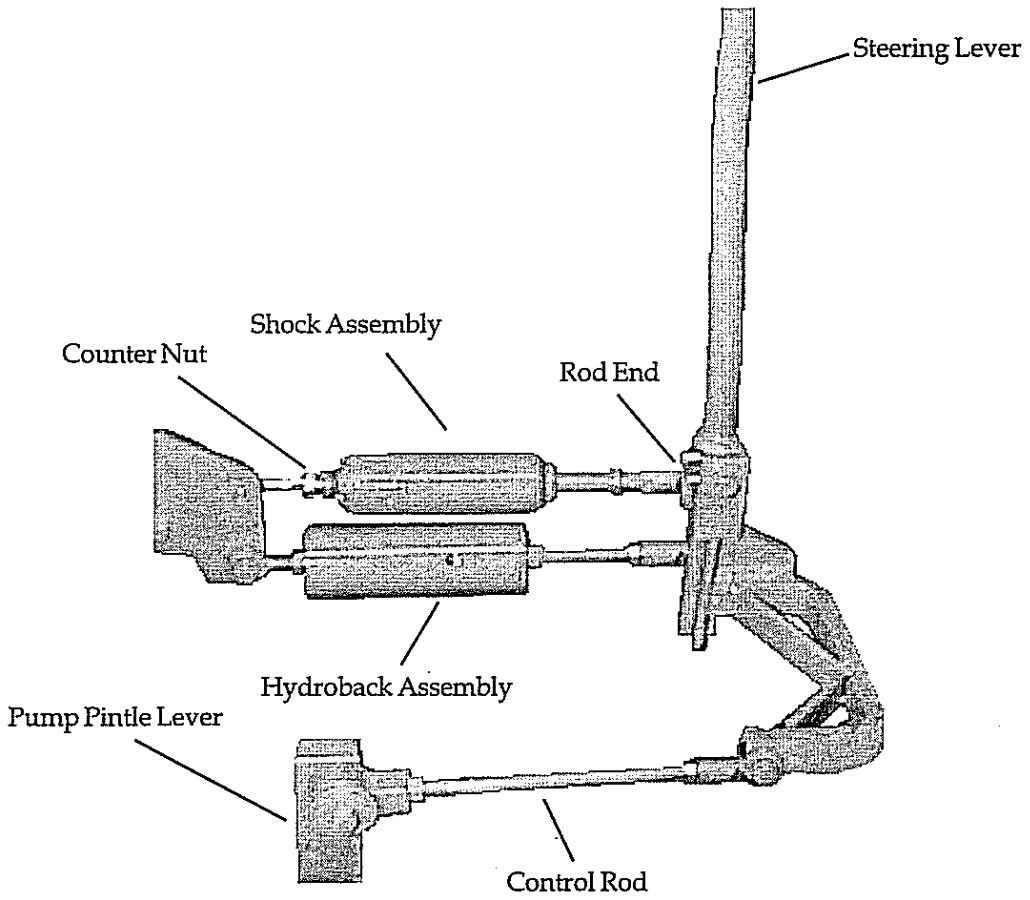


Fig. 4.1

4.1.1 OPERATION

Two (2) steering levers control speed, direction and turning of the loader. The steering levers are are connected to the two (2) hydrostatic drive pump levers. Moving the camplate levers cause oil to be pumped to the drive motors resulting in drive to the wheels. Refer to section 2.2.2 for details on pump operation.

The RH lever controls the wheels on the RH side of the loader and the LH lever, the LH wheels. Loader speed is controlled by the distance each lever is moved from centre or neutral position (Fig. 4.1.1).

The further away from neutral, the faster the travel speed.

For maximum power and slow travel speed move the steering levers a small amount from netral position.

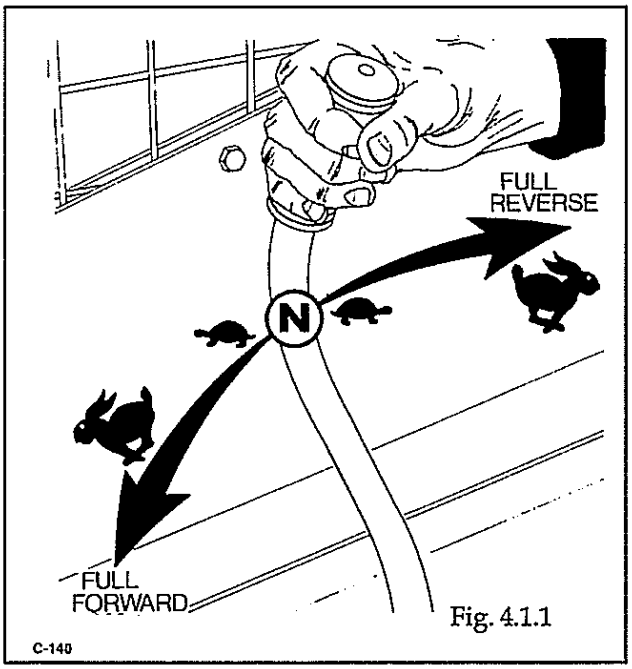


Fig. 4.1.1

WARNING To avoid personal injury do not start the engine unless you are in the seat with the seat belt fastened around you.

To drive the loader forward in a straight line, move both steering levers forward the same amount (Fig.4.1.1a).

To drive the loader in reverse in a straight line, move both control levers back the same amount (Fig. 4.1.1b).

The loader is steered by moving one lever further forward than the other. To turn right, move the LH lever further than the RH lever (Fig. 4.1.1d). To turn left, move the RH lever further than the LH lever (Fig. 4.1.1c).

For the loader to pivot or "skid steer" within its own length, move one lever forward and the other back (Fig. 4.1.1c and 4.1.1d).

WARNING To avoid personal injury always keep feet on the foot pedal controls while operating the loader.

The steering levers are equipped with a hydroback assembly which will return the steering levers to neutral position if released during operation.

For safety on start up the levers automatically are centred in neutral position when the engine is shut off and the seat bar raised.

WARNING Toavoid personal injury stop the engine, engage the parking brake and lower the boom arms before you get off the loader.

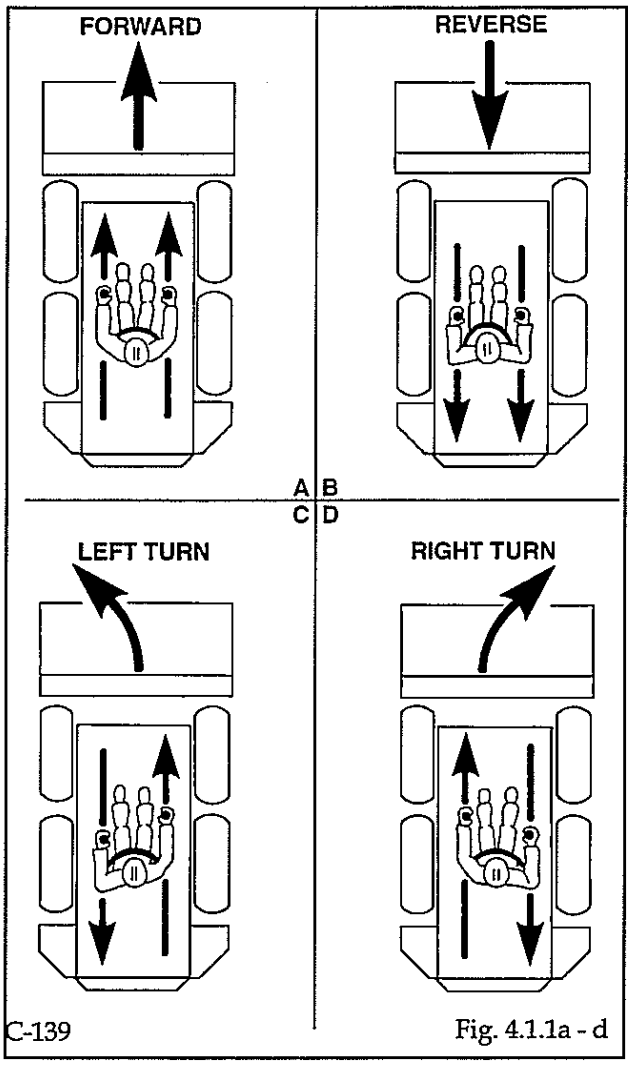


Fig. 4.1.1a - d

4.1.2 NEUTRAL ADJUSTMENT

The steering levers are designed to return to neutral position if released during operation.

If the loader creeps with the steering levers in neutral position, the hydroback system may require adjustment.

Before making any adjustment on the hydroback system check the entire steering linkage for free play. If any free play exists in the linkage, adjustment of the spring return system will not be possible.

Check the rod ends for bearing wear or looseness (Fig,. 4.1.2a).

Check the counter nuts at each rod end making sure they are tight and there is no wear or free play on the threads.

Check the pintle lever clamp bolt and rollpin for tightness and wear.

The following instructions are applicable to either the RH or LH steering lever hydroback system.

1. Remove any attachment, raise the boom arms and engage the boom supports. Shut off the engine.

2. Block the loader securely with all four (4) wheels clear of the ground.

3. Remove the seat.

4. Determine which direction the pump pintle lever must move to place the pump in neutral position (Fig. 4.1.2b).

   If the loader is creeping forward the pump pintle lever must be moved to change the front of the loader.

   If the loader is creeping backward the pump pintle lever must be moved toward the rear of the loader.

   The pintle position should only be adjusted at the hydroback assembly.

5. Lower the seat bar to release the steering neutral detent linkage.

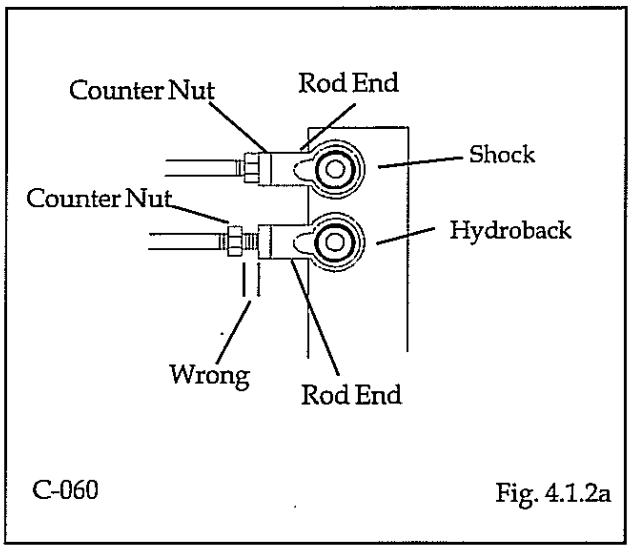


Fig. 4.1.2a

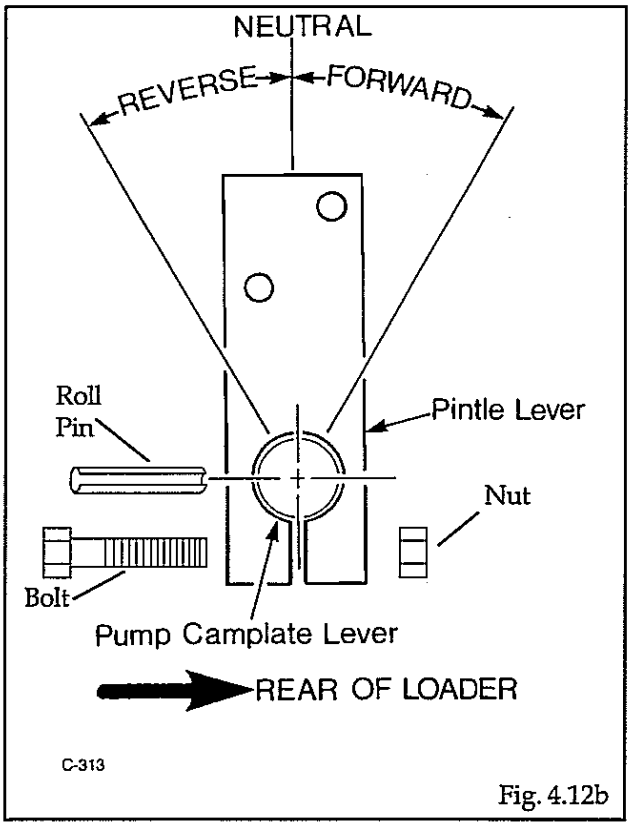


Fig. 4.12b

6. LOADER CREEPING FORWARD:

WARNING Do not service the loader with the engine running.

a. Slacken the counter nut on the rod end of the hydroback rod one (1) or two (2) turns (Fig. 4.1.2c).

b. Turn the hydroback rod out one (1) or two (2) turns.

NOTE: There must be a minimum of 3/8 in. of threads engaged in rod end to prevent stripping of threads.

c. Lower the seat bar and start the engine and check for wheel creep. If additional adjustment are required shut off the engine and repeat steps A and B.

WARNING Do not start the engine unless you are in the seat with the seat belt fastened around you.

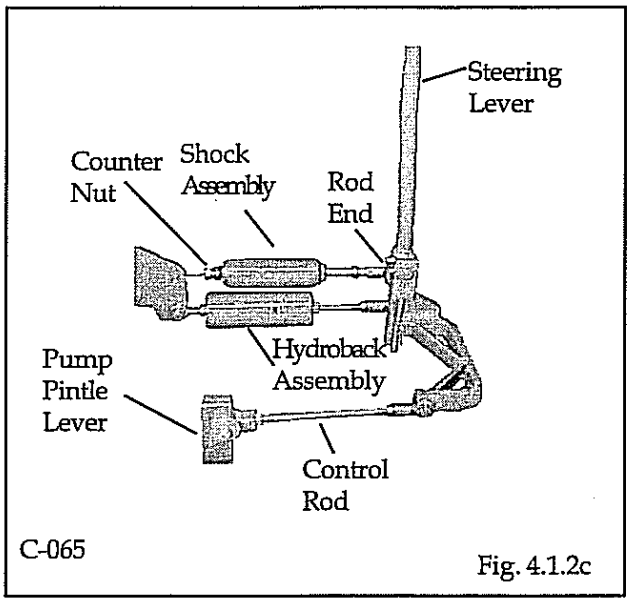


Fig. 4.1.2c

7. LOADER CREEPING REARWARD:

a. Slacken the counter nut on the rod end of the hydroback rod one (1) or two (2) turns (Fig. 4.1.2c).

b. Turn the hydroback rod in one (1) or two (2) turns.

NOTE: There must be a minimum of 3/8 in. of threads engaged in rod end to prevent stripping of threads.

c. Lower the seat bar and start the engine and check for wheel creep. If additional adjustment are required shut off the engine and repeat steps A and B..

8. Tighten the counter nuts against the rod end while preventing the hydroback rod from turning.

9. After performing the neutral adjustment it may be necessary to adjust the steering lever neutral detent linkage.

WARNING Do not start the engine unless you are in the seat with the seat belt fastened around you.

Lower the seat bar and start the engine. With the seat bar up, check for wheel creep.

If wheel creep is detected refer to section 4.3.2 for seat bar and neutral detent adjustment.

4.1.3 NEUTRAL DETENT ADJUSTMENT

For safety during start up, the steering control levers are designed to be automatically centered in neutral position when the seat bar is the up position.

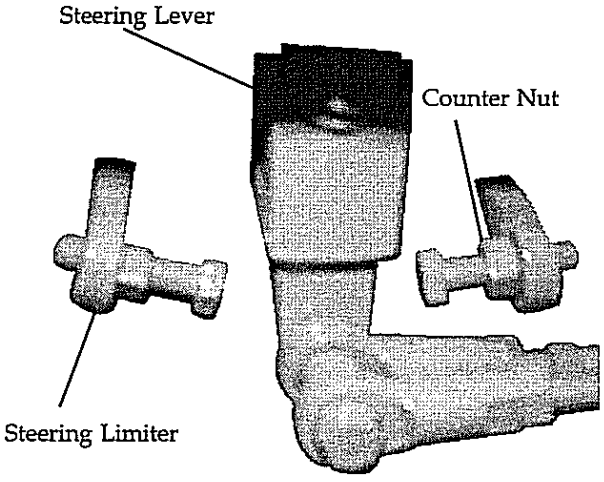
When the seat bar is lowered into the operating position, the steering lever centering or neutral detent linkage is released.

If the loader creeps while the engine is running and the seat bar is in the up position, the neutral detent linkage may require adjustment for the complete adjustment procedure refer to section 4.3.2.

4.1.4 STEERING LIMITER - ADJUSTMENT

Adjust the steering limiter with the wheels off the ground as follows:

1. Raise the seat bar, remove the seat and hydrostatic shield.
2. Ensure the engine RPM is set to 2700 +/- 50.
3. Lower the seat bar. Move the RH steering control lever full forward and adjust the limiter stop bolt against the control lever (Fig. 4.1.4a). Tighten the counter nut.
4. Check the wheel speed with a proper tach. Fig. 4.1.4b The RPM should be set to 61 at 2700 RPM and 65 for 2950 RPM.



C-586 Fig. 4.1.4a

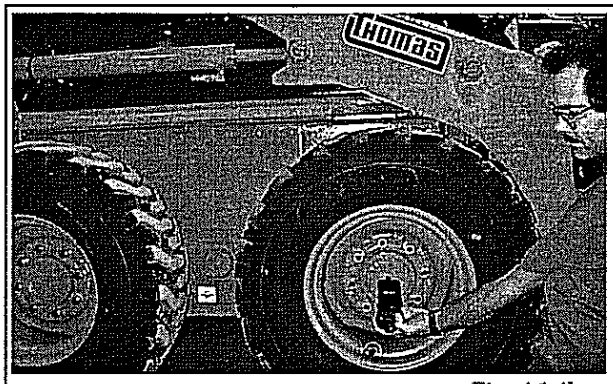


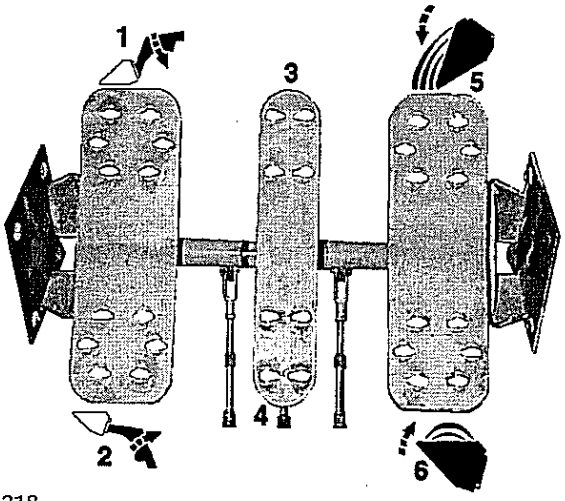
Fig. 4.1.4b

4.2 FOOT PEDALS

4.2.1 OPERATION

Operation of the boom lift cylinders, bucket tilt cylinders and auxiliary hydraulic circuit are controlled by foot pedals (Fig. 4.2.1a) connected to a hydraulic control valve. The hydraulic control valve is a series type valve which allows simultaneous use of both the boom and lift or bucket tilt circuits.

WARNING Always keep feet on the foot pedal controls while operating the loader.



C-318

Fig. 4.2.1a

Boom Lift : The LH pedal is the boom lift control (Fig. 4.2.1). To raise the boom press on the heel (2) of the pedal. To lower the boom press on the toe (1) of the pedal. Firm pressure on the toe (1) of the pedal will lock the boom in the float position. This allows the bucket to follow the ground as the loader moves backward.

Auxiliary Hydraulics - The centre pedal is used to engage the auxiliary hydraulic circuit to power an attachment such as a backhoe. Pressing on the toe (3) of the pedal provides hydraulic pressure to the female quick connect coupling located at the front of the boom arms. Firm pressure on the toe (3) of the pedal places the valve in detent position providing a continous flow of hydraulic flow of hydraulic oil to the attachment. Pressing on the heel of the pedal (4) provides hydraulic pressure to the male quick connect coupling reversing the flow of hydraulic oil. When the auxiliary circuit is not in use return the foot pedal to neutral position otherwise starting the loader may be difficult or impossible and damage to the starter may occur.

Bucket Tilt - the RH pedal is the bucket tilt (dump) control. Pressing on the toe (5) of the pedal will dump the bucket. Pressing on the heel (6) of the pedal will roll the bucket back.

WARNING To avoid personal injury stop the engine, lower the boom arms, engage the parking brake and check that the foot pedals are locked before getting out of loader.

4.2.2 FOOT PEDAL - REMOVAL

NOTE: To facilitate installation and removal of control pedals removal of the front step shield may be required.

1. Remove any attachment, raise the lift arms and engage the boom supports. Lower the lift arms to rest on the support pins.

WARNING Do not work on a loader with the boom arms in a raised position unless the boom supports are engaged.

2. Remove the three clevis pins and disconnect the control cables from the foot pedals.
3. Remove the nylock nut and bolt holding the shaft in place.
4. Slide the cross shaft until there is sufficient clearance to raise the shaft and pedal assembly out of the machine.

Foot Pedal - Installation

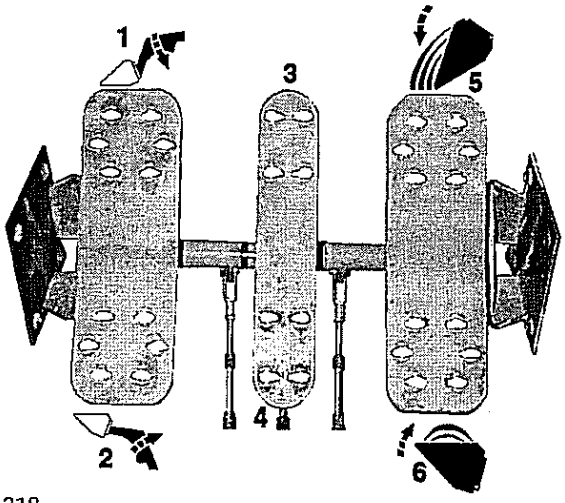
1. Thoroughly clean the foot pedal area and check the control cables for damage.

2. Slide the spacer washers on one end of the cross shaft and lower foot pedal assembly into machine.

3. Line up the shaft with the drive housing bushing and secure with the 3/8 X 1 1/4 bolt and nut.

4. Check the control cable jam nuts to ensure proper adjustment and attach to control pedals with clevis pin and cotter pin. Check for correct cable adjustment (Fig. 4.2.2e).

NOTE: If front step shield has been removed for this procedure, ensure it is reinstalled.



C-318

Fig. 4.2.1c

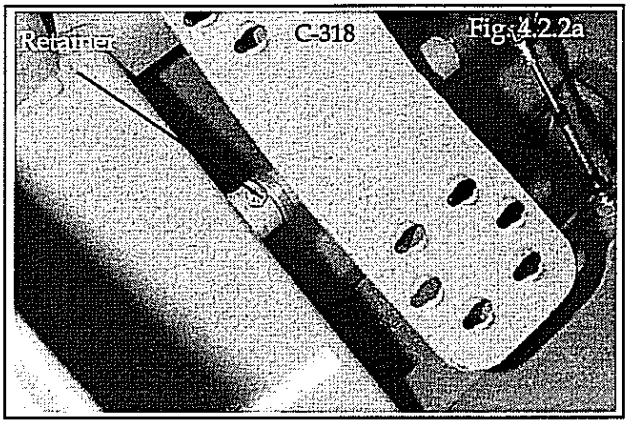


Fig. 4.2.2a

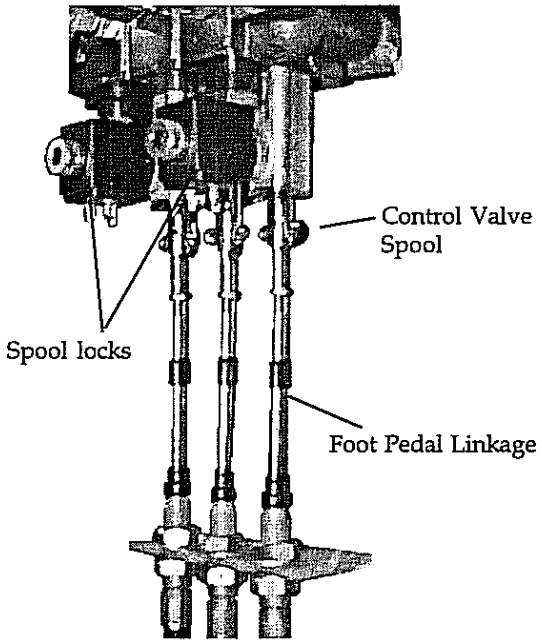


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Fig. 4.2.2e

4.2.2 AUXILIARY CONTROL PEDAL
Hand Control Unit - Removal

NOTE: To facilitate installation and removal of control pedals removal of the front step shield may be required.

1. Remove any attachment, raise the lift arms and engage the boom supports. Lower the lift arms to rest on the support pins.

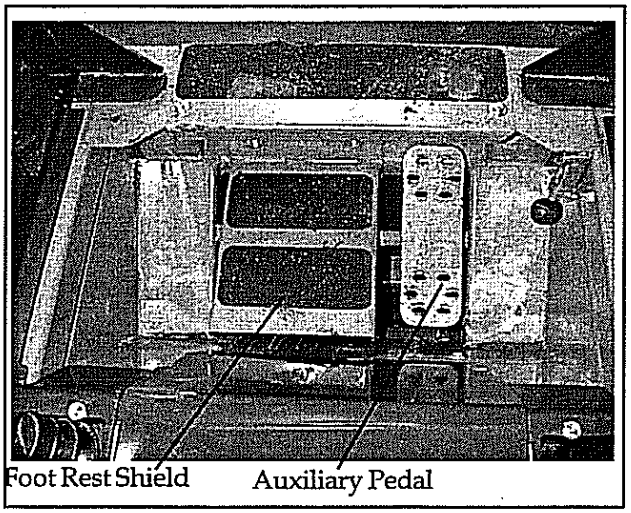
2. Remove the two retaining bolts securing the foot rest shield to the machine (Fig. 4.2.2e).

3. Remove the clevis pin and disconnect the control cable from the auxiliary pedal.

4. Remove the retaining bolt from the cross shaft.

5. Slide the cross shaft until it clears the mounting brackets and lift clear of the machine.

6. Remove the spacers from the cross shaft and slide the control pedal off the cross shaft.



Foot Pedal - Installation

1. Install spacers and control pedals on cross shaft.

2. Lower the pedal and cross shaft assembly into the machine.

3. Slide the cross shaft until it slides into place. Reinstall the retaining bolt.

4. Reinstall the control cable clevis pin and cotter pin.

NOTE: If front step shield has been removed for this procedure, ensure it is reinstalled.

5. The purpose of the foot pedal locking system is to prevent movement of the control valve spool causing accidental activation of the hydraulic system by stepping on the foot pedals when entering or exiting the loader.

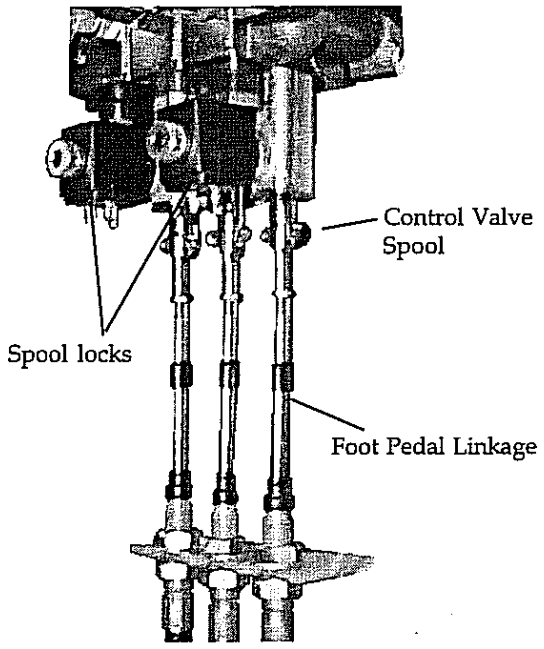
WARNING Do not leave the boom arms in a raised position unless the boom supports are engaged.

6. The control valve spool must move approximately .110 in. (2.8 mm) either side of neutral position before hydraulic flow occurs (Fig. 4.2.2e).

7. Test the foot pedals with the seat bar down to ensure the pedals move freely and do not bind.

   Check the operation of the foot pedal lock each time the loader is used. Keep all shafts, springs and linkages lubricated with a silicone lubricant.

WARNING Do not start the engine unless you are in the seat with the seat belt fastened around you.



C-598

Fig. 4.2.2e

4.2.3 *SAFETY SWITCH - ADJUSTMENT*

For operator safety during start up the loader is equipped with a safety switch connected to the starting circuit.

When the seat bar is in the down position the lever in the safety start switch is moved inward disengaging the starting circuit (Fig. 4.2.3a).

When the seat bar is in the up position the lever on the starting switch moves outward (Fig. 4.2.3b).

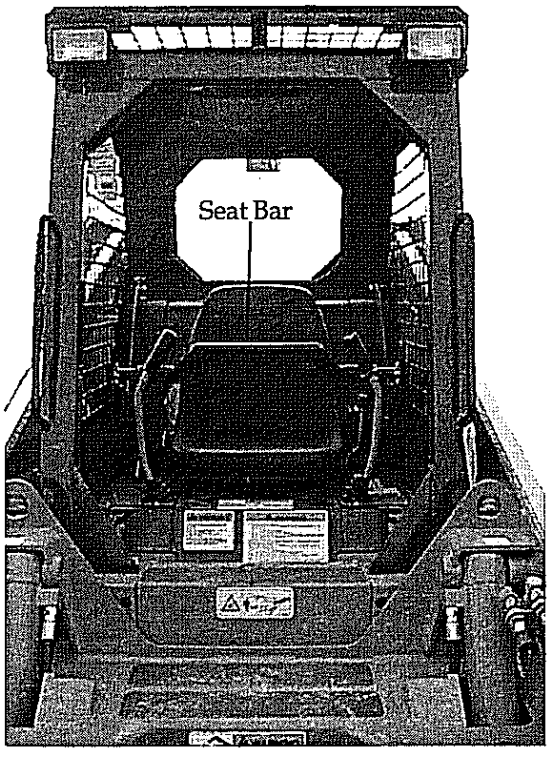


Fig. 4.2.3a

Adjust the safety start switch as follows:

1. Remove any attachment raise the boom arms and engage the boom supports. Shut off the engine.

2. Check to ensure the safety start switch is securely screwed into the mounting bracket.

3. With the seat bar in the full down position, loosen the alien screw which secures the safety switch mounting bracket.

4. Rotate the mounting bracket until the lever on the end of the safety start switch is fully depressed against the loader cross member.

5. Tighten the allen screw.

4.3.1 SEAT BAR - OPERATION

For operator protection the loader is equipped with a seat bar. When the seat bar is in the up position (Fig. 4.3.1a) the steering levers are returned to and restricted in the neutral position. The control valve is locked to prevent accidental cycling of the foot pedals when entering or exiting the loader.

⚠ WARNING Stop the engine, lower the boom arms and engage the restraint bar before getting out of the loader.

⚠ WARNING Do not start the engine unless you are in the seat with the seat belt fastened around you.

When the seat bar is lowered to the operating position (Fig. 4.2.3a) the foot pedals and the steering levers are free to move.

A safety start switch locks out the loader starting circuit when the seat bar is lowered. The loader must be started with the seat bar in the up position.

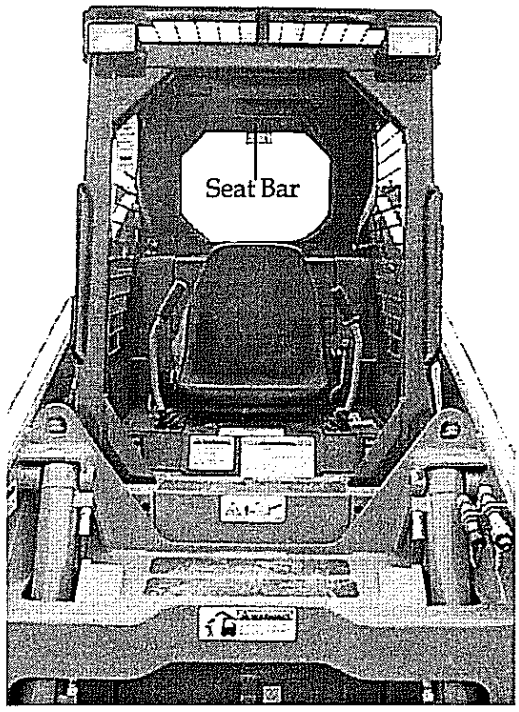


Fig. 4.2.3b

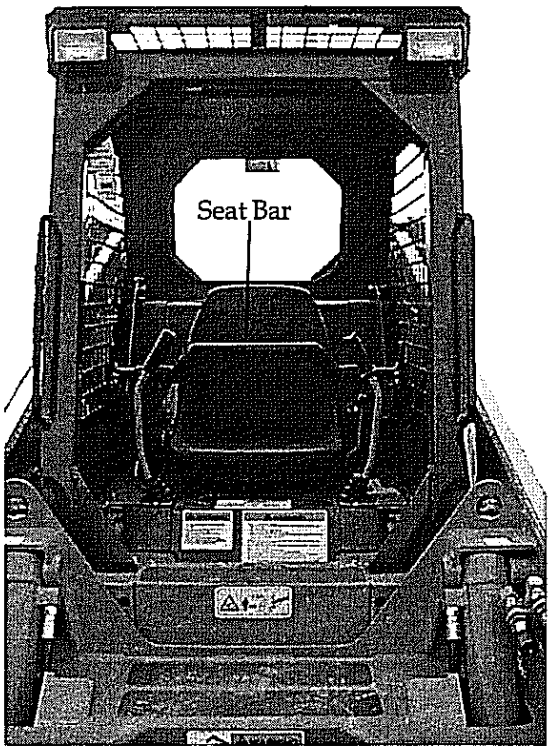


Fig. 4.2.3a

4.3.2 *SEAT BAR - ADJUSTMENT*

The following procedure is for the complete adjustment of the seat bar linkage, steering detent and foot pedal shield.

Before making any adjustment check that the machine does not creep with the engine running, seat bar in the down position and the steering levers in neutral. If wheel creep is detected, the steering lever neutral adjustment will have to be completed before proceding to the following adjustments. Refer to Section 4.1.2 for procedure.

⚠ WARNING Do not start the engine unless you are in the seat with the seat belt fastened around you.

1. Remove any attachment raise the boom arms and engage the boom supports. Shut off the engine.

2. Remove the seat, step shield, floor plate and front step shield.

3. Lock the seat bar in the up position.

4. With the steering levers in neutral position, adjust the LH pivot assembly so the "V" is lined up on the pintle lever (Fig 4.3.2a).

   Tighten the pivot assembly bolts on the LH side.

5. With the steering levers in neutral position, adjust the RH pivot assembly so the "V" is lined up on the pintle lever (Fig 4.3.2b).

   Tighten the pivot assembly bolts on the RH side.

6. Adjust and tighten the foot pedal linkage (Fig. 4.3.2c).

   Adjust the linkage so that no upward tension is applied by the cam on the foot pedal lock arms.

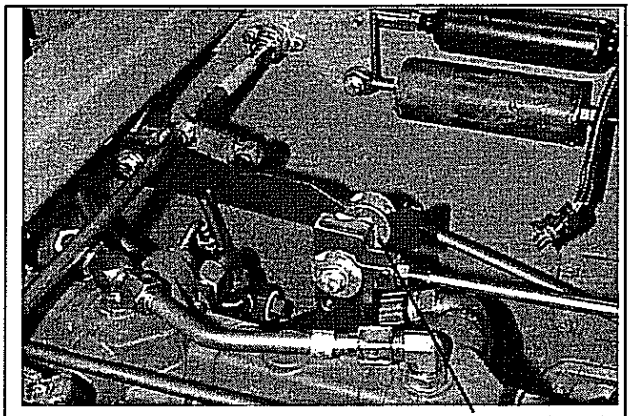
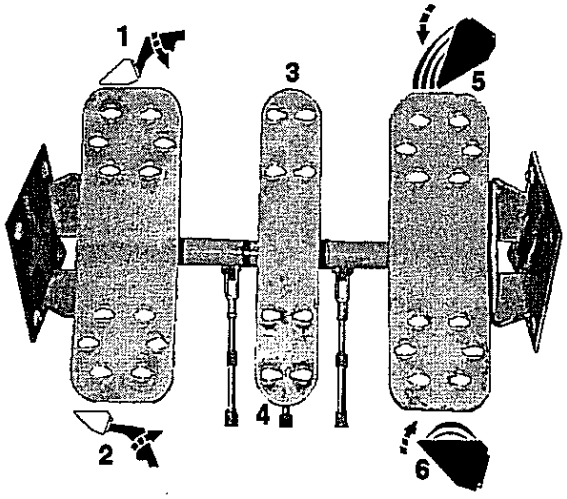


Fig 4.3.2a LH Pivot Assembly (V)

Fig 4.3.2b RH Pivot Assembly (V)



C-318 Fig.4.3.2c

9. Check that with the engine running and the seat bar in the up position that the loader does not creep. Shut off the engine.

   If the loader creeps readjust the pivot assemblies.

10. Lower the seat bar and with the engine off, check to ensure the foot pedals and the steering control levers move freely without binding.

    Keep all shafts, springs and linkages lubricated with a silicone lubricant.

WARNING Do not start the engine unless you are in the seat with the seat belt fastened around you.

4.4 *THROTTLE AND STOP CONTROL*

4.4.1 THROTTLE and STOP CONTROL - OPERATION

The diesel engine throttle is located on the left hand side of the loader next to the seat belt latch (Fig. 4.4.1).

Pushing the lever full forward increases the engine speed to maximum high idle. Pulling the lever back decreases the engine RPM. The engine should always be operated at full speed and the loader travel speed controlled with the steering control levers.

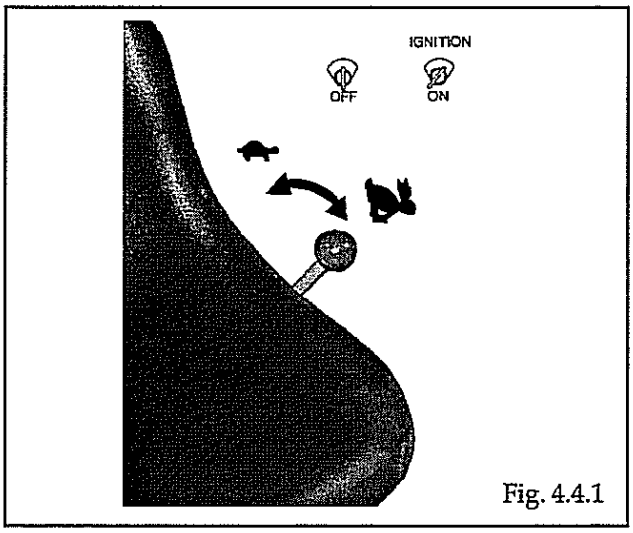


Fig. 4.4.1

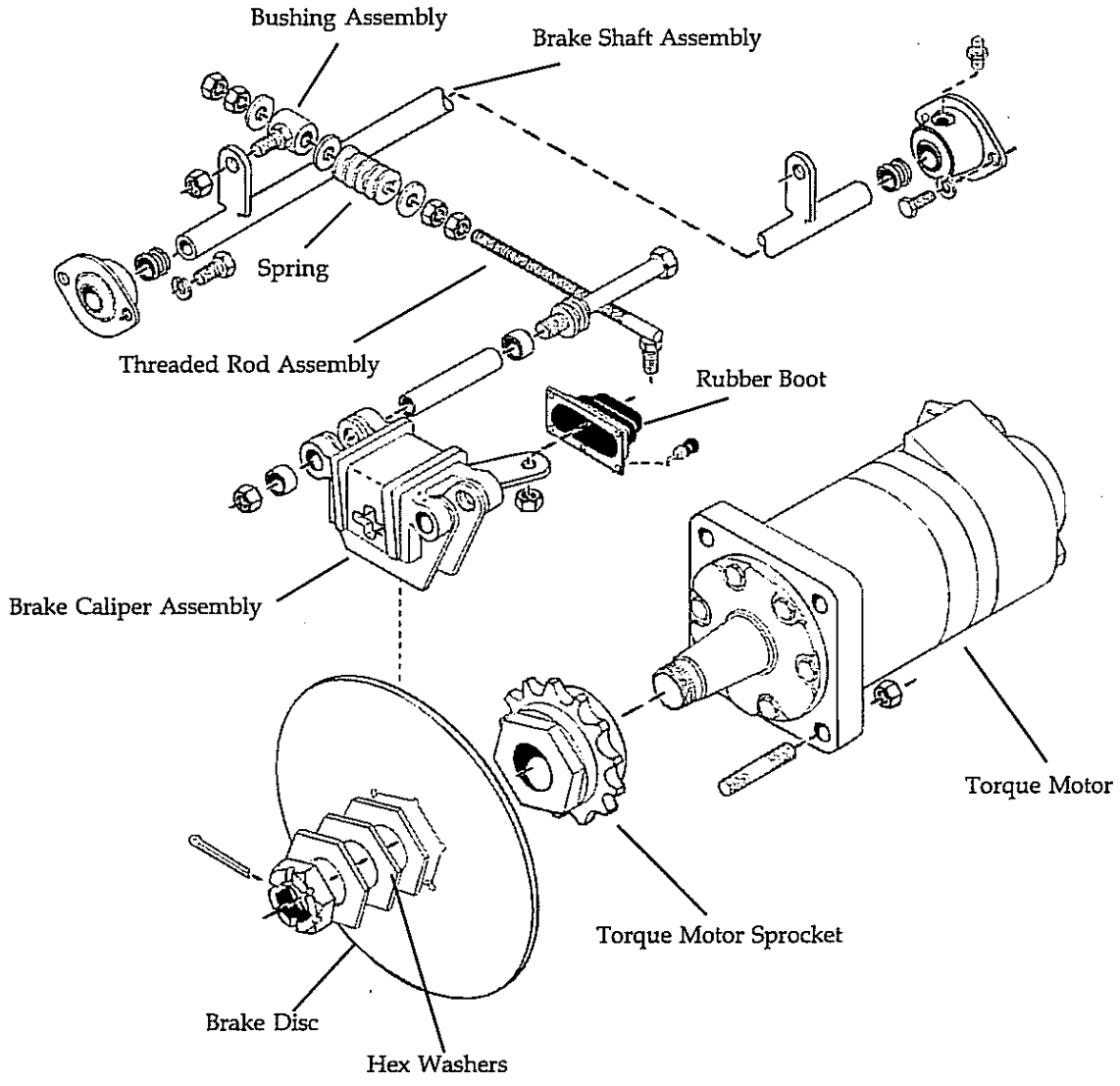
4.5 *PARKING BRAKE*

4.5.1 OPERATION

The loader is equipped with two (2) mechanical, caliper type disc brakes mounted on the output shaft of each hydrostatic drive motor. Both brakes are activated by lifting the restraint bar to the locked upright position.

The brake will be released when the restraint bar is in the down position.

IMPORTANT To prevent brake damage disengage the brake before operating the loader.



C-071

Fig. 4.5.2a

Adjustment :

1. Remove any attachment raise the boom arms and engage the boom supports. Shut off the engine.

2. Raise the seat and remove the the hydrostatic shield.

3. Block the loader securely with all four (4) wheels clear of the ground, set with the brake released (bar down).

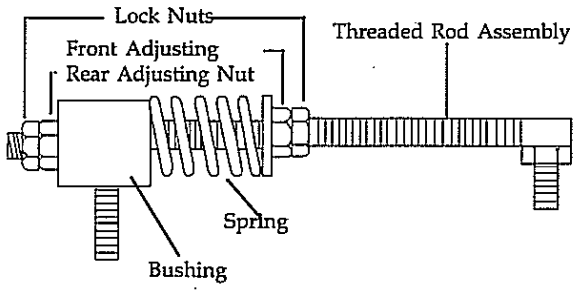
4. Loosen the lock nuts. (Fig. 4.5.2b). To increase brake pressure move nuts out, thereby loosening the spring. To decrease brake pressure move nuts in thereby increasing spring pressure. Usually finger tight will work, if nuts are free moving, to reach the desired application pressure.

   Measurement taken at the restraint bar should be 22 to 28 lbs. push before it hits the latches.

5. Release the brake and allow the bar to drop to the lowest level. Adjust the other two (2) 3/8 in. UNC nuts to ensure that no tension is applied to the brake pads when the lever is in the down position (Fig. 4.5.2a).

   If the handle effort is within the above specifications (22 to 28 lbs. push) and the brake pads and the brakes do not perform correctly check the brake pads and disc for wear or damage. If necessary replace. Refer to sections 4.5.3 and 4.5.4.

WARNING To avoid personal injury stop the engine, lower the boom arms, engage the parking brake and check that the foot pedals are locked before getting out of loader.



C-057 Fig. 4.5.2b

4.5.3 PARKING BRAKE CALIPER and PAD REMOVAL

1. Remove any attachment raise the boom arms and engage the boom supports. Shut off the engine.

2. Raise the seat and remove the the hydrostatic shield.

3. Block the loader securely with all four (4) wheels clear of the ground, set with the brake released (bar down).

4. Remove the wheels. On reassembly torque the wheel nuts 100 - 110 ft. lbs. (136 - 149 N.M.).

WARNING To avoid personal injury stop the engine, lower the boom arms, engage the parking brake and check that the foot pedals are locked before getting out of loader.

5. Remove the final drive inspection cover (Fig. 4.5.3a) located between the axles on the final drive housing. On reassembly apply silicone to the inspection cover to prevent leakage of the drive lubricating oil.

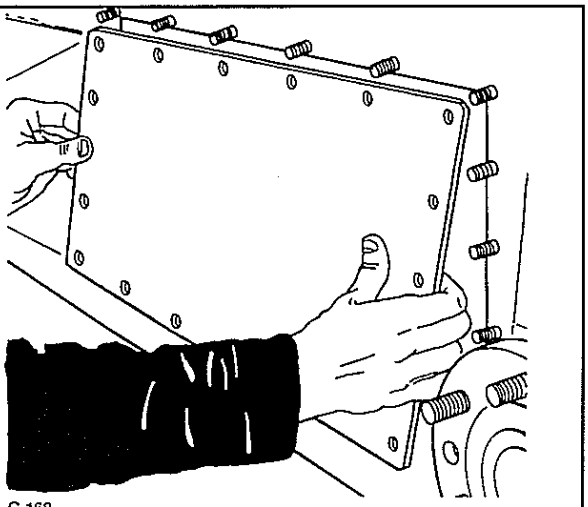


Fig. 4.5.3a

6. Remove the bolt end of threaded rod assembly from brake lever on caliper (Fig. 4.5.3b).

7. Loosen the brake caliper assembly.

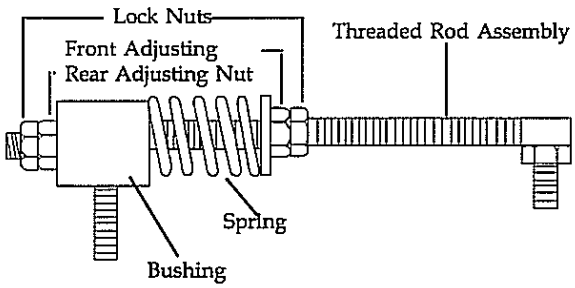
8. Remove the stainless steel "z" pin and hex washers from the torque motor sprocket.

9. Spread the brake pads apart to allow removal of the brake disc.

10. Remove the caliper bolts.

11. Remove the caliper assembly and brake pads.

12. Clean off brake boot material and remove it.



C-057
Fig. 4.5.3b

4.5.4 PARKING BRAKE CALIPER and PAD REPLACEMENT

1. Apply silicone around the outside of the brake caliper mounting bolt holes. Insert two (2) 1/2 X 5 in. UNC long bolts, with 1/2 in. washers under the head, through the holes into both side transmissions.

2. Slide a 1/2 in. diameter hardened washer onto each of the four (4) bolts on the inside of both transmissions.

3. Install two (2) 3/8 in. long spacers on the mounting sleeves (one per sleeve) of the brake caliper assemblies and position the brake caliper assemblies onto the two (2) 1/2 X 5 in.UNC long bolts. The levers will extend through the lever sleeves of the transmission walls.

4. Slide two (2) 1/2 in. long over the the opposite end of the caliper sleeves. Install two (2) 1/2 in. UNC nylock nuts onto the brake caliper mounting bolts but do not tighten.

5. Spread the brake pads apart on both caliper assemblies to allow you to insert the brake disc between them onto the torque motor sprocket. The disc must be free to float on the motor sprocket. Once in place, tighten the nylock nuts onto the brake mounting bolts to 85 ft. lbs.. Make sure the activating arm is in the rear slot of the caliper.

6. Install two (2) 1/4 in. OD X 3/16 in. thick and one 2 1/4 in. OD X 1/8 in. thick hex washers over the hex of the torque motor sprockets. Secure washers and and brake discs by inserting the 1/8 in. X 3 3/4 in. long stainless steel pin. Bend both ends of each pin over equal length to make a "z".

7. Remove any paint or dirt from the oval tube through which the brake lever protrudes. Use a good quality cleaner such as "Spot Check Cleaner/ Remover " from Magna Flux Corp. Remove dirt and oil from the protruding portion of the brake levers as well. Also, clean the brake boot with alcohol.

8. Stretch the rubber boot over the brake lever and onto the oval tube. Position the boot to remove twisting of the rubber. Caution must be taken to prevent contamination of the inside of the boots with oil and dirt.

To avoid personal injury wear latex gloves on your hands. The chemical used to seal the boots is an instant bonding agents. If bonding of skin happens follow instructions on the product safety sheets.

9. Carefully apply one drop of loctite superbonder #420 to the line where the boot seals to the lever . Add another drop to where the boot contacts the oval tube. By capillary action the adhesive will wick around the contact areas. Wait one minute and then check for adhesion by working the boot and inspecting for gaps and voids.

10. Assemble the brake rod actuator linkage.

11. Adust the brakes. See section 4.5.2 for the procedure.

SECTION 5
Electrical

5.1 WIRING

5.1.1 Wiring Diagram (ROPS Side)

1. Brake
2. Battery
3. Pre Heat
4. Air Filter
5. Hydraulic Oil Temperature
6. Engine Water Temperature
7. Engine Oil Temperature
8. Hi Flow Hydraulics
9. Auxiliary, Rear
10. Auxiliary, Front
11. Lights
12. Seat Belt
13. Low Fuel
14. Light Switch
15. Hour Meter
16. Fuel Gauge
17. Ignition Switch
18. Connector Plug
19. Horn
20. Front Worklights

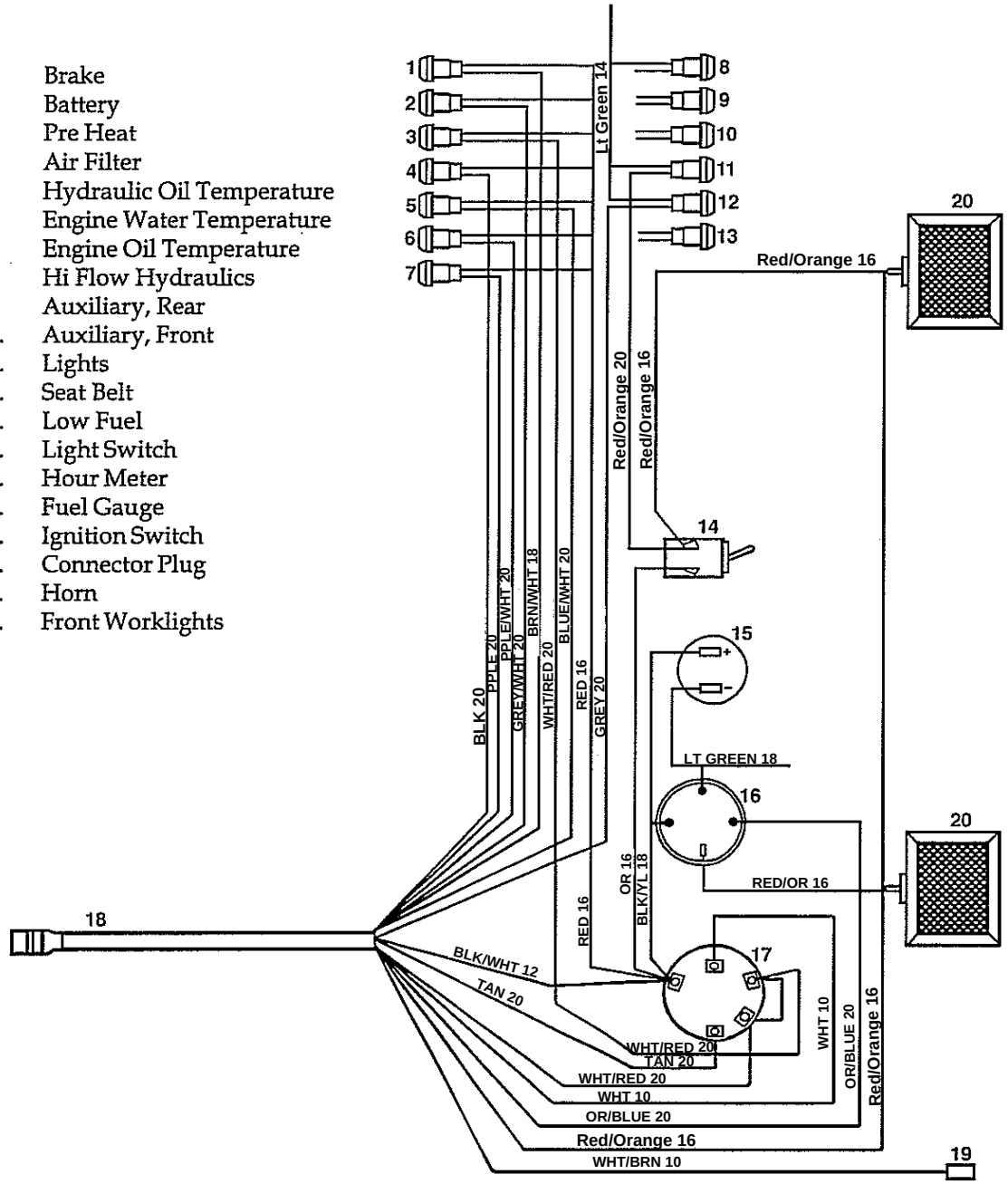
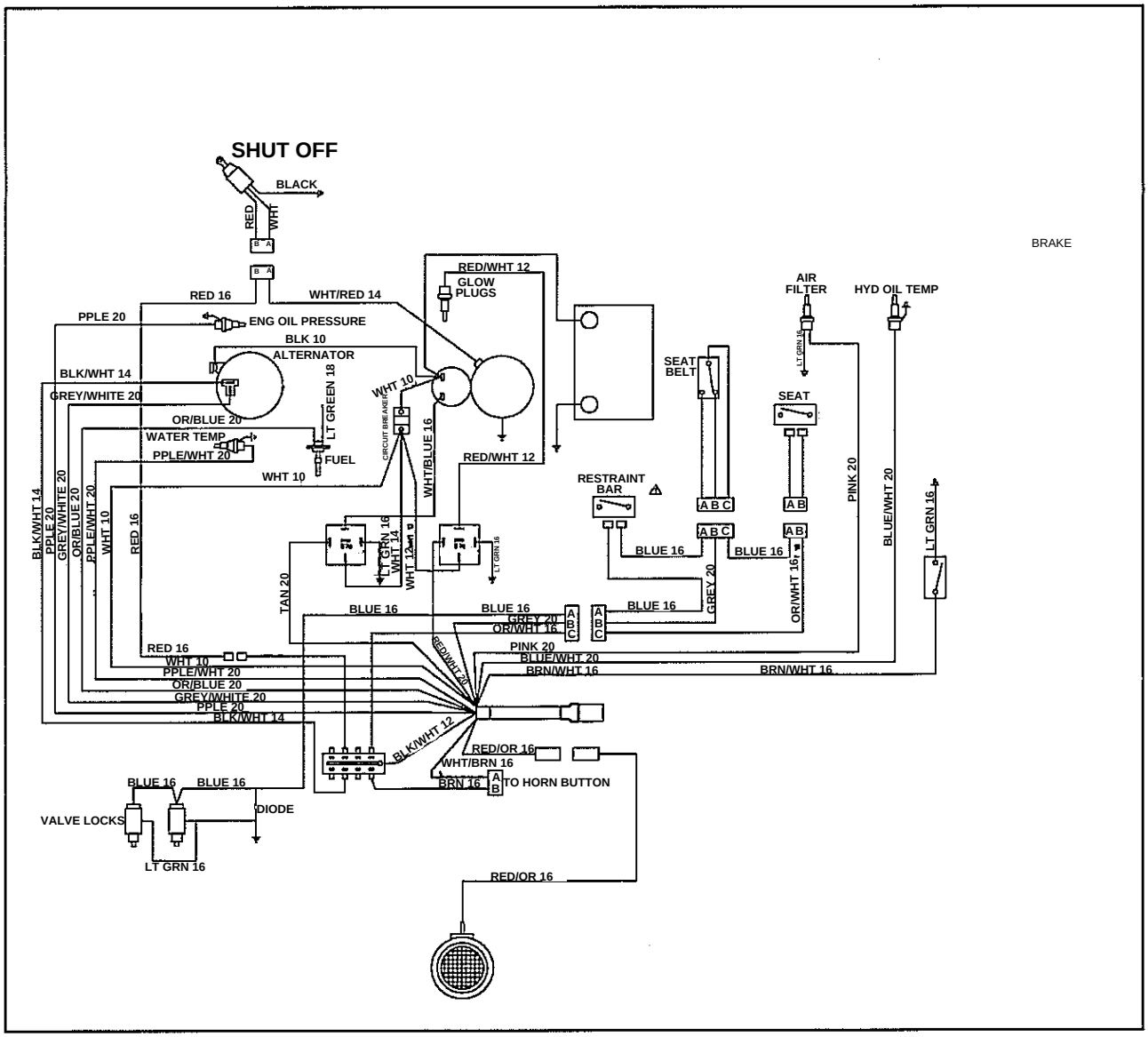


Fig. 5.1

5.1 WIRING

5.1.1 Wiring Diagram (Engine Side)

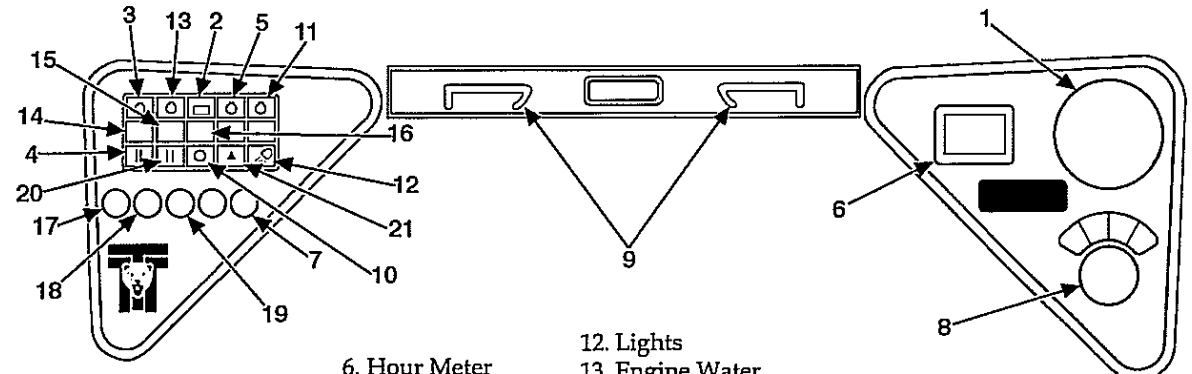


1. Shut Off Solenoid
2. Engine Oil Pressure Sender
3. Glow Plugs
4. Alternator
5. Water Temperature Sender
6. Fuel Level Sender
7. Circuit Breaker
8. Starter
9. Battery
10. Seat Belt with Switch
11. Switch, Normally Open
12. Seat Switch
13. Air Filter Sender
14. Hydraulic Oil Temperature Sender
15. Switch, Normally Open
16. Relay
17. Control Valve Locks
18. Tail Light
19. Fuse Panel
20. Engine Wire Harness

5.1.2 SPECIFICATIONS

FANBELT Fan sag under load of 13.2 to 15.4 lbs. (6 to 7 KGf)		T173 HLS II 0.2765 to 0.3543 in. (7 to 9 mm)
ALTERNATOR Output current		45A/14V/ 2800 RPM
Total resistance of rotor coil, measured between terminal "F" and "E"	STD MAX	6 10
Brush Length	STD MAX	15.5 mm (0.6102 in. 10.3 mm (0.4055 in.
REGULATOR INTERNAL		
Cut in Voltage		4.5 to 5.8 Volts
No-Load regulating voltage		13.8 to 14.8 Volts
Resistance between Terminals:		
"IG" and "F" with open contacts		0
"IG" and "F" with contacts		Approx 11
"L" and "E" with open contacts		0
"L" and "E" with contacts		Approx 100
"N" and "E"		Approx 2
"B" and "E" with open contacts		Infinity
"B" and "L" with contacts		0
Point Gap		0.0118 to 0.0177 in. (0.3 to 0.45 mm)
STARTER MOTOR		
No - load test	Current Voltage Speed	90 A or less 11.5 V 3500 RPM or more
O.D of commutator	STD. MIN.	1.1811 in. (30.0 mm) 1.1417 in. (0.5 tp 0.9mm)
Mica undercutting	STD. MIN.	0.0197 to 0.0354 in. (0.5 tp 0.9mm0 0.0079 in. (0.2mm)
Brush Length	STD. MIN.	0.7480 in. (19mm) 0.5000 in. (12.7 mm)
GLOW PLUG Resistance		Approx. 1.5
BATTERY Voltage		12V
BCI Group Size		24 (3478)
Amp hour capacity		140
0 degrees F , (-17.8 degrees C) cranking amps		455 (730 /125 min. reserve)
Ground polarity		Negative

5.2 *INSTRUMENTATION*



1. Fuel Gauge
2. Alternator Light
3. Engine Oil Pressure
4. Hyd. Oil Temp. Light
5. Engine Preheat Indicator
6. Hour Meter
7. Light Switch
8. Ignition Switch
9. Boom Supports
10. Brake Light
11. Light Filter
12. Lights
13. Engine Water Temp.
14. Aux. Hyd.
15. Aux Option Light
16. Hi-Flow Hyd.
17. Aux. Front Switch
18. Aux. Option Switch
19. Hi-flow Hyd.
20. Low Hyd. Oil
21. Seat Belt

5.2.1 FUEL GAUGE

The fuel gauge indicates the quantity of fuel in the fuel tank. The fuel tank capacity is 16.8 gal (64.1 l). The diesel engine must not be allowed to run out of fuel otherwise air will have to be removed from the fuel (refer to section 7).

WARNING To avoid eye injury use safety goggles when cleaning with compressed air.

Testing:

FUEL SENDER

1. With the key switch off, connect one ohmmeter lead to the ground terminal of the fuel sender (Fig. 5.2.1a). Connect the other ohmmeter lead to the positive terminal of the fuel sender.

TEST RESULTS

50 - 500 ohm reading: good fuel sender
High or low reading: Faulty fuel sender replace

FUEL GAUGE

1. Remove the right hand instrument panel. With the ignition off, connect one ohmmeter lead to the "S: terminal of the fuel sender (Fig. 5.2.1b).

TEST RESULTS

150 - 250 ohm reading: good fuel gauge
High or low reading: Fuel gauge faulty, replace

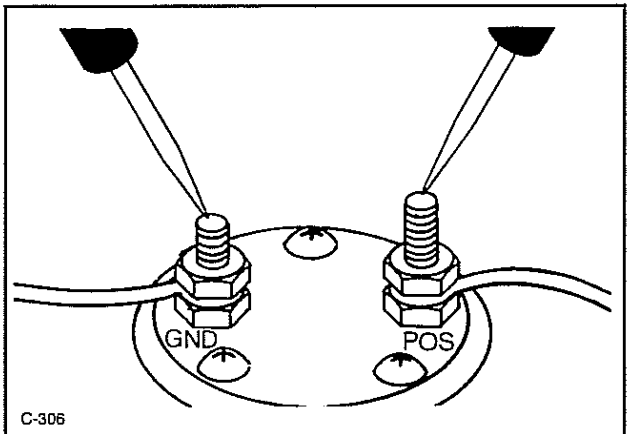


Fig. 5.2.1a

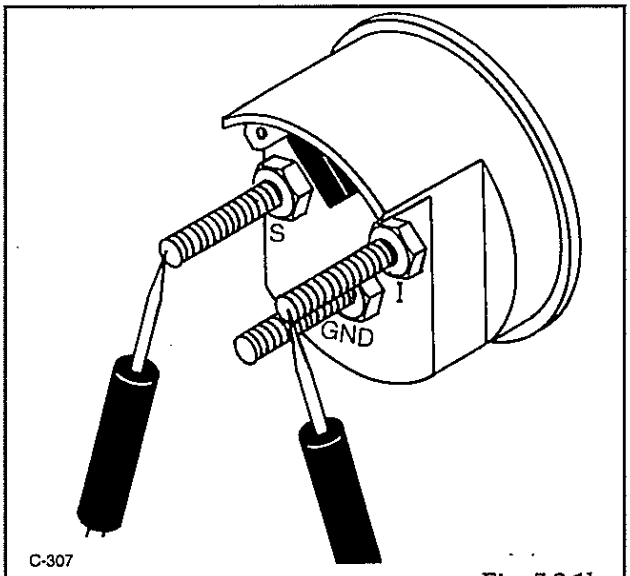


Fig. 5.2.1b

3. With the ignition off, connect one ohmmeter lead to the "S" terminal of the fuel gauge (Fig. 5.2.1c). Connect the other ohmmeter lead to a clean ground on the frame.

TEST RESULTS

50 -500 ohm reading: Wire to "S" Terminal good
High or Low reading: Faulty wire to "S" terminal

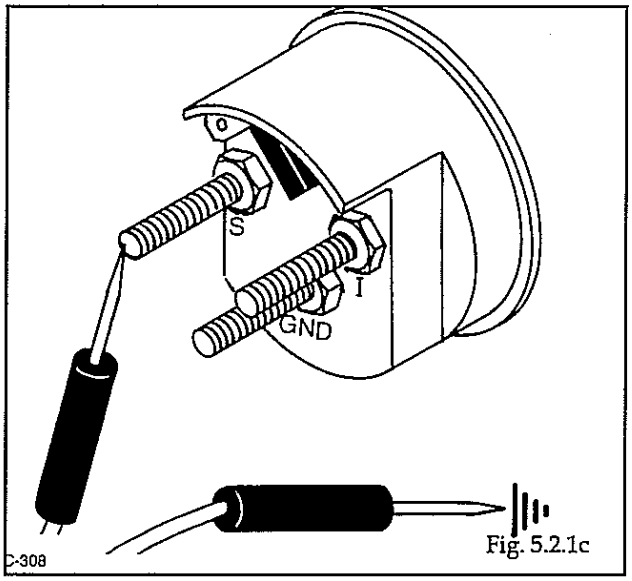


Fig. 5.2.1c

5.5.2 ALTERNATOR LIGHT

The Alternator warning light will come on if the alternator is not producing sufficient current. With the key switch in the on position the alternator light will go off. For complete operating description and testing of the charging system refer to engine repair manual.

5.5.3 ENGINE OIL PRESSURE

If the light comes on during operation or fails to go out after starting, shut off the engine immediately and determine cause.

1. With the engine off, disconnect the wire from the oil pressure sender switch. Turn the key switch to the on position.

TEST RESULTS

If the light remains on, check the coolant temperature sender. If the light remains on, check the coolant temperature sender. If the light goes out, check the engine oil level before checking for a malfunction of the sender switch or oil pump.

5.2.4 HYDRAULIC OIL TEMPERATURE LIGHT

The hydraulic oil temperature light measures the temperature of the hydraulic oil. If the light comes on during operation shut off the engine and determine cause of overheating. Check the hydraulic oil cooler for air flow restrictions. Refer to troubleshooting section.

5.2.5 GLOW PLUGS

The disel engine is equipped with glow plugs to assist in starting. The glow plugs are activated by turning the ignition key counterclockwise as far as possible and held in this position approx. 8 seconds.

TEST 1: GLOW PLUG CONNECTORS

Before performing any tests on the glow plug circuit disconnect the negative or ground cable from the battery. With the key switch off, connect one ohmmeter lead to the first glow plug nut (Fig. 5.2.5a). Connect the other ohmmeter lead to the second glow plug nut.

TEST RESULTS

Low or Zero: Good continuity
High Resistance: Bad connection, remove the connector and clean. Continue and check between third and fourth glow plugs.

TEST 2: GLOW PLUG

With the ignition off, disconnect the connectors from the glow plugs. Connect one ohmmeter lead to the glow plug terminal. Connect the other ohmmeter lead to a clean ground. Check each glow plug.

TEST RESULTS

1.5 ohm reading: Good glow plug
Infinite or zero reading: Faulty glow plug , replace

TEST 3: KEY SWITCH TO GLOW PLUG

Remove the bolts securing the RH instrument panel to the frame. With the key switch off, connect one ohmmeter lead to the terminal marked 30 on the key switch. Rotate the key counterclockwise to the "heat" position.

TEST RESULTS

Low or zero reading: Good continuity
High reading: Faulty wire from switch to glow plug. Replace.

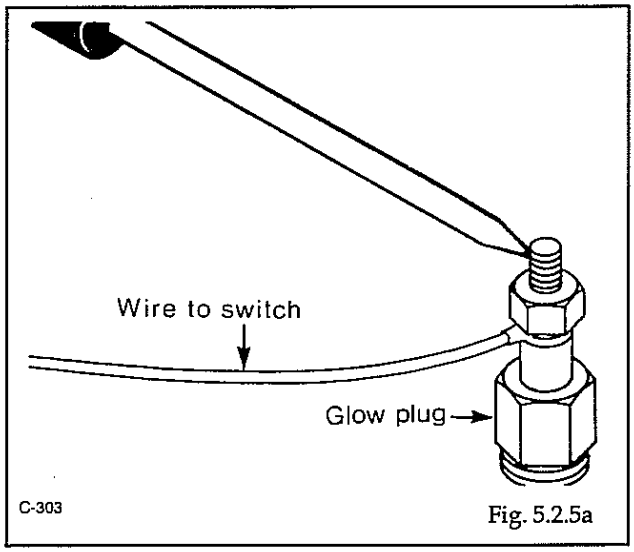


Fig. 5.2.5a

TEST 4: KEY SWITCH - HEAT POSITION CHECK

Connect one ohmmeter lead to the terminal marked 19 on the key switch. Connect the other ohmmeter lead to the terminal marked 30 on the key switch. Rotate the key counterclockwise to the "heat" position.

TEST RESULTS

Low or Zero reading: Good contact through switch
High Reading: Faulty wire, replace.

TEST 5: KEY SWITCH TO INDICATOR

Connect one ohmmeter lead to the terminal marked 19 on the key switch. Connect the other lead on the glow plug indicator.

TEST RESULTS

Low or Zero reading: Good continuity
High reading: Faulty wire, replace.

Connect one ohmmeter lead to the terminal marked 17 on the key switch. Connect the other lead to the terminal on the glow plug indicator.

TEST RESULTS

Low or Zero reading: Good continuity.
High reading: Faulty wire, replace.

5.2.6 HOUR METER

The hour meter records the number of engine operating hours and has a total read out of 9999.9 hours.

5.2.7 LIGHT SWITCH

The light switch is an ON - OFF toggle switch. Pushing the switch up will turn on the headlights and rear worklights. Pushing the switch down will shut the lights off.

5.2.8 IGNITION SWITCH

The ignition switch is a four (4) position switch. OFF, PRE-HEAT, RUN and START. Turning the key counterclockwise will engage the PREHEAT. To activate the starter, turn the key clockwise. When the key is released it will return to the RUN position.

TESTING

Before performing any tests on the key switch, diconnect the negative or ground wire from the battery. Remove the bolts which secure the instrument panel to the ROPS.

TEST 1: "ON" POSITION

Connect the ohmmeter leads across the key switch terminals marked 30 and AC (Fig. 5.2.8a). Turn the switch to the "ON" osition .

RESULTS

Low Resistance reading: Good
High Resistance reading: Faulty switch, replace

TEST 2: "START" POSITION

Connect the ohmmeter leads between the terminals marked 30 and 50 on the key switch (Fig. 5.2.8b).Connect the ohmmeter leads between the terminals marked 30 and 17 on the key switch (Fig. 5.2.8b). Turn the switch to the "START" position and observe the ohmmeter reading.

TEST RESULTS

Low Resistance reading: Good switch
High Resistance reading: Faulty switch, replace

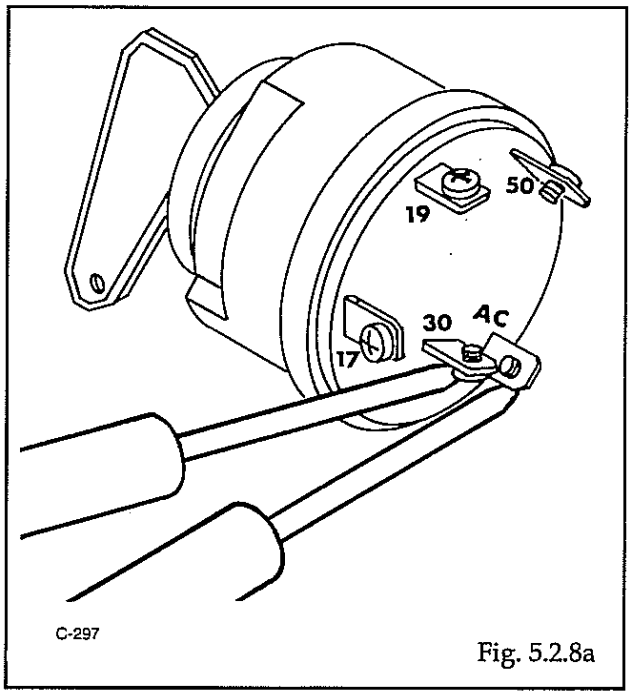


Fig. 5.2.8a

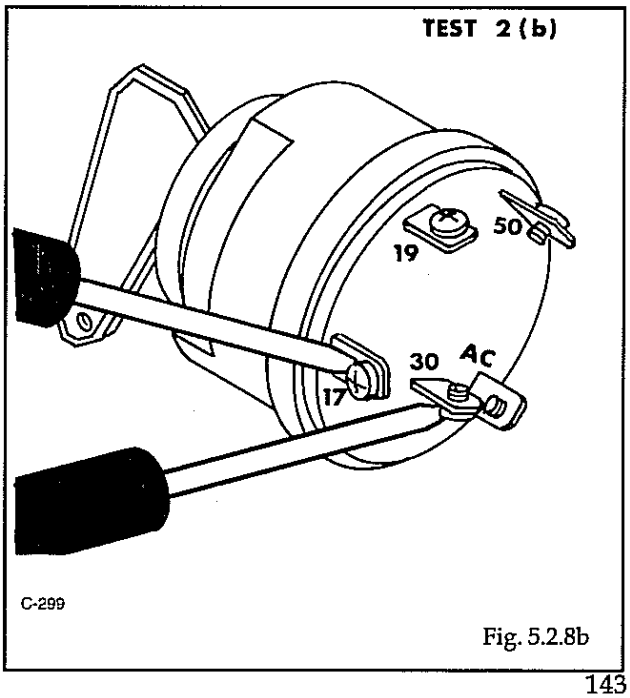


Fig. 5.2.8b

TEST 3: "HEAT " POSITION

Connect the ohmmeter leads between the terminals marked 30 and 19 on the key switch (Fig. 5.2.8b). Turn the switch to the "HEAT" position and observe the ohmmeter reading.

TEST RESULTS

Low Resistance reading: Good
High Resistance reading: Faulty switch, replace

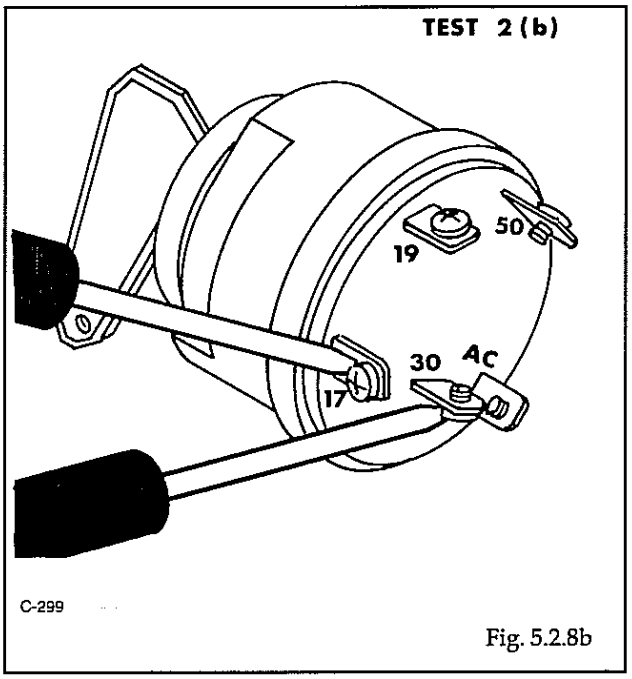


Fig. 5.2.8b

5.2.9 BOOM SUPPORTS

For safety while performing regular service or maintenance work the loader is equipped with boom support pins. For details of operation refer to operation section of the 173HLS II Owner / Operator Manual.

5.2.10 BRAKE LIGHT

The brake light will come on if the parking brake is engaged.

5.2.11 AIR FILTER

The air filter light when illuminated indicates there is an obstruction in the intake or that the air filter needs servicing. When the light is illuminated, stop the engine and service.

5.2.12 LIGHTS

When the light is illuminated, it indicates your headlights are ON and will serve as a reminder to turn them OFF when the loader is not in use.

5.2.13 ENGINE WATER TEMPERATURE

The coolant temp. light will come on if there is a rise in engine temperature. If this occurs, shut off the engine immediately and determine the cause.

5.3 COMPONENTS

5.3.1 BATTERY SAFETY PRECAUTIONS

WARNING

Lead acid batteries contain sulfuric acid which will damage the eyes of skin on contact. Always wear goggles to avoid acid in the eyes.If acid contacts the eyes, wash immediately with clean water and seek medical attention. Wear rubber gloves and protective clothing to keep acid off the skin. If acid contacts the skin, wash off immediately with clean water.

1. When mixing battery electrolyte, it is important to pour the concentrated acid into the water and not the water into the acid.

2. When working with acid, such as filling batteries, splash proof goggles should be worn. (Additional protective clothing may be advisable if many batteries are handled.

3. When adding water or electrolyte, non-metallic containers and/or funnels must be used.

4. Acid must not be stored in excessively warm locations or in direct sunlight.

5. Hydrogen and oxygen gases are produced during normal battery operation. The gas mixture can explode if flames or sparks are brought near the battery. Manufacturers recommendations should be closely followed to hold the charging rate at a limit that prevents rapid generation of hydrogen gas. When charging or using a battery in an enclosed space, always provide adequate ventilation.

6. Excercise care to avoid tools or metallic objects falling across the battery terminals.

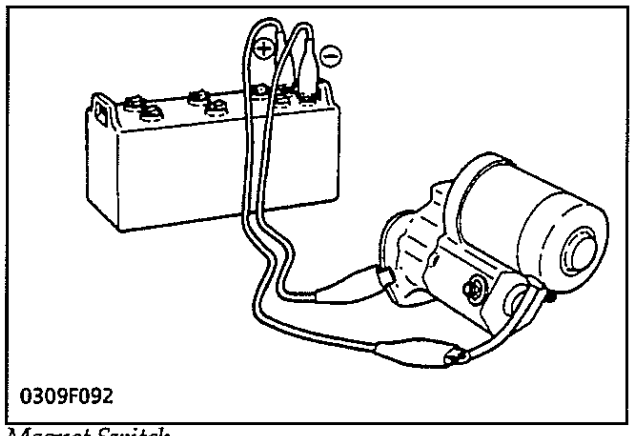
7. Never break a live circuit at the terminals. An arc could occur whenever charger leads or booster cable leads are disconnected. Any arc could ignite the accumulated hydrogen gas! Always disconnect the ground cable first at a point away from the battery terminals.

8. Remove cell caps when charging or using jumper cables.

5.3.2 STARTER

Motor Test

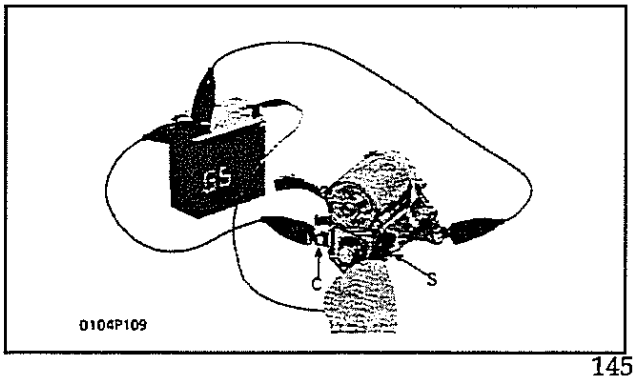
1. Disconnect the connecting lead from the "C" terminal of the starter and connect a jumper lead from the connecting lead to the positive battery terminal.
2. Connect a jumper lead temporarily between the starter body and the negative battery terminal.
3. If the motor does not run, check the motor.



Magnet Switch

1. Disconnect the connecting lead from the "C" terminal of the starter.
2. Connect the jumper leads from the negative terminal of the 6V battery to the body and "C" terminal of the magnet switch.
3. The pinion gear should pop out, when a jumper lead is connected between the positive terminal of the battery to the "S" terminal of the magnet switch.
4. The pinion gear should stay out without the jumper from the negative terminal to the "C" terminal.

NOTE: Each test should be carried out for a short time, about 3 to 5 seconds.



WARNING

To prevent personal injury do not charge a frozen battery because it can explode. Let the battery warm to 60° F. (15.5 °C.) before putting on a charge.

5.3.3 *BATTERY REMOVAL AND INSPECTION*

The battery is located in the ROPS behind the operator's seat. Remove the battery as follows:

1. Fold the seat back down and remove the two (2) wing nuts which secure the battery compartment cover (Fig. 5.3.2a). Open the cover.

2. Loosen the cable clamps on the positive and negative battery terminals.

3. Use a puller to remove the negative (ground) cable from the battery. Them remove the positive cable.
4. Note the location of the positive and negative terminals so the battery can be properly positioned during installation.

5. Remove the holddowns and battery.

6. Inspect the cables for corrosion and damage. Remove corrosion using a wire brush and soda solution. Replace the cables having damaged or deformed terminals.

7. Clean the outside of the battery case if the original battery is to be installed. Flush the top cover with soda solution to remove acid film. Be careful to prevent soda solution from entering the cells. Remove corrosion from the terminals with a wire brush. Inspect for cracks or other damage which would result in a leakage of electrolyte.

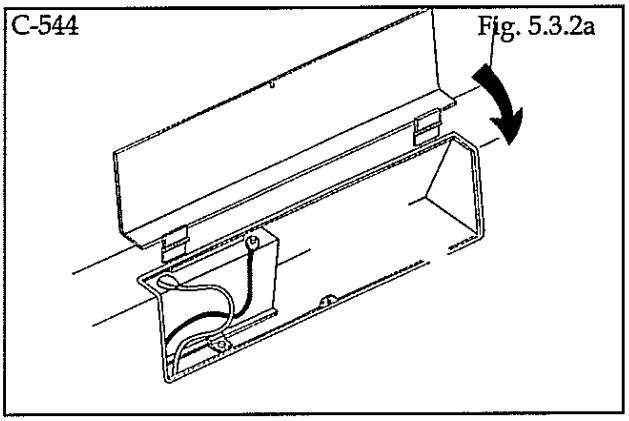


Fig. 5.3.2a

5.3.4 *JUMP START*

Inspect the battery on a regular basis for damage such as a cracked or broken case or cover which allow electrolyte loss.

Check the battery cables for tightness and that they are corrosion free. Remove any acid corrosion from the battery and cables with a baking soda and water solution. Coat the terminal connections with di-electric grease.

If it is necessary to use a battery booster to start the engine BE CAREFUL!!

The ignition must be in the off position. The booster battery to be used must be 12 volts. Connect the end of the first cable to the loader battery positive (+) terminal, or to the optional boosting lug. Connect the end of the second cable to the negative (-) terminal of the boosting battery. Connect the other end of the negative (-) cable to the engine. Keep cables away from moving parts. Start the engine.

After the engine has started, remove the ground cable (-) first, then remove the cable from the boosting lug.

5.3.5 *TESTING: CIRCUIT BREAKER*

1. With the ignition off connect one ohmmeter lead to one of the terminals on the circuit breaker.

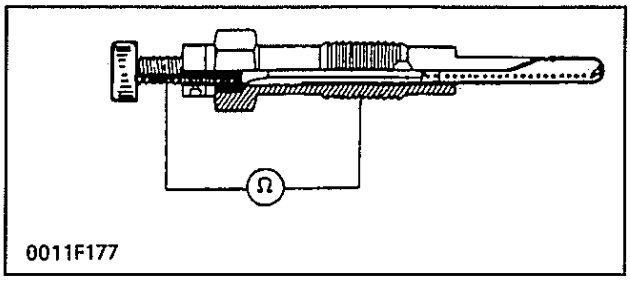
2. Connect the other ohmmeter lead to the other breaker terminal.

TEST RESULTS

Low Resistance reading :	Good
High Resistance reading:	Defective circuit breaker, replace

5.3.6 *GLOW PLUG*

1. Disconnect the leads from the glow plug.
2. Measure the resistance with a circuit tester across the glow plug terminal and the housing.
3. If "0" ohms are indicated, the screw at the tip of the glow plug and the housing are short - circuited. If the reference valve is not indicated, the glow plug is faulty, replace the glow plug.

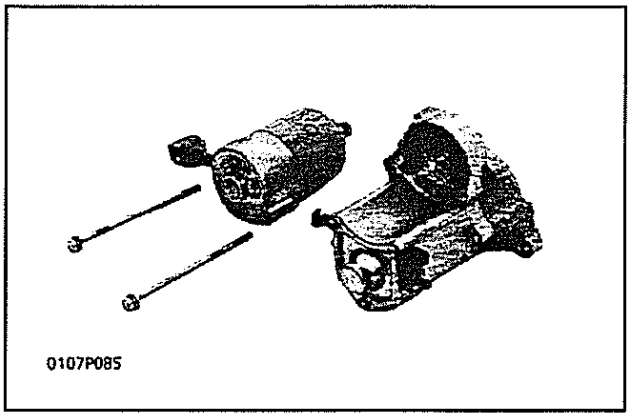


Glow Plug Resistance	Factory Spec.	0.8 ohms

5. 4 *STARTER DISASSEMBLY and ASSEMBLY*

Starter Motor

1. Disconnect the connecting lead.
2. Remove the mounting nuts.
3. Remove the magnet switch by sliding it up so that it is connected from the drive lever.



Brush Holder

1. Draw out the brush from the holder while holding the springup.
2. Remove the brush holder.

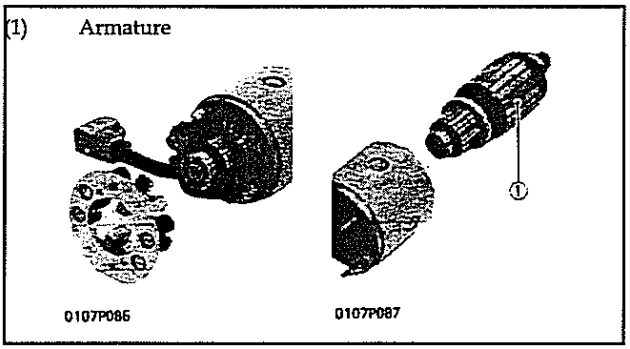
(When Reassembling)

1. Do not damage the brush, commutator and bearing.

Armature

1. Draw out the armature.

(1) Armature

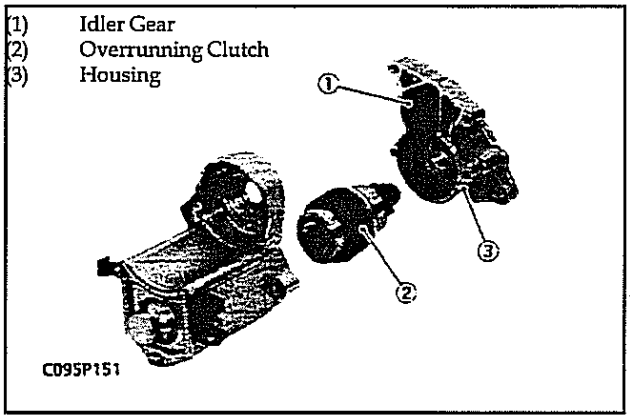


Housing, Idler Gear and Overrunning Clutch

1. Remove the housing.
2. Remove the idler gear (1) and the overrunning clutch (2).

NOTE: Do not damage the clutch bearing and do not let the dust adhere to it.
Do not lose the steel ball in the overrunning clutch.

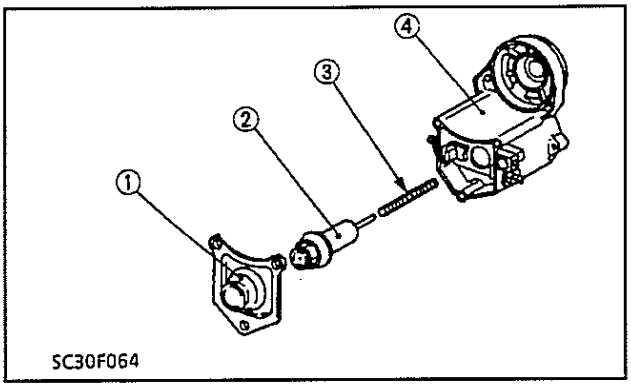
(1) Idler Gear
(2) Overrunning clutch
(3) Housing



Plunger

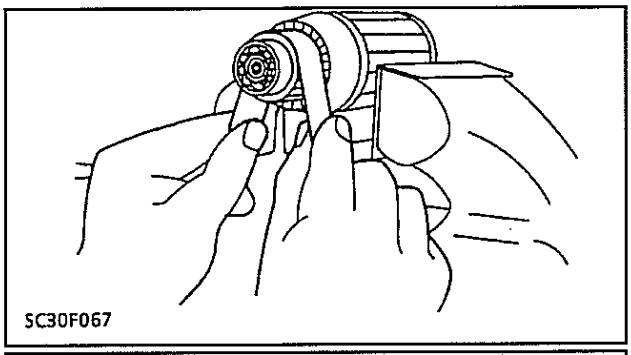
1. Remove the end cover (1) of solenoid switch (4).
2. Remove the plunger (2) and spring (3).

(1) End Cover
(2) Plunger
(3) Spring
(4) Solenoid Switch



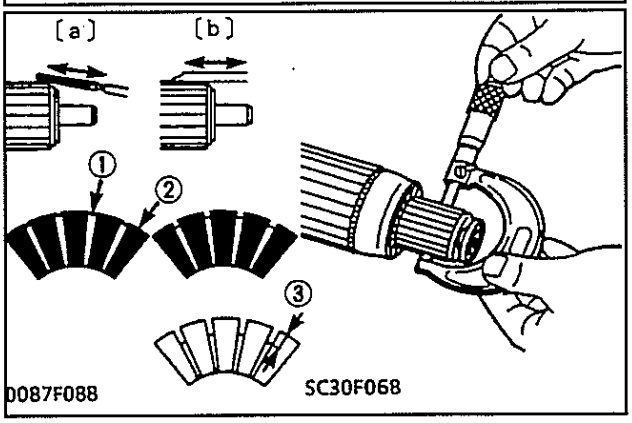
Commutator and Mica

1. Check the contact face of the commutator for wear and grind the commutator with sandpaper if it is slightly worn.
2. Measure the commutator O.D. at several points.
3. If the difference of the O.D.'s exceeds the allowable limit, correct the commutator on a lathe to the factory specification.
4. If the mimimum O.D. is less than the allowable limit, replace the armature.
5. Measure the mica undercut.
6. If the undercut is less than the allowable limit, correct with a saw blade and chamfer the segment edges.



Commutator O.D.	Factory Spec.	30 mm 1.1811 in.
Commutator O.D.	Allowable Limit	29 mm. 1.1417 in.

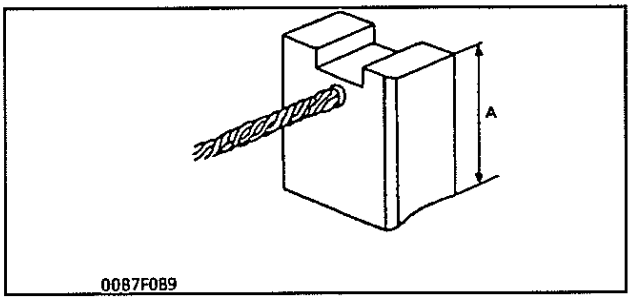
Mica under cut	Factory Spec.	0.5 to 0.8 mm 0.0197 to 0.0315 in.
	Allowable Limit	.2 mm 0.0079 in.



Brush Wear

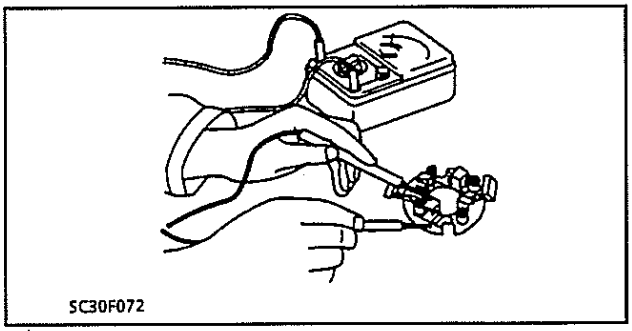
1. Measure the brush length A.
2. If the length is less than the allowable limit, replace the brush.

Brush Length	Factory Spec.	15 mm 0.59 in.
	Allowable Limit	10.0 mm 0.394 in.



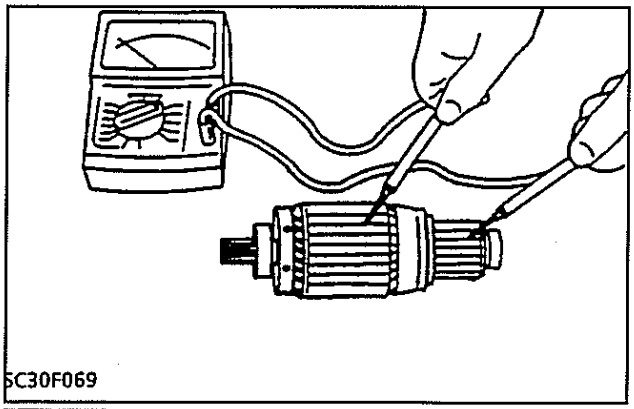
Brush Holder

1. Check the continuity across the brush holder and holder support with an ohmmeter.
2. If it conducts, replace it.



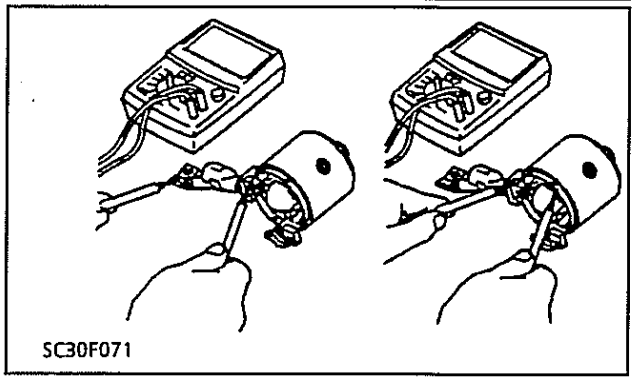
Armature Coil

1. Check the continuity across the commutator and armature core with an ohmmeter.
2. If it conducts, replace.



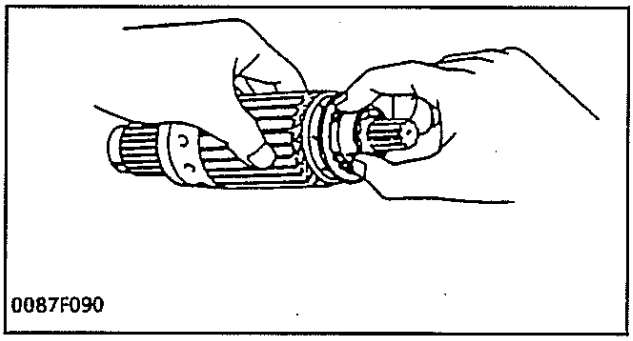
Yoke

1. Check the continuity across the lead and brush with an ohmmeter.
2. If it does not conduct, replace the yoke.
3. Check the continuity across the yoke and brush with an ohmmeter.
4. If it does not conduct, replace the yoke.



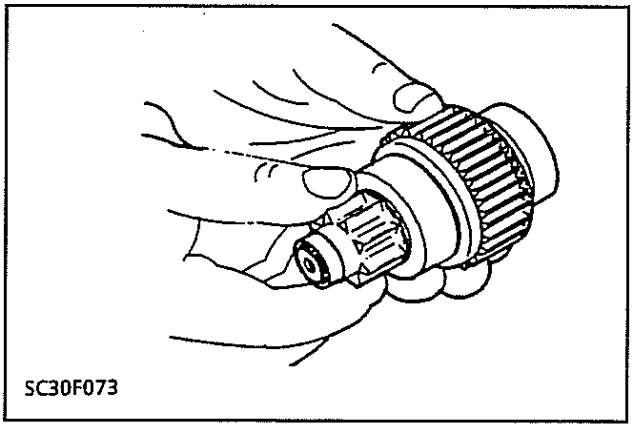
Armature Bearing

1. Check the bearing for smooth operation.
2. If it does not rotate smoothly, replace it.



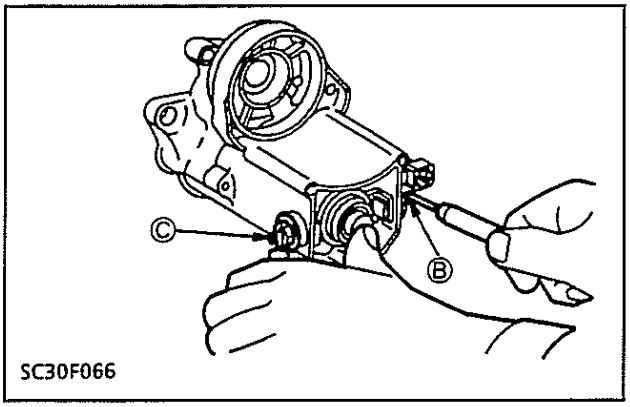
Overruning Clutch

1. Check the clutch for smooth rotation.
2. The overruning clutch should engage and rotate with the pinion shaft in driving direction and disengage in reverse.



Magnet Switch

1. Check the continuity across the 'C' terminal and the 'B' terminal with an ohmmeter pushing the plunger.
2. If it does not conduct, check the contacts.



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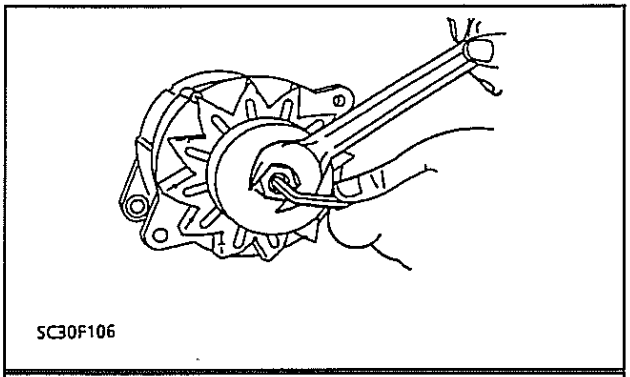
5. 5 *ALTERNATOR*

Pulley

1. Hold the shaft with an Allen wrench and remove the nut.
2. Remove the pulley.
3. Remove the fan.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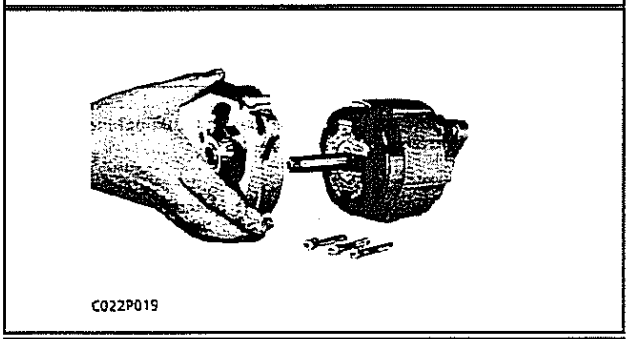
Drive Side End Frame and Rotor

1. Remove the through bolts.
2. Remove the drive end frame.
3. Draw out the rotor.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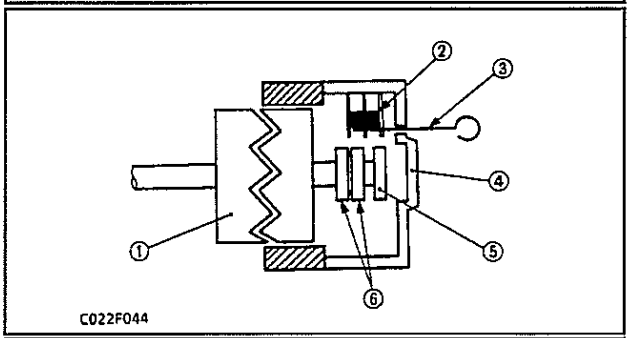
(When Reassembling)

1. Install the rotor, lifting up on the brushes with a wire through the access hole.

(1) Rotor
(2) Brush
(3) Wire
(4) End Frame
(5) Bearing
(6) Slip Ring



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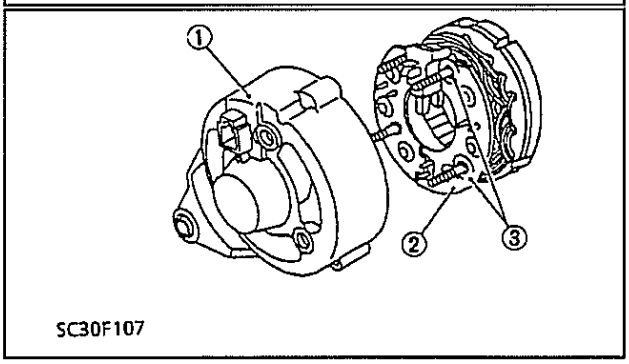
Recifier

1. Remove the nuts.
2. Remove the end cover (1).
3. Remove the recifier (2).

When Reassembling)

1. Be sure to install the insulation washer (3) on the bolt at the positive diode side.



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Slip Ring

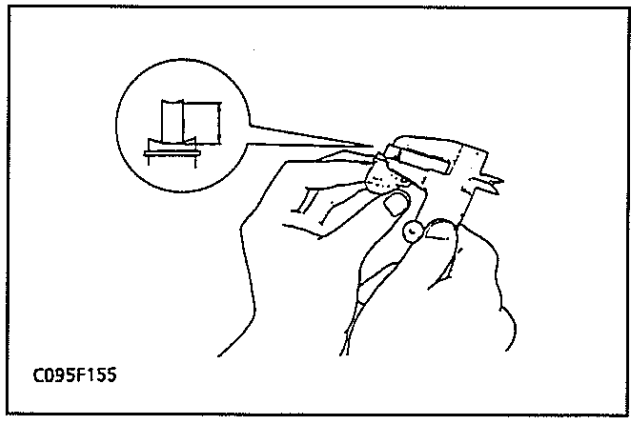
1. Check the slip ring for score.
2. If scored, correct with sandpaper or a lathe.

Slip Ring O.D.	Factory Spec.	32.5 mm 1.2795 in.
	Allowable Limit	32.1 mm 1.2638 in.

Brush Wear

1. Check the length of the brush. If the length is shorter than the allowable limit, replace.
2. Make sure that the brush moves smoothly.
3. If the brush is defective, replace.

Brush Length	Factory Spec.	12.5 mm 0.4921 in.
	Allowable Limit	5.5 mm 0.2165 in.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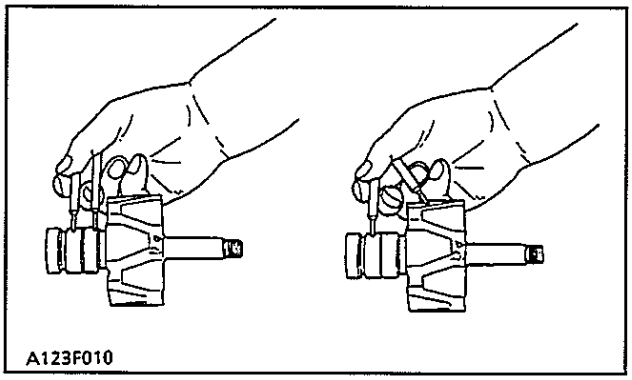
Rotor Coil

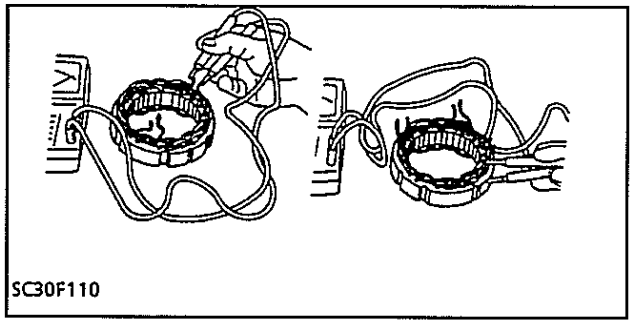
1. Check the continuity across the slip ring and core with an ohmeter.
2. If conduct, replace.
3. Measure the resistance across the slip rings.
4. If the resistance is 0 ohms, replace.

RESISTANCE - 4 ohms


A123F010

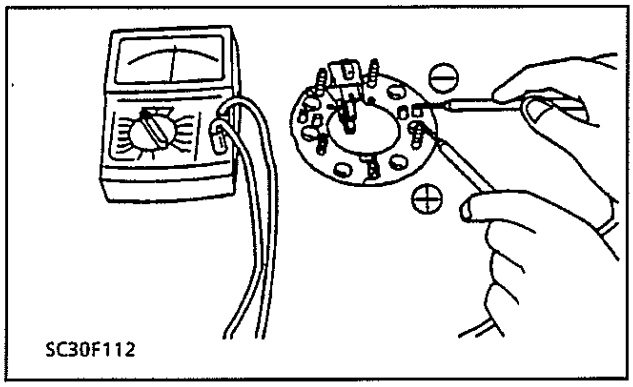
Stator Coil

1. Check the continuity across each lead of the stator coil with an ohmmeter.
2. If it does not conduct, replace.
3. Check the continuity across each stator coil lead and core with an ohmmeter.
4. If it conducts, replace.


SC30F110

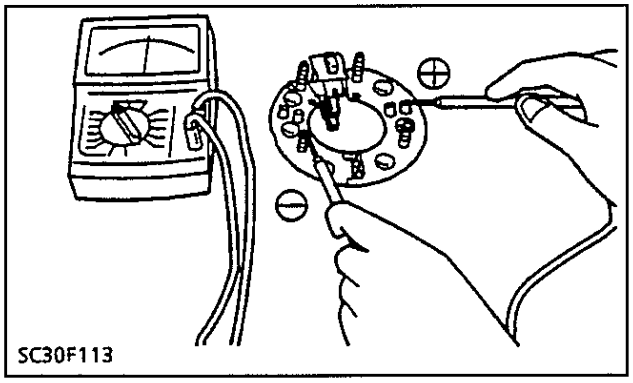
Positive Diodes

1. Connect the positive lead of the ohmmeter to the M6 screw and the negative lead to each coil connecting terminal and check the continuity.
2. If a certain valve is not indicated, replace the diode assembly.
3. Interchange the connection of the leads and check the continuity.
4. If any valve is indicated, replace the diode.



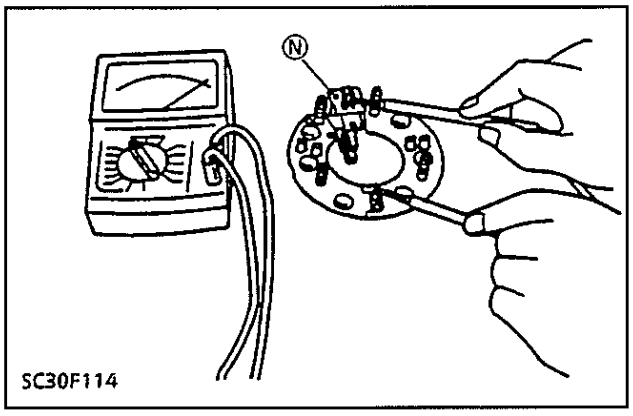
Negative Diodes

1. Connect the positive lead of the ohmmeter to the M5 screw and the negative lead to each coil connecting terminal and check the continuity.
2. If a certain valve is not indicated, replace the diode assembly.
3. Interchange the connection of the leads and check the continuity.
4. If any valve is indicated, replace the diode.



"N" Terminal and Coil Connection

1. Check the continuity across "N" terminal and coil connecting terminals (inside) with an ohmmeter.
2. If it does not conduct, replace.



5.6 *ELECTRICAL PANEL*

The loader is equipped with a 12 volt, negative ground electrical system. The fuse and relay panels are located in the engine compartment just in front of the battery box. The panel consists of the following:

1. Glow Plug Relay
2. Starter Relay
3. Fuse Panel
5. Electrical Fuel Solenoid Shuttoff
6. Spare
7. Spare
8. Spare
9. Seatbelt Warning
10. Horn (optional)
11. Spare
12. Solenoid Auxiliary Hydraulics

The Safety system consists of integrated, seat and lap belt switches as well as a restraint bar switch and valve lock switches and solenoids.

The loader will start with the bar in the up position with no operator and the lap belt not fastened, however this is for service procedures only. The foot pedals and control levers will remain in the locked position. When the operator is in the seat with the lap belt fastened and the restraint bar down, all funtions should be operational at this time.

If one of these functions fail to operate, see section 5.4.3.

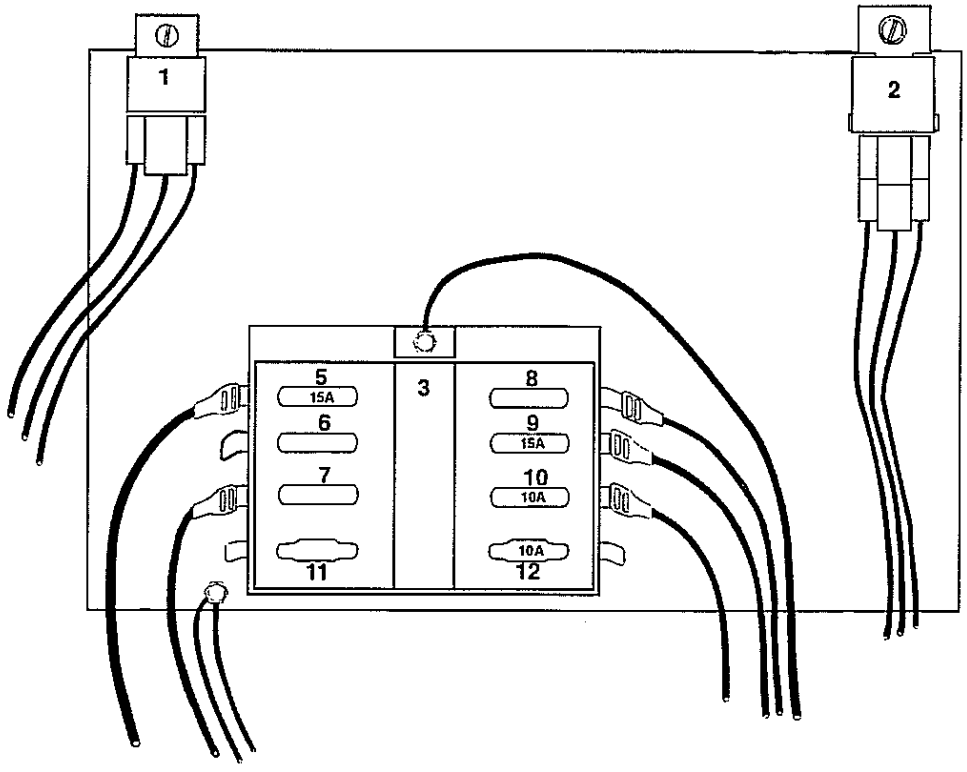


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Fig. 5.3.5a

5.7 TROUBLESHOOTING: STARTING SYSTEM

PROBLEM	CAUSE	CORRECTIVE ACTION	SECTION
Starter will not engage	Battery discharged	Check and charge battery or replace	5.3
	Loose or disconnected wiring	Check and repair	
	Defective starter switch	Check and if necessary replace	5.2.8
	Defective solenoid	Check and if necessary replace	
	Defective starter	Check and if necessary replace	
Starter motor turns but does not engage	Defective overrunning clutch or low battery	Replace	4.1.2
Pinion engages but starter motor does not turn over	Defective starter	Check and if necessary replace	
	Defective solenoid	Check and if necessary replace	
Starter motor rotates at full speed before pinion engages	Defective pinion spring	Replace	3.1.3
Starter does not disengage after engine starts	Faulty ignition switch	Check and if necessary replace	5.2.8
	Defective solenoid	Check and if necessary replace	

5.7 TROUBLESHOOTING: CHARGING SYSTEM

PROBLEM	CAUSE	CORRECTIVE ACTION	SECTION
Battery low in charge or discharge	Drive belt slipping	Adjust	
	Defective Battery	Check and if necessary replace	5.3

5.7 TROUBLESHOOTING - CHARGING SYSTEM

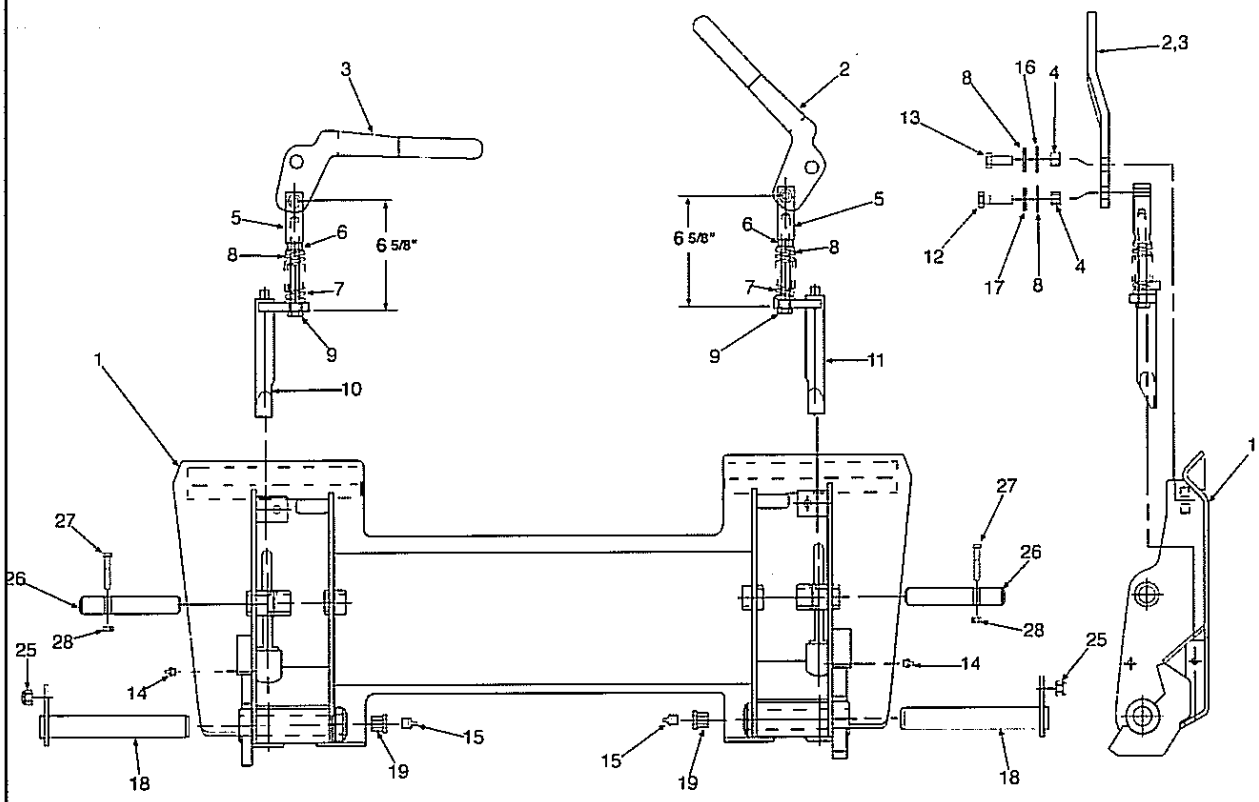
PROBLEM	CAUSE	CORRECTIVE ACTION	SECTION
Battery low in charge or discharge.	Faulty wiring or connections	Check and repair	
	Defective Regulator	Check and if necessary replace	
	Dirty alternator slip rings or brushes	Check and repair	
Alternator overcharging and battery overheats	Defective battery	Check and if necessary replace	5.3
	Defective voltage regulator	Check and if necessary replace	
	Defective alternator	Check and if necessary replace	3.2
Low or no output from alternator	Drive belt slipping	Adjust	7.3.5
	Faulty wiring or connections	Check and if necessary repair or replace	5.2.2
	Defective voltage regulator	Check and if necessary replace	5.2.2
	Defective alternator	Check and if necessary repair or replace	
	Defective recitfier	Check and if necessary repair or replace	
Charge indicator lamp dims	Faulty wiring or connections	Check and repair	
	Dirty alternator slip rings or brushes	Check and repair	
Charge indicator goes out but becomes brighter with increased speed.	Faulty wiring or connections	Check and repair	
Charge indicator lamp is "ON" with the engine running	Drive belt slipping	Adjust	7.3.5
		Perform alternator voltage output test	
		Perform alternator current output test	

5.7 *TROUBLESHOOTING - LOCKING MECHANISM*

PROBLEM	CAUSE	CORRECTIVE ACTION	SECTION
Park brake on with the restraint bar down	Park brake light switch out of adjustment or defective	Remove seat and seat plate Adjust switch	
	Axles have too much end play	Check switch located under the side panel on left side of machine. Adjust or replace if necessary	
Foot pedal locks will not release	Safety switch out of adjustment or defective. Defective relay Defective solenoid Short in wire harness	Remove seat and seat plate Adjust switch	
		Check the safety switch located on the pintle lock rod at the bulkhead, when the restraint bar is completely down. The switch should be fully depressed against the bulkhead. If not adjust.	
		Check continuity of safety relay located in the electrical panel	
		Check wire connections at the solenoid lock on the control valve	

SECTION 6
Main Frame

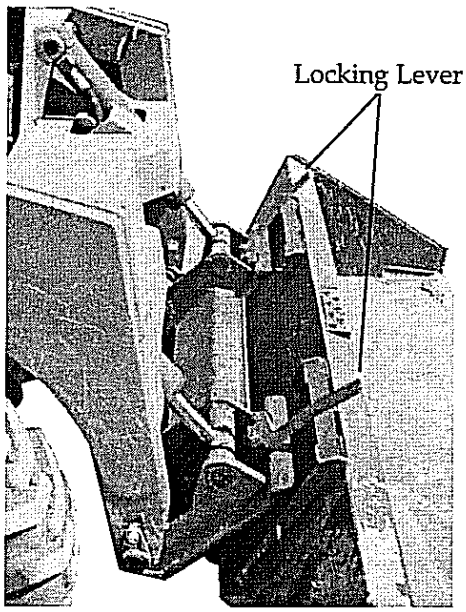
6.1 *QUICK* - TACH ASSEMBLY



1. Welded Assy
2. Handle, RH
3. Handle, LH
4. Bushing
5. Linkage Block
6. Nut
7. Spring
8. Washer, Flat
9. Bolt
10. Pin, Lock LH
11. Pin, Lock RH
12. Bolt
13. Bolt
14. Grease Fitting
15. Grease Fitting
16. Washer, Spring
17. Washer, Lock
18. Pin Assy
19. Bushing, Bi-Rod
25. Nut
26. Pin
27. Bolt
28. Nut

Fig. 6.1

6.1.1 QUICK - TACH OPERATION



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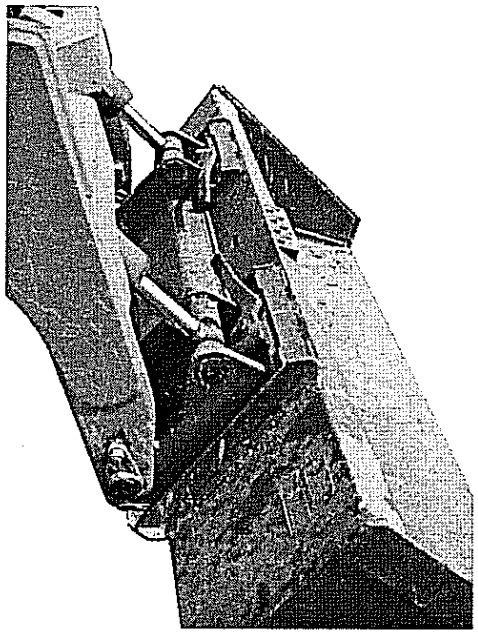

C-661p

Fig.6.1.1

The Quick - Tach which is standard equipment allows changing from one attachment to another quickly without having to remove bolts or pins.

To operate, disengage the safety lock and lift the locking lever (Fig. 6.1.1) up to completely retract the lock pins. Tilt the quick - tach frame forward with the bucket tilt cylinders and drive into the attachment. Retract the bucket tilt cylinders which will line up the bottom of the attachment with the quick - tach lock pins. Push the locking lever down, extending the lock pins and safety lock. Before operating ensure that the lock pins and safety lock are fully engaged.

6.1.2 QUICK - TACH PREVENTATIVE MAINTENANCE

To keep the quick - tach locking pins and linkage working freely and to prevent pin and bushing wear the quick - tach must be lubricated every eight (8) hours. More often in dirty applications.

Lubricate the quick - tach as follows:

1. Remove the attachment from the loader quick - tach.

2. Clean any dirt build up around the linkage assembly inside the the quick - tach.

3. Lubricate the grease fittings on each of the lock pin bushings with a good quality multi-purpose lithium based grease until excess shows (Fig. 6.1.2a).

4. Lubricate the grease fitting on the quick - tach lock handle bushing (Fig. 6.1.2b).

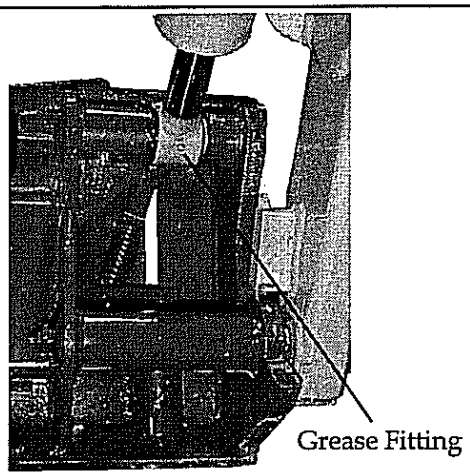

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Fig. 6.1.2b

6.1.3 QUICK - TACH REMOVAL

1. Start the engine. Raise the lift arms. Place blocking under the rear of the quick - tach frame is supported by the blocking (Fig. 6.1.3a).

2. Tilt the quick - tach forward until the front of the frame rests on the ground.

WARNING

To avoid personal injury stop the engine, engage the parking brake and cycle the foot pedals to ensure they are locked before getting out of the loader.

3. Shut off the engine and engage the parking brake. Cycle the foot pedals to relieve any hydraulic pressure in the system.

WARNING

To avoid eye injury wear safety goggles and always use a brass drift and hammer to remove or install pins.

4. Remove the locknut and lockbolt from the tilt cylinder rod end pins (Fig. 6.1.3a).

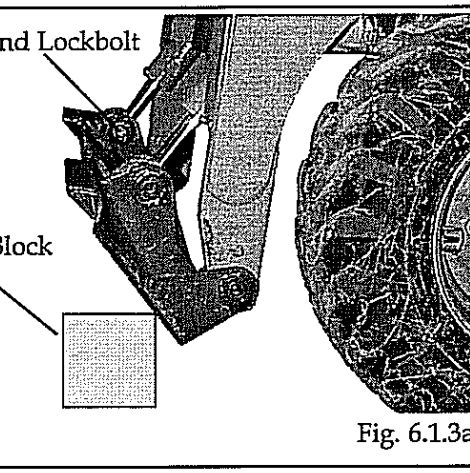

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Fig. 6.1.3a

5. Using a hammer and punch (Fig. 6.1.3b), remove the tilt cylinder rod end pivot pins.

6. Remove the lunch pin and washer from the boom hinge pin.

7. Using a hammer and punch remove the boom hinge pin.

8. Remove the quick - tach from the lift assembly.

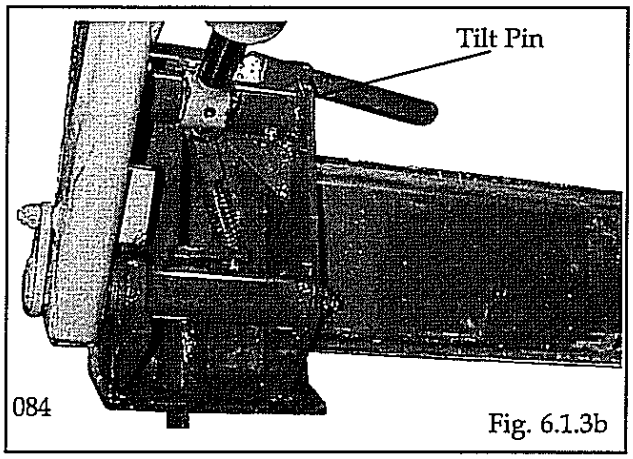

Fig. 6.1.3b

6.1.4 QUICK - TACH ASSEMBLY

1. Place the linkage block in the vise.

2. Insert the retaining bolt through the locking pin.

3. Install the spring, flat washer and jam nut.

4. Thread the retaining bolt into the linkage block and adjust until there is tension on the spring.

5. Install the locking pin assembly into the quick - tach lock pin bushing.

6. Install the retaining bolt through the linkage block and handle assembly.

7. Cycle the locking handle to ensure correct engagement and sufficient pressure to hold the over-centre handle in position. (See Fig.6.1).

6.1.5 QUICK - TACH DISASSEMBLY

1. Remove the bolt from the locking handle linkage block.

2. Pull the linkage block spring and pin assembly straight up.

3. Place the linkage block in the vise and loosen the 1/2 in. UNC jam nut.

4. Remove the retaining bolt and flat washer and spring.

6.1.6 *QUICK - TACH INSTALLATION*

1. Put a floor jack under the quick - tach. Position the quick - tach between the lift arms.

2. Raise the quick - tach with the floor jack and line up the boom hinge bushing with the rear quick - tach bushings.

3. Lubricate and install the boom hinge pins (Fig., 6.1.6a).

4. Install the washer and nut in the boom hinge pin retainer.

5. Extend the tilt cylinders until the cylinder rod end bushings line up with the quick - tach bushings.

6. Install the tilt cylinder rod end pivot pins (Fig. 6.1.6b).

7. Install the pivot pin lock bolts and lock nuts (Fig. 6.1.6b).

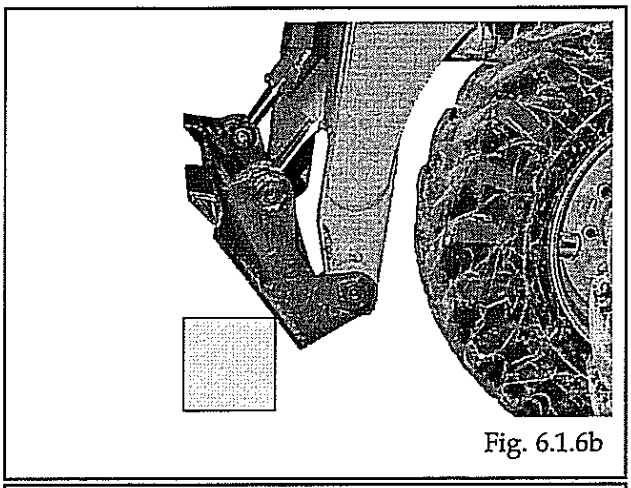

Fig. 6.1.6b

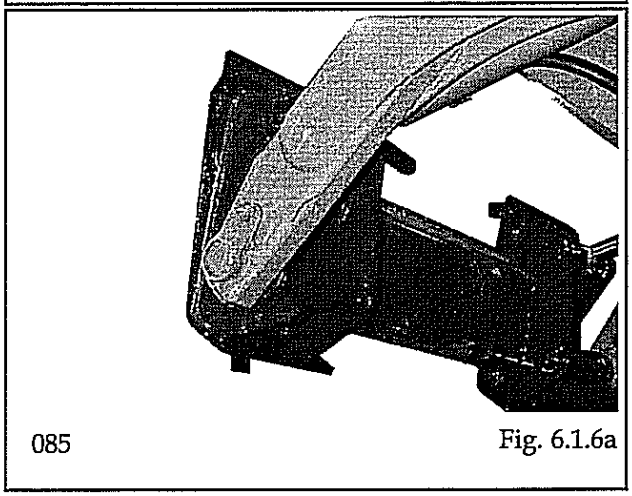

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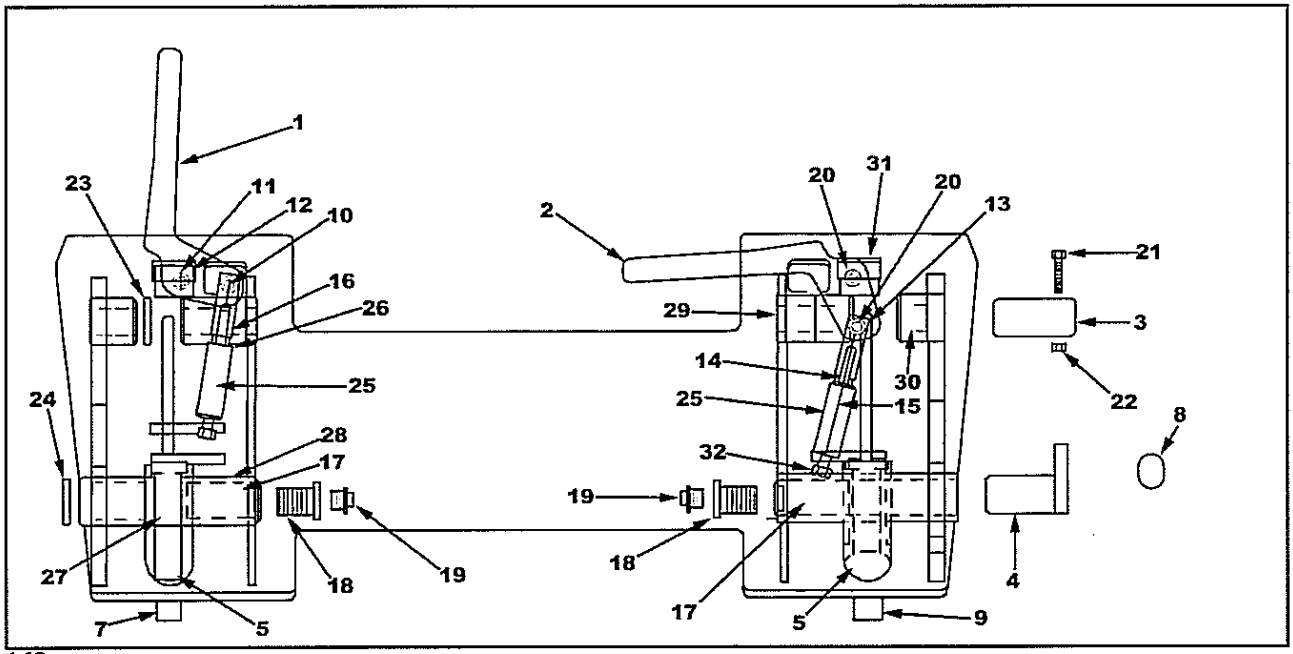
Fig. 6.1.6a

6.1.7 *UNIVERSAL QUICK - TACH*

1. LH Handle
2. RH Handle
3. Pin
4. Pin Assy
5. Bushing, Pin Guide
7. LH Lock Pin
8. Nut
9. RH Lock Pin
10. Bolt
11. Washer
12. Bolt
13. Linkage Block
14. Nut
15. Spring
16. Lock Washer
17. Hardened Bushing
18. Reducer Bushing
19. Grease Fitting
20. Spacer Bushing
21. Bolt
22. Nut
23. Washer
24. Washer
25. Bushing, Sprg Stabilizer
26. Washer
27. Grease Nipple
28. Hinge, Bushing
29. Bushing, Inside Tilt
30. Bushing, Outside Tilt
31. Bar, Handle Mt.
32. Nut



6.1.8 *QUICK - TACH DISASSEMBLY*

1. Remove the bolt from the locking handle linkage block.
2. Pull the linkage block spring and pin assembly straight up.
3. Place the linkage block in the vise and loosen the 1/2 in. UNC jam nut.
4. Remove the retaining bolt and flat washer and spring.

6.1.9 *QUICK - TACH ASSEMBLY*

1. Place the linkage block in the vise.
2. Insert the retaining bolt through the locking pin.
3. Install the spring, flat washer and jam nut.
4. Thread the retaining bolt into the linkage block and adjust until there is tension on the spring.
5. Install the locking pin assembly into the quick - tach lock pin bushing.
6. Install the retaining bolt through the linkage block and handle assembly.
7. Cycle the locking handle to ensure correct engagement and sufficient pressure to hold the over - centre handle in position.

6.2. *BOOM ARMS*

6.2.1 *BOOM ARMS - REMOVAL*

When securing or hoisting your **Thomas** Loader, use chains and slings approved for hoisting and securing loads minimum 3/8 in. grade 40.

1. Stop the engine and cycle the foot pedals to relieve any hydraulic pressure in the system.
2. Remove the quick - tach assembly from the boom arms (see section 6.1.3).
3. Fasten chains and a chain hoist to the lift arms (Fig. 6.2.1a).
4. Put a floor jack under the boom arms (Fig. 6.2.1b).

   Lock the boom lift foot pedal in float position (see section 4.2.1).
5. Raise the boom arms until the pivot pins in the rod end of the boom cylinders can be removed.

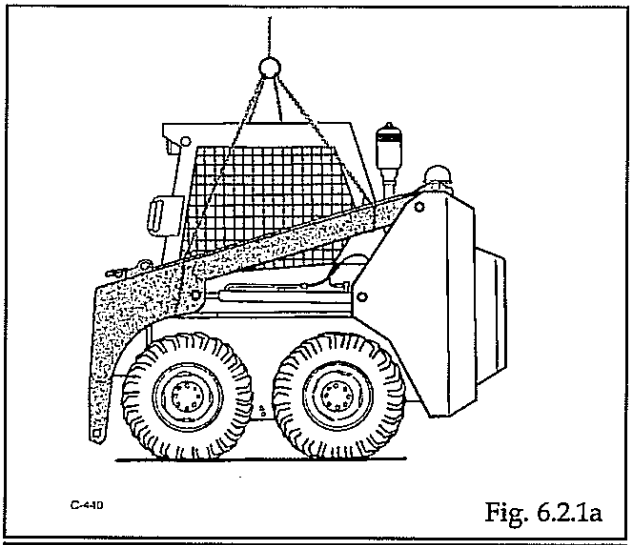


Fig. 6.2.1a

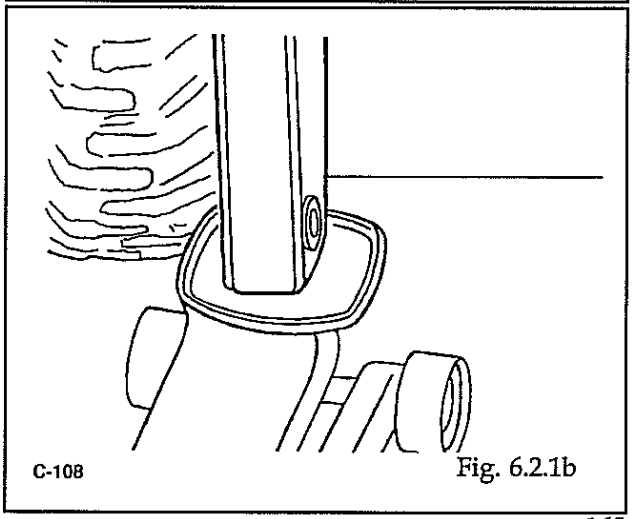


Fig. 6.2.1b

6. Remove the locknuts and lock bolts from the rod end pivot pins (Fig. 6.2.1c).

WARNING To avoid eye injury wear safety goggles and always use a brass drift and hammer to remove or install pins.

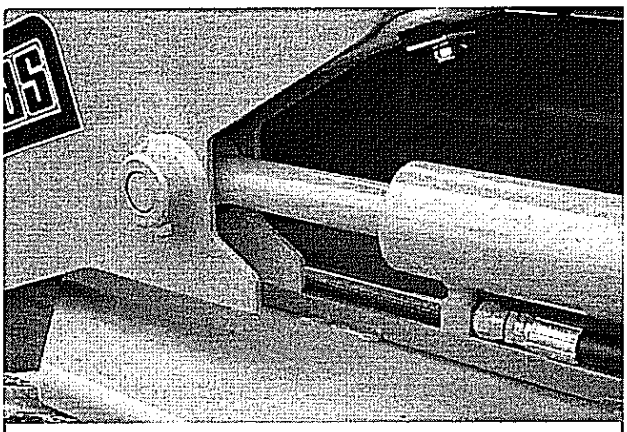


Fig. 6.2.1c

7. Remove the boom cylinder rod end pivot pin (Fig. 6.2.1d). Place a support under the boom cylinder to prevent the cylinder from falling when the pin is removed.

8. Lower the lift arms and remove the floor jack.

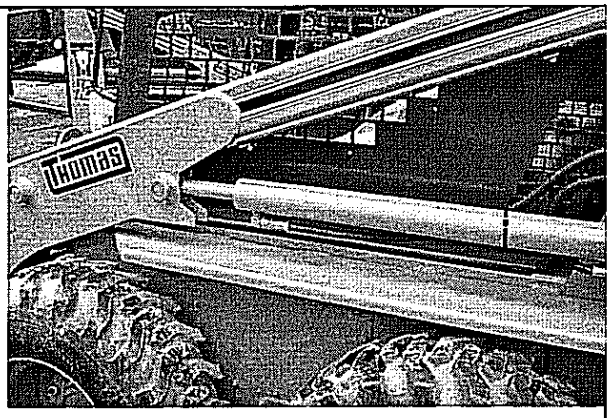


Fig. 6.2.1d

9. Remove the locknuts and lock bolts from the rear boom pivot pins (Fig. 6.2.1e).

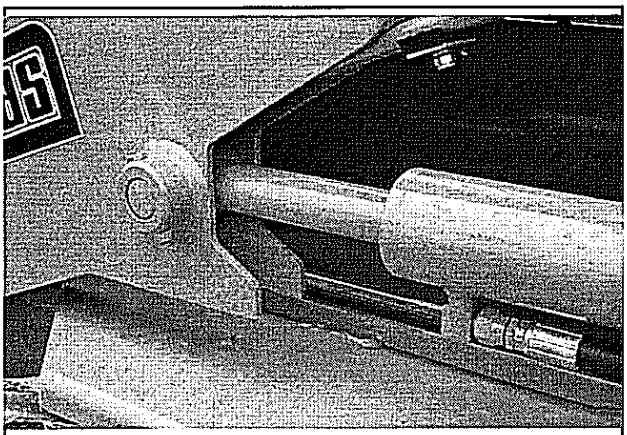


Fig. 6.2.1e

10. Tighten the chain hoist and remove the rear boom pivot pins (Fig. 6.2.1f).

11. Raise the boom arms with the chain hoist and remove from the loader.

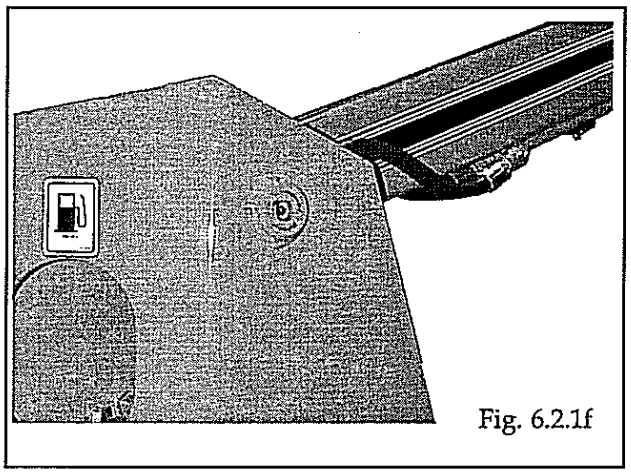


Fig. 6.2.1f

WARNING

To avoid eye injury wear safety goggles and always use a brass drift and hammer to remove or install pins.

6.2.2 BOOM ARMS - INSTALLATION

1. With a chain hoist, position the boom arms on the loader and align the boom arm and main frame pivot bushing.

2. Install the pivot pins in the main frame and boom arms.

3. Install the locknuts and bolts (Fig. 6.2.2a) in the boom pivot pins.

4. Lower the boom arms and remove the chain hoist and chains from the boom arms.

5. Align the lift cylinder rod end bushing and the boom arm pivot bushings.

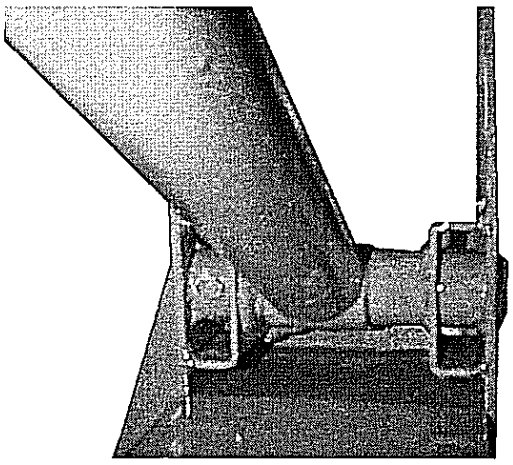


Fig. 6.2.2a

6. Coat with antisieze and install the pivot pins in the boom arms and lift cylinders (Fig. 6.6.2b).

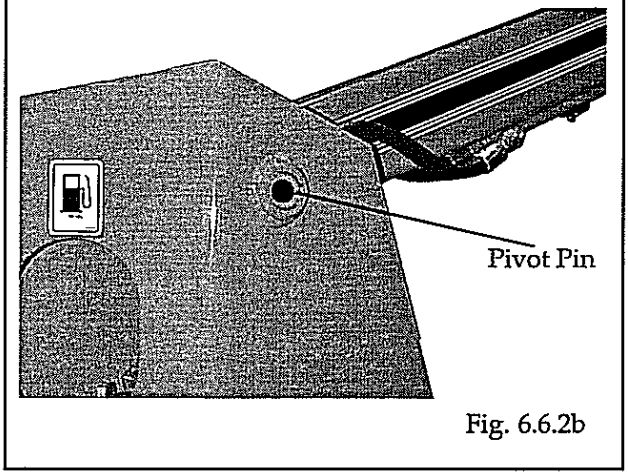


Fig. 6.6.2b

7. Install the locknuts and lock bolts in the lift cylinder pivot pins (fig. 6.6.2c).

8. Install the quick - tach assembly on the boom arms (see section 6.1.6).

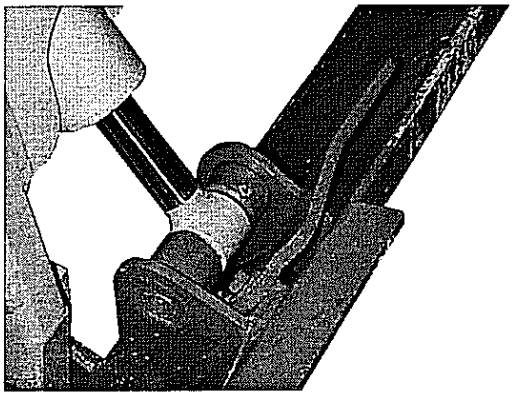
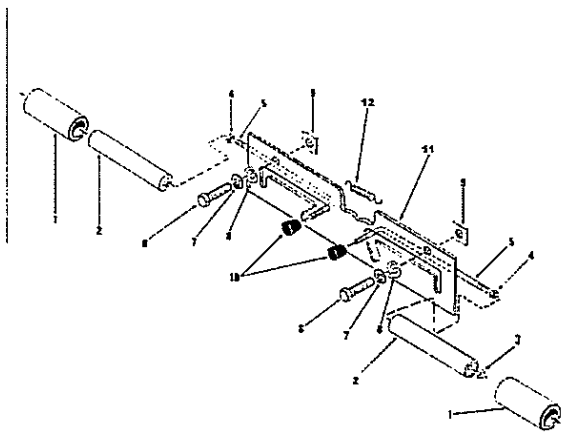


Fig. 6.6.2c

6.2.3 *BOOM SUPPORTS*

For safety while performing regular service or maintenance work the loader is equipped with boom supports (Fig. 6.2.3). The boom supports when extended prevent the boom from lowering when pressure is relieved or the control accidentally is cycled.

1. Secure the boom arms in the raised position.
2. Take measurements with boom support pins in the engaged position (Pins out).
3. Pins should protrude past the inner boom plate a minimum of 1/4 in.
4. Adjustments are made by:
   - a/ Remove the centre dash panel
   - b/ Remove the boom handle and pin assy.
   - c/ Loosen the jam nut.
   - d/ Turn the pin in or out on the engagement handle.
   - e/ Tighten the jam nut and reassemble.
   - f/ Take measurements and readjust if necessary.
   - g/ Lubricate the boom pin assy. (Every 8 Hrs)



See T173HLS II Parts Manual for Parts breakdown

Fig. 6.2.3

6.3 *OPERATOR GUARD (ROPS)*

6.3.1 *OPERATOR GUARD (ROPS) - REMOVAL*

1. Disconnect and remove the battery from the operator guard (ROPS). See section 5.3.2 for procedure.

2. Disconnect the battery cable from the starter motor solenoid.

3. Disconnect the engine wire harness from the ROPS wiring harness at the plug connections inside the engine compartment (Fig. 6.3.1a).

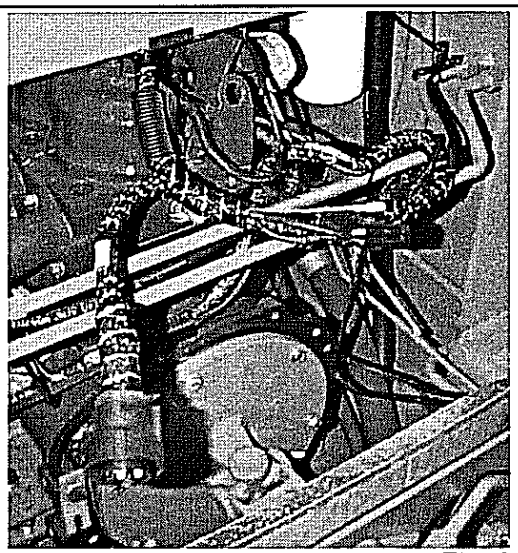


Fig. 6.3.1a

4. Disconnect the battery ground cable from the loader mainframe (Fig. 6.3.1b). Remove the ground cable from the loader.

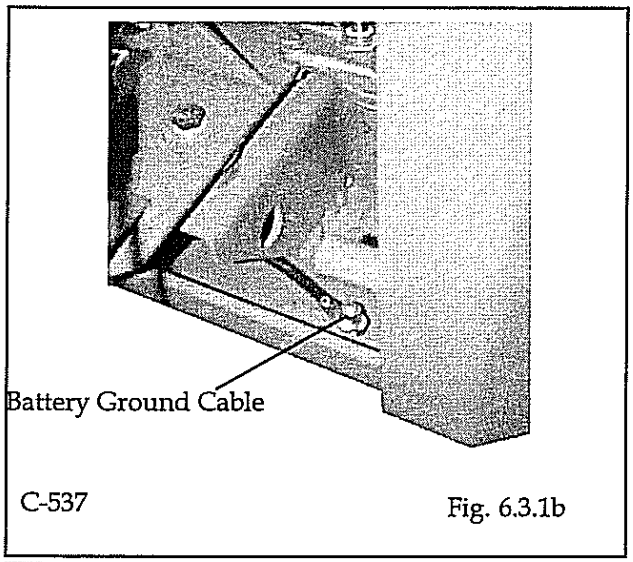


Fig. 6.3.1b

5. Remove the exhaust pipe and the exhaust pipe mount (Fig. 6.3.1c).

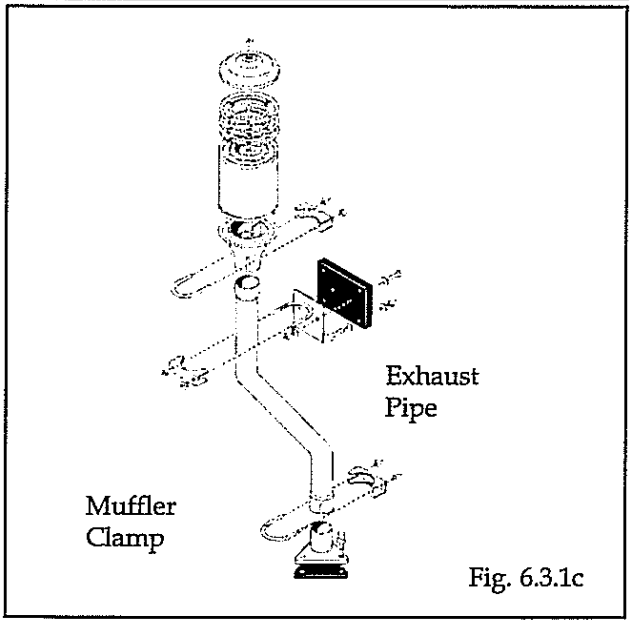


Fig. 6.3.1c

6. Remove the seat mount and seat assembly from the loader (Fig. 6.3.1d).Remove the fasteners located at the front of the seat. Disconnect the electrical plug. Lift the seat assembly out of the machine. When installing the seat, be sure the seatplate locks are in place at the rear.

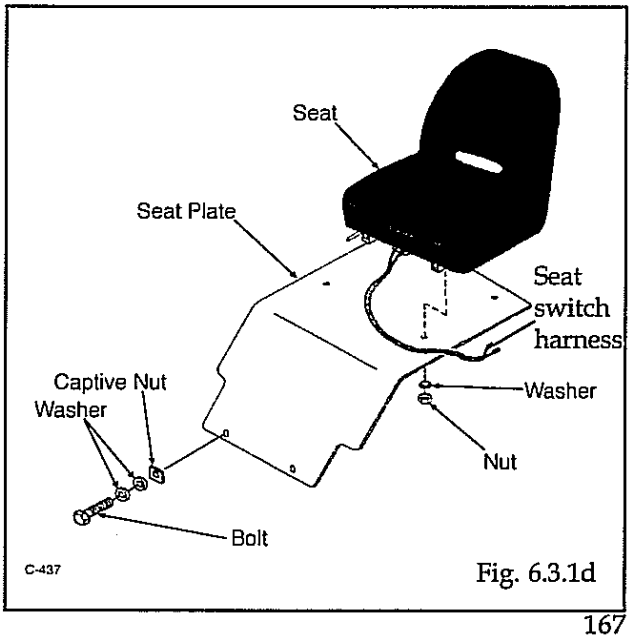


Fig. 6.3.1d

7. Remove the two (2) front ROPS isolator nuts. (Fig. 6.3.1e).

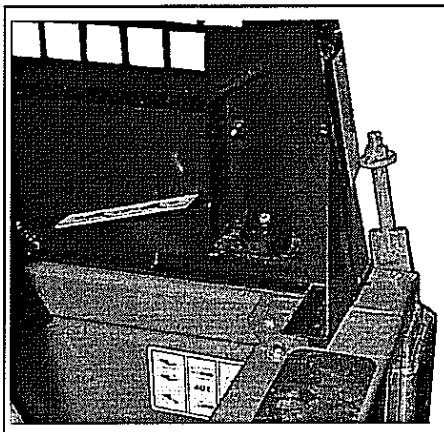


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Fig. 6.3.1e

8. Remove the two (2) rear ROPS isolator nuts (Fig. 6.3.1f).

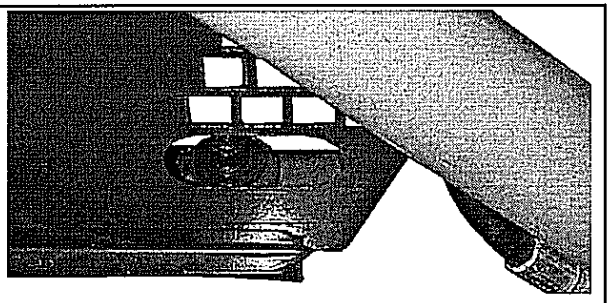

Fig. 6.3.1f

9. Attach chains and a chain hoist to the ROPS as shown in Fig. 6.3.1g. Remove the ROPS from the loader.

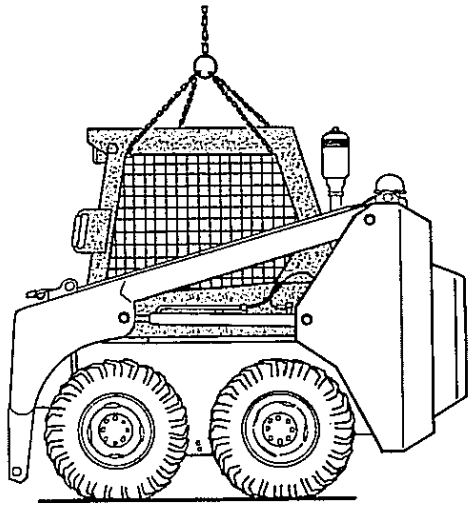

Fig. 6.3.1g

6.3.2 *OPERATOR GUARD (ROPS) - INSTALLATION*

1. Using a chain hoist raise the operators guard (ROPS) and install it on the main frame. Line up the front and rear isolator holes in the ROPS with the mounting holes in the main frame (fig. 6.3.2a).

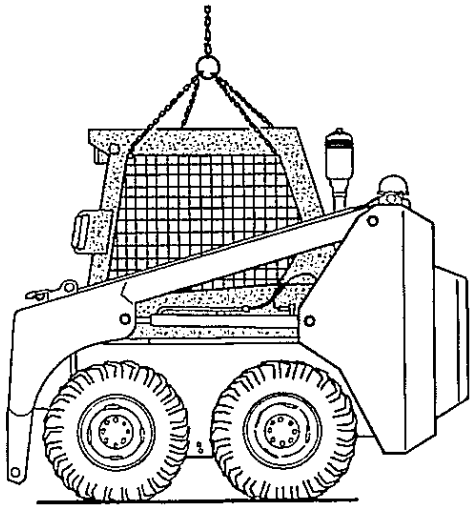

Fig. 6.3.2.a

2. Install the two (2) front isolators (Fig. 6.3.2b&c).

   Torque: 55 to 60 ft. lbs.

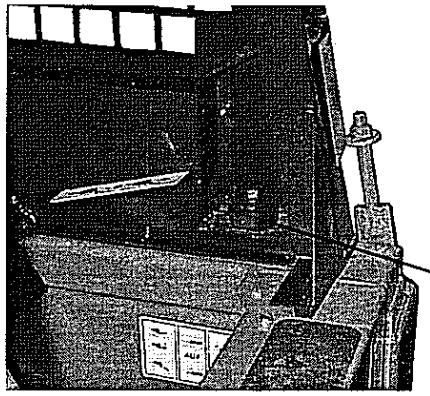

Fig. 6.3.2.b

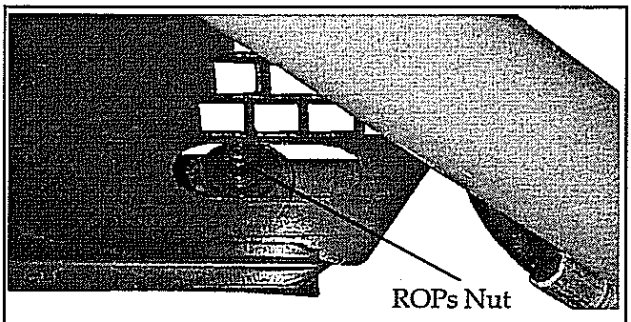

Fig. 6.3.2.c

3. Install the seat and seat mount assembly in the loader (Fig. 6.3.2d).

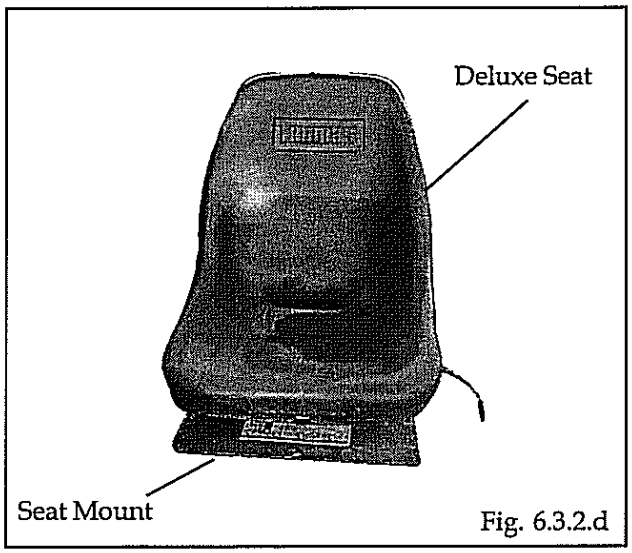

Fig. 6.3.2.d

6.4 *REAR DOOR*

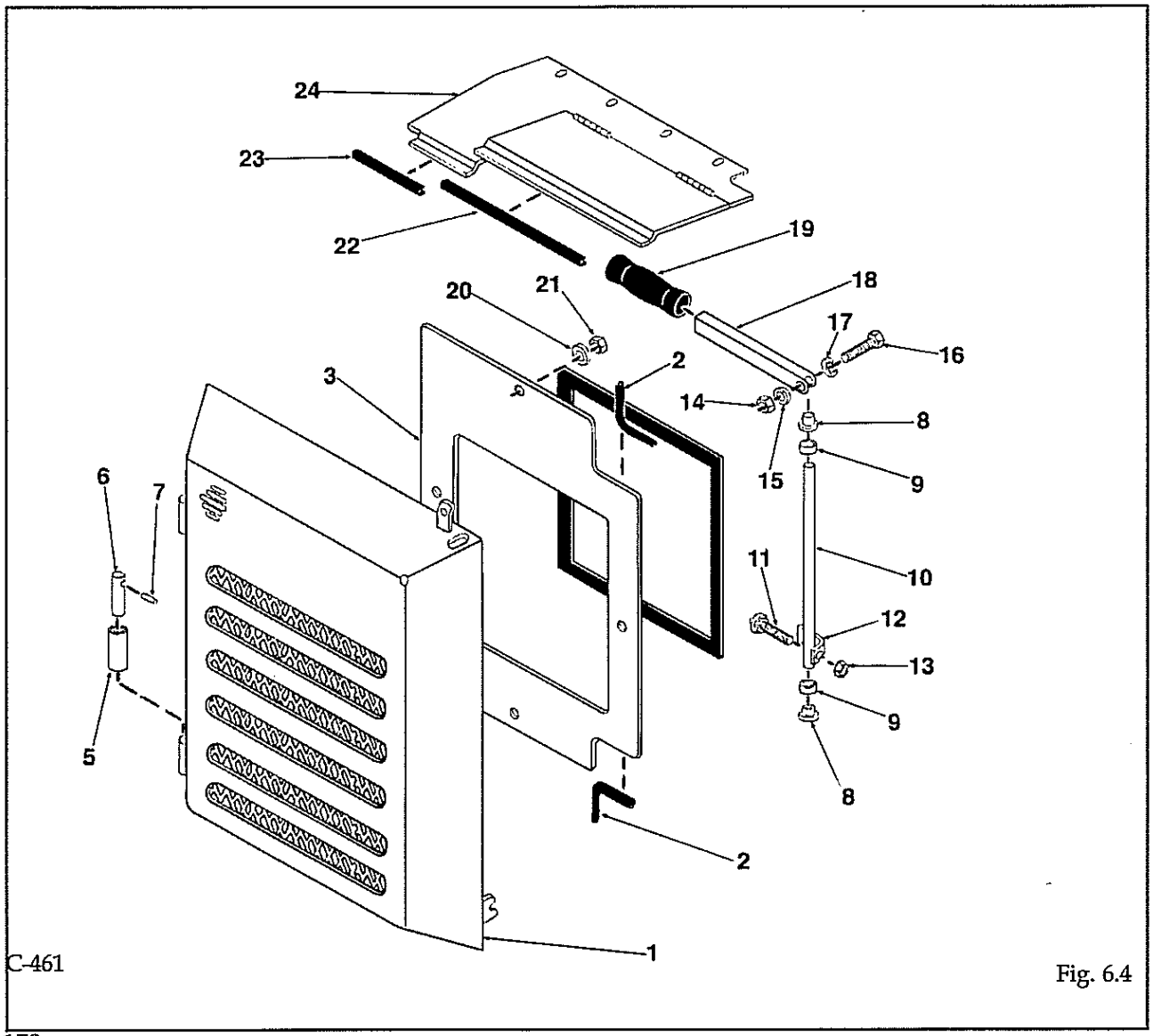

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Fig. 6.4

6.4.1 REAR DOOR REMOVAL

1. Remove the two (2) nuts securing the oil cooler to the rear door (Fig. 6.4.1a). Carefully lay the oil cooler with the hoses attached on the ground.

NOTE: If it is necessary to remove the hydraulic oil cooler from the loader the hydraulic oil reservoir must be drained.

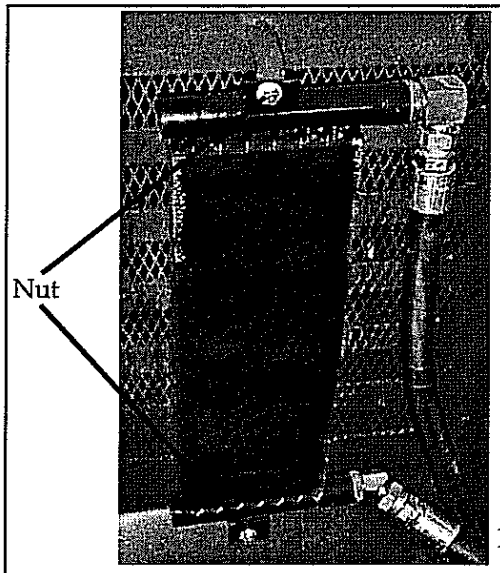

Fig. 6.4.1a

2. Attach chains and a chain hoist to the rear door (Fig. 6.4.1b). Lift the rear door with the chain hoist clear of the hinges. Remove the door from the loader.

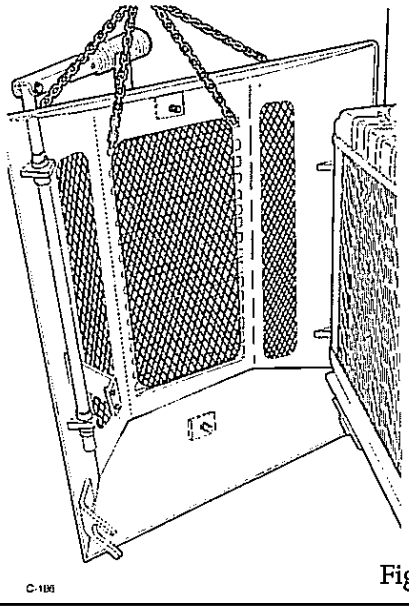
Fig. 6.4.1b

6.4.2 REAR DOOR - INSTALLATION AND ADJUSTMENT

1. Attach chains and a chain hoist to the rear door (Fig. 6.4.1b). Raise the rear door with the chain hoist and installthe rear door on the loader.

2. Install the hydraulic oil cooler on the rear door (Fig. 6.4.1a). Check that the hoses running to the oil cooler are not kinked or interfere when the door is opened or closed.

3. Adjust the set collar on the lock rod so that the lock rod lines up with the locking pin on the main frame (Fig. 6.4.2a).

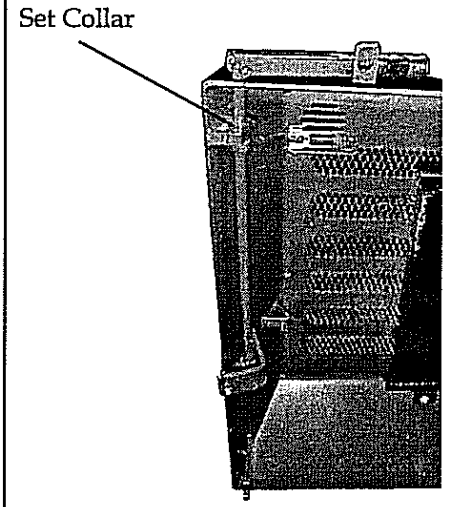

Fig. 6.4.2a

4. Set the lock adjustment brackets (Fig. 6.4.2b) so that the door when shut has an even gap all around the door. (Fig. 6.4.2c).

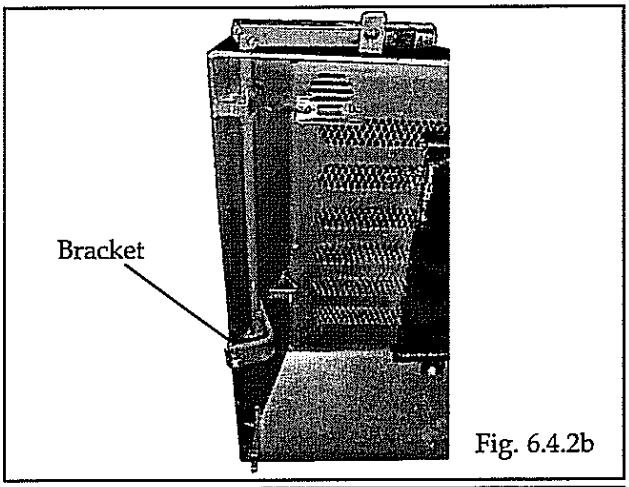

Fig. 6.4.2b

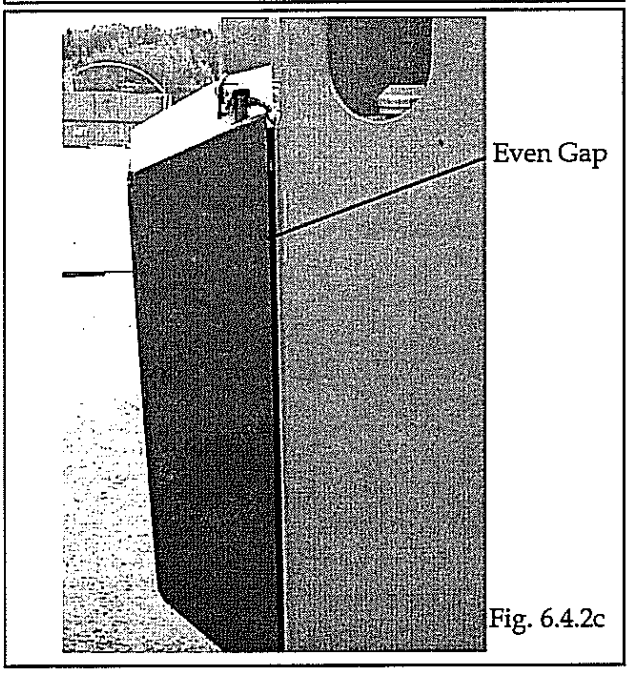

Fig. 6.4.2c

5. Set the door spring (Fig. 6.4.2d) so that when the door is shut the spring is compressed and there is approximately a 1/8 in. (3mm) gap between the adjustment nut and mounting bracket.

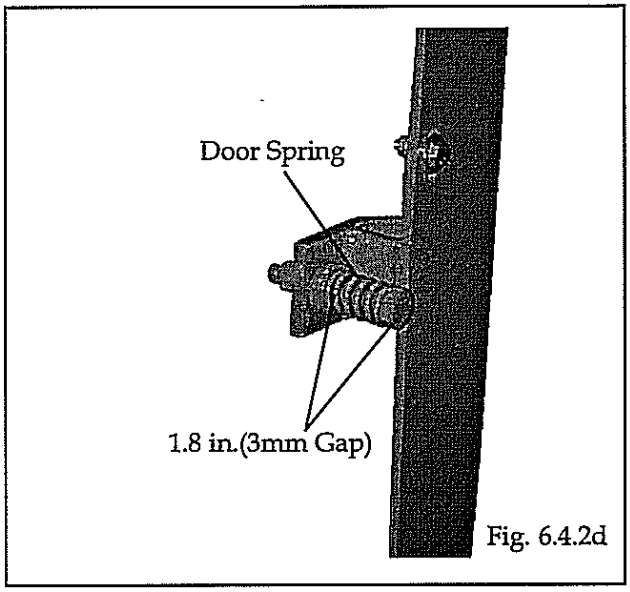

Fig. 6.4.2d

SECTION 7
Engine

SECTION 7
Engine (Continued)

7.1 ENGINE REMOVAL

7.1.1 ENGINE REMOVAL

1. Remove the engine compartment shield from the loader (Fig. 7.1.1a).

2. Disconnect the battery cables at the battery. Remove the negative or ground cable first.

3. Disconnect the battery cable from the starter motor solenoid.

4. Disconnect the engine wiring harness from the ROPS wiring harness at the plug connections inside the engine compartment (Fig. 7.1.1b).

5. Disconnect the hydraulic oil temperature sender wire from the sender on the oil reservoir (Fig. 7.1.1c). Be sure the wire is completely disengaged.

6. Disconnect the engine ground wire (Fig. 7.1.1d).

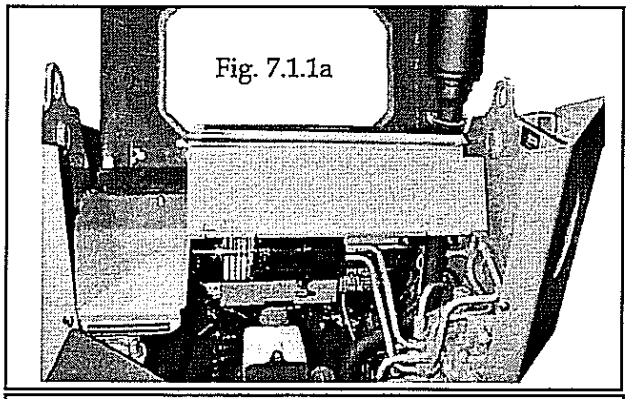

Fig. 7.1.1a

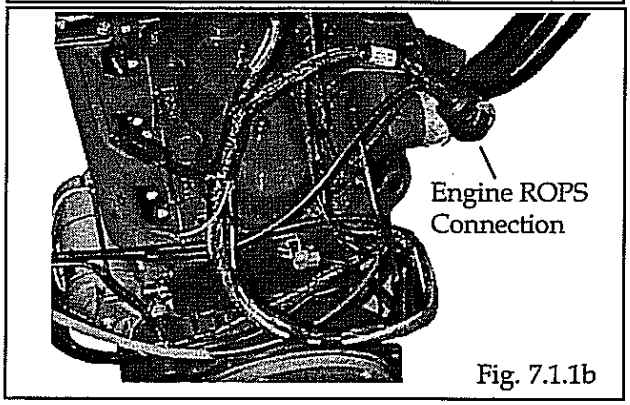

Fig. 7.1.1b

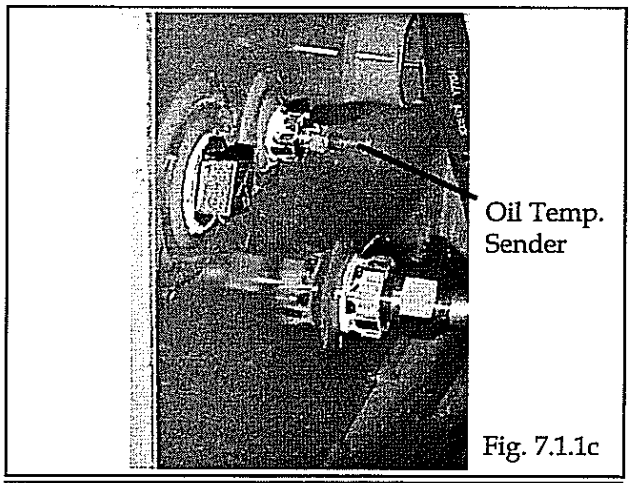

Fig. 7.1.1c

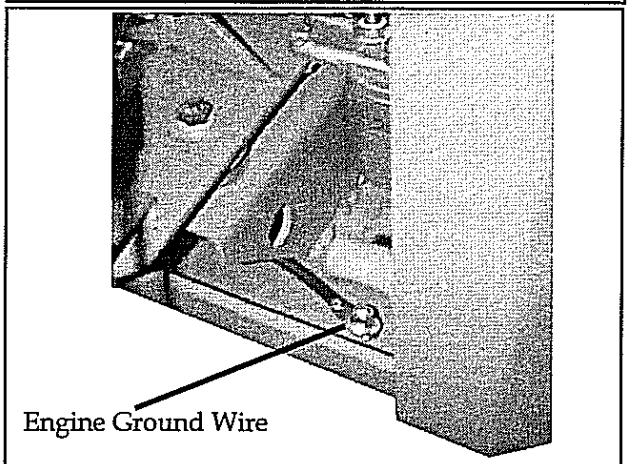

Fig. 7.1.1d

7. Shut off the fuel at the fuel tank (Fig. 7.1.1e).

8. Disconnect the fuel line at the filter inlet.

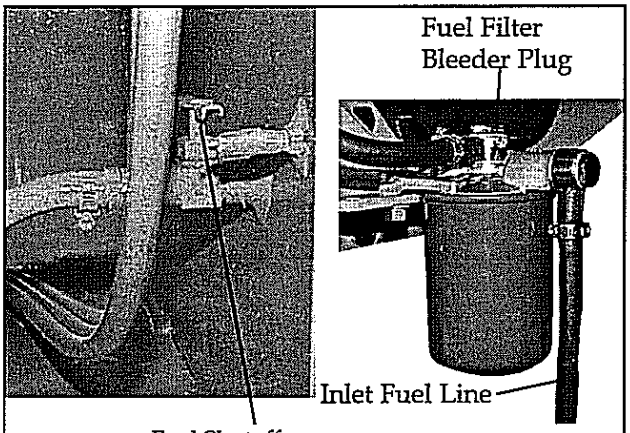

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Fig. 7.1.1e

9. Disconnect the fuel overflow line from the injector.

10. Remove the muffler exhaust assembly by disconnecting the lower muffler clamp (Fig. 7.1.1f).

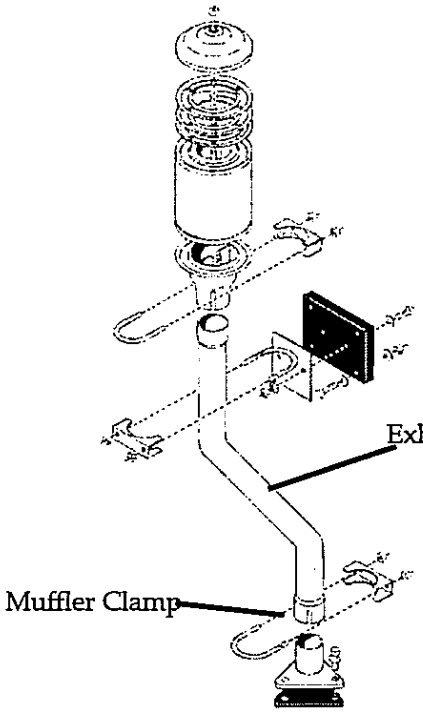


Fig. 7.1.1f

11. Disconnect the throttle control rod from the throttle lever assembly on the fuel injection pump (Fig. 7.1.1g).

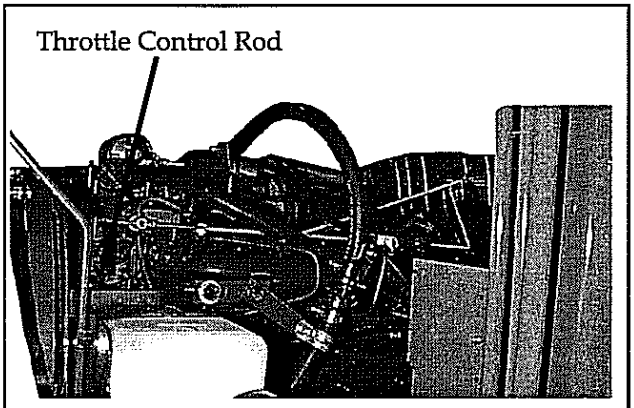


Fig. 7.1.1g

12. Remove the four (4) engine mounting bolts (Fig. 7.1.1h).

On reassembly torque bolts 60 ft. lbs. (81.3 N.M.)

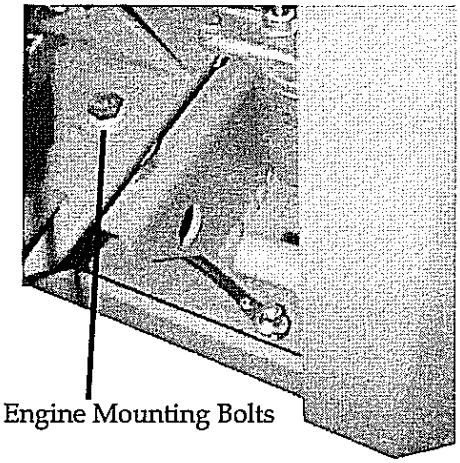


Fig. 7.1.1h

13. Connect chains to the lifting lugs located at the front and rear of the engine. Using a chain hoist lift the engine and remove it out through the rear of the loader main frame (Fig. 7.1.1i).

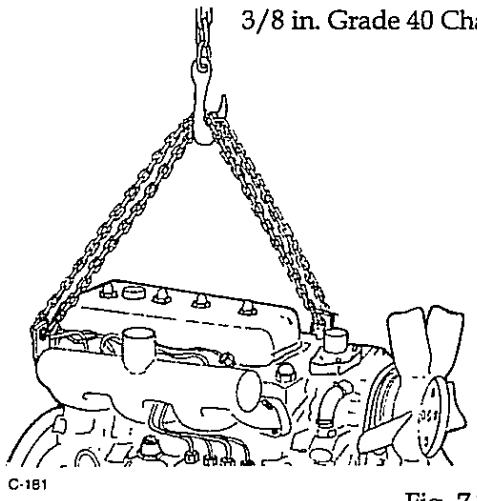


Fig. 7.1.1i

The double universal joint bolted to the engine flywheel is splined at the pump end.

The universal joint will slide off the pump shaft as the engine is removed (Fig. 7.1.1j).

Ensure all wires and connections are free from binding during the engine removal phase.

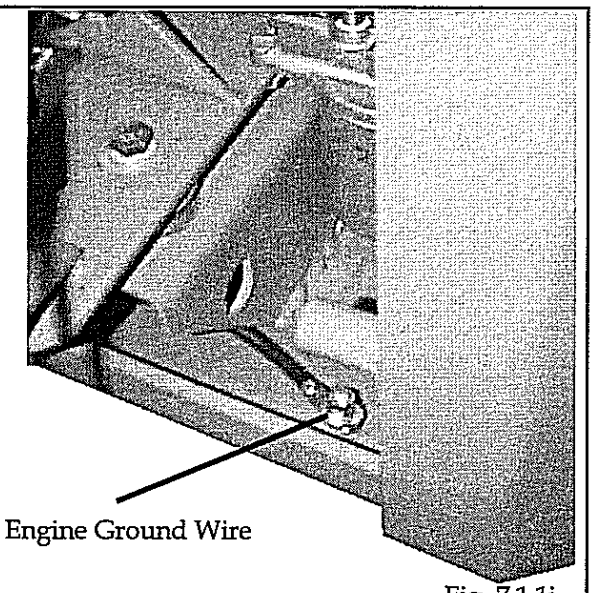


Fig. 7.1.1j

7.1.2 ENGINE INSTALLATION

1. Connect chains to the engine (Fig. 7.1.2a) at the lifting lugs mounted at the front and rear of the engine.

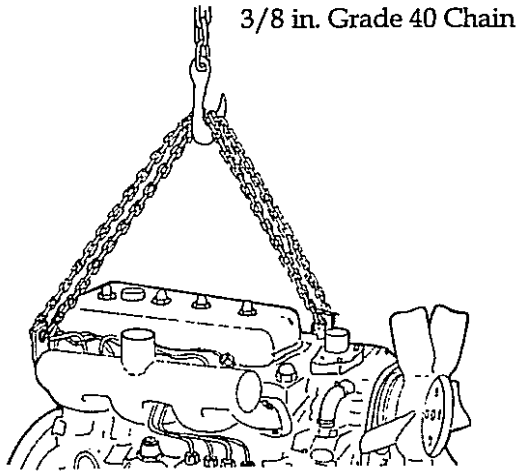


Fig. 7.1.2a

2. Using a chain hoist lift the engine and place it in the loader main frame. Line up the double universal joint with the hydrostatic drive pump as the engine is installed (Fig. 7.1.2b).

3. Install the engine isolators and engine mounting bolts. Visually check to ensure the spline coupler and pump shaft are fully engaged, showing at least 1/8 in. of protrusion. Torque the mounting bolts to 60 ft. lbs.

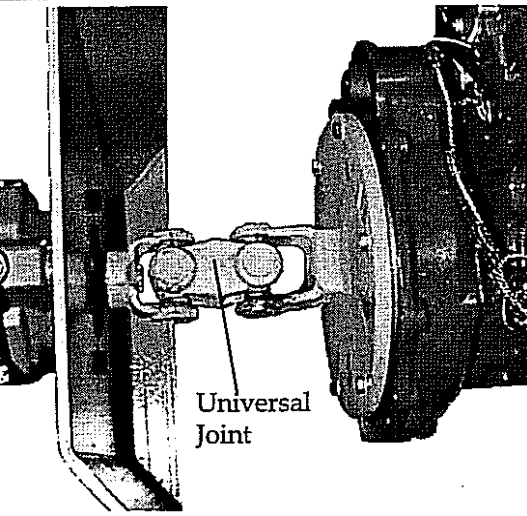


Fig. 7.1.2b

4. Connect the throttle control rod to the throttle lever assembly on the fuel injection pump (Fig. 7.1.2c).

   Refer to section 4.4.2 for throttle adjustment procedure.

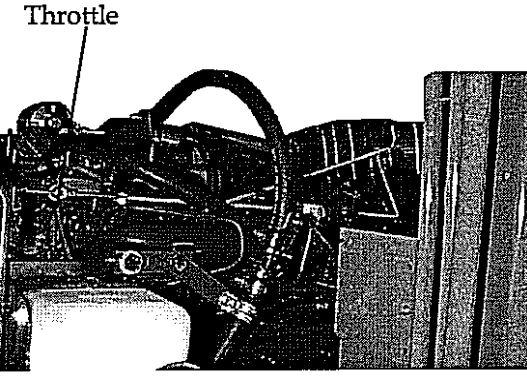


Fig. 7.1.2c

5. Install the muffler exhaust assembly.

6. Install the engine compartment shield.

7. Connect the hose between the air cleaner and the engine intake manifold.

8. Connect the fuel lines at the fuel filter and the injection overflow.

9. Open the fuel shutoff located on the fuel tank. It may be necessary to bleed air from the fuel system prior to starting the engine.

10. Connect the ground wire from the engine to the main frame (Fig. 7.1.2d).

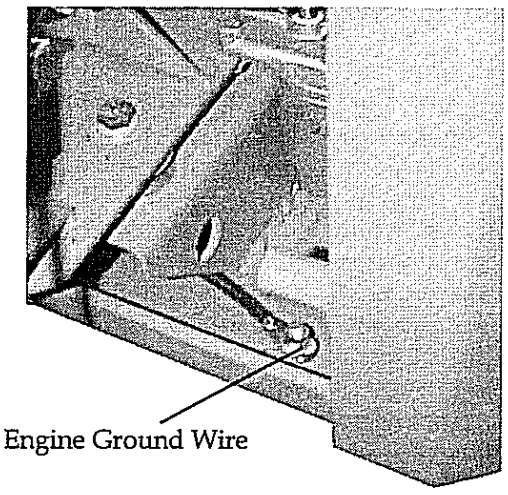


Fig. 7.1.2d

11. Connect the wire to the hydraulic oil temperature sender (fig. 7.1.2e).

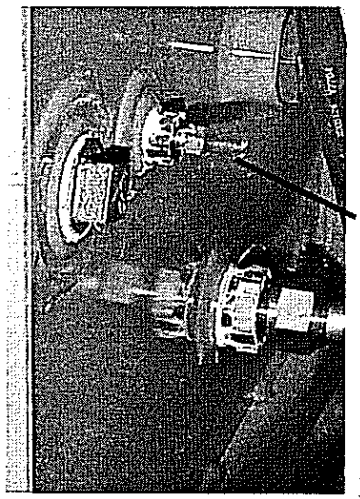


Fig. 7.1.2e

12. Connect the engine wiring harness with the ROPS wiring harness (Fig. 7.1.2f).

13. Connect the battery cable to the starter motor solenoid.

14. Connect the battery cables to the battery, ground wire last.

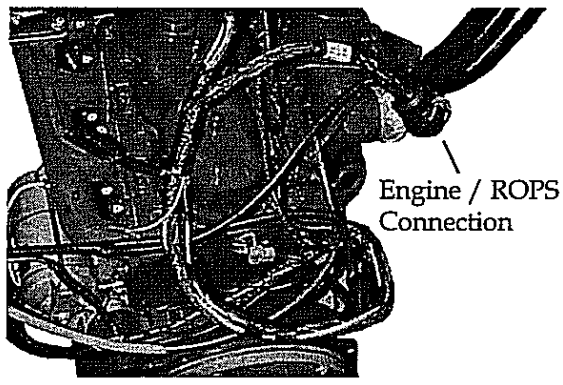


Fig. 7.1.2f

General Precautions

1. During disassembly, carefully arrange removed parts in a clean area to prevent confusion later. Screws, bolts and nuts should be placed in their original position to prevent reassembly errors.
2. When special tools are required, use Kubota genuine special tools. Special tools which are not frequently used should be made according to the the proper drawings.
3. Before disassembling or servicing live wires, make sure to always disconnect the grounding cable from the battery first.
4. Remove oil and dirt from parts before measuring.
5. Use only Kubota parts.
6. Gaskets and O-rings must be replaced during reassembly. Apply grease to new O-rings or oil seals before reassembly.
7. When reassembling external or internal snap rings, position them so that the sharp edge faces against the direction from which force is applied.
8. Be sure to perform run-in on the serviced or reassembled engine. Do not attempt to give heavy load at once, or serious damage may result to the engine.

7.1.3 DAILY CHECK POINTS

Checking Engine Oil Level

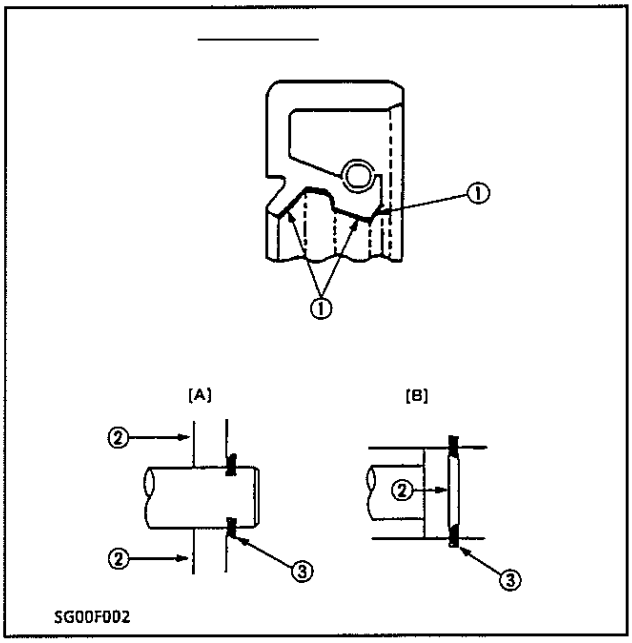
1. Level the engine.
2. To check the oil level, draw out the dipstick, wipe it clean, reinsert it and draw it out again. Check to see that the oil level lies between the two notches.
3. If the level is low, add new oil to the specified level.

Checking and Replenishing Cooling Waterl

1. Remove the radiator cap and check to see that the cooling water level is just bellow the port.
2. If low, add clean water and antifreeze.

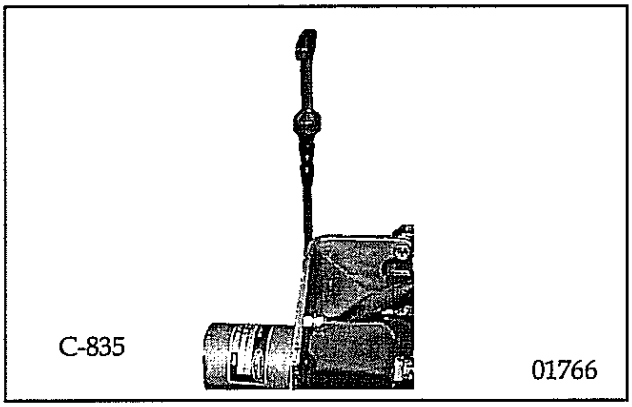
CAUTION

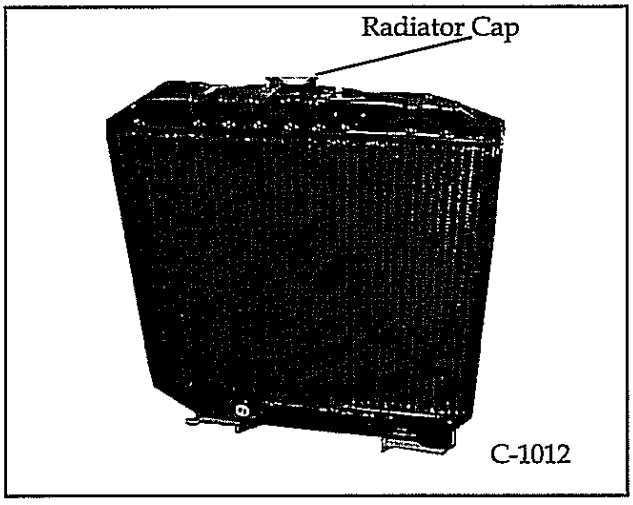
Do not remove the radiator cap until cooling water temp. is below the boiling point. Then, loosen the cap until pressure is relieved.



CAUTION

Certain components used in this engine contain asbestos (head-gaskets, exhaust gaskets) Handle with care.

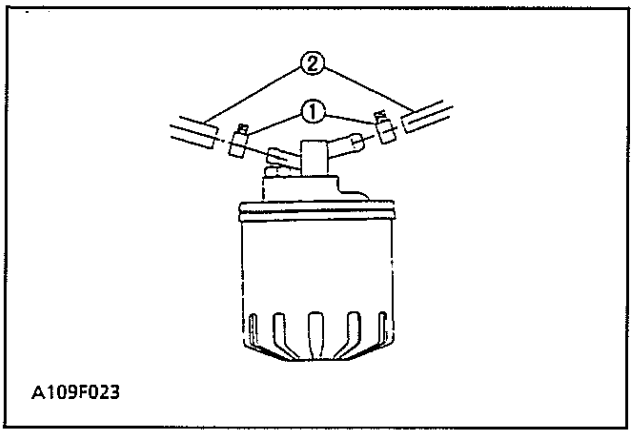




7.1.4 50 HOUR CHECK POINTS

Checking Fuel Pipe

1. If the clamp (1) is loose, apply oil to the threads and securly retighten it.
2. The fuel pipe (2) is made of rubber and ages regardless of the period of service. Change the fuel pipe together with the clamp every two years.
3. However, if the fuel pipe and clamp are found to be damaged or deteriorated earlier than two years, then change or remedy.
4. After the fuel pipe and the clamp have been



(1) Clamp
(2) Fuel Pipe

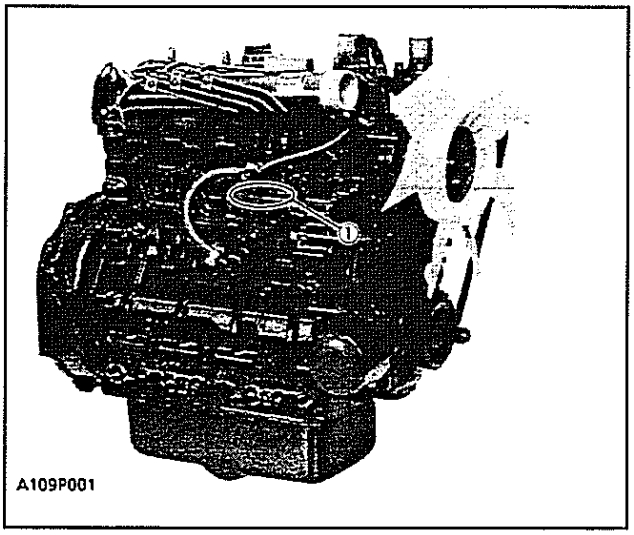
⚠ CAUTION Stop the engine before attempting any of the checks prescribed above.

Bleeding the Fuel System

1. Fill the fuel tank with fuel and open the fuel cock.
2. Open the vent screw on top of the fuel filter and bleed air off the filter first. (Fig
3. Open the air vent plug on the fuel injection pump.
4. Pull the engine stop knob back completely to prevent the engine from starting while turning the key to rotate the engine for about 10 secs.
5. Close the air vent plug.

NOTE: Always keep the air vent plug on the fuel injection pump closed except when air is vented, or it may cause the engine to stop.

(1) Air Vent Plug



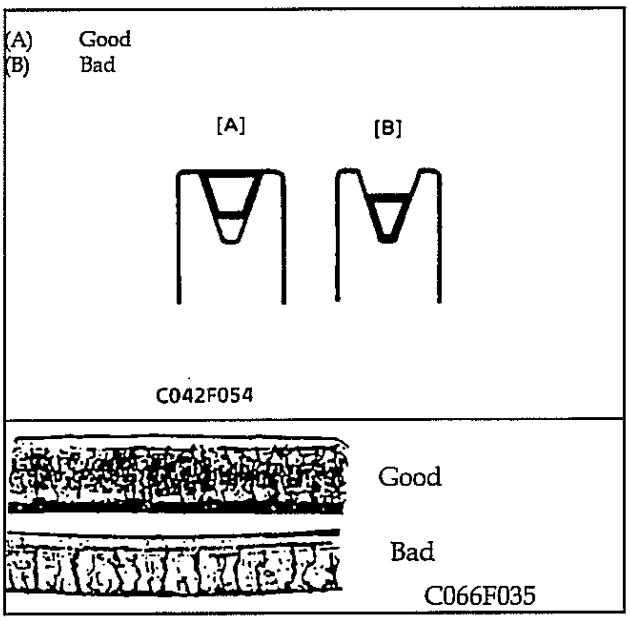
7.1.5 100 HOUR CHECK POINTS

Checking Fan Belt Tension

1. Press the fan belt between the fan pulley and pulley at a force of 98 N (10kgf, 22lbs). Check if the fan belt deflection is 10 to 12 mm (0.394 to 0.472 in.)
2. If the deflection is not within the factory specifications, loosen the bolts and nuts and relocate the alternator to adjust.

Checking Fan Belt Damage

1. Check the fan belt for damage.
2. Check if the fan belt is worn and sunk in the pulley groove.
3. Replace the fan belt if the belt is damaged or nearly worn out and deeply sunk into the pulley groove.



7.1.6 400 HOUR CHECK POINTS

Changing the Fuel Filter

Water and dust in the fuel is collected in the filter. Therefore it is important for proper engine performance to change the filter every 400 hours.

1. Remove the the used filter cartridge with a filter wrench.
2. Apply a thin film of fuel or light oil on the surface of the new filter gasket before screwing on.
3. Tighten the filter only hand tight.
4. Loosen the the air vent plug to let the air out.
5. Follw the air bleed procedure, start the engine and then check for leaks.

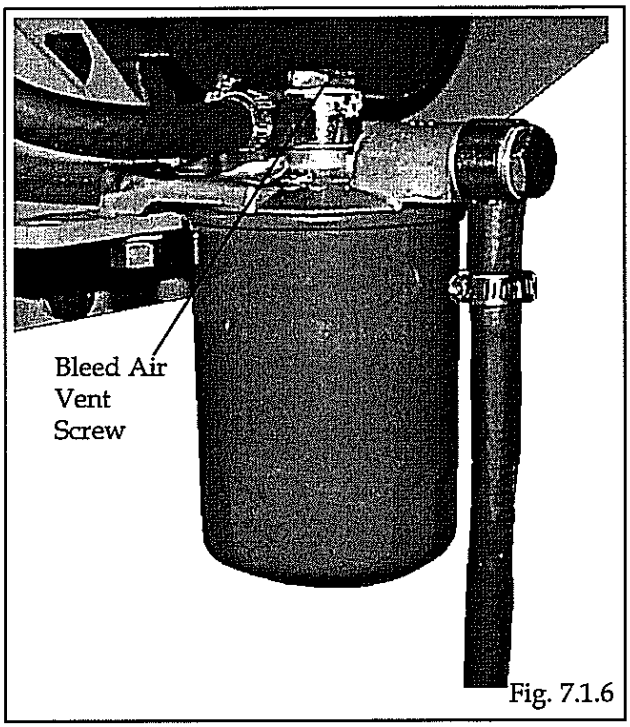


Fig. 7.1.6

7.2.1 VALVE ADJUSTMENT

Checking Valve Clearance: Do this check any time this engine is disassembled.

IMPORTANT: **Valve clearance must be checked and adjusted when the engine is cold.**

1. Remove the rocker arm cover.

2. Align the "1TC" mark on the flywheel and projection (Fig. 7.2.3a) on the housing so that the No. 1 piston comes to the compression or overlap top dead centre.

3. Check the following valve clearance using a feeler gauge (Fig. 7.2.3b).

4. If the clearance is not within the factory specifications adjust with the adjusting screw.
   0.18 to 0.22 mm
   .0071 to 0.0087 in.

NOTE: The "TC" marking on the flywheel is just for No. 1 cylinder. There is no "TC" marking for the other cylinders. No. 1 piston comes to the TDC. position when the "TC" marking is aligned with the projection in the window on the flywheel housing (fig. 7.2.3a). Turn the flywheel 15° (0.26 rad) clockwise or counterclockwise to centre on the overlap position. Now, refering to the table to the right, readjust the valve clearance. (The piston is at top dead centre when both the In. and Ex. valves do not move ; it is at the overlap position when both valves move.)

The firing order is 1, 3, 2 and 4. After completing the valve adjustment on #1 cylinder repeat the process for 3, 2 and 4. Turn the crankshaft 180° each time to do the next cylinder.

WARNING

To avoid personal injury ensure the battery ground cable is disconnected before continuing on with the valve clearance check.

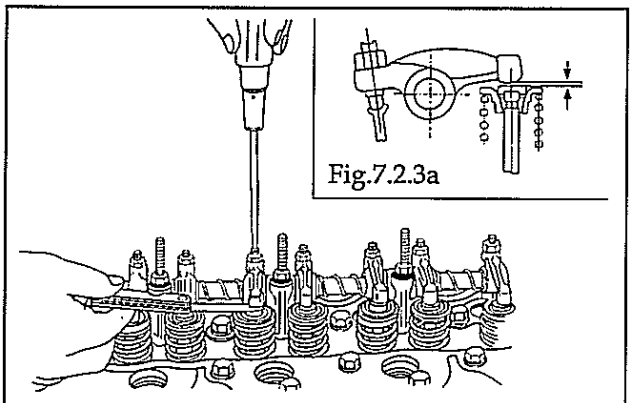


Fig.7.2.3a

Fig. 7.2.3b

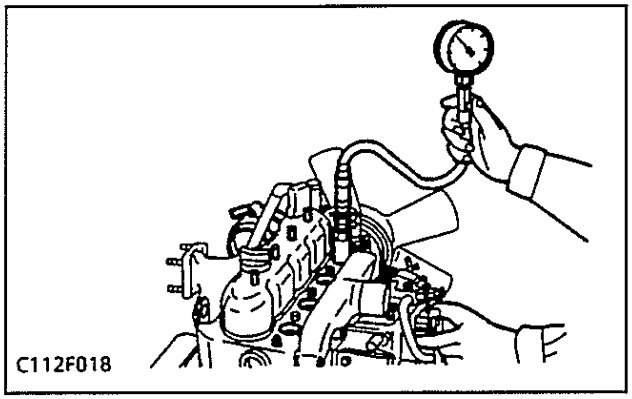
Engine model valve arrangemet Adjustable cylinder location of piston		In.	Ex.
When No. 1 piston is compression top dead centre	1st	*	*
	2nd	*	
	3rd		*
	4th		
When No. 1 piston is overlap position	1st		
	2nd		*
	3rd	*	
	4th	*	*
	5th		

7.2.2 *CHECKING and ADJUSTING*

Compression Pressure

1. After warming up the engine, stop it and remove the air cleaner , the muffler and all nozzle holders.
2. Install a compression tester for diesel engines to the nozzle holder hole.
3. After makingsure that the speed control lever is set at the stop position (non-position), run the engine at 200 to 300 RPM with the starter.
4. Read the maximum pressure. Measure the pressure more than twice.
5. If the measurement is below the allowable limit, check the cylinder, piston rings, top clearance, valve and cylinder head.

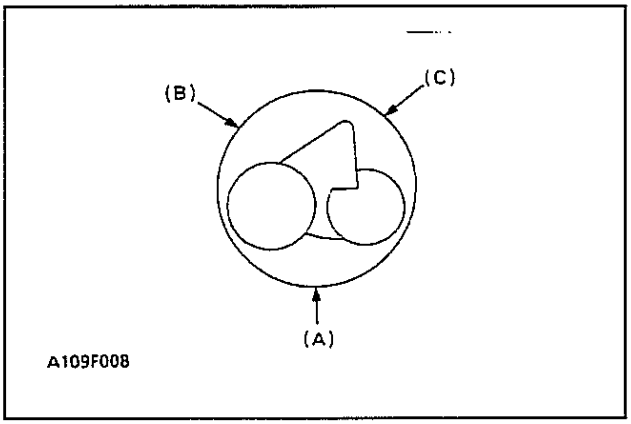
NOTE: Variances among cylinders compression values should be under 10%.



Compression Pressure	Factory Specs.	36 to 38 kgf/cm²/250 rpm 35.3 37.2 MPa/250 rpm 512 to 540 psi/250 rpm
	Allowable Limit	26 kgf/cm²/250 rpm 24.5 MPa/250 rpm 355 psi/250 rpm

Top Clearance

1. Remove the cylinder head (then don't attempt to remove the cylinder head gasket).
2. Bring the piston to its top dead centre, fasten 1.5 mm dia. 5 to 7 mm long fuse wires to 3 to 4 spots on the piston top with grease so as to avoid the recess for intake and exhaust valves and the combustion chamber ports.
3. Bring the piston to it's bottom dead centre, install the cylinder head and tighten the cylinder head to specified torque.
4. Turn the crankshaft until the piston exceeds it's top dead centre.
5. Remove the cylinder head and measure squeezed fuse wires for thickness.
6. If the measurement is not within the specified value, check the oil clearance of the crankpin journal and the piston pin.

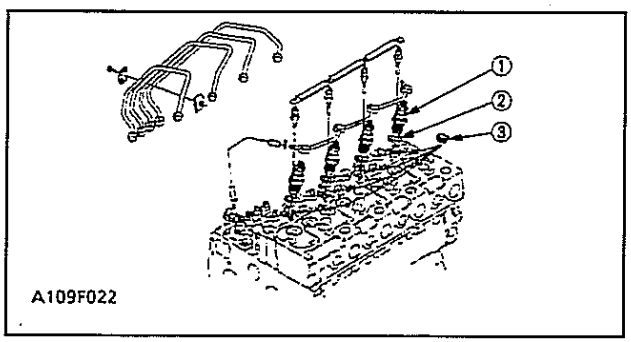


Top Clearance	Factory Specs.	0.55 to 0.70 mm 0.0217 to 0.0276 in.

Tightening Torque	Cylinder Head Bolts	93.1 to 98.0 N-n 9.5 to 10.0 kgf-m 68.7 to 72.3 ft. lbs.

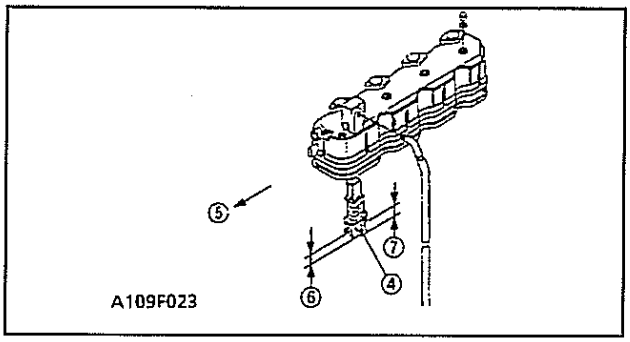
Cylinder Head and Nozzle Holder

1. Remove the injection pipes and overflow pipes.
2. Remove the glow plugs.
3. Remove the nozzle holder and copper gaskets.
4. Remove the heat seal.
5. Remove the head cover.



(When Reassembling)

1. Check to see that the cylinder head cover gasket is not defective.
2. Be sure to place the heat seal (3) and breather oil shield (4).



(1)	Nozzle Holder	(2)	Copper Gasket
(3)	Heat Seal	(4)	Breather Oil Shield
(5)	Gear Case Side	(6)	Short Plate
(7)	Long Plate		

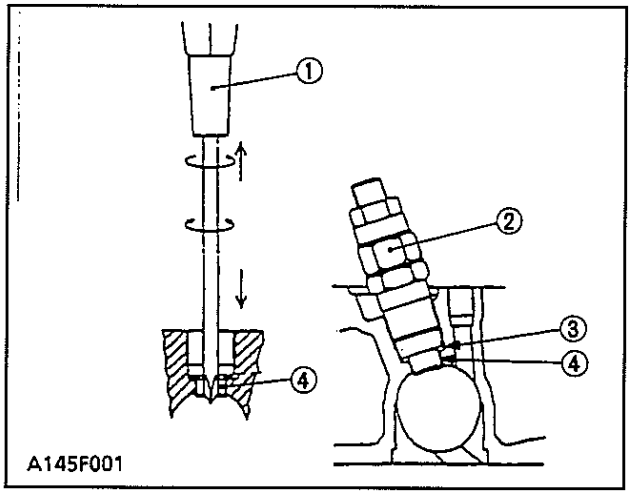
Nozzle Heat Seal Service Removal Procedure

IMPORTANT

Use a plus phillips head screwdriver that has a Dia. which is bigger than the heat seal hole (approx. 6mm / 1/4 in.).

1. Drivescrewdriver lightly into the heat seal hole.
2. Turn screwdriver three or four times each way.
3. While turning the screwdriver, slowly pull the heat seal out together with the injection nozzle gasket.

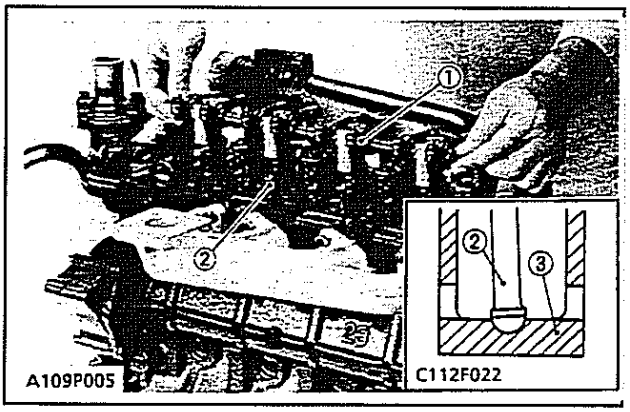
   If the heat seal drops, repeat the above procedure. Heat seal and injection nozzle gasket must be changed when the injection nozzle is removed for cleaning or for service.



(1)	Plus Screwdriver	(2)	Injection Nozzle
(3)	Injection Nozzle O-ring	(4)	Heat Seal

Rocker Arm, Push Rod an In/Ex. Manifold

1. Remove the rocker arm as a unit.
2. Remove the push rods.
3. Remove the In./Ex. manifold.



(When Reassembling)

1. When putting the push rods onto the tappets, check to see if their ends are properly engaged with the grooves.

IMPORTANT

After reassembling the rocker arms, be sure to adjust the valve clearance

7.2.3 *CYLINDER HEAD and VALVES*

Cylinder Head and Tappet

1. Loosen the pipe band and remove the water return pipe.
2. Remove the cylinder head bolts in the order of # 18 to # 1 and remove the cylinder head.
3. Remove the cylinder head gasket and O-ring.
4. Remove the tappets from the crankcase.

(When Reassembling)

1. Replace the head gasket witha new one.
2. Before installing the tappets, apply engine oil thinly around tham.
3. Install the cylinder head, using care not to damage the O-ring.
4. Tighten the cylinder head bolt gradually in the order of #1 to (# 14 - # 18 - #22) after applying engine oil.
5. Retighten the cylinder head bolt after running the engine for 30 minutes.

NOTE: Mark the cylinder number to the tappets to prevent interchanging.

Tightening Torque	Cylinder Head Bolts	93.1 to 98.0 N-n 9.5 to 10.0 kgf-m 68.7 to 72.3 ft. lbs.

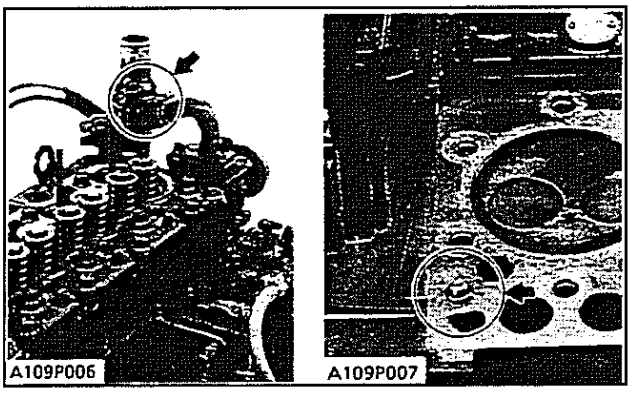
Valve

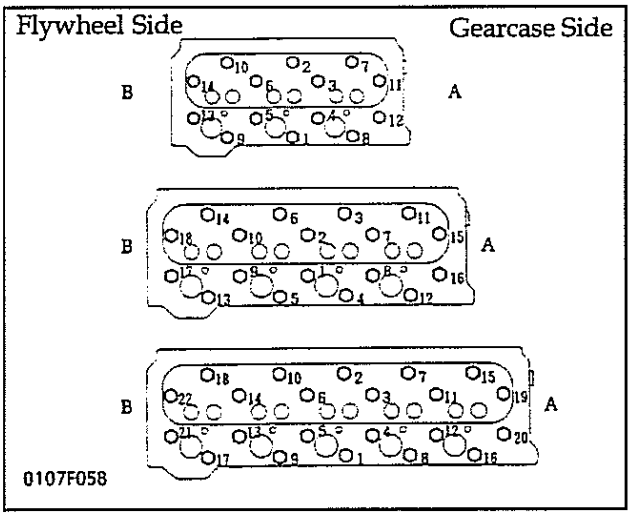
1. Remove the valve cap (1).
2. Remove the valve spring collet (2) with a valve lifter.
3. Remove the valve spring retainers (3), valve spring (4) and valve (5).

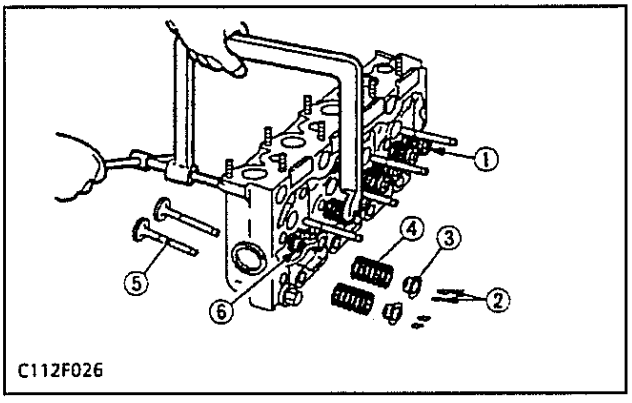
(When Reassembling)

1. Wash the valve stem and valve guide hole and apply engine oil sufficiently.
2. After installing the valve spring collets, lightly tap the stem to assure proper fit with a plastic hammer.

(1) Valve Cap (2) Valve Spring Collet
(3) Valve Spring Retainer (4) Valve Spring
(5) Valve (6) Valve Stem Seal







7.2.4 GEARCASE

Fuel Feed Pump and Pump Cover

1. Loosen the pipe clamp and remove the fuel pipe from the injection pump side.
2. Remove the fuel feed pump (1).
3. Remove the injection pump cover (2).

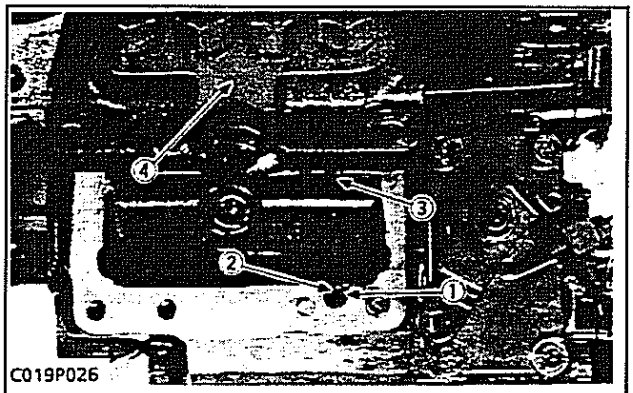
(When Reassembling)

1. Apply a liquid gasket to the both sides of the fuel feed pump gasket.

(1) Fuel Feed Pump
(2) Injection Pump Cover

Injection Pump

1. Align the control rack pin (3) with the notch (1) on the crankcase and remove the injection pump (4).
2. Remove the injection pump shims.
3. In principle, the injection pump should not be disassembled.



(1) Notch
(2) Groove
(3) Control Rack Pin
(4) Injection Pump

(When Reassembling)

1. When installing the injection pump, insert the control rack pin (3) firmly into the groove (2) of the fork lever and thrust lever.

NOTE : Model V2203 Serial #60897

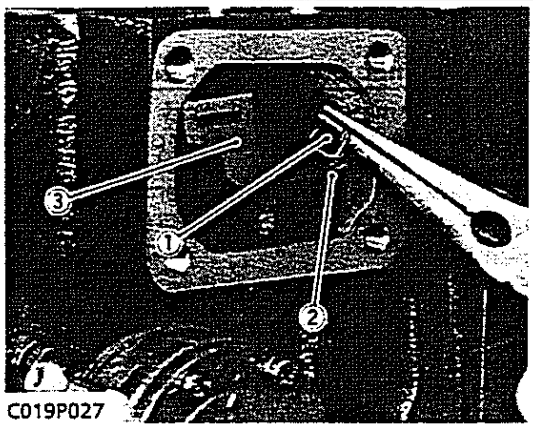
1. The sealant is applied to both sides of the soft metal gasketshim. The liquid gasket is not required for assembling.
2. Addition or reduction of shim (0.05 mm / 0.0020 in.) delays or advances the injection timing by approx. 0.0087 rad (0.5°).
3. In disassembling and replacing, be sure to use the same number of new gasket shims with the same thickness.

Governor Spring

1. Remove the governor springs 1(2) and 2 (1) from the fork lever 2 (3).

(When Reassembling)

1. Fix the governor springs 1 and 2 to the governor lever and pull the springs through the window of the injection pump and springs will be able to be hooked on to the governor fork lever 2 with ease.



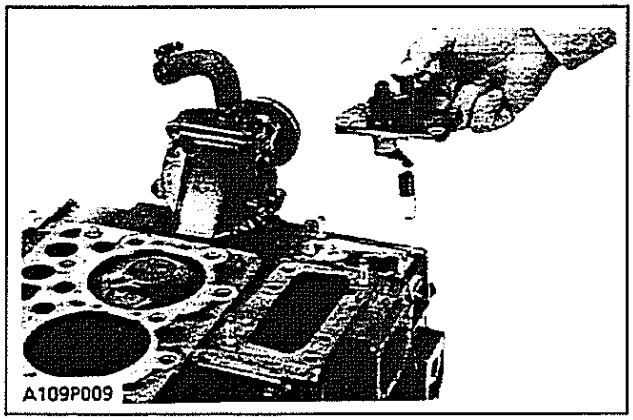
(1) Governor Spring
(2) Governor Spring 1
(3) Fork Lever 2

Speed Control Plate

1. Remove the speed control plate with the governor springs 1 and 2.

(When Reassembling)

1. Be careful not to drop the governor springs 1 and 2 into the gearcase.
2. Apply a liquid gasket to both sides of the speed control plate gasket.



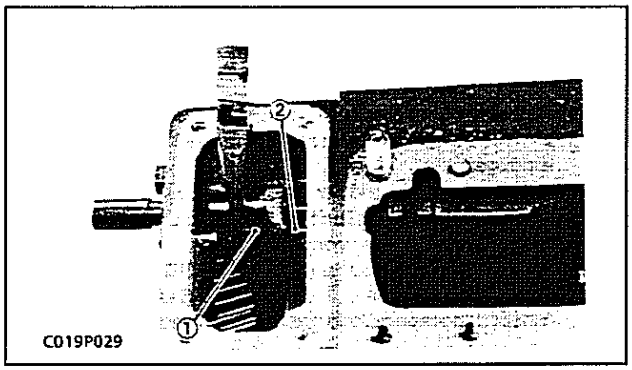
Start Spring

1. Remove the start spring (1) from the fork lever 1 (2).

(When Reassembling)

1. Be careful not to drop the start spring onto the gearcase.
2. Hook the start spring so that the longer hook is on the fork lever side.

(1) Start Spring
(2) Fork Lever 1

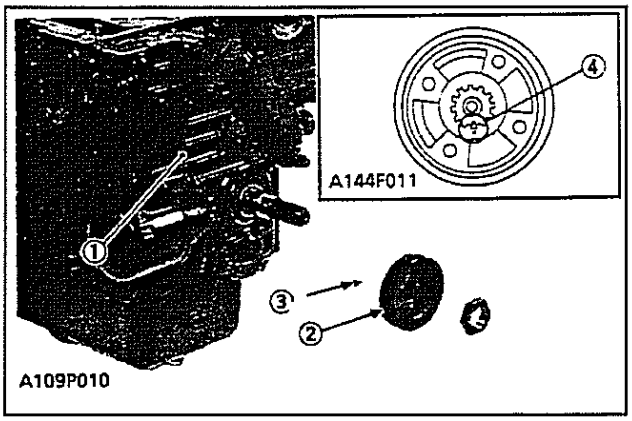


Gearcase

1. Pull out the fan drive pulley (2) with a puller.
2. Remove the feather key (3).
3. Remove the gearcase.(1).

(When Reassembling)

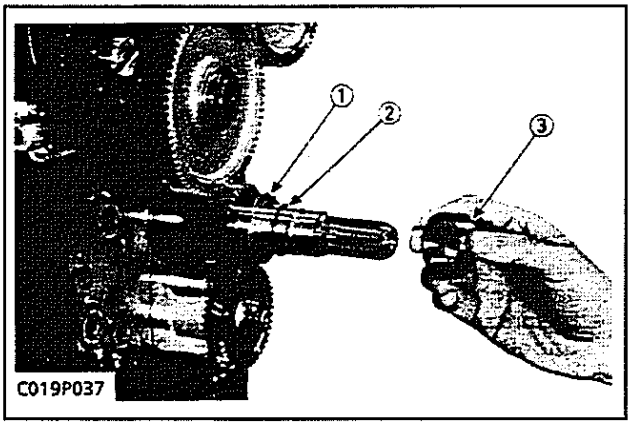
1. Apply a liquid gasket to both sides of the gearcase gasket.
2. Grease thinly to the oil seal and install it, ensuring the lip does not come off.
3. Install the pulley to the crankshaft, aligning the marks on them.



Crankshaft Oil Slinger

1. Remove the crankshaft collar (3).
2. Remove the O-ring (2).
3. Remove the crankshaft oil slinger (1).

(1) Crankshaft Oil Slinger
(2) O-ring
(3) Crankshaft Collar



Idler Gear ands Camshaft

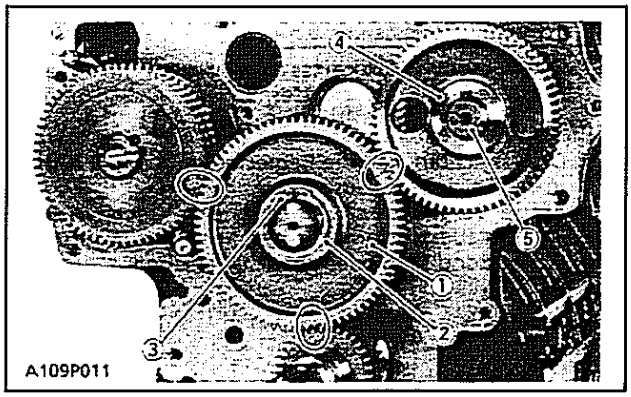
1. Remove the idler gear (1).
2. Align the round hole on the cam gear with the camshaft stopper mounting screw position and remove the bolts.
3. Remove the cam gear (4) with the camshaft (5).

(When Reassembling)

1. Apply engine oil thinly to the camshaft and idle gear bushing before installation.

IMPORTANT

When installing the idle gear, be sure to align the alignment marks on gears.

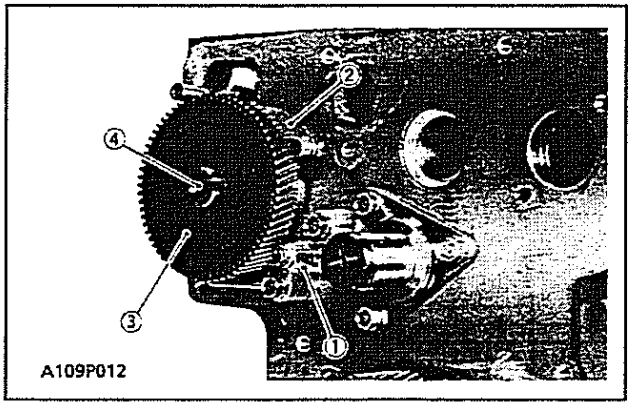


(1) Idler Gear
(2) Idler Collar 2
(3) External Snap Ring
(4) Cam Gear
(5) Camshaft

Fuel Camshaft and Fork Lever Assembly

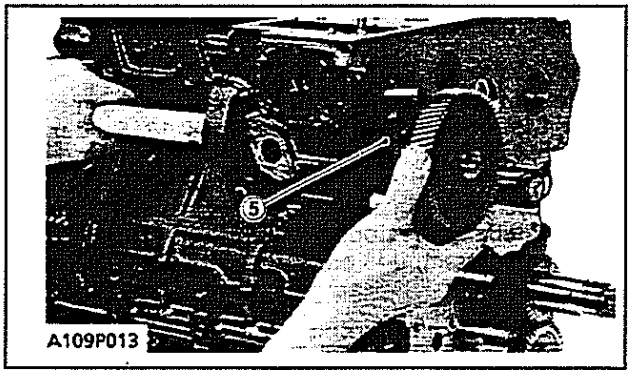
1. Remove the fuel camshaft cover.
2. Remove the fork lever holder mounting bolt.
3. Remove the fuel camshaft stopper.
4. Remove the fuel camshaft and fork lever shaft at the same time.

(1) Fork Lever Holder
(2) Fuel Camshaft Stopper
(3) Injection Pump Gear
(4) Fuel Camshaft
(5) Fork Lever Assembly



Oil Pump and Crank Gear

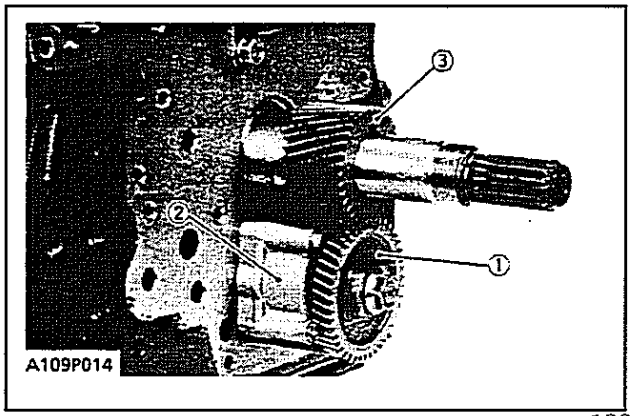
1. Pull out the oil pump drive gear (1) with a puller.
2. Remove the oil pump mounting bolts.
3. Remove the oil pump (2).
4. Remove the crank gear with a special - use puller set.
5. Remove the feather key on the crankshaft.



(When Reassembling)

1. Check to see that the feather key is on the crankshaft.
   Heat the crank gear to approx. 80 ° C (176°F) and fit on the crankshaft.

(1) Oil Pump Drive Gear
(2) Oil Pump
(3) Crankshaft



Oil Pan and Oil Strainer

1. Remove the oil pan and strainer.

(When Reassembling)

1. After cleaning the oil strainer, install it.
2. Install the oil strainer (1), being careful not to damage the O-ring.
3. Apply a liquid gasket to both sides of the oil pan gasket.
4. To avoid uneven tightening, tighten the mounting bolts in diagonal order from the centre.

Piston

1. Turn the flywheel and bring the piston to the bottom dead centre.
2. Remove the connecting rod bolt and take off the connecting rod cap.
3. Turn the flywheel and bring the piston to the top dead centre.
4. Pull out the piston upward by lightly tapping it from the bottom of the crankcase with the grip of a hammer.

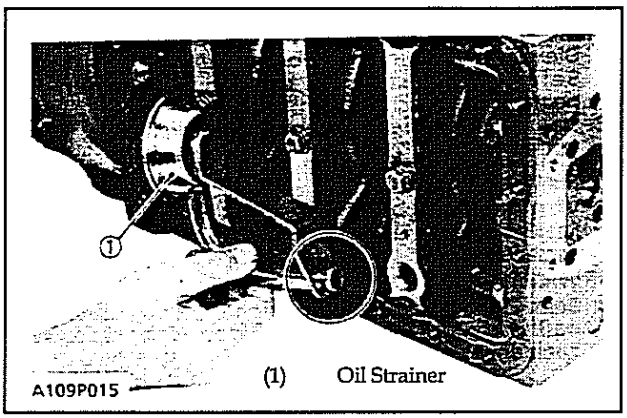
(When Reassembling)

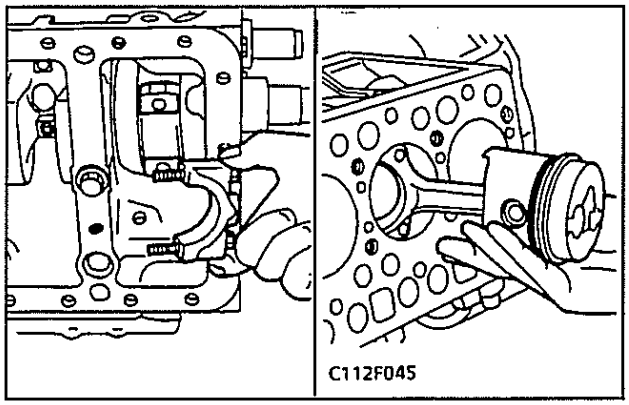
1. Apply engine oil to the piston, piston ring and cylinder bore.
2. When inserting the piston into the cylinder, face the number (1) on the connecting rod to the injection pump.
3. Align the number one on the connecting rod and connecting rod cap.
4. Apply engine oil to the crankpin bearings and bolts.

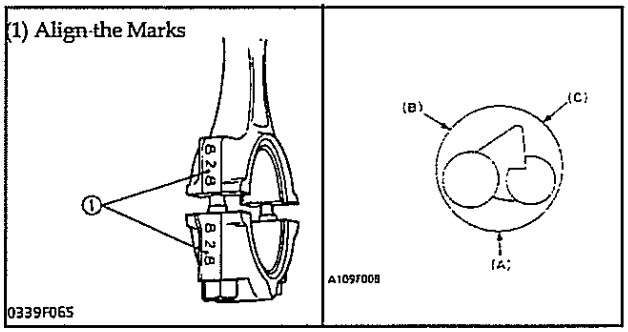
Tightening Torque of Connecting Rod Bolt	Non-flangeable bolt	36.3 to 41.2 N-m 3.7 to 4.2 kgf/m 26.6 to 30.4 ft. lbs.
	Flangeable bolt	44.1 to 49.0 N-m 4.5 to 5.0 kgf/m 32.5 to 36.2 ft. lbs.

IMPORTANT

The oil rings edge is hard chromium plated. When inserting the piston into the cylinder, make certain the piston ring compressor is tight so that the oil ring is not caught by the cylinder, peeling off the plating.







IMPORTANT

Do not change the combination of cylinder and piston. Make sure of the position of each piston by marking.

IMPORTANT

Place the piston rings so that there gaps every 120° (2.09 rad) with no gap facing the piston pin in the cylinder

Piston Ring and Connecting Rod

1. Remove the piston rings using a piston ring tool.
2. Remove the piston pin (1) and separate the connecting rod (7) from the piston (2).

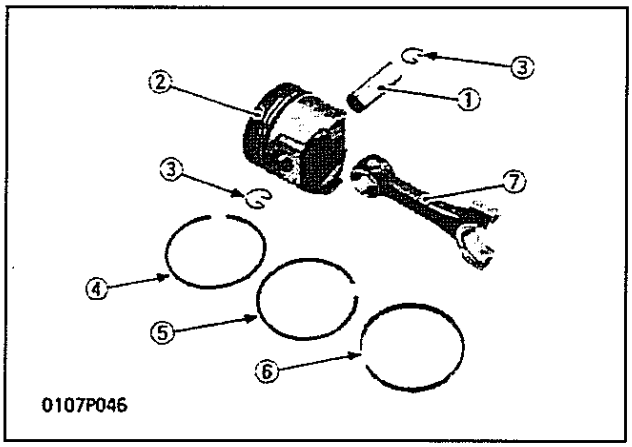
(When Reassembling)

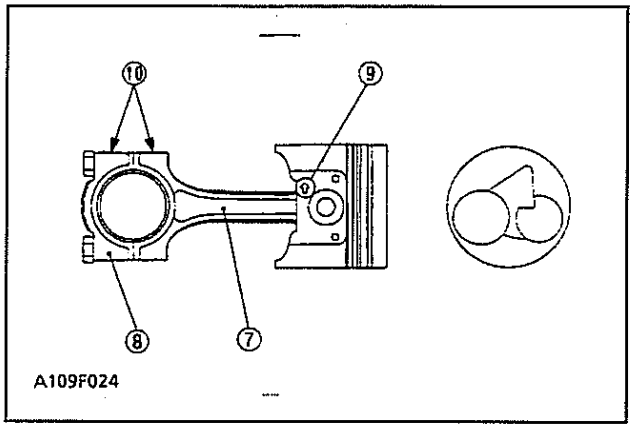
1. When installing the ring, assemble the rings so that the manufacturer's mark (13) near the gap faces the top of the piston.
2. When installing the oil ring onto the piston, place the expander joint (11) on the opposite side of the oil ring gap (12).
3. Apply engine oil to the piston pin.
4. When installing the connecting rod to the piston in 80°C (176°F) oil for 10 to 15 minutes and insert the piston pin to the piston.

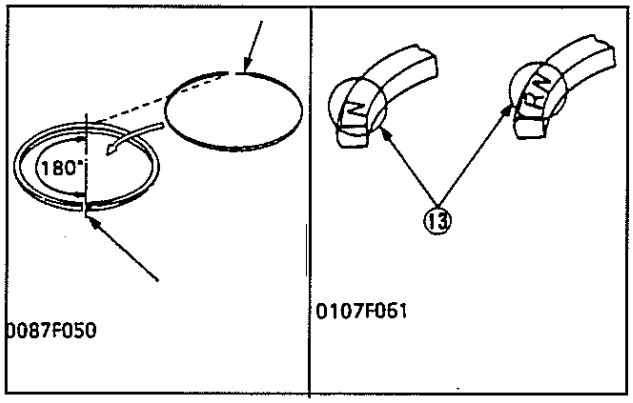
NOTE: When installing the connector rod to the piston, align the mark (10) on the connecting rod to the arrows direction of casting mark on the piston.

(1) Piston Pin
(2) Piston
(3) Piston Pin Snap Ring
(4) Compression Ring 1
(5) Compression Ring 2
(6) Oil Ring
(7) ConnectingRod
(8) Connecting Rod Cap
(9) Casting Mark
(10) Mark
(11) Expander Joint
(12) Oil Ring Gap
(13) Manufacturer's Mark

IMPORTANT Mark the same number on the connecting rod and the piston so as not to change the combination







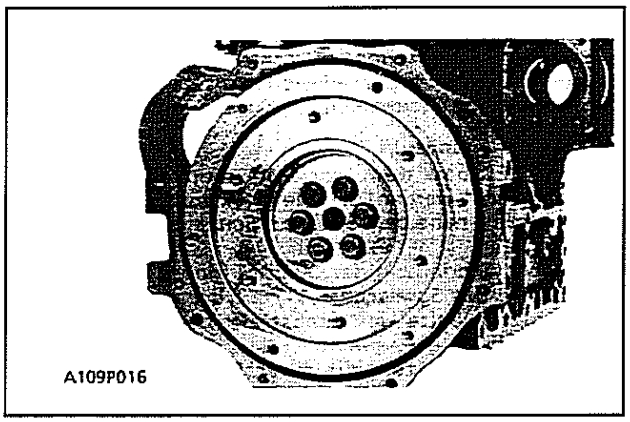
7.2.5 *FLYWHEEL and CRANKSHAFT*

Flywheel

1. Lock the flywheel not to turn using the flywheel stopper.
2. Remove the flywheel screws, except for two which must be loosened and left as they are.
3. Set a flywheel puller and remove the flywheel.

(When Reassembling)

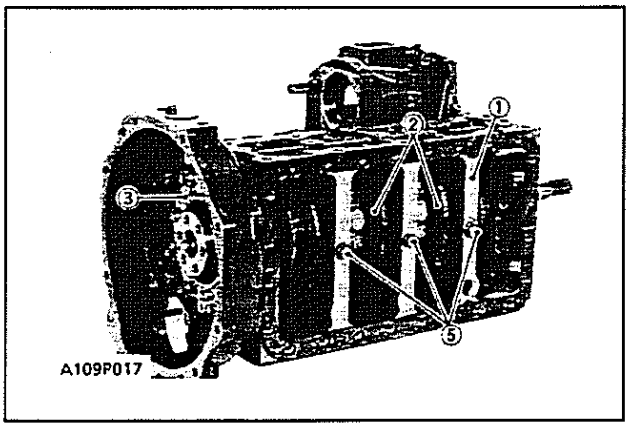
1. Apply engine oil to the flywheel bolt.



Bearing Case Cover and Crankshaft

NOTE: Before disassembling, check the side clearance of crankshaft. Also check it during reassembly.

1. Remove the bearing case cover (3).
2. Remove the bearing case screw 2 (5).
3. Pull out the crankshaft.

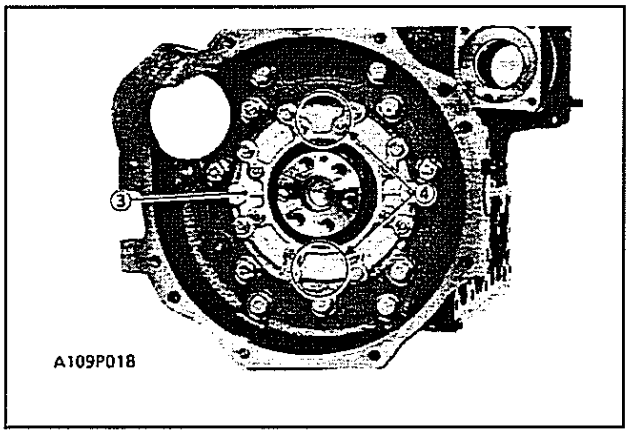


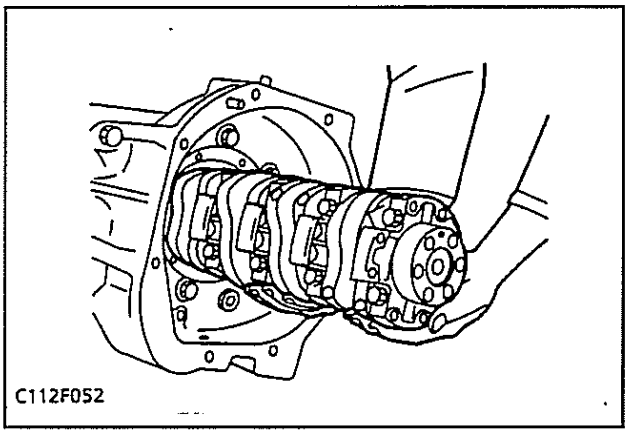
(When Reassembling)

IMPORTANT

1. Install the crankshaft sub assembly, aligning the screw hole of main bearing case 2 (2) with the screw hole of cylinder block (1).
2. Apply engine oil to the seat and thread of bearing case screw 2 (5) and tightening it.
3. Install the bearing case cover (3) to position the casting mark "T" (4) on it downward or the casting mark "up" (4) on it upward.
4. Tighten the bearing case cover mounting screws with even force on the diagonal line.

(1) Cylinder Block
(2) Main Bearing Case 2
(3) Bearing Case Cover
(4) Casting Mark "T" or "UP"
(5) Bearing Case Screw 2



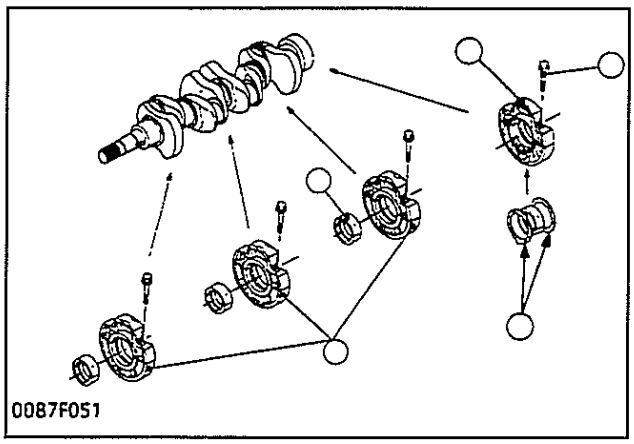


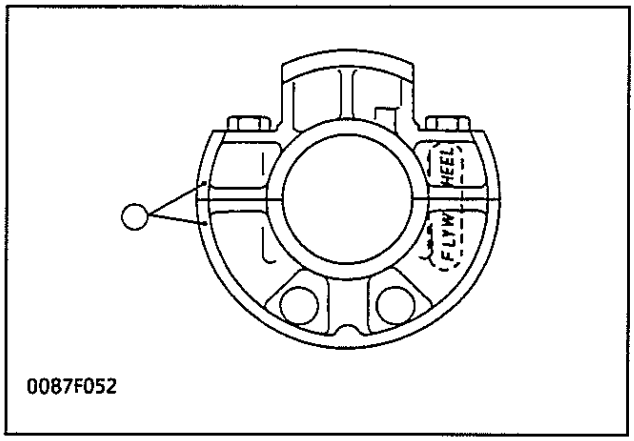
Main Bearing Case Assembly

1. Remove the two bearing case screws 1 (4) and remove the main bearing case assembly 1 (3), being careful with the thrust bearing (2) and crankshaft bearing 2 (5).
2. Remove the main bearing case 1, 2, and 3 (1) as above.

(When Reassembling)

1. Clean the oil passage in the main bearing case.
2. Apply clean engine oil on the crankshft bearing 2 and thrust bearings.
3. Install the main bearing case assemblies in the original positions. Since diameters of main bearing cases vary, install them in order of makings (A,B,C) from the gear case side.
4. Match the alignment numbers (6) on the main bearing case.
5. When installing the main bearing case 1,2, and 3, face the mark "FLYWHEEL" to the flywheel.
6. Be sure to install the thrust bearing with its oil groove facing outward.
7. Confirm that the main bearing case moves smoothly and horizontally after tightening the bearing case screw 1 to the specified torque.



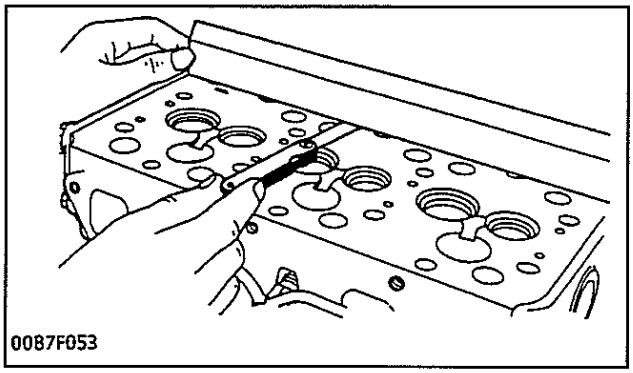


7.2.6 SERVICING

CYLINDER HEAD

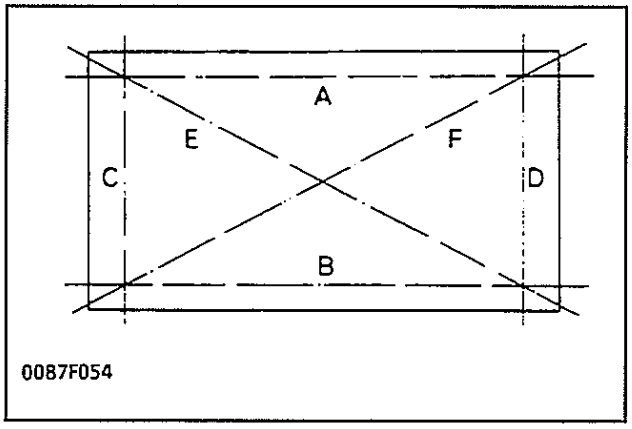
Cylinder Head Surface Flatness

1. Thoroughly clean the cylinder head surface.
2. Place a straight edge on the cylinder head's four sides and two diagonal as shown in the diagram.
3. If the measurement exceeds the allowable limit, replace the cylinder head.



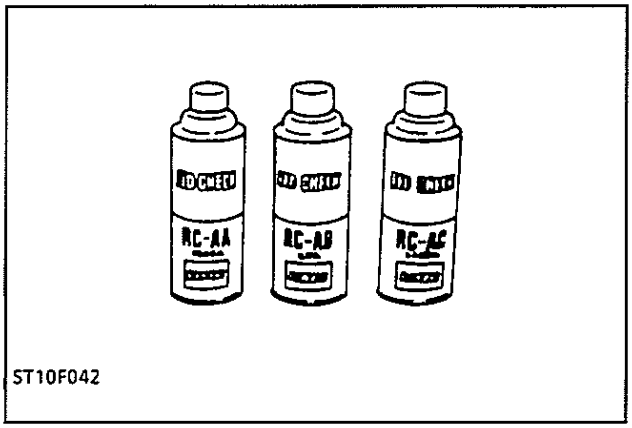
NOTE: Do not place the straight edge on the combustion chamber.

Cylinder Head Surface Flatness	Allowable Limit	0.05 mm / 500 mm 0.0019 in. / 19.69 in.



Cylinder Head Flaw

1. Prepare an air spray red check.
2. Clean the surface of the cylinder head with detergent.
3. Spray the cylinder head surface with the red permeative liquid.
4. Wash away the red permeative liquid on the cylinder head surface with the detergent.
5. Spray the cylinder head surface with white developer. If flawed, it can be identified as red marks.

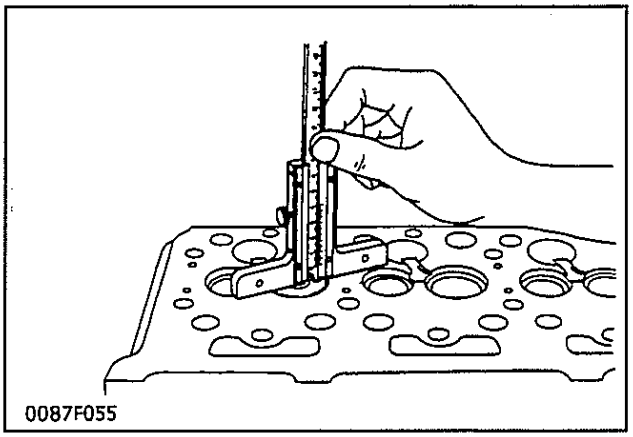


ST10F042

Valve Recessing

1. Clean the cylinder head, the valve face and seat.
2. Insert the valve into the guide.
3. Measure the valve recessing or protrusion with adepth gauge or dial gauge.
4. If the measurement exceeds the allowable limit, replace the valve or cylinder head.

Valve Recessing	Factory Spec.	(protrusion) 0.05 mm (0.0020 in. to (recessing) 0.15mm (0.0059 in.
	Allowable Limit	(recessing) 0.04 mm (0.0157 in.)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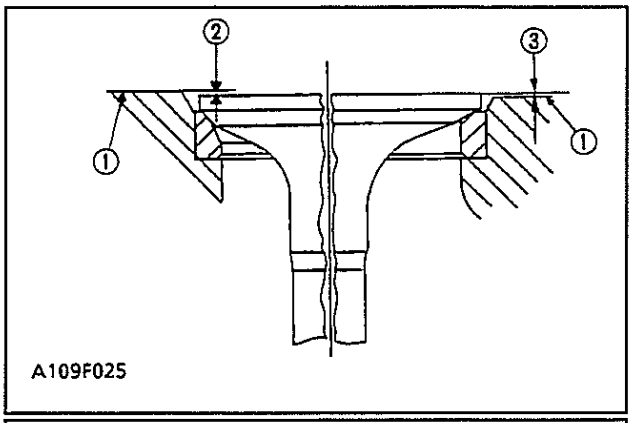
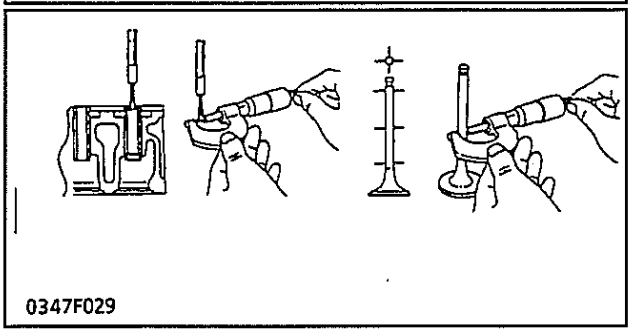
(1) Cylinder Head Surface
(2) Recessing
(3) Protrusion



A109F025

Clearance between Valve Stem and Guide

1. Remove the carbon from the valve guide section.
2. Measure the valve stem O.D. with an outside micrometer.
3. Measure the valve guide I.D. of the cylinder head at the most wear as shown in the diagram with a small hole gauge Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace the valve or cylinder head.


0347F029

Clearance between valve stem and guide	Factory Specs.	8.015 to 8.030 mm 0.0016 to 0.0028 in.
	Allowable Limit	0.1 mm 0.0039 in.

Valve Guide I.D.	Factory Specs.	8.015 to 8.030 mm 0.0016 to 0.0028 in.

Valve Stem O.D.	Factory Specs.	7.960 to 7.975 mm 0.3134 to 0.3140 in.

Correcting Valve and Valve Seat

NOTE: Before correcting the valve and seat, check the valve stem and the I.D. of the valve guide section and repair them if necessary.

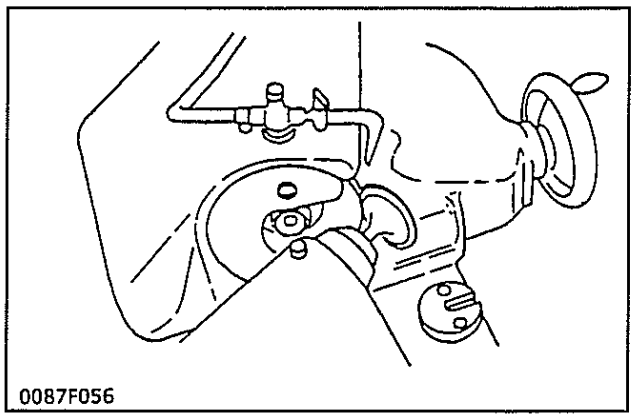
Correcting Valve

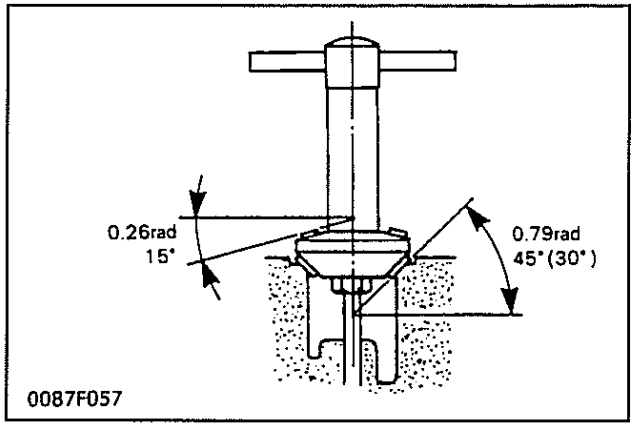
1. Correct the valve with a valve refacer.

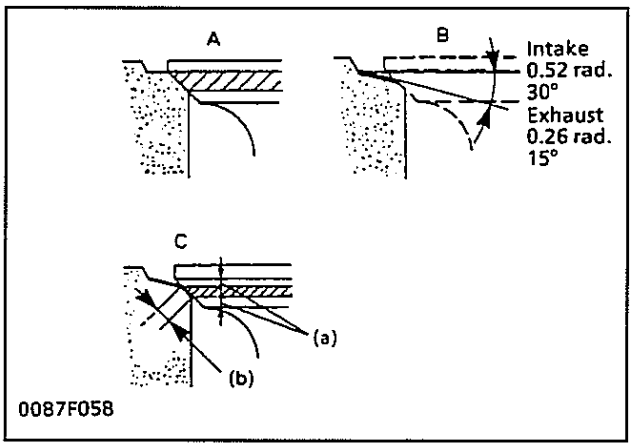
Correcting Valve Seat

1. Slightly correct the seat surface with a 60°(Intake Valve) or 45° (Exhaust Valve) seat cutter (1).
2. Resurface the seat surface with 30° valve seat cutter to intake valve seat and with 15° valve seat cutter to exhaust valve seat so that the width is close to specified valve seat width. (2.12 mm / 0.0835 in.).
3. After resurfacing the seat, inspect for even valve seating, apply a thin film of compound between the valve face and the valve seat and fit them with valve lapping tool.
4. Check the valve sealing with prussian blue, the valve seating surface should show good contact all the way around.

(A) Check Contact
(B) Correct Seat Width
(C) Check Contact
(a) Identical Dimensions
(b) Valve Seat Width







(When Removing)

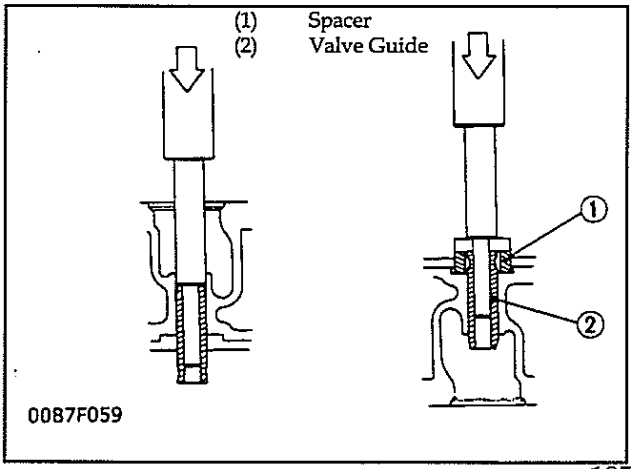
1. Using a valve guide replacing tool. press out the used valve guide.

(When Installing)

1. Clean a new valve guide and apply engine oil to it.
2. Using a valve guide replacing tool, press in a new valve guide until it is flush with the cylinder head as shown in the diagram.
3. Ream precisely the I.D. of the valve guide to the specified dimension.

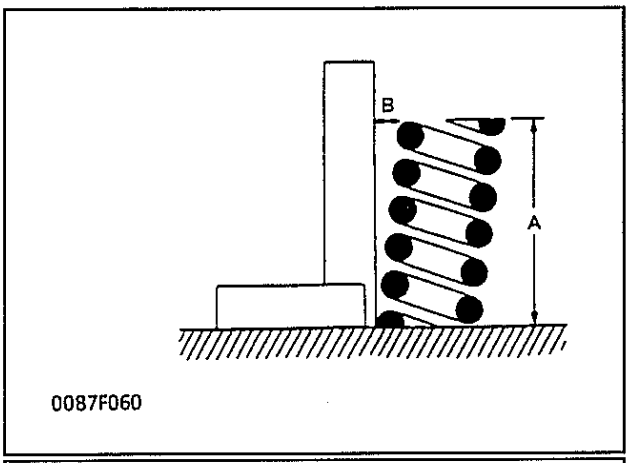
NOTE: Be careful not to strike valve guide with a hammer etc. during replacement.

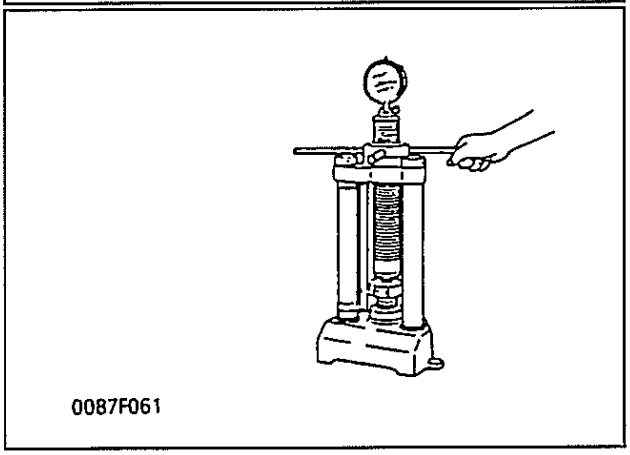
Valve Guide I.D.	Factory Specs.	8.015 to 8.030 mm .03156 to 0.3161 in.

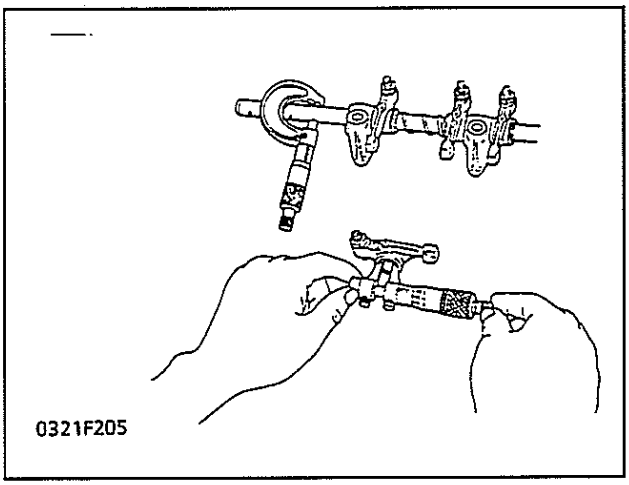


Valve Spring

1. Measure the length A with vernier calipers. If the measurement is less than the allowable limit, replace.
2. Put the spring on a surface plate, place a square on the side of the spring and check to see if the entire side is in contact with the square. Rotate the spring and measure the maximum B.
3. Check the entire durface of the spring for scratches. Replace it, if any.
4. Place the spring on a tester and compress it to the same length it is actually compressed in the engine.
   Read the compression load on the gauge.
   If the measurement exceeds the allowable limit, replace it.







Free Length	Factory Specs.	41.7 to 42.2 mm 1.6417 to 1.6614 in.
	Allowable Limit	41.2 mm 1.6220 in.

Tilt	Factory Specs.	1.0 mm 0.039 in.

Setting Load \ Setting Length	Factory Specs.	12.0 kgf / 35.0 mm 117.6 N / 35.0 mm 26.4 lbs. / 1.3780 in.
	Allowable Limit	10.2 kgf / 35.0 mm 100.0 N / 35.0 mm 22.5 lbs. / 1.3780 in.

Oil Clearance of Rocker Arm Shaft and Bearing

1. Measure the rocker arm bearing I.D. with an inside micrometer.
2. Measure the rocker arm shaft O.D. with an outside micrometer.
3. If the clearance exceeds the allowable limit, replace the bushing.
4. If the clearance still exceeds the allowable limit after replacing the bushing, replace the rocker arm shaft.

Oil clearance of rocker arm shaft and bush	Factory Specs.	0.018 to 0.070 mm 0.0007 to 0.0026 in.
	Allowable Limit	0.15 mm 0.0059 in.

Rocker Arm Shaft O.D.	Factory Specs.	13.973to 13.984 mm 0.5501 to 0.5506 in.

Rocker Arm Bushing I.D.	Factory Specs.	14.002 to 14.043 mm 0.5513 to 0.5529 in.

Oil clearance of rocker arm shaft and bush	Factory Specs.	0.016 to 0.045 mm 0.0006 to 0.0015 in.
	Allowable Limit	0.15 mm 0.0059 in.

Rocker Arm Shaft O.D.	Factory Specs.	13.973to 13.984 mm 0.5501 to 0.5506 in.

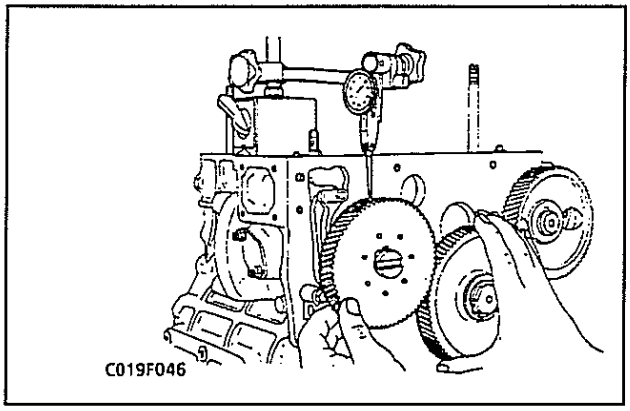
Rocker Arm Bushing I.D.	Factory Specs.	14.000 to 14.018 mm 0.5512 to 0.5517 in.

7.2.7 *TIMING GEAR and CAMSHAFT*

Timing Gear Backlash

1. Set a dial indicator (lever type) with its tip on the gear tooth.
2. Move the gear to measure the backlash, holding its mating gear.
3. If the backlash exceeds the allowable limit, check the oil clearance of the shafts and gear.
4. If the oil clearance is proper, replace the gear.

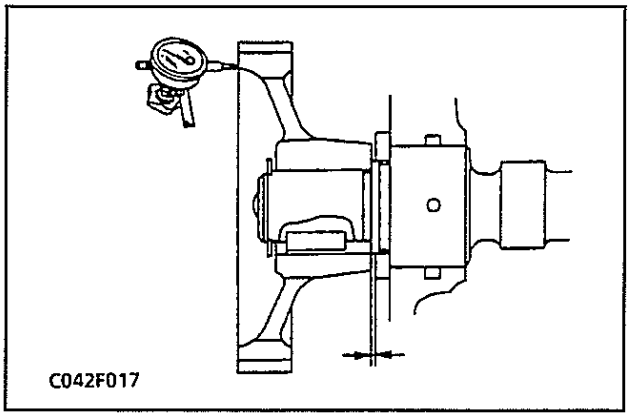
Crank Gear Idler Gear	Factory Specs.	0.0415 to 0.1122 mm 0.0016 to 0.0044 in.
	Allowable Limit	0.15 mm 0.0059 in.
Idler Gear Cam gear	Factory Specs.	0.0415 to 0.1154 mm 0.0016 to 0.0045 in.
	Allowable Limit	0.15 mm 0.0059 in.
Idler Gear Injection Pump Gear	Factory Specs.	0.0415 to 0.1154 mm 0.0016 to 0.0045 in.
	Allowable Limit	0.15 mm 0.0059 in.
Crank Gear Oil Pump Gear	Factory Specs.	0.0415 to 0.1090 mm 0.0016 to 0.0043 in.
	Allowable Limit	0.15 mm 0.0059 in.



End Play Of Camshaft

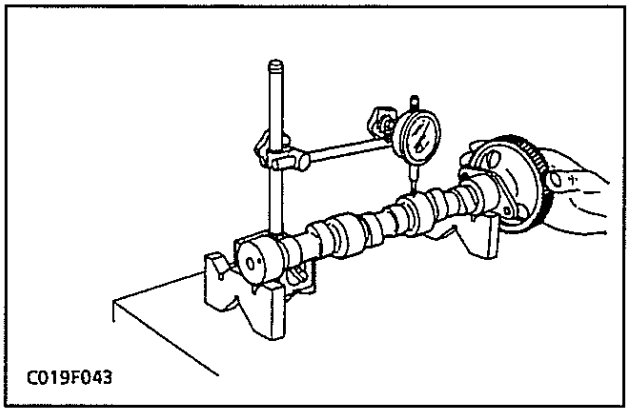
1. Move the camshaft to the flywheel side.
2. Set a dial indicator to the cam gear face.
3. Pull the cam gear with the camshaft to its end.
4. Measure the clearance between the cam gear and camshaft stopper.
5. If the clearance exceeds the allowable limit, replace the camshaft stopper.

End Play of Camshaft	Factory Specs.	0.07 to 0.22 mm 0.0027 to 0.0087 in.
	Allowable Limit	0.3 mm 0.0118 in.



Camshaft Alignment

1. Support the camshaft with V-blocks on the surface plate and set a dial indicator with its tip on the intermediate journal at right angle.
2. Rotate the camshaft on the V-blocks and get the misalignment (half of the measurement).
3. If the misalignment exceeds the allowable limit, replace the camshaft.

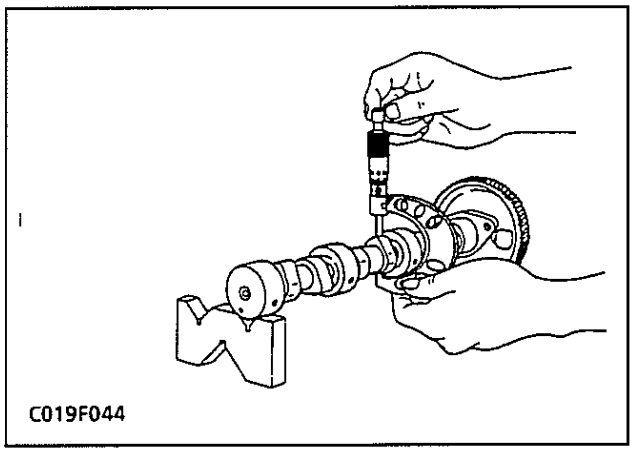


Camshaft Alignment	Allowable Limit	0.01 mm 0.00039 in.

Intake and Exhaust Cam Height

1. Measure the height of the cam at its highest point with an outside micrometer.
2. If the measurement is less than the allowable limit, replace it.

Intake and Exhaust Cam Height	Factory Specs.	33.47 mm 1.3177 in.
	Allowable Limit	33.42 mm 1.3157 in.



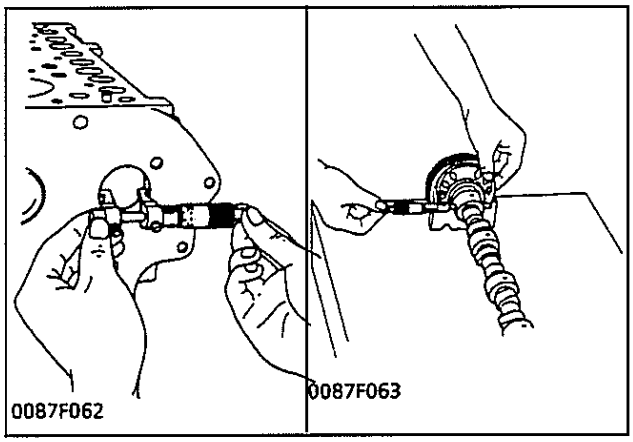
Oil Clearance of Camshaft Journal

1. Measure the camshaft journal O.D. with an outside micrometer.
2. Measure the cylinder block bore I.D. for camshaft with an inside micrometer.
3. If the clearance exceeds the allowable limit, replace the camshaft.

Oil Clearance of camshaft journal	Factory Specs.	0.050 to 0.091 mm 0.0020 to 0.0036 in.
	Allowable Limit	0.15 mm 0.0059 in.

Camshaft Journal O.D.	Factory Specs.	39.934 to 39.950 mm 1.5722 to 1.5728 in.

Camshaft Bearing I.D.	Factory Specs.	40.000 to 40.025 mm 1.5748 to 1.5758 in.



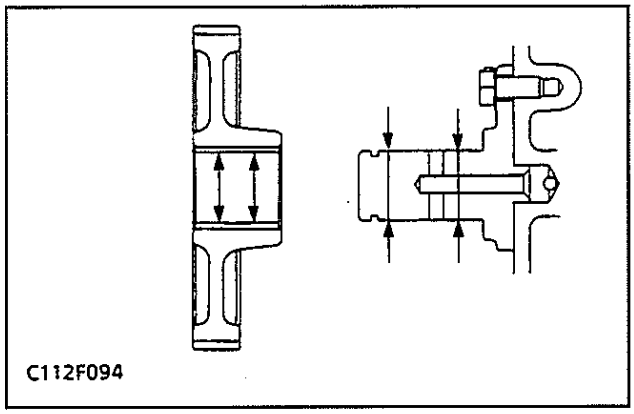
Clearance between Idler Gear Shaft and Idler Gear Bushing

1. Measure the idler gear shaft O.D with an outside micrometer.
2. Measure the idler gear bushing I.D. with an outside micometer and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the camshaft.

Clearance between idler gear shaft and idler gear bushing	Factory Specs.	0.025 to 0.0066 mm 0.0010 to 0.0026 in.
	Allowable Limit	0.1 mm 0.0039 in.

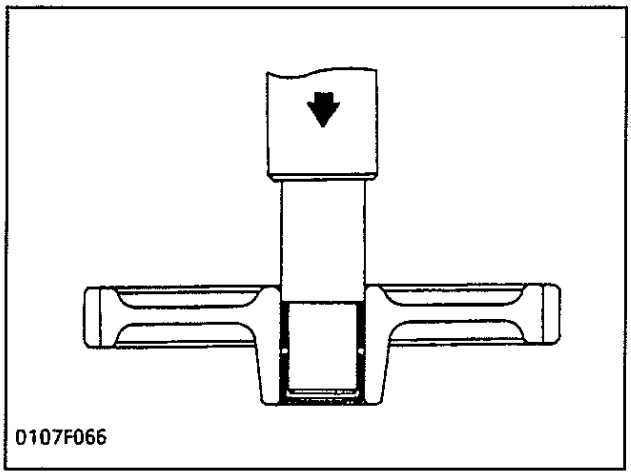
Idler Gear Bushing I.D.	Factory Specs.	32.000 to 32.025 mm 1.2598 to 1.2608 in.

Idler Gear Shaft O.D.	Factory Specs.	31.959 to 31.975 mm 1.2582 to 1.2589 in.



Replacing the Idler Gear Bushing

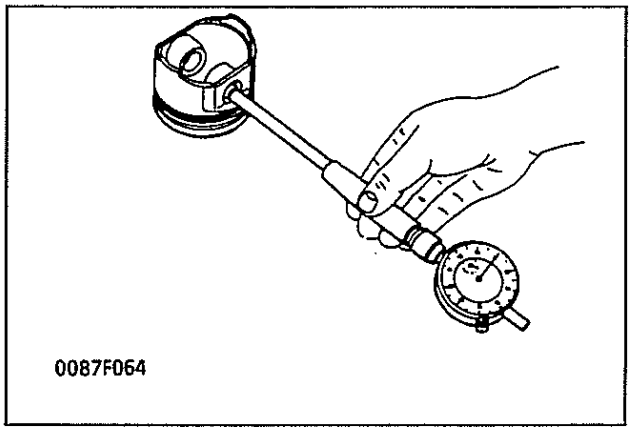
1. Press the used bushing out using an idler gear bushing replacing tool.
2. Press fit the new bushing.



7.2.8 PISTON and CONNECTING ROD

Piston Pin - Bore I.D.

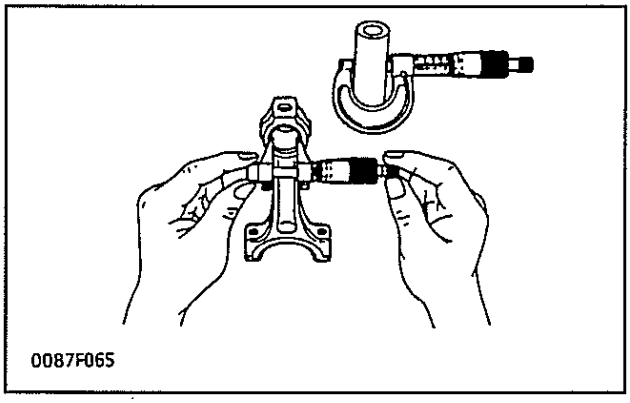
1. Measure the I.D. of the piston pin-bore in both the horizontal and vertical directions with a cylinder gauge.
2. If the measurement exceeds the allowable limit, replace the piston.



Piston Pin-Bore I.D.	Factory Specs.	25.000 to 25.013 mm 0.9843 to 09848 in.
	Allowable Limit	25.05 mm 0.9862 in.

Oil Clearance between Piston Pin and Small End Bushing

1. Measure the O.D. of the piston pin where it contacts the bushing with an outside micrometer.
2. Measure the I.D. of the piston pin bushing at the connecting rod small end with a cylinder gauge. Calculate the oil clearance.
3. If the clearance exceeds the allowable limit, replace the bushing. If it still exceeds the allowable limit, replace the piston pin.



Oil clearance between piston pin and small end bushing	Factory Specs.	0.014 to 0.038 mm 0.0006 to 0.0015 in.
	Allowable Limit	0.15 mm 0.0059 in.

Piston Pin O.D.	Factory Specs.	25.002 to 25.011 mm 0.9843 to 0.9847 in.

Small End Bushing I.D.	Factory Specs.	25.025 to 25.040 mm 0.9852 to 09858 in.

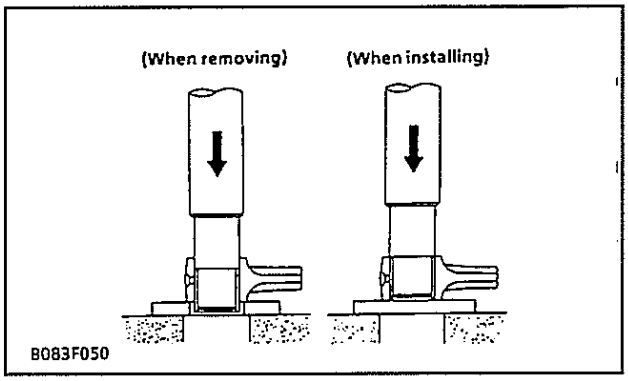
Replacing Connecting Rod Small End Bushing

(When Removing)

1. Press out the small end bushing with a connecting rod small end bushing replacing tool.

(When Installing)

1. Clean a new small end bushing and bore and apply engine oil to them
2. Press fit a new bushing, taking care to see that the connecting rod hole matches the bushing hole.

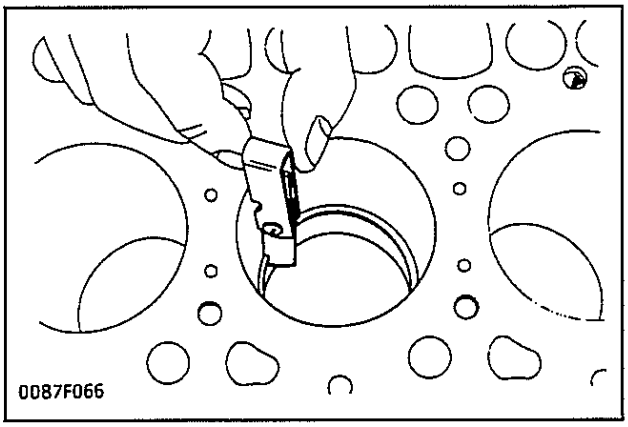


Piston Ring Gap

1. Insert the piston ring into the lower part of the liner (the least worn out part) with the piston.
2. Measure the ring gap with a feeler gauge.
3. If the gap exceeds the allowable limit, replace the ring.

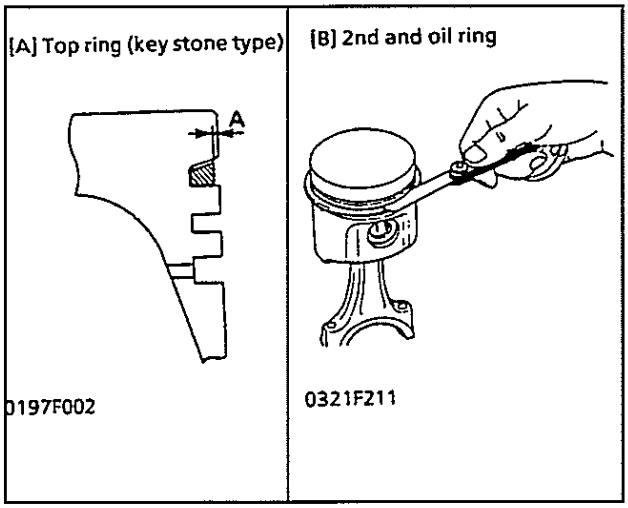
Compression Ring 1,2	Factory Specs.	0.30 to 0.45 mm 0.0118 to 0.0177 in.
	Allowable Limit	1.25 mm 0.0492 in.

Oil Ring	Factory Specs.	0.25 to 0.45 mm 0.0098 to 0.0177 in.
	Allowable Limit	1.25 mm 0.0492 in.



Clearance Between Piston Ring and Groove

1. Remove carbon from the ring grooves.
2. Measure the clearance between the ring and the groove with a feeler gauge of depth gauge.
3. If the clearance exceeds allowable limit, replace the ring since compression leak and oil shortage result.
4. If the clearance still exceeds the allowable limit after replacing the ring, replace the piston.



Factory Spec.	2nd ring	0.093 to 0.12 mm 0.0037 to 0.0047 in.
	Oil Ring	0.020 to 0.052 mm 0.00079 to 0.0020 in.

Allowable Limit	2nd ring	0.2 mm 0.0059 in.
	Oil Ring	0.15 mm 0.0059 in.

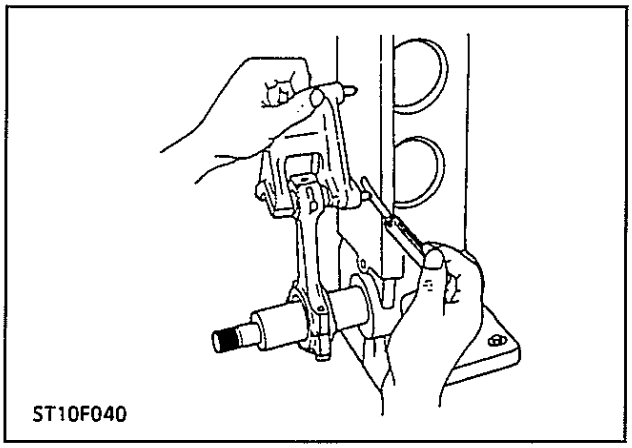
Factory Specs.	more than 0.2 mm 0.079 in.

Connecting Rod Alignment

NOTE: Since the I.D. of the connecting rod small end bushing is the basis of this check, check the bushing for wear beforehand.

1. Install the piston pin into the connecting rod.
2. Install the connecting rod on the connecting rod alignment tool.
3. Put a gauge over the piston pin and move it against the face plate.
4. If the gauge does not fit squarely against the face plate, measure the space between the pin of the gauge and the face plate.
5. If the measurement exceeds the allowable limit, replace the thrust bearing 1 and 2.

Connecting Rod Alignment	Allowable Limit	0.05 mm 0.0020 in.

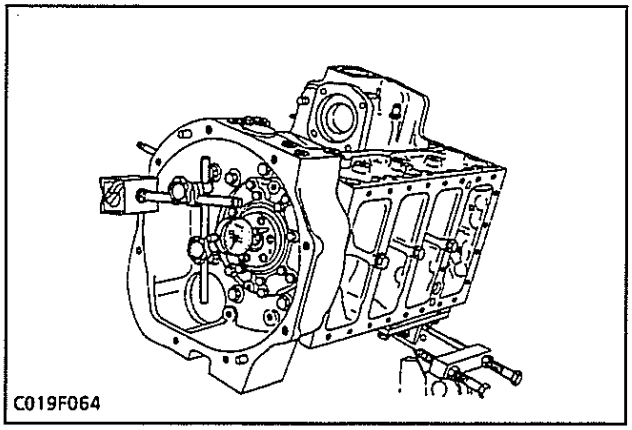


7.2.9 CRANKSHAFT

Side Clearance of Crankshaft

1. Move the crankshaft to the flywheel side.
2. Set a dial indicator to the crankshaft.
3. Measure the end play by pulling the crankshaft toward the crank gear.
4. If the measurement exceeds the allowable limit, replace the thrust bearing 1 and 2.

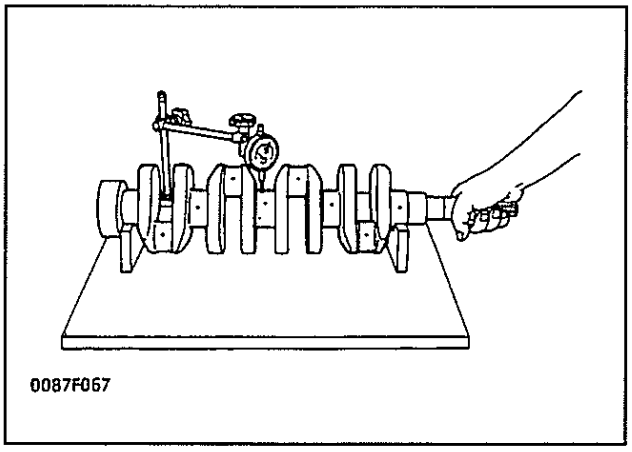
Crankshaft Side Clearance	Factory Specs.	0.15 to 0.31 mm 0.0059 to 0.0122 in.
	Allowable Limit	0.5 mm 0.0197 in.



Crankshaft Alignment

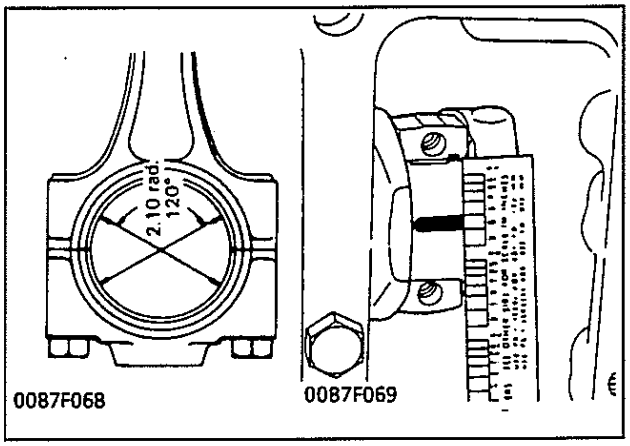
1. Support the crankshaft with a V-blocks on the surface plate and set a dial indicator with its tip on the intermediate journal at right angle.
2. Rotate the crankshaft on the V-blocks and get the misalignment (1/2 of the measurement).
3. If the misalignment exceeds the allowable limit, replace the crankshaft.

Crankshaft Alignment	Allowable Limit	0.02 mm 0.0079 in.



Oil Clearance Between Crank Pin and Crank Pin Bearing

1. Clean the crank pin and crank pin bearing.
2. Put a strip of platigage on the centre of the crank pin in each direction as shown in the figure.



IMPORTANT	Never insert the press gauge into the crank pin oil hole.

3. Install the connecting rod cap and tighten the screws to the specified torque and remove the cap.

IMPORTANT	Fasten the crankshaft so that it does not turn.

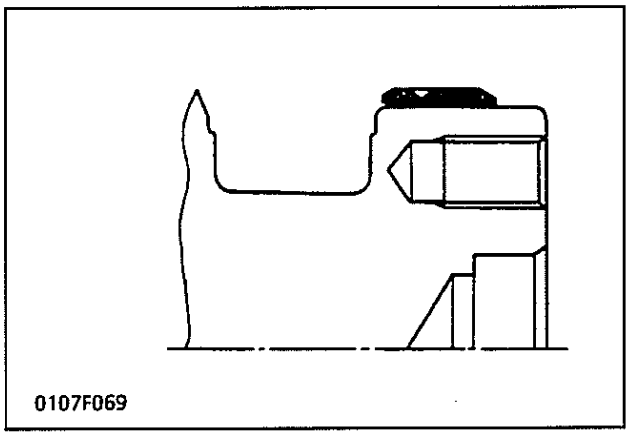
4. Measure the amount of the flattening with the scale and get the oil clearance.
5. If the clearance exceeds the allowable limit, replace the bearing.

(Reference)
When the oil clearance is to be measuredby removing the crankshaft, tighten the connecting rod cap with the specified torque, then measure the crank pin bearing I.D. with a cylinder gauge or an inside micrometer. Calculate the oil clearance.

Oil Clearance between crank pin and the crank pin bearing	Factory Specs.	0.025 to 0.087 mm 0.0009 to 0.0034 in.
	Allowable Limit	0.2 mm 0.0079 in.

Crank Pin O.D.	Factory Spec.	46.959 to 46.975 mm 1.8488 to 1.8494 in.

Crank Pin Bearing I.D.	Factory Spec.	47.000 to 47.046 mm 1.8504 to 1.8522 in.



Crankshaft Sleeve Wear

1. Check the wear on the crankshaft sleeve.
2. If the wear exceeds the allowable limit or when the engine oil leaks, replace the crankshaft sleeve.

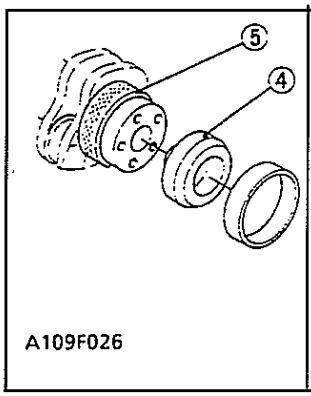
Wear of Sleeve	Allowable Limit	0.1 mm 0.004 in.

Replacing Crankshaft Sleeve

1. Remove the used crankshaft sleeve using a special puller set.
2. Set the sleeve guide (4) to the crankshaft.
3. Set the stopper (5) to the crankshaft as shown in fugure.
4. Heat a new sleeve to a temperature between 150° and 200° (302° and 392° F) and fix the sleeve to the crankshaft as shown in figure.
5. Press fit the sleeve using the auxiliary socket for pushing (3).

NOTE: Mount the sleeve with its largely chamfered surface facing outward.

(1) Crankshaft Sleeve
(2) Crankshft
(3) Auxiliary Socket for Pushing
(4) Sleeve Guide
(5) Stopper



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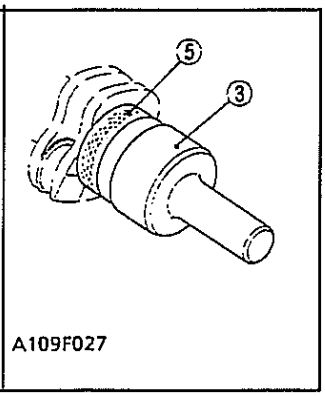

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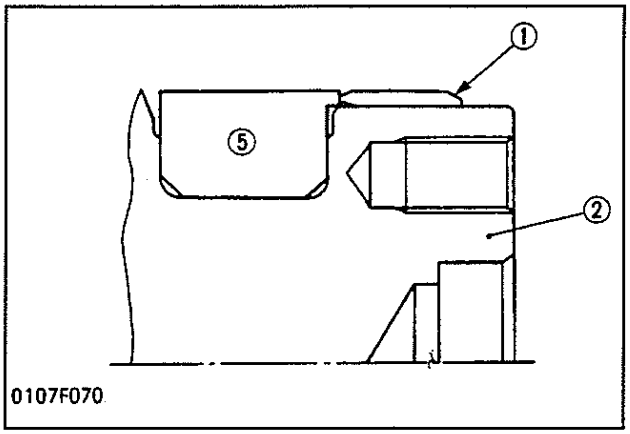

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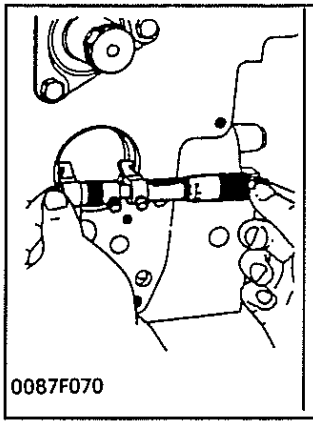
Oil Clearance Between Crank Journal and Crankshaft Bearing 1

1. Measure the O.D. of the crankshaft journal with an outside micrometer.
2. Measure the I.D. of the crankshaft bearing 1 with an inside micrometer. Calculate the oil clearance.
3. If the clearance exceeds the allowable limit, replace the crankshaft bearing.

Oil Clearance between crankshaft journal and the crankshaft bearing1	Factory Specs.	0.04 to 0118 mm 0.0016 to 0.0046 in.
	Allowable Limit	0.2 mm 0.0079 in.

crankshaft journal 1 O.D.	Factory Spec.	51.921 to 51.940 mm 2.0441 to 2.0449 in.
Crankshaft bearing 1 I.D.	Factory Spec.	51.980 to 52.039 mm 2.0466 to 2.0488 in.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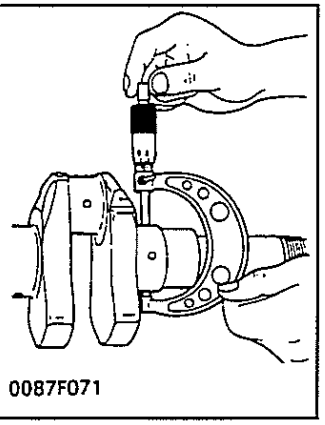
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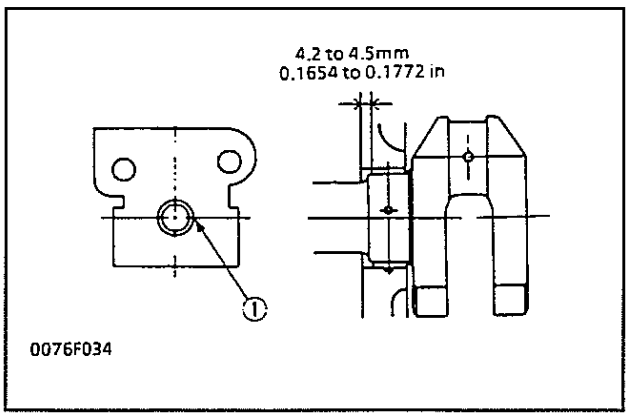
Replacing Crankshaft Bearing 1
(When Removing)

1. Press out the bearing 1 with crankshaft bearing 1 replacing tool.

(When Installing)

1. Clean a new bearing 1 and bore and apply engine oil to them.
2. Press fit a new bearing 1 using an inserting tool, taking due care to see that the seam of bearing 1 faces the exhaust manifold side.



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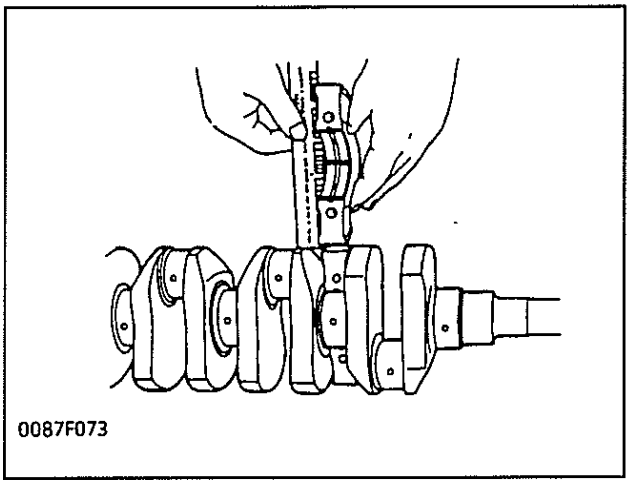
Oil Clearance Between Crank Journal and Crankshaft Bearing 2

1. Clean the crankshaft journal and crankshaft bearing.
2. Put a strip of plastigauge on the centre of the journal.

IMPORTANT	Never insert the plastigauge into the oil hole of the journal.

3. Install the main bearing case and tighten the screws to the specified torque and remove the cases again.
4. Measure the amount of the flattening with the scale and get the oil clearance.
5. If the clearance exceeds the aloowable limit, replace the crankshaft bearing.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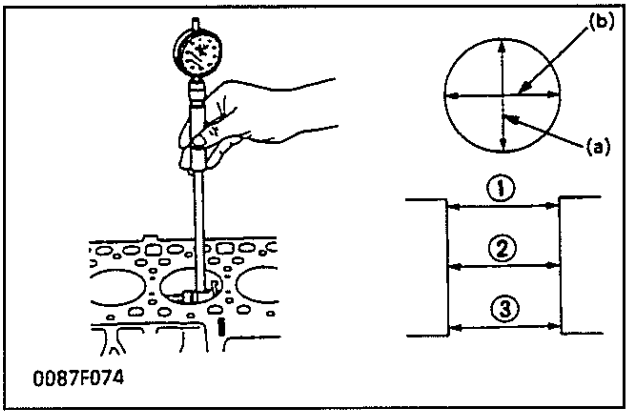
Oil Clearance between crankshaft journal and the crankshaft bearing2	Factory Specs.	0.04 to 0104 mm 0.0016 to 0.0041 in.
	Allowable Limit	0.2 mm 0.0079 in.

Crankshaft journal 1 O.D.	Factory Spec.	51.921 to 51.940 mm 2.0441 to 2.0449 in.
Crankshaft bearing 1 I.D.	Factory Spec.	51.980 to 52.025 mm 2.0466 to 2.0482 in.

7.2.10 CYLINDER BORE

Cylinder Bore I.D.

1. Measure the six points shown in the figure with a cylinder gauge to find out the maximum wear. Generally, position (1) in the (a,b) direction (at about 20 mm (0.79 in.) from the top shows the maximum wear. Since position (3) at the lower part of the bore will show the minimum wear, find these differences.



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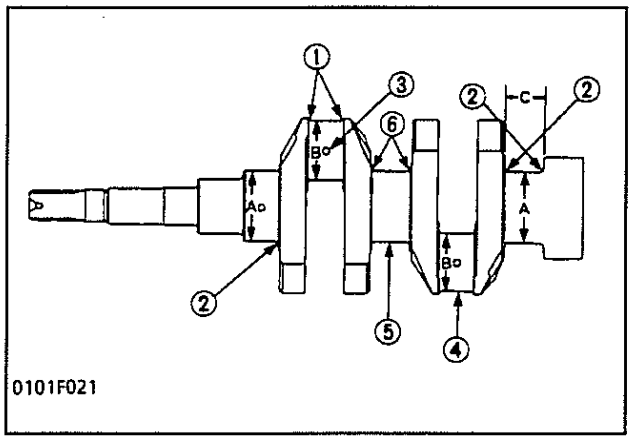
Cylinder bore I.D.	Factory Spec.	87.000 to 87.022 mm 3.4252 to 3.4261 in.
	Allowable Limit	+ 0.15 mm 0.0059 in.

Undersized and Oversized Bearing

If the standard size bearing cannot be employed due to excessive wear of the crankpin and crank journal, employ under size or over size bearing.

1. The crankpin (4), crank journal (5) and crank journal side surface (6) must be fine finished to higher than 0.000016 in.
2. Grind the crankpin (4) crank journal (5) with a wheel which has specified round corner and width without shoulder.
3. Be sure to chamfer the oil hole circumference (3) with an oil stone.



(1) 3.3 to 3.7 mm radius (0.1299 to 0.1457 in. radius)
(2) 2.8 to 3.3 mm radius (0.1102 to 0.1260 in. radius)
(3) Oil hole must be 1.0 to 1.5 mm radius (0.0394 to 0.0591 in. radius)

Size	Code No.	Name Of Bearing	Bearing Mark	Crankshaft processing Dimensions	
-0.2 mm -.008 in.	17331-2391-1	Crankshaft Bearing 1 (0.2 minus)	020 US	A	51.721 to 51.740 mm 2.0363 to 2.0370 in.
-0.2 mm -.008 in.	17331-2393-1	Crankshaft Bearing 2 (0.2 minus)	020 US		
-0.4 mm -0.016 in.	17331-2392-1	Crankshaft Bearing 1 (0.4 minus)	040 US		51.521 to 51.540 mm 2.0284 to 2.0291 in.
-0.4 mm -0.016 in.	17331-2394-1	Crankshaft Bearing 2 (0.4 minus)	040 US		
-0.2 mm -0.008 in.	17331-2297-1	Crank Pin Bearing (0.2 minus)	020 US	B	46.759 to 46.775 mm 1.8409 to 1.8415 in.
-0.4 mm -0.016 in.	17331-2298-1	Crank Pin Bearing (0.4 minus)	040 US		46.559 to 46.575 mm 1.8330 to 1.8337 in.
+0.2 mm +0.008 in.	15221-2395-1 19202-2397-1	Thrust Bearing 1 (+0.2) Thrust Bearing 2 (+0.2)	020 OS	C	26.20 to 26.25 mm 1.0315 to 1.0335 in.
+0.4 mm +0.016 in.	15221-2396-1 19202-2398-1	Thrust Bearing 1 (+0.4) Thrust Bearing 2 (+0.4)	040 OS		26.40 to 26.45 mm 1.0394 to 1.0413 in.

7.2.11 COMPRESSION TEST

Before performing the compression test ensures that the battery is fully charged and that the valve clearances are correct.

WARNING This test must be done with the engine cranking. To prevent personal injury block the loader securely with all four (4) wheels clear of the ground.

1. Block the loader securely with all four (4) wheels clear of the ground.

2. Run the engine until warm.

3. Shut off the fuel supply at the tank (Fig. 7.2.3c).

4. Disconnect the air intake and remove the injectors from the engine.

5. Connect a compression tester to the cylinder to be tested.

6. Crank the engine with the starter at 200 to 300 RPM and read constant maximum on the tester.

7. Crank the test twice for each cylinder running the engine for 5 to 10 seconds for each test.

TEST RESULTS

Factory Specs.	Allowable Limit 10% or less
36 to 38 kgf/cm²/250 rpm 35.3 to 37.2 Mpa/250 rpm 512 to 540 psi/250 rpm	26 kgf/cm²/250 rpm 24.5 MPa/250 rpm 355 psi/250 rpm

If the compression pressure is low pour a small amount of oil through the injector holes and test again.

* If pressure recovers check for wear on piston rings

* If pressure does not recover check valves and cylinder head for damage.

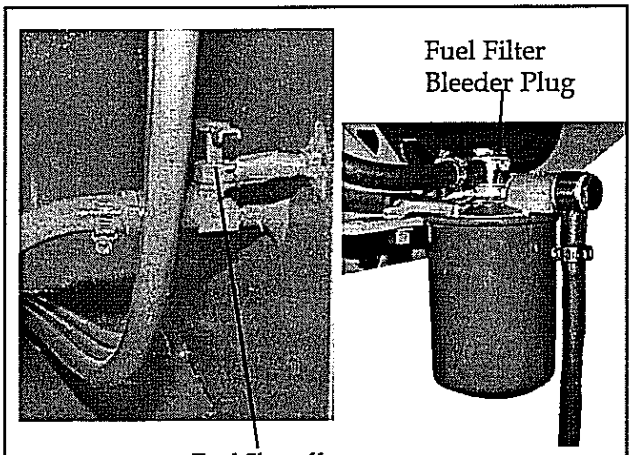
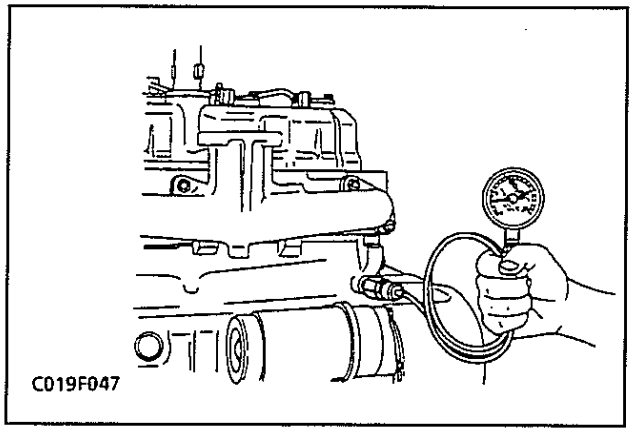


Fig. 7.2.3c

7.1.13 CHECKING

Engine Oil Pressure

1. Remove the oil switch and set a pressure tester.
2. Start the engine. After warming upthe oil, measure the oil pressure of both idling and rated speeds.
3. If the oil pressure is less than the allowable limit, check the following:
   1/ Engine oil insufficient
   2/ Oil strainer clogged
   3/ Oil pump defective
   4/ Excessive oil clearance of bearing
   5/ Foreign matter in the relief valve


C019F047

At Rated Speed	Factory Specs.	3.0 to 4.5 kgf/cm² 294.2 to 441 kPa 42.7 to 64 psi
	Allowable Limit	2.5 kgf/cm² 245 kPa 36 psi

At Idle Speed	Allowable limit	0.5 kgf/cm² 49 kPa, 36 psi

7.2.14 SERVICING

Rotor And Lobe Clearance

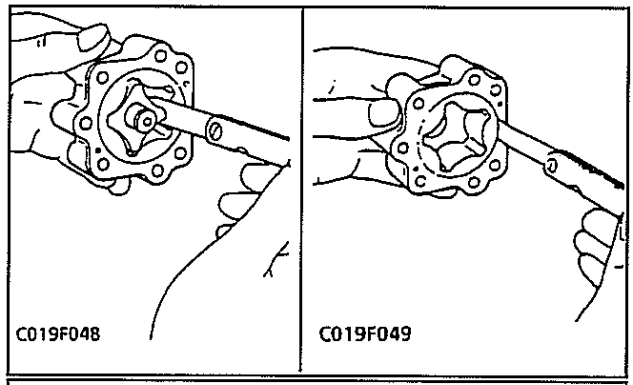
1. Measure the clearance between lobes of the inner rotor and the outer rotor with a feeler gauge.
2. Measure the clearance between the outer rotor and the pump body with a feeler gauge.
3. If the clearance exceeds the factory spec. replace the oil pump rotor assembly.

Clearance between inner rotor and outer rotor	Factory Spec.	0.03 to 0.14 mm 0.0012 to 0.0055 in

Clearance between outer rotor and pump body	Factory Spec.	0.11 to 0.19 mm 0.0043 to 0.0075 in

Clearance Between Rotor And Cover

1. Put a strip of plastigauge onto the rotor face with grease.
2. Install the cover and tighten the screws.
3. Remove the cover carefully and measure the width of the press gauge with a sheet of gauge.
4. If the clearance exceeds the factory spec. replace oil pump rotor assembly.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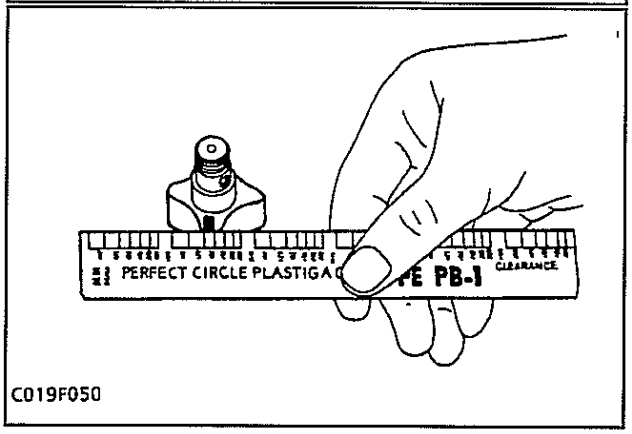


C019F050

End Clearance between inner rotor and cover	Factory Spec.	0.105 to 0.150 mm 0.0041 to 0.0059 in

7.3 *COOLING SYSTEM*

7.3.1 ADDING FLUID

When adding coolant to the engine cooling system, it can be done easily by removing the overflow tank cover and bringing the coolant level up to the first mark on the bottom of the overflow tank (Fig. 7.3.1a).

⚠ WARNING	To prevent personal injury DO NOT remove the radiator cap when the engine is hot.

Usea 50 - 50 mixture of ethylene glycol and water. Do not use pure antifreeze or more than 50% anti-freeze in the cooling system. This mixture will provide freeze protection to -34°F (-37°C).

To drain the cooling system. attach a hose to the drain valve located at the engine block . Remove the radiator cap. Turn the drain valve handle so that it's toward the valve outlet. To completely drain the radiator remove the drain plug located at the bottom of the radiator (Fig. 7.3.1b).

To fill the cooling system; close the drain valve on the engine block and refit the radiator drain plug. Fill the radiator with a 50 - 50 mixture of ethylene glycol and water. Refit the radiator cap.

7.3.2 RADIATOR INSPECTION - TESTING

The radiator cooling fins must be kept free of debris otherwise overheating of the engine can occur. Inspect the radiator cooling fins for damage or buildup of debris. Repair any damage and if necessary blow the radiator fins with compressed air to remove dirt buildup.

⚠ WARNING	To prevent eye injury use safety goggles when cleaning with compressed air.
IMPORTANT	To prevent radiator fin damage fin do not use air pressure higher than 30 PSI (2.1 kg/cm sq.) when cleaning the radiator.

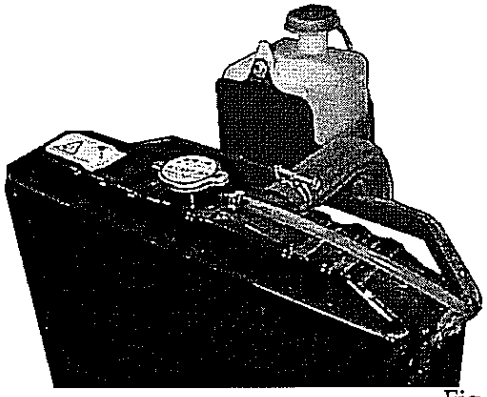


Fig. 7.3.1a

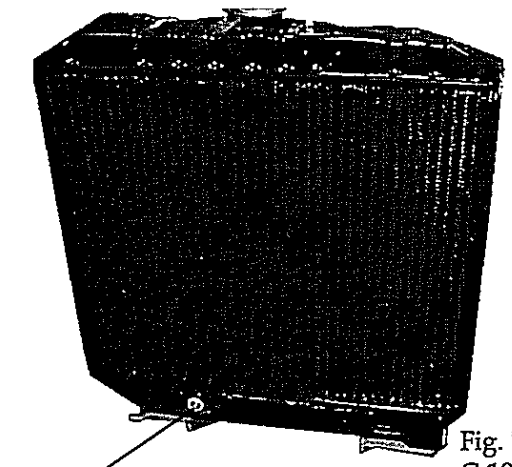


Fig. 7.3.1b
C-1012

Test the radiator for leaks as follows :

1. Ensure the radiator is full of coolant.

2. Attach a radiator tester and increase the pressure to 12.8 lbs./in² (0.9 kg/cm²) Fig. 7.3.2.

3. Start the engine and run until warm.

4. Shut off the engine and carefully remove the radiator cap.

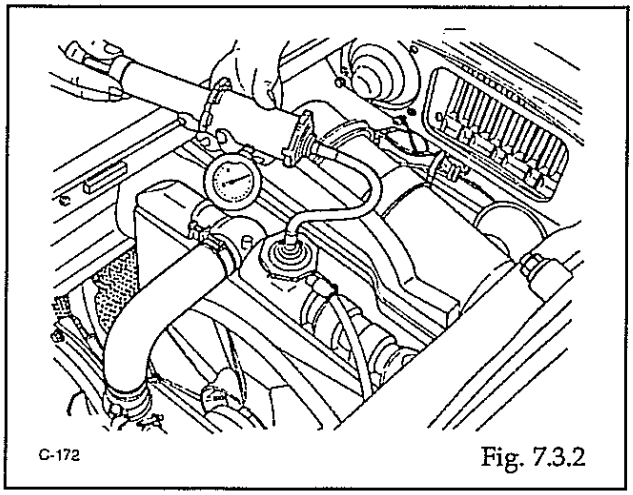

C-172

Fig. 7.3.2

WARNING

To prevent personal injury DO NOT remove the radiator cap when the engine is hot.

7.3.3 RADIATOR CAP - PRESSURE TEST

1. Attach a radiator tester to the radiator cap (Fig. 7.3.3).

2. Apply the specified pressure 12.8 lbs./in.² (0.9 kg/cm²).

3. Check that the pressure does not drop by more than 4.3 lbs./in.² (0.3 kg/cm²).

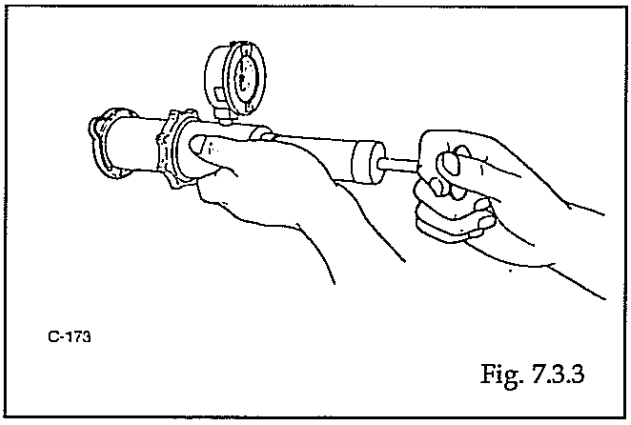

C-173

Fig. 7.3.3

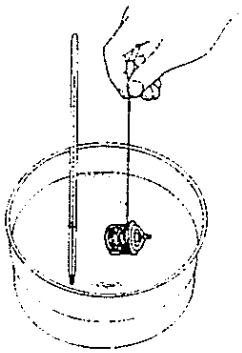
7.3.4 THERMOSTAT - TEST

1. Push down the thermostat valve and insert a string between the valve and the valve seat (Fig. 7.4.3).

2. Place the thermostat and a thermometer in a container with water and gradually heat the water.

3. Hold the string to suspend the thermometer in the water. When the water temperature rises the valve will open allowing the thermostat to fall from the string.

4. Check the temperature at the point where the thermostat falls. Continue to heat the thermostat and note the temperature when the thermostat is fully open.
   Start to open: 157.1 - 162.5°F (69.5 - 72.5C)
   Fully Open: 185.5°F (85°C)

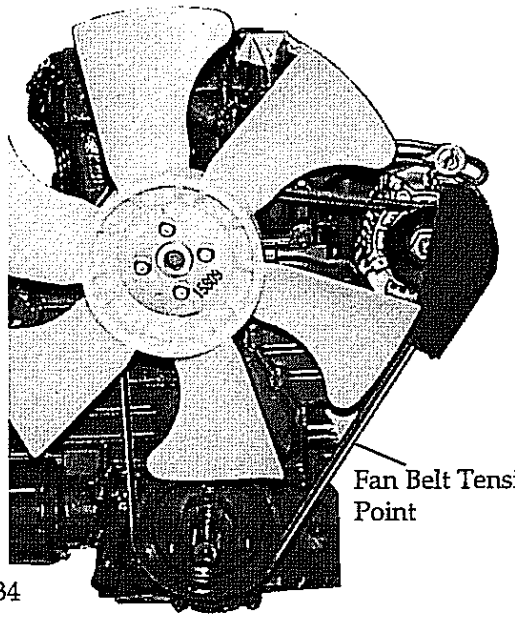

Thermostat Operation Check

C-171

Fig. 7.4.3

7.3.5 *FAN BELT - ADJUSTMENT*

Check the fan belt tension midway between the fan pulley and alternator pulley (Fig. 7.3.5). Deflection should be between 1/4 to 3/8 in. (7 to 9 mm) with a force of 13 - 15 lbs. (6 to 7 Kg).



C-834

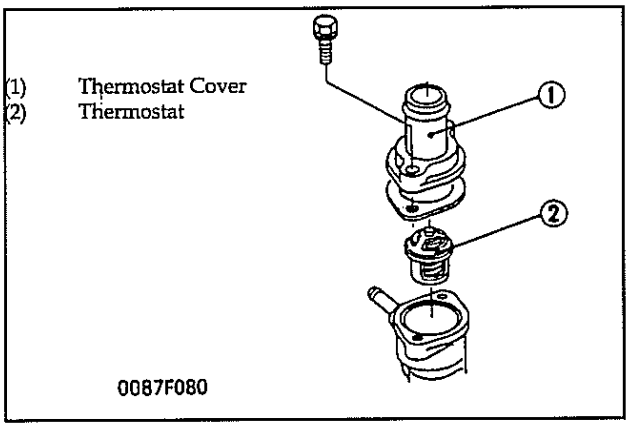
7.3.6 *COOLANT COMPONENTS ASSEMBLING AND DISASSEMBLING*

Thermostat

1. Remove the thermostat cover (1).
2. Remove the thermostat (2).

(When Reassembling)

1. Apply a liquid gasket only at the thermostat cover side of the gasket.

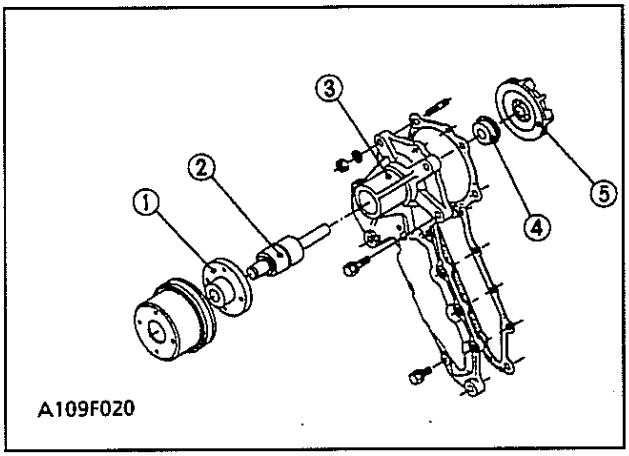


Water Pump

1. Remove the fan and fan pulley
2. Remove the water pump from the gearcase cover.
3. Remove the water pump flange (1).
4. Press out the water pump shaft (2) with the impeller (5) on it.
5. Remove the impeller from the water pump shaft.
6. Remove the mechanical seal (4).

(When Reassembling)

1. Replace the mechanical seal with a new one.

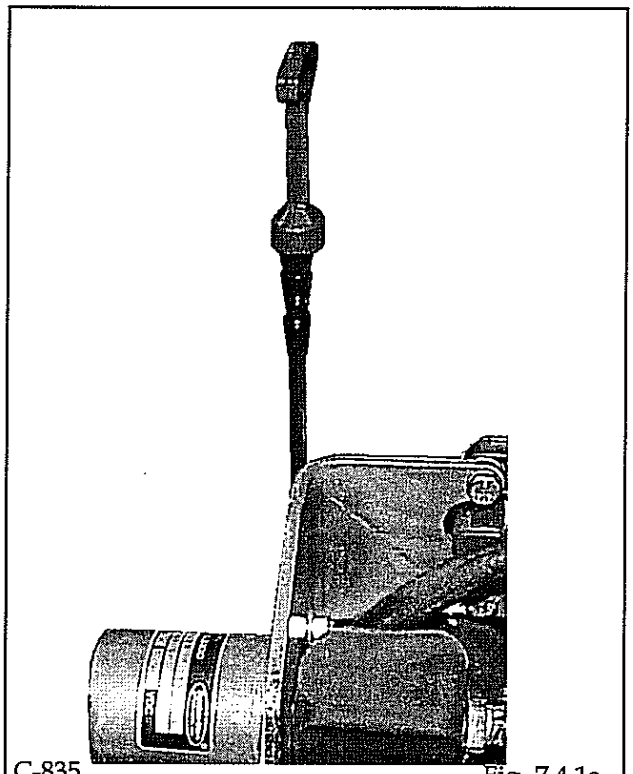


(1) Water Pump Flange
(2) Water Pump Shaft
(3) Water Pump Body
(4) Mechanical Seal
(5) Impeller

7.4 LUBRICATION SYSTEM

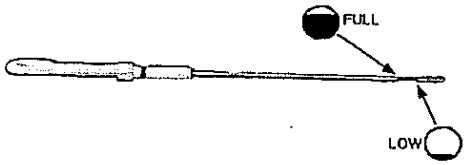
7.4.1 OIL LEVEL CHECK

To check the oil level, stop the engine with the loader on level ground, open the rear door and remove the dipstick (Fig. 7.4.1a).



C-835 Fig. 7.4.1a

Keep the oil level between the full and low mark on the dipstick (Fig. 7.4.1b). Do not fill above the full mark - use a good qualitiy 10W30 motor oil which meets API classification CD/CE.



C-642 Fig. 7.4.1b

7.4.2 REPLACE ENGINE OIL AND FILTER

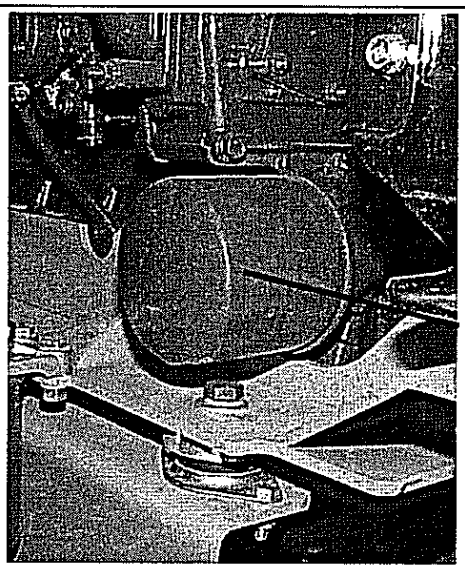
Operate the engine until warm, approx. five (5) minutes. Stop the engine.

Remove the oil drain plug located at the bottom of the oil pan.

Remove the oil filter (Fig. 7.4.2). Clean the filter housing surface. Put clean oil on the seal of the new filter. Install the new filter and tighten hand tight.

Replace the oil drain plug. Remove the filler cap and add 10W30 API classification SE/CD engine oil. Start the engine and check for leaks at the filter. Stop the engine. Recheck the oil level and add oil until level is at the top mark on dipstick.

Change the engine oil the oil filter every 150 hours.



Engine Oil Filter

Fig. 7.4.2 C-828

7.5 *FUEL SYSTEM*

7.5.1 FUEL FILTER REPLACEMENT

The fuel filter is located on the RH side of the engine in the engine compartment (Fig. 7.5.1). The filter element should be changed every 400 operating hours.

To replace the filter, close the fuel inlet line shut - off located on the side of the fuel tank. Remove the filter element. Lubricate the seal on the new filter with light oil and install the filter hand tight. Open the fuel inlet shut - off. It may be necessary to remove air from the fuel system after changing the filter element by removing bleed plug and pump until fuel flows.

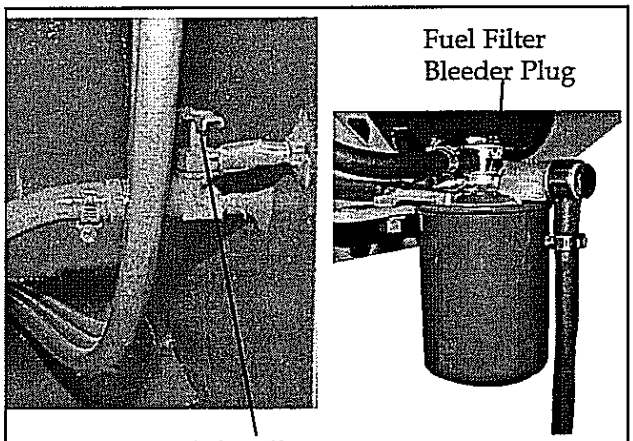


Fig. 7.5.1

7.5.2 REMOVING AIR FROM FUEL SYSTEM

Air must be removed from the fuel:

1. after replacement of the fuel filter
2. when the tank has been run out of fuel before starting the engine.

To remove air, ensure the fuel inlet shut- off located on the side of the fuel tank is open. Place the throttle at idle and open the bleed valve (Fig. 7.5.2) on top of the injector pump. Turn the engine over with the starter. When the engine starts and runs smoothly, close the valve.

WARNING To prevent personal injury never add fuel to the loader when the engine is running or hot NO SMOKING

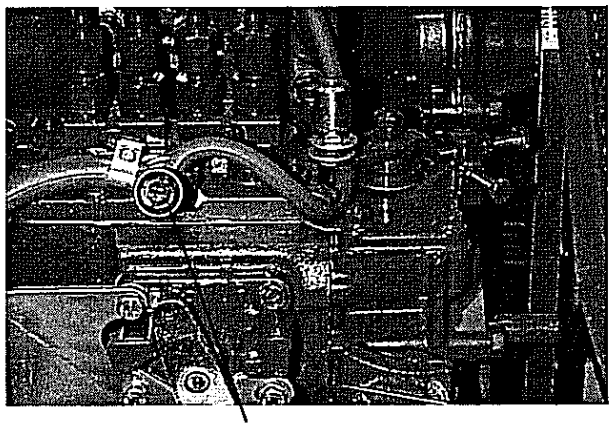


Fig. 7.5.2

WARNING To prevent personal injury, stop, cool and clean the engine of flammable materials before servicing. Never service or adjust engine with the engine running.

7.5.3 CHECKING AND ADJUSTING

INJECTION PUMP

Injection Timing

1. Remove the injection pipes.
2. Set the speed control lever to maximum fuel discharge position

NOTE: The V2203 pump has a displacement angle. In adjusting the injection timing, pull the stop lever from its free position by 0.436 +/- 0.035 rad. (25° +/- 2°) toward the stop position.

3. Turn the flywheel counterclockwise (facing the flywheel) until the fuel fills up to the hole of the delivery valve holder for 1st cylinder.
4. Turn the flywheel further and stop turning when the fuel begins to flow over, to get the present injection timing.
5. (The flywheel has mark 1TC and four lines indicating every 0.087 rad. (5°) of crank angle from 0.175 rad. (10°) to 0.436 rad. (25°) before mark 1TC.) Calculate the angle which the projection of the window points out. If the calculation differs fromspecified injection timing, add or remove the shim to adjust.

(Injection Timing)

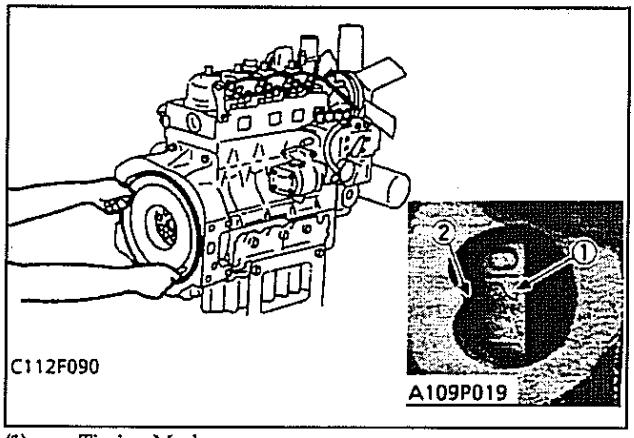
V2203: (17° to 19°) B.T.D.C.

NOTE: The sealant is applied to both sides of the soft metal gasket shim. The liquid gasket is not required for assembling.

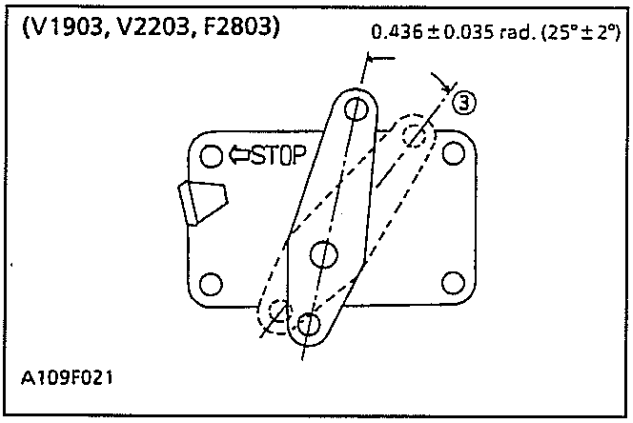
Shims are available in thickness of 0.20 mm, 0.25 mm, and 0.30 mm. Combine these shims for adjustments.

Addition or reduction of shim (0.05 mm, 0.0020 in.) delays or advancesthe injection timing by apporx. 0.0087 rad. (0.5°).

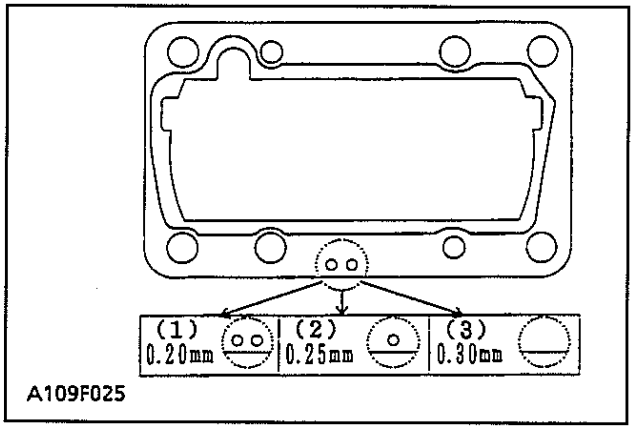
In disassembling and replacing , be sure to use the same number of new gasket shims with the same thickness.



(1) Timing Mark
(2) Projection



(3) Stop Lever in Free Position

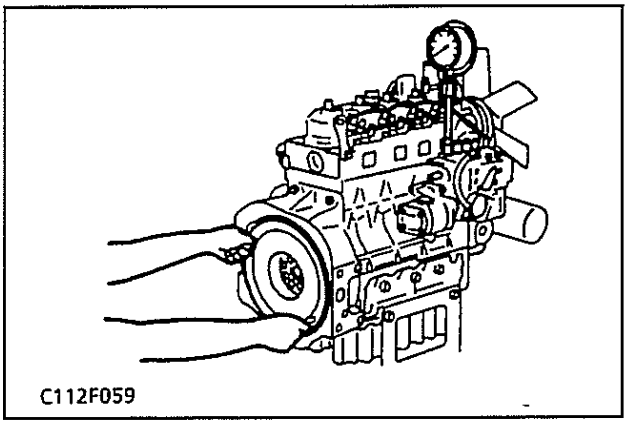


(5) 2 - holes: 0.20 mm
(6) 1 - hole: 0.25 mm
(7) without hole: 0.30 mm

Fuel Tightness of Pump Element

1. Remove the injection pipe.
2. Install the injection pump pressure tester (1) to the injection pump[.
3. Set the speed control lever to the maximum speed position.
4. Turn the flywheel ten times or more to increase the pressure.
5. If the pressure cannot reach the allowable limit, replace the pump element or injection pump assembly.

Fuel tightness of pump element	Allowable Limit	150 kgf/cm² 14.7 MPa, 2133 psi



(1) Injection Pump Pressure Tester

Fuel Tightness of Delivery Valve

1. Set a pressure tester to the fuel injection pump.
2. Rotate the flywheel and raise the pressure to 155 - 160 kg/cm².
3. Now turn the flywheel back about 1/2 a turn (to keep the plunger free). Maintain the flywheel at this position and clock the time taken for the pressure to drop from the 150 kg/cm² down to 140 kg/cm².
4. Measure the time needed to decrease the pressure from 150 to 140 kg/cm² (14.7 to 13.7 MPa, 2133 to 1990 psi).
5. If the measurement is less than allowable limit, replace the delivery valve.

Fuel tightness of delivery valve	Allowable Limit	150 to 140 kgf/cm² 14.7 to 13.7 MPa, 2133 - 1900 psi

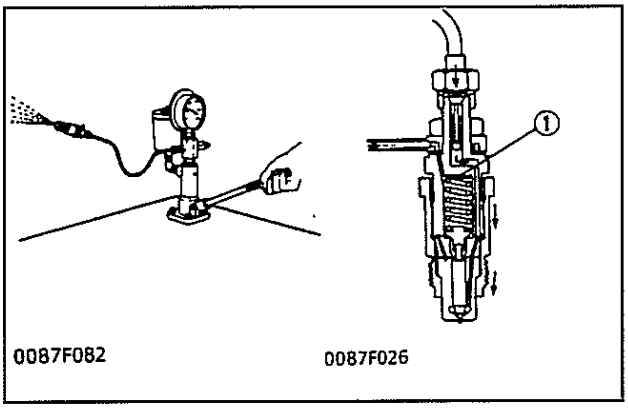
7.5.4 INJECTION NOZZLE

Fuel Tightness of Pump Element

1. Set the injection nozzle to the nozzle tester.
2. Slowly move the tester handle to measure the pressure at which fuel begins jetting out from the nozzle.
3. If the measurement is not within the factory specifications, disassemble the injection nozzle and change the adjusting washer (1) until the proper injection pressure is obtained.

(Reference)

1. Pressure variation with 0.025 mm (0.00098 in.) difference of adjusting washer thickness. Approx. 6 kgf/cm² (588.6 kPa, 85.32 psi)

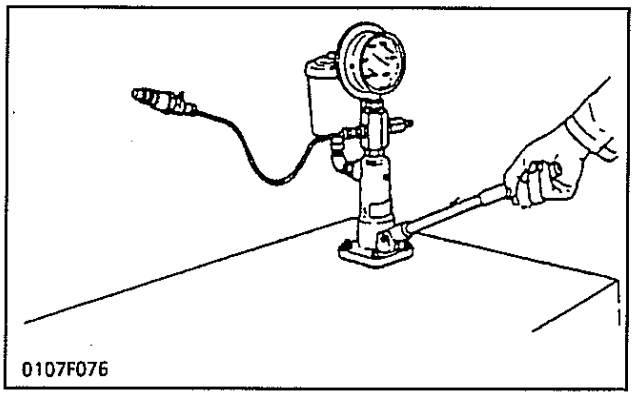


WARNING

Check the nozzle injection pressure and condition after confirming that there is nobody standing in the direction the fume goes. If the fume contacts the the human body, cells may be damaged and blood poisoning may be caused.

Fuel Tightness of Needle Valve Seat

1. Set the injection nozzle to the nozzle tester. Apply a pressure 130 kgf/cm² (12.75 MPa, 1849 psi).
2. After keeping the nozzle under the pressure for 10 seconds, check to see if fuel leaks from the nozzle.
3. If fuel should leak, replace the nozzle piece

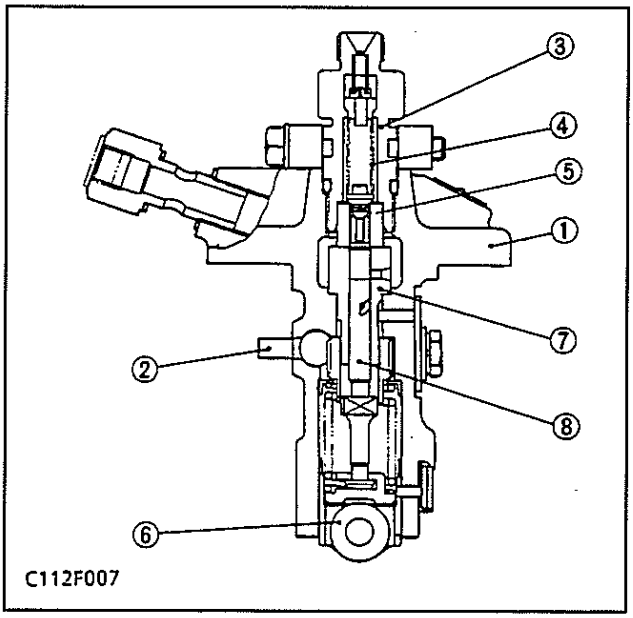


7.5.5 DISASSEMBLING and ASSEMBLING

INJECTION PUMP

IMPORTANT If replacing the pump element, the amount of fuel injection should be adjusted on a specified bench.

(1) Pump Body
(2) Control Rack
(3) Delivery Valve Holder
(4) Delivery Valve Spring
(5) Delivery Valve
(6) Tappet Roller
(7) Cylinder
(8) Plunger



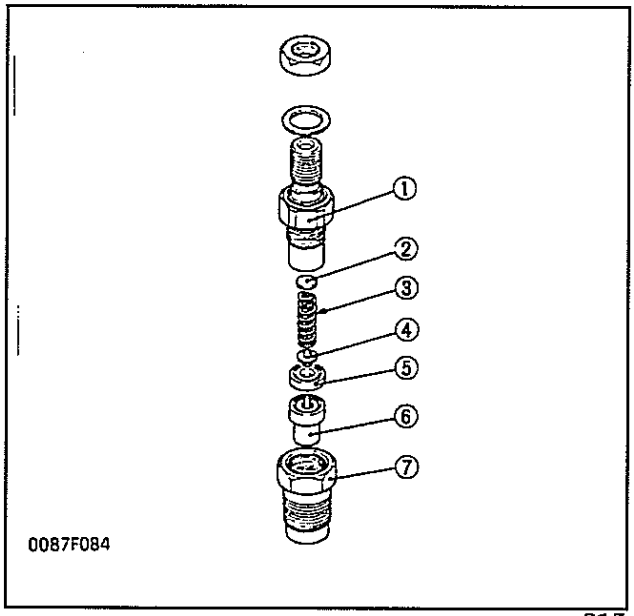
Nozzle Holder

1. Secure the nozzle retaining nut (7) with a vise.
2. Remove the nozzle holder (1) and take out parts inside.

(When Reassembling)

1. Assemblethe nozzle in clean fuel oil.
2. Install the push rod (4), noting its direction.
3. After assembling the nozzle, be sure to adjust the fuel injection pressure.

(1) Nozzle Holder
(2) Adjusting Washer
(3) Nozzle Spring
(4) Push Rod
(5) Distance Piece
(6) Nozzle Piece
(7) Nozzle Retaining Nut



7.6 AIR INTAKE SYSTEM

7.6.1 AIR FILTER MAINTENANCE

Daily Maintenance

If the air cleaner service indicator light on the dash panel shows red the filter element must be replaced.(Fig. 7.6.1)

Check all hose clamps for tightness and inspect the hoses for damage. Check the vacuator for damage.

Servicing Cleaner Element

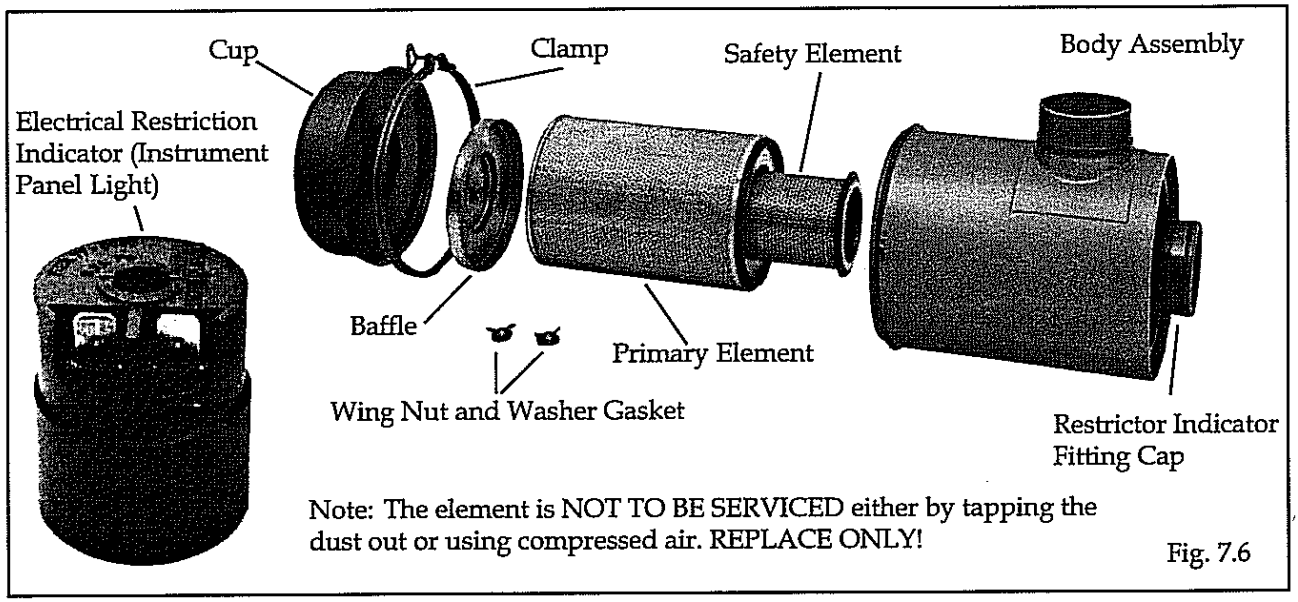
1. Empty the dust cap as required. Dust should not be allowed to build closer than 1 in. from the baffle.

2. Loosen the wing nut and remove the primary element, as gently as possible. Before installing the new element inspect the element and gasket for shipping or storage damage.

3. Always clean the inside of the housing and gasket seating surface making sure no dust is allowed into the intake duct.

4. Check for uneven dirt patterns on the old filter. Make sure the new gasket is seating evenly. Reinstall the dust cap, making sure it seals 360 ° around the cleaner body. Reset the restriction indicator.

5. Check all connections between the air cleaner and the engine to be certain they are tight and leak-free.



Note: The element is NOT TO BE SERVICED either by tapping the dust out or using compressed air. REPLACE ONLY!

Fig. 7.6

7.7 SPECIFICATIONS, SPECIAL TOOLS, TROUBLESHOOTING

7.7.1 SPECIFICATIONS

Engine Model		V2203
Number of Cylinders		4
Horsepower		52 (29.5 KW)
Bore X stroke		2197 (134.08)
Displacement		133.4 cu. in. (2186 cc)
Max Torque		115 ft. lbs. @1600 RPM
Compression Ration		23:1
Engine Compression		427 - 469 PSI (30 - 33 kgf/cm. sq.)
Maximum High Idle		2800 RPM
Low Idle		875 + or - 25 RPM
Firing Order		1-3-4-2
Cylinder Arrangement		In - line vertical
Valve Arrangement		Overhead
Muffler		Vertical (spark arrestor)
Cylinder Liners		
I.D of Cylinder liners	STD	3.4252 to 3.4261 in. (87.000 to 87-022 mm)
	MAX	+0.0059 in. (+ 0.15 mm)
Cylinder Head		
Distortion (head warp)		0.0019 in. / 19.69 in.
Thickness of Gasket		0.0512 to 0.0551 in.
Thickness of gasket shims		0.0079 in. (0.2 mm)
Top Clearance		0.0217 to 0.0276 in.
Cylinder Head Bolt & Nut Torque		68.7 to 72.3 ft. lbs. (93.1 to 98.0 mm)
Valves		
Valve Seat Width		0.08350in. (2.12 mm)
Valve Seat Angle		45° ex. 60 in.
O.D. of Valve Stems (int and ext)		0.3134 to 0.3140 in. (7.960 to 7975 mm)
I.D of Valve Guides (int. and ext)		0.3156 to 0.3161 (8.015 to 8.030 mm)
Clearance Between Valve	STD	0.00167 to 0.0026 (0.04070 to 0.070 mm)
Stems and Guides	MAX	0.0630 in. (1.6 mm)
Valve Clearance (intake & exhaust)	Cold	0.0071 to 0.0087 in. (0.18 to 0.22 mm)
Valve Springs		
Free Length	STD	1.6417 to 1.6614 in. (41.7 to 42.2 mm)
	MIN	1.6220 in. (41.2 mm)
Fitted Length		1.3780 (35.0 mm)
Load to compress	STD	26.4 lbs. (1.3780 in.)
to fitted length	MAX	22.5 lbs. (1.3780 in.)
Squareness		0.0394 in. (1.0 mm)
Valve Rocker Arms		
O.D. of Rocker Arm Shafts		0.5501 to 0.5506 in. (13.973 to 13984 mm)
I.D. of Rocker Arm Bushings		0.5513 to 0.5529 in. (14.002 to 14.043 mm)
Clearance between Rocker	STD	0.0007 to 0.0026 in. (0.018 to 0.070 mm)
Arm Shafts and Bushings	MAX	0.0059 in. (0.15 mm)

7.7 SPECIFICATIONS, SPECIAL TOOLS, TROUBLESHOOTING

7.7.1 SPECIFICATIONS

Camshaft		
O.D. of camshaft bearing journal		1.5722 to 1.5728 in. (39.934 to 39.950 mm)
I.D. of camshaft bearing		1.5748 to 1.5758 in. (40.000 to 40.025 mm)
Clearance between		
camshaft bearing	STD.	0.0020 to 0.0036 in. (0.050 to 0.091 mm)
journals and bearings	MAX.	0.0059 in. (0.15 mm)
Alignment of camshafts	MAX.	0.00039 in. (0.01 mm)
Cam height	STD. (intake)	1.3177 in. (33.47 mm)
	Min. (intake)	1.3157 in. (33.42 mm)
	STD. (exhaust)	1.3177 in. (33.47 mm)
	MIN. (exhaust)	1.3157 in. (33.42 mm)
Gear backlash	STD.	0.0016 in. (0.15 mm)
	MAX.	0.0059 in. (0.15 mm)
Piston Rings		
(Top ring, 2nd ring)	STD.	0.0118 to 0.0177 in. (0.30 to 0.45 mm)
Ring gap	MAX.	0.0492 in. (1.25 mm)
(oil ring)	STD.	0.0098 to 0.0177 in. (0.25 to 0.45 mm)
	MAX.	0.0492 in. (1.25 mm)
Side clearance	(top ring)	
of ring in groove	(2nd ring)	0.0037 to 0.0047 in. (0.093 to 0.120 mm)
	(Oil ring)	0.0008 to 0.0020 in. (0.020 to 0.052 mm)
Oversizes of piston ring		0.0197 in. (0.5 mm)
Pistons		
I.D. of piston	STD.	0.9843 in. (25.00 mm)
bosses	MAX.	0.9843 in. (25.00 mm)
O.D. of piston pin		.9843 in. (25.002 mm)
I.D. of connecting rod small end bushings (fitted)		.9852 in. (25.025 mm)
Clearance between piston	STD.	0.0006 to 0.0015 in. (0.0014 to 0.038 mm)
pin and small end bushing	MAX.	0.0059 in. (0.15 mm)
Connecting rod	STD.	.0020 (.05 mm)
alignment	MAX.	.0020 (.05 mm)
Crankshaft		
Crankshaft	STD.	.00079 in. (.02 mm)
alignment	MAX.	.00079 in. (.02 mm)
O.D. of crankshaft journals		2.0441 to 2.0449 in. (51.921 to 51.940 mm)
I.D. of crankshaft bearing 1		2.0465 to 2.0488 in. (51.980 to 52.039 mm)
I.D. of crankshaft bearing 2		2.0465 to 2.0482 in. (51.980 to 52.025 mm)
Clearance between	STD.	0.0016 to 0.0046 in. (0.040 to 0.118 mm)
crankshaft journals and bearing 1	MAX.	0.0079 in. (0.20 mm)
Clearance between	STD.	0.0016 to 0.0041 in. (0.040 to 0.104 mm)
crankshaft journals and bearing 2	MAX.	0.0079 in. (0.20 mm)
Undersizes of crankshaft bearing 1		0.0079 to 0.0157 in. (0.2 to 0.4 mm)
Undersizes of crankshaft bearing 2		0.0079 to 0.0157 in. (0.2 to 0.4 mm)
O.D. of crankpins		1.8488 in. (46.959 mm)
I.D. of crankpin bearings		1.8504 in. (47.00 mm)

7.7 SPECIFICATIONS, SPECIAL TOOLS, TROUBLESHOOTING

7.7.1 SPECIFICATIONS

Clearances between crank pins and bearings	STD.	.0009 in. (.025 mm)
	MAX.	0.0079 in.(0.20 mm)
Undersizes of crankpin bearings		0.0079 in. (0.2 mm) 0.0157 in. (0.4 mm)
End play of crankshaft	STD.	0.0059 to 0.0122 in. (0.15 to 0.31 mm)
	MAX.	0.0197 in. (0.5 mm)
Oversizes of crankshaft side metal 1.2		0.0079 in. (0.2 mm) 0.0157 in. (0.4 mm)
Fuel Injection Nozzles		
Opening pressure		1990.8 to 2133.0 lb./sq. in. (140 to 150 kgf/cm.sq.
Fuel tightness of nozzle valve seat		Dry nozzle at 1848.6 to 1990.8 lb./sq. in.
Injector Pump		
Fuel tightness of plunger	STD.	10 sec. or more; initial pressure from 2133 PSI (150 KGF)
	MIN.	5 secs. or less
Fuel tighness of delivery valve	STD.	10 secs. or more; initial pressure from 2133 lb./sq/ in.
	MIN.	5 secs. or less
Injection Timing		(17° to 19° before) TDC
Oil Pump		
Oil pressure (normal running)	STD	42.7 to 64.0 lb./sq. in. (3.0 to 4.5 kgf./cm. sq.)
	MIN.	35.6 lb./sq. in. (2.5 kgf/cm.sq.)
Rotor Lobe clearance	STD	0.0016 to 0.0051 in. (0.04 to 0.13 mm)
	MAX.	0.0079 in. (0.20 mm)
Rotor Type		
Radial clearance between outer rotor and pump body	STD	0.0043 to 0.0075 in. (0.11 to 0.19 mm)
	MAX.	0.0098 in. (0.25 mm)
End clearance between rotor and cover	STD.	0.0041 to 0.0059 in. (0.105 to 0.150 mm)
	MAX.	0.0079 in. (0.2mm)
Radiator		
Opening pressure of cap		12.8 lb./sq. in. (0.9kgf/cm. sq.)
Test pressure		12.8 lb./sq. in. (0.9kgf/cm. sq.)
Thermostat		
Opening temperature	(beginning)	176.9°F to 182.3 °F (80.5°C to 83.5°C)
	(full open)	203°F (95°C)
Distance of lift		0.3150 in. (8mm)
Fanbelt		
Belt sag under load 13.2 to 15.4 lb. (6 to 7 kgf)		0.2756 to 0.3543 in. (7 to 9 mm)
Alternator		
Output current		14V/35 A 4000 RPM
Total resistance of rotor coil, measured between terminal "F" and "E"	STD.	4
	MAX.	10
Brush length	STD.	.4921 in. (12.5 mm)
	MIN.	.2165 in. (5.5 mm)

7.7 SPECIFICATIONS, TROUBLESHOOTING

7.7.1 SPECIFICATIONS

Regulator		
Cut in voltage		4.5 to 5.8 volts
No load regulating voltage		13.8 to 14.8 volts
Resistance between terminals: "IG" and "F" with open contacts		0
"IG" and "F" with contacts		approximately 11
"L" and "E" with open contacts		0
"L " and "E" with contacts		approximately 100
"N" and "E"		approximately 23
"B" and "E" with open contacts		infinity
"B" and "L" with contacts		0
Point gap		0.0118 to 0.0177 in. (0.3 to 0.45 mm)
Starter Motor		
No load test	Current	90A or less
	Voltage	11.5V
	Speed	3500 RPM or more
O.D. of commutator	STD.	1.1811 in. (30.0 mm)
	MIN.	1.1417 in. (29.0 mm)
Mica undercutting	STD.	0.0197 to 0.354 in. (0.5 to 0.9 mm)
	MIN.	0.0079 in. (0.2 mm)
Brush length	STD.	0.7480 in. (19 mm)
	MIN.	0.5000 in. (12.7 mm)
Glow Plug		
Resistance		approximately 0.8

7.7.2 TORQUE SPECIFICATIONS

Bolt Torques

Material Grade	Standard Bolt	Special Bolt	Special Bolt
Nominal Diameter	SS41; S20C	S43C, S48C (Refined)	SCR3, SCM3 (Refined)
M6	7.8 - 9.3 N.M.	9.8 - 11.3 N.M.	12.3 - 14.2 N.M.
	0.80 - 0.95 kgf/m	1.00 - 1.15 kgf/m	1.25 - 1.45 kgf/m
	5.8 - 6.9 lb. ft.	7.2 - 8.3 lb. ft.	9.0 - 10.5 lb. ft.
M8	17.7 - 20.6 N.M.	23.5 - 27.5 N.M.	29.4 - 34.3 lb.ft.
	1.80 - 2.10 kgf/m	2.40 - 2.80 kgf/m	3.00 - 3.50 lb. ft.
	13.0 - 15.2 lb. ft.	17.4 - 20.3 lb. ft.	21.7 - 25.3 lb. ft.
M10	39.2 - 45.1 N.M.	48.0 - 55.9 N.M.	60.8 - 70.6 N.M.
	4.00 - 4.60 kgf/m	4.90 - 5.70 kgf/m	6.20 - 7.20 kgf/m
	28.9 - 33.3 lb. ft.	35.4 - 41.2 lb. ft.	44.8 - 52.1 lb.ft.
M12	62.8 - 72.6 N.M.	77.5 - 90.2 N.M.	103.0 - 117.7 lb. ft.
	6.40 - 7.40 kgf/m	7.90 - 9.20 kgf/m	10.50 - 12.00 kgf/m
	46.3 - 53.5 lb. ft.	57.1 - 66.5 lb. ft.	75.9 - 86.8 lb. ft.
M14	107.9 - 125.5 N.M.	123.6 - 147.1 N.M.	166.7 - 196.1 N.M.
	11.00 - 12.80 kgf/m	12.60 - 15.00 kgf/m	17.00- 20.00 kgf/m
	79.6 - 92.6 lb. ft.	91.1 - 108.5 lb. ft.	123.0 - 144.7 lb. ft.
M16	166.7 - 191.2 N.M.	196.1 - 225.5 N.M.	259.9 - 304.0 N.M.
	17.00 - 19.50 kgf/m	20.00 - 23.00 kgf/m	26.50 - 31.00 kgf/m
	123.0 - 141.0 lb. ft.	144.7 - 166.4 lb. ft.	191.7 - 224.2 lb. ft.
M18	245.2 - 284.4 N.M.	274.6 - 318.7 N.M.	343.2 - 402.0 N.M.
	25.00 - 29.00 kgf/m	28.00 - 32.50 kgf/m	35.00 - 41.00 kgf/m
	180.0 209.8 lb. ft.	202.5 - 235.1 lb.ft.	253.2 - 296.5 lb. ft.
M20	333.4 - 392.2 N.M.	367.7 - 431.5 N.M.	490.3 - 568.7 N.M.
	34.00 - 40.00 kgf/m	37.50 - 44.00 kgf/m	50.00 - 58.00 kgf/m
	245.9 - 289.3 lb. ft.	271.2 - 318.2 lb. ft.	361.6 - 419.5 lb. ft.

7.7.3 TROUBLESHOOTING
Engine

Condition	Possible Causes
Engine does not develop full power.	1. Clogged air cleaner. 2. Fuel line obstruction. 3. Improper injection timing. 4. Improper nozzle injection pressure and angle 5. Low cylinder compression. 6. Insufficient fuel injection. 7. Improper valve lash adjustment. 8. Burned, worn or sticking valves. 9. Blown head gasket. 10. Worn or sticking piston ring.
Low Cylinder Compression	1. Burned, worn or sticking valves. 2. Bent valve stem 3. Broken or weak valve spring. 4. Blown cylinder head gasket. 5. Worn or sticking piston ring. 6. Scored piston. 7. Improper valve lash.
Poor Engine Idling	1. Improper injection timing. 2. Air in injection pump. 3. Improper governor adjustment.
Engine Knocks	1. Diluted or thin oil. 2. Insufficient oil supply. 3. Low oil pressure. 4. Worn crankshaft thrust bearing. 5. Excessive flywheel runout. 6. Excessive connecting rod or main bearing clearance. 7. Seized bearing. 8. Clogged oil passages. 9. Bent or twisted connecting rod. 10. Crankshaft journals out-of-round. 11. Excessive piston-to-cylinder bore clearance. 12. Excessive piston ring side clearances. 13. Broken or damaged rings. 14. Excessive piston pin clearance. 15. Seized piston. 16. Piston pin retainer loose or missing. 17. Improper valve lash adjustment. 18. Worn valve lifter. 19. Excessive timing gear backlash. 20. Low cylinder compression. 21. Improper injection timing. 22. Improper nozzle injection pressure and angle.
Low Oil Pressure	1. Engine oil level low. 2. Wrong grade or oil. 3. Clogged oil pump. 4. Faulty oil pressure relief valve. 5. Worn oil pump driveshaft or gears or broken oil pipe. 6. Excessive main or connecting rod clearances.

7.7.3 TROUBLESHOOTING
Engine

Condition	Possible Causes
Oil Pressure Warning Light Fails to Operate	1. Bulb burned out. 2. Oil pressure sensor is faulty. 3. Warning light circuit faulty.
Excessive Oil Consumption	1. Engine oil level is too high. 2. Leakage in the cylinder head gasket. 3. Oil past the piston and rings. 4. Worn, broken or sticking piston rings. 5. Clogged return hole of oil ring. 6. Worn valves and/or valve guides or worn seal. 7. Leakage past oil seals and gaskets. 8. External oil leaks from the engine.
Engine Overheats	1. Insufficient amount of coolant in radiator. 2. Hose connection leakingor collapsed hose. 3. Radiator leakage. 4. Loose, worn or broken V-Belt. 5. Radiator fins bent or clogged. 6. Radiator cap not sealed. 7. Thermostat operating improperly. 8. Insufficient amount of engine oil. 9. Water pump operating improperly. 10. Improper valve clearance. 11. Restriction in the exhaust system. 12. Improperly installed cylinder head gasket. 13. Rust and/or scale clogged water ports. 14. Extended engine idling.
Excessive Fuel Consumption	1. Improper injection timing. 2. Leakage at the injection pipe connectors. 3. Leakage at the fuel shutoff valve. 4. Improper adjusted nozzle.
Temperature Gauge Fails to Reach Normal Operating Temperature	1. Faulty temperature sender. 2. Faulty thermostat. 3. Faulty temperature gauge.
Excessive Exhaust Smoke	1. Air cleaner dirty or restricted. 2. Excessive fuel delivery. 3. Low cylinder pressure.
Excessive Oil Consumption	1. Engine oil level too high. 2. External oil leaks from engine. 3. Worn valves, valve guides or seals. 4. Head gasket not sealing. 5. Oil loss past the pistons and rings.
Engine Stops While Operating	1. Lack of fuel in fuel tank. 2. Clogged fuel filter. 3. Air mixed in the fuel system. 4. Faulty components.
Undesireable Exhaust (White or Pale)	1. Excessive engine oil. 2. Improper lubricating oil viscosity. 3. Faulty injection timing.

7.7.3 TROUBLESHOOTING

Engine

Condition	Possible Causes
Undesireable Exhaust Colour (Black or Light Grey)	1. Unsuitable fuel. 2. Excess injection. 3. Faulty engine components. 4. Overloading. 5. Clogged air cleaner. 6. Low cylinder pressure. 7. Clogged air filter.
Engine Does Not Start	1. Faulty starter switch. 2. Insufficient charging or complete discharge. 3. Lack of fuel. 4. Air mixed in the fuel system. 5. Clogged fuel filter. 6. Irregular or faulty fuel supply. 7. Glow plug not heating. 8. Improper lubricating oil viscosity. 9. Clogged air cleaner. 10. Faulty starter motor. 11. Main shift lever is not in the neutral position. 12. Shut off solenoid faulty.
Engine Overheats	1. Improper injection timing. 2. Leakage at the injection pipe connectors. 3. Leakage at the fuel shutoff valve. 4. Improper adjusted nozzle.

Cooling System

Condition	Possible Causes
High Temperature Indication - Overheating	1. Coolant level low. 2. Fan belt loose. 3. Radiator hose(s) collapsed. 4. Radiator blocked to airflow. 5. Faulty radiator cap. 6. Tractor overloaded. 7. Idle speed low. 8. Air trapped in cooling system. 9. Incorrect cooling system component(s) installed. 10. Faulty thermostat. 11. Water pump shaft broken or impeller loose. 12. Radiator tubes clogged. 13. Cooling system clogged. 14. Casting flash in cooling passages. 15. Brakes dragging. 16. Excessive engine friction. 17. Anti-freeze concentration too high - over 68%. 18. Missing air seals. 19. Faulty gauge or sending unit. 20. Loss of coolant flow caused by leakage or foaming.

7.7.3 TROUBLESHOOTING
Cooling System

Condition	Possible Causes
Low Temperature Indication - Overheating	1. Thermostat stuck open. 2. Faulty gauge or sending unit.
Coolant Loss - Boil Over	Refer to Engine Overheating Causes in addition to the following: 1. Overfilled cooling system. 2. Quick shutdown after hard (hot) running. 3. Air in system resulting in occasional "burping of coolant. 4. Insufficient anti-freeze in mixture allowing ` coolant boiling point to be too low. 5. Anti-freeze deteriorated because of aging. or contamination. 6. Leaks due to loose hose clamps, loose nuts, bolts, drain valve, faulty hoses or defective radiator. 7. Faulty head gasket. 8. Cracked head, manifold or block.
Coolant Entry into Crankcase or Cylinder	1. Faulty head gasket. 2. Crack in head, manifold or block. 3. Faulty cylinder liner O-ring.
Noise	1. Fan contacting shroud. 2. Loose water pump impeller. 3. Glazed fan belt. 4. Loose fan belt. 5. Rough surface on drive pulley. 6. Water pump bearing down. 7. Belt alignment.
Temperature Lamp On Or Gauge Reads Hot But Temperature Is OK	1. Wrong sending unit. 2. Sending wire shorted to ground.

NOTE: Immediately after shutdown, the engine enters a condition known as heat soak. This is caused by cooling system being inoperative while the engine temperature is high. If coolant temperature rises above the boiling point, expansion and pressure may push some coolant out of the radiator overflow tube. If this does occurs frequently, it is considered normal.

Condition	Cause	Remedy
Fuel Not Reaching Injection Pump	1. Fuel shutoff valve closed. 2. Restricted fuel filters. 3. Air in system. 4. Fuel leakage.	1. Check that the fuel shutoff valve at the fuel tank is on the "ON" position. 2. Check and flush the fuel filter clean. 3. Bleed the fuel system. 4. Check the fuel lines and connections for damage.
Fuel Reaching Nozzles but Engine Will Not Start	1. Low cranking speed. 2. Incorrect throttle adjustment. 3. Incorrect pump timing. 4. Fuel leakage. 5. Faulty injectors. 6. Low compression.	1. Check the cranking speed. 2. Check the throttle control travel. 3. Check the pump timing. 4. Check the fuel lines and connectors for leakage. 5. See injection troubleshooting. 6. Check the engine compression.
Engine Hard To Start	1. Low cranking speed. 2. Incorrect pump timing. 3. Restricted fuel filter. 4. Contaminated fuel. 5. Low compression. 6. Air in system.	1. Check the cranking speed. 2. Check the pump timing. 3. Check and flush the fuel filter clean. 4. Check for water in the fuel. 5. Check the engine compression. 6. Check for air leaks on the suction side of the system.
Engine Stops and Starts	1. Fuel starvation. 2. Contaminated fuel. 3. Restricted air intake. 4. Engine overheating. 5. Air in system.	1. Check and flush clean restricted fuel lines. 2. Check for water in the fuel. 3. Check for restrictions in the air intake. 4. Check cooling system. 5. Check for air leaks on the suction side of the system.
Erratic Engine Operations (Surge, Misfiring, Poor Governor Regulation)	1. Fuel leakage. 2. Fuel starvation. 3. Incorrect timing. 4. Contaminated fuel. 5. Air in system. 6. Faulty or sticking injector nozzles. 7. Incorrect engine timing.	1. Check the injector lines and connectors. 2. Check and flush clean restrictor fuel. 3. Check the pump timing. 4. Check for water in the fuel. 5. Bleed the fuel system. 6. See injector troubleshooting. 7. Check for faulty engine valves.
Engine Does Not Develop Full Power	1. Incorrect throttle adjustment. 2. Incorrect maximum no-load speed. 3. Fuel starvation. 4. Air in system. 5. Incorrect timing. 6. Low compression. 7. Incorrect engine timing.	1. Check for insufficient throttle control movement. 2. Check maximum no-load speed adjustment. 3. Check and flush clean restricted fuel. 4. Check for air leaks on the suction side of the system. 5. Check pump timing. 6. Check engine compression. 7. Check for improper valve adjustment or faulty valves.

Condition	Cause	Remedy
Engine Emits Black Smoke	1. Restricted air intake. 2. Engine overheating. 3. Incorrect timing. 4. Faulty injectors. 5. Low compression. 6. Incorrect engine timing.	1. Check for a restricted air intake. 2. Check cooling system. 3. Check the pump timing. 4. See injection troubleshooting. 5. Check the engine compression. 6. Check the engine valves.
Pump Fails to Deliver Fuel to All Injectors	1. Blocked fuel lines to pump. 2. Air in fuel lines to injectors. 3. Control rod seized in OFF position.	1. Remove fuel lines and flush or replace. 2. Bleed fuel lines. 3. Repair or replace control rod.
Pump Fails to Deliver Fuel to One Injectors	1. Air in fuel line to injector. 2. Plunger spring broken. 3. Plunger seized. 4. Delivery valve seized. 5. Badly scored plunger and barrel.	1. Bleed fuel line. 2. Replace spring. 3. Repair or replace barrel and plunger assy. 4. Repair or replace delivery valve. 5. Replace barrel and plunger assembly.
Governor Fails to Maintain Maximum or Minimum No-Load Fuel Delivery.	1. Control spring broken. 2. Governor weights siezed. 3. Governor weight carrier broken. 4. Thrust pad siezed. 5. Cross shaft bolt broken or missing. 6. Pump link spring broken.	1. Replace control spring. 2. Repair or replace weight assembly and/or camshaft . 3. Replace weight assembly. 4. Replace thrust pad and/or camshaft. 5. Replace bolt. 6. Replace spring.

Condition	Cause	Remedy
Nozzle Does Not "Buzz" While Injecting	1. Needle valve stuck. 2. Leakage. 3. Nozzle damaged.	1. Check needle valve is clean and not binding. 2. Check valve seat is not leaking. 3. Examine nozzle retaining cap for damage.
Nozzle Leak - Back	1. Needle valve worn. 2. Blocked nozzle assembly. 3. Loose nozzle retaining nut.	1. Replace nozzle assembly. 2. Check
Nozzle Opening Pressure Incorrect	1. Air in fuel line to injector. 2. Plunger spring broken. 3. Plunger seized. 4. Delivery valve seized. 5. Badly scored plunger and barrel.	1. Bleed fuel line. 2. Replace spring. 3. Repair or replace barrel and plunger assy. 4. Repair or replace delivery valve. 5. Replace barrel and plunger assembly.
Nozzle Seat Leakage	1. Incorrectly seated. 2. Sticking or binding needle valve	1. Check for carbon or foreign matter on faces of nozzle or nozzle assembly. 2. Repair or replace nozzle assembly.
Spray Pattern Distorted	1. Obstructed needle valve. 2. Obstructed needle valve orifice. 3. Damaged nozzle or needle valve.	1. Check for carbon or foreign matter on faces of nozzle or nozzle assembly. 2. Check for carbon in orifice. Flush clean or replace nozzle assembly. 3. Replace nozzle assembly.

SECTION 8
Maintenance / Specifications

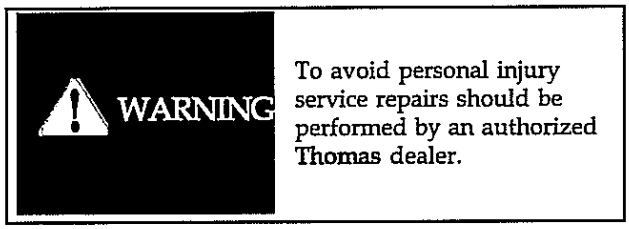
8.1 *PREVENTATIVE MAINTENANCE SCHEDULE*

ITEM	SERVICE REQUIRED	8 Hours	50 Hours	150 Hours	400 Hours	1000 Hours
Engine Oil	Check level and add as necessary. Use 10W30 or 20W50 API Classification SE/CD	■				
Radiator	Check level and add as necessary. Fill with 50% mixture of ethylene glycol and water. Check cooling fins for dirt. If necessary, blow out with compressed air. Check rubber seal around radiator baffle.	■				
Hydraulic Oil	Check level and add as necessary. Use 10W30 API Classification SE/CD	■				
Engine Oil	Check cooling fins for dirt. If necessary, blow out with compressed air.	■				
Air Cleaner	Empty dust cap. Check condition indicator and service or replace element as required.	■				
Tires and Wheel Nuts	Check for low pressure or tire damage. Inflate standard tires 50 PSI (345KPa), flotation tires 30 - 35 PSI (207 - 241 KPa). Check wheel nut torque 100 - 110 lbs. (136 - 149 N.M.).	■				
Safety Equipment	Check all safety equipment for proper operation and condition. Seat belt, boom supports, quick - tach support, parking brake, steering, seat bar, seat switch and foot pedal locks, safety treads, front shield and cab side screens. If necessary, lubricate foot pedal and steering control linkages, springs and shafts. If necessary repair or replace.	■				
Final Drive	Check chain and sprocket condition. Check every 150 Hrs.	■				
Decals	Check for damaged safety or instruction decals (see section 8.5). If necessary, replace.	■				
Lubrication	Grease all hinge pin fittings until excess shows.	■				
Engine Oil	Check level and add as necessary. Use 10W30 API Classification SE/CD		■			
Engine Oil Filter	Change engine oil filter element. Initial change only.		■			
Hydraulic Oil Filter	Change hydraulic oil filter element. Initial change only.		■			
Muffler	Check the muffler for carbon buildup and plugging. If necessary clean. Check every 100 hours.		■			
Safety System Linkages and Springs	Check and if necessary adjust. Lubricate lock springs, shaft and linkage.		■			

8.1 *PREVENTATIVE MAINTENANCE SCHEDULE*

ITEM	SERVICE REQUIRED	8 Hours	50 Hours	150 Hours	400 Hours	1000 Hours
50 Hour Service	Perform complete 50 hour service.		■			
Engine Oil	Check level and add as necessary. Use 10W30 or 20W50 API Classification SE/CD			■		
Engine Oil Filter	Change engine oil filter element. Change every 150 hrs.			■		
Hydraulic Oil Filter	Change hydraulic oil filter .			■		
Preventative Maintenance Service Check	It is recommended as a preventative maintenance procedure that the 50 hour service be repeated every 150 hours.			■		
Final Drive	Check chain and sprocket condition.			■		
Engine Fuel Filter	Replace engine fuel filter				■	
Hydraulic Oil	Change hydraulic oil. Replace with 10W30 API Classification SE/CD.					■
Final Drive	Change final drive lubricating oil. Use 10W30 API Classification SE/CE.					■
Engine Cooling System	Drain, flush and refill. Use 50% ethylene glycol and water.					■
Hydraulic Reservoir Filters	Remove and replace 100 micron suction element in the oil reservoir.					■

NOTE: **For complete engine service details refer to the engine manufacturers service manual.**



8.2 50 HOUR SERVICE CHECK

The following service check is to be performed by your dealer after the first 50 hours.

1. ENGINE

1.1 Oil Filter:
Change the engine oil filter. Use only original replacement parts. Change the oil filter every 150 hours.

1.2 Engine Oil:
Change the engine oil. Use only 10W30 API Classification SE/CD oil. Change engine oil every 75 hours.

1.3 Coolant Level:
Check that the coolant is to the proper level. The cooling system is filled with a 50% mixture of ethylene glycol and water.

1.4 Radiator for Leaks and Dirt:
If necessary flush the radiator with compressed air. A dirt buildup on the radiator cooling fins can cause both engine and hydraulic system overheating. Check rubber gasket on radiator baffle.

1.5 Fan Belt Tension and Condition:
Check fan belt for cuts or wear, if necessary replace. Check tension and adjust.

1.6 Fuel System for Leaks:
Make visual inspection of fuel system for leaks and potential hazards such as fuel lines touching exhaust manifold, flywheel, etc. Replace fuel filter every 400 hours.

1.7 Air Intake and Cleaner System:
Visually inspect the air cleaner system and be sure all hose clamps are secure. Check that the filter indicator is not indicating that filter service is required.

1.8 Exhaust System:
Visually inspect the exhaust system and ensure all clamps are secure and the manifold bolts/nuts.

1.9 Engine speed:
Check and if necessary adjust engine RPM maximum no load high idle.

To prevent personal injury stop, cool and clean the engine before servicing. Never service or adjust machine with the engine running.

1.10 Muffler:
Check muffler for carbon and soot buildup and plugging. If necessary clean.

2. HYDRAULIC/HYDROSTATIC

2.1 Hydraulic Oil Filter:
Change the hydraulic oil filter. Change the hydraulic filter every 150 hours after the initial change. Lubricate the filter cartridge seal with system fluid.

2.2 Hydraulic Oil Level:
If oil is visible in the oil level sight glass the level is satisfactory. If additional oil is required use only 10W30 API Classification SE/CD oil. Fill to the top or maximum check point.

2.3 Hoses and Pipes:
Make a visual inspection of all hydraulic lines and fittings for leaks. Check that steel lines do not touch one another.

2.4 Cylinders:
Inspect cylinders for leaks. Extend cylinders and check for rod damage.

2.5 Hydraulic Functions:
Check that the following operate properly; control valve float position, auxiliary hydraulic detent, hydraulic cylinders.

2.6 Pumps and Motors, Leakage:
Inspect pumps and motors for leaks.

2.7 Oil Cooler:
Inspect the oil cooler for leaks, fin damage or clogged with dirt. If necessary, flush with compressed air.

To prevent personal injury do not repair or tighten hydraulic hoses or fittings with the engine running or the system under pressure.

3. FINAL DRIVE

3.1 Oil Level:
Check lubricating oil level. If necessary add 10W30 API Classification SE/CD oil.

Keep the rear door closed except for servicing. Make sure the door is closed and latched before operating the loader.

3.2 Drive Chain Condition:
Check drive chains for any sign of wear or damage. Check lubrication oil in housing for signs of contamination.

3.3 Hydrostatic Motor Mounting Bolts:
Check torque 80 ft. lbs. (115 - 122 N.M.)

3.4 Axle Bearing End Play:
Axle bearings are preloaded and must have no end play. Inspect and adjust if necessary.

4. CONTROLS AND SAFETY EQUIPMENT

4.1 Control Levers, Operation and Linkage:
Check that the steering levers operate freely without binding, they return to neutral when released and the machine travels in a straight line with both levers in forward position.

4.2 Foot Pedals, Operation and Linkages:
Check that the foot pedals operate freely without binding. Before leaving the operators seat, ensure the pedals are locked, raise the safety bar and unbuckle the seat belt, to test the seat switch, grasp the seat bar and raise your weight off the seat and check pedals at the same time to ensure they are locked. Lubricate linkage.

4.3 Engine Throttle Control:
Check that the throttle control operates freely without binding or slackening off due to vibration.

4.4 Parking Brake:
Check that the parking brake engages and completely disengages. Park brake automatically engages with the seat bar up.

4.5 Boom Supports:
Check that the boom supports operate without binding.

NOTE: **Ensure the boom supports are fully retracted before raising or lowering the boom.**

4.6 Quick - Tach, Operation and Linkage:
Ensure the quick-tach linkage operates smoothly without binding and the safety locks engage completely.

4.7 Seat Belt:
Check seat belt condition. If necessary replace. For your safety, the loader is equipped with electrically activated safety devices through the seat and seat belt.

5. ELECTRICAL

5.1 Battery:
Maintenance free.

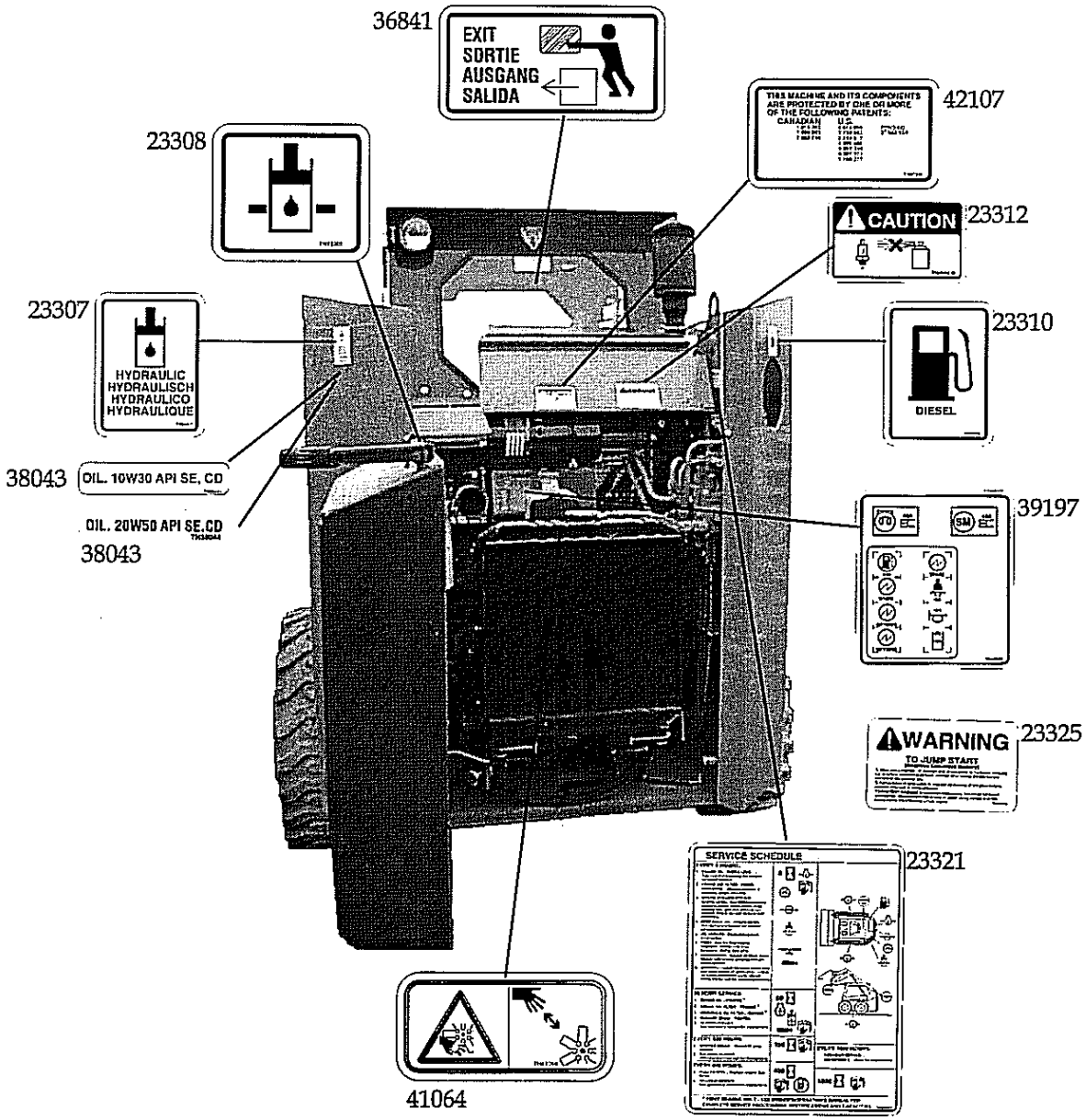
5.2 Battery Terminals:
Check battery terminals for corrosion. If necessary, clean.

5.3 Operation of Starter:
Make a complete check of all electrical equipment, gauges, warning devices, pre-heat indicator, worklights, seat switch and belt and all optical equipment to ensure they are operating correctly.

To avoid personal injury stop the engine, engage the parking brake and cycle the foot pedals to ensure they are locked before getting out of the loader.

6. GREASE/LUBRICATION

Lubricate the following points with a good quality grease. Numbers marked () indicate the number of fittings at each location.
Rear Boom Pivots (2)
Boom Cylinder Bushings (4)
Bucket Cylinder Bushings (4)
Engine Universal Joint (2)
Boom Supports (2)
Quick - Tach Pivot and Lock Pins (4)
Boom Lock Down (2)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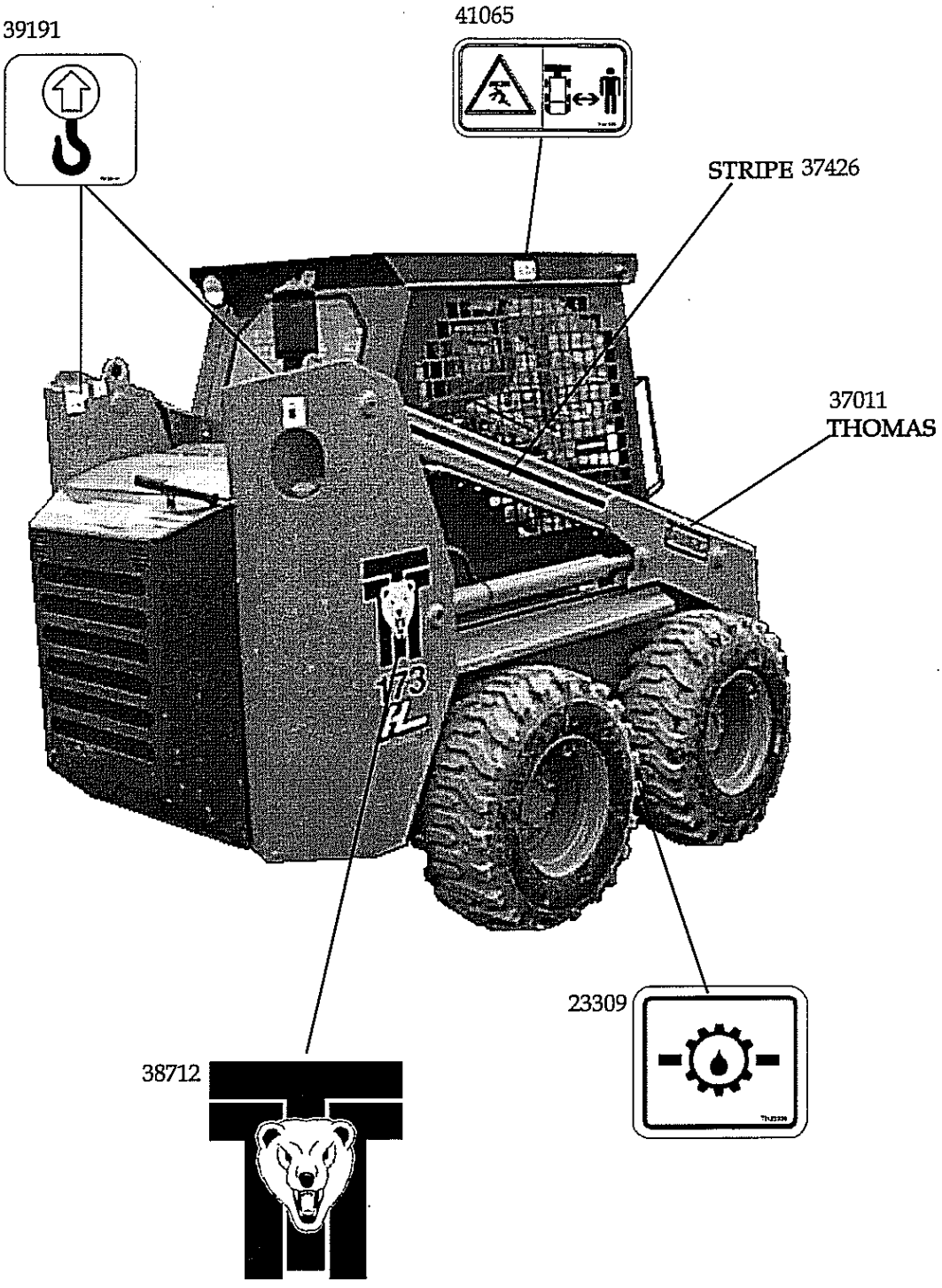
SORTIE
AUSGANG
SALIDA
42107
23308
CAUTION
23312
23307
HYDRAULIC
HYDRAULISCH
HYDRAULICO
HYDRAULIQUE
23310
DIESEL
38043
OIL. 10W30 API SE, CD
OIL. 20W50 API SE,CD
38043
39197
WARNING
TO JUMP START
23325
SERVICE SCHEDULE
23321
41064


39191
41065
STRIPE 37426
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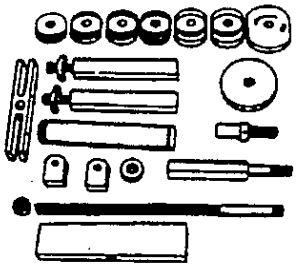
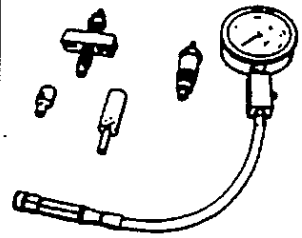
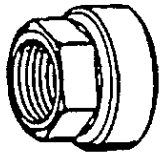
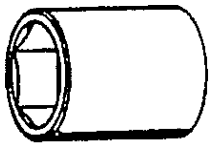
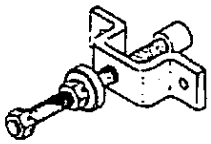
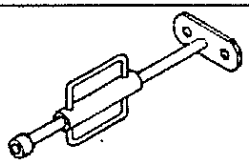
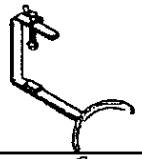
THOMAS
23309
38712

8.7 SPECIAL TOOLS

Order No.	Illustration	Description	Model Usage
916-30042-01 Th. No. 25197		Dry liner puller - Used for removing and installing the dry liner of the engine. Consists of : 304742 (64mm), 304743 (68mm), 304745 (76mm), 304746 (82 mm), 304747 (105 mm), Removing plates; 304748 Installing plate	KUBOTA
07909-30202-01 Th. No. 25198		Diesel engine compression tester - Used to measure diesel engine compression and diagnosis of need for major over-haul.	KUBOTA
07916-30820-01 Th. No. 25199		Crankshaft Nut Socket - Used to take off and fix the crankshaft nut (46 mm)	KUBOTA
07916-30840-01 Th. No. 25200		Nozzle Removal Socket - Used to unfasten the screw type nozzle holders.	KUBOTA
70090-01125-01 Th. No. 960456		Nozzle Disassembly Socket - Used in place of a vice for disassembly and repair of nozzles.	KUBOTA
960456		Hydraulic Flow and Pressure Gauge Assembly.	All Models

8.7 SPECIAL TOOLS

Order No.	Illustration	Description	Model Usage
955280		Axle Installation Tool - To install axle in final drive housing. Qty 1	T103 T133 T133S
960849 955281		Seal Installation Tool - To install axle seal in final drive housing. Qty 3	T103 T133 T133S
955283		Axle Extraction Tool - To remove axle from final drive housing. Qty 1	ALL
955287		Seal Installation Tool - To install axle seal in final drive housing. Qty 1	T173 T233
957189		Seal Installation Tool - To install axle seal in final drive housing.	T173HL T173HLS T203HD T233HD
959849		Chain Tension Tool - To check chain tightness	T103 T133 T133S
U-1288		1 each. Combination wrench 1/2", 9/16 " 7/16 ", 1 1/4 ", 1 1/16 ", 3/4 ", 11/16 ", Sockets 1", 1/2 " drive, 7/8 ", 1/2 " drive, tool punch, allen wrench 5/32 " and 1/8".	All Models