CHAIN CASE
BRAKE ASSEMBLY
Service and Repair I

FOR UNITS WITH EXTERIOR MOUNTED BRAKES. All models up to:

Model 930 - S/N 8301005 - 9301798
Model 940 - S/N 8401002 - 9405598
Model 960 - S/N 8601002 - 960319N

(For units with internal brakes see page 6-5)

NOTE: Removal of R.O.P.S. is recommended.

1. Block machine off ground and drain chain case.
2. Remove T-Bar panel and chain case cover.
3. Loosen primary drive chain.
4. Cap and plug the drive motor hoses and fittings. Remove drive motor.
5. Remove brake cable.

TO SERVICE BRAKES: (service of input shaft not required)

6. Remove the six (6) 3/8 inch cap screws and brake housing cover.
7. Remove the steel bar and brass brake pad from roll pins. Slide brake disc off input shaft. Repeat for second disc. (**NOTE:** location of two (2) steel pads for reassembly.) (See figure 6-2)

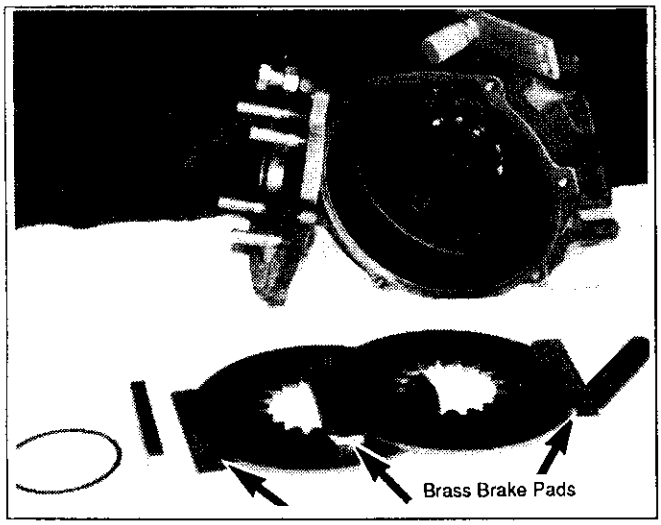


Figure 6-2

TO SERVICE INPUT DRIVE SHAFT:

8. Remove the primary drive chain.
9. Remove four (4) 1/2 inch flanged nuts securing the brake housing to the chain case and remove brake housing from machine
10. Remove the retaining nut and chain drive sprocket from shaft.
11. Remove input shaft through brake housing area. (See figure 6-3)

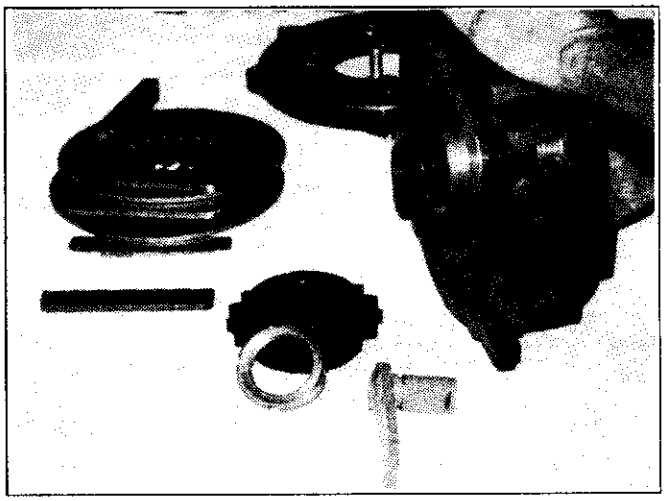


Figure 6-3

CHAIN CASE
BRAKE ASSEMBLY
Service and Repair I (continued)

12. Remove snap ring and bearing from output side of the brake housing.

NOTE: Bearing is not a press fit to shaft or housing, although some pressure may be required due to close tolerance of fit.

13. Reverse procedure to assemble using adequate silicone sealant at housing cover and motor connections. Replace O-ring at brake housing to chain case connection.

14. Before connecting brake cable adjust 3/4 inch take-up bolt. Tighten bolt against brake pads and disc until tight, then loosen 1/4 to 1/2 turn and secure jam nut. (See figure 6-4)

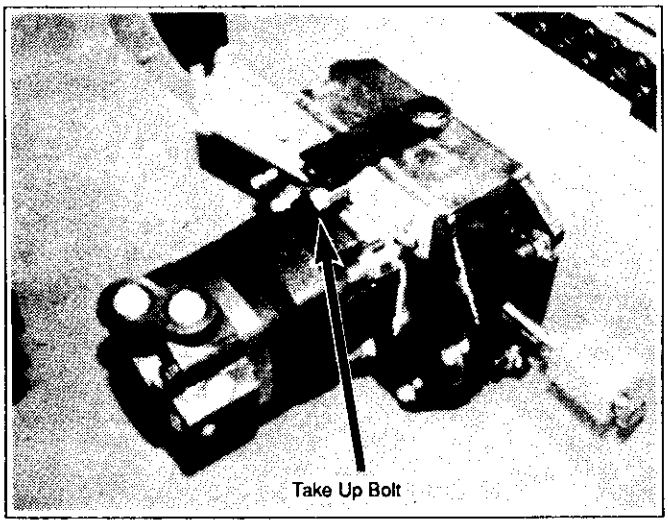


Figure 6-4

CHAIN CASE

BRAKE ASSEMBLY and INPUT DRIVE SHAFT

Service and Repair II

FOR UNITS WITH BRAKE DISC INSIDE CHAIN CASE. Includes models starting at:

Model 930 - S/N 9301900
Model 940 - S/N 9405759
Model 960 - S/N 9603401

1. Block machine off the ground.
2. Remove T-Bar panel assembly and chain case cover.
3. Loosen primary drive chain.
4. Loosen 3/4 inch brake adjusting bolt at end of caliper (approximately 2 full turns) to allow maximum travel of the "stationary" puck. (See figure 6-5)

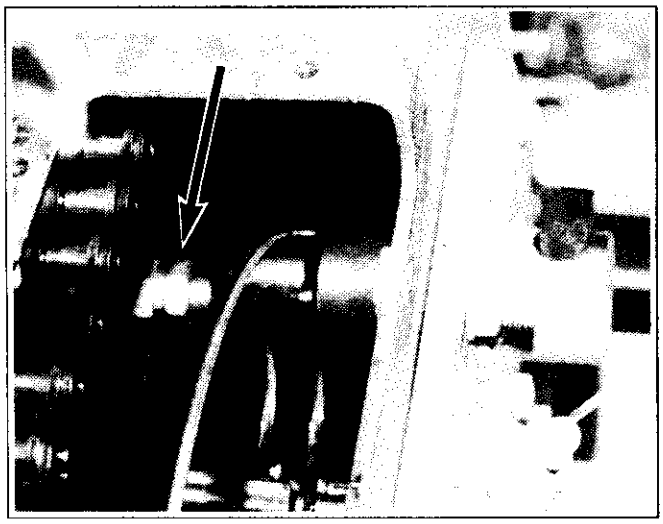


Figure 6-5

5. Remove brake cable from mounting clip and lift cam lever out of brake caliper.
6. Remove four (4) 3/8 inch cap screws from brake caliper mount.
7. Slide caliper off brake disc and remove through chain case mounting hole. (In some cases it may be necessary to disconnect primary drive chain. (See figure 6-6)
8. **To Service Brake Pucks**. . . remove the 3/4 inch adjustment bolt from the end of the caliper and cam lever from opposite end.

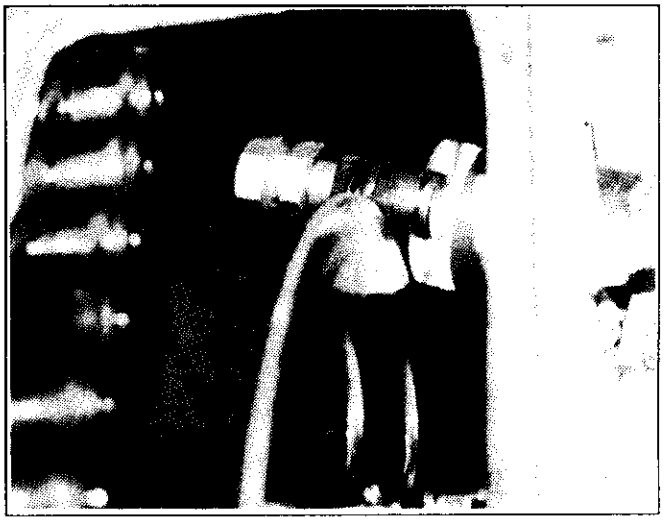


Figure 6-6

9. Push cam follower and brake pucks out lever end. Replace O-ring when assembling and be sure to install with the O-ring to to lever end of caliper.

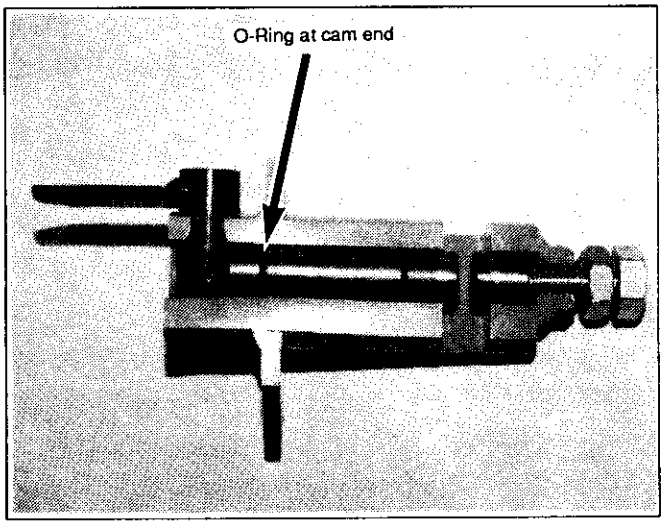


Figure 6-7

(Continued on next page.)

CHAIN CASE

BRAKE ASSEMBLY and INPUT DRIVE SHAFT

Service and Repair II (continued)

10. **To Remove Brake Disc.** . . . the brake disc retaining pin must be removed. This is located behind the left rear wheel and right front wheel. (See figure 6-8)

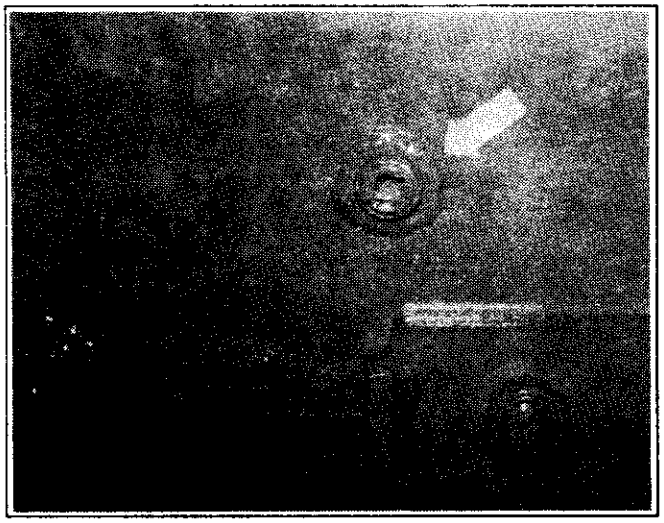


Figure 6-8
(right hand side shown)

TO SERVICE INPUT SHAFT AND BEARING ASSEMBLY.

11. Drain chain case and remove drive motor.
12. Disconnect primary drive chain.
13. Remove brake caliper/motor mounting plate.
14. Remove snap rings from input shaft and bearing housing.
15. Push input shaft out toward chain drive side of mounting plate. (See figure 6-9)

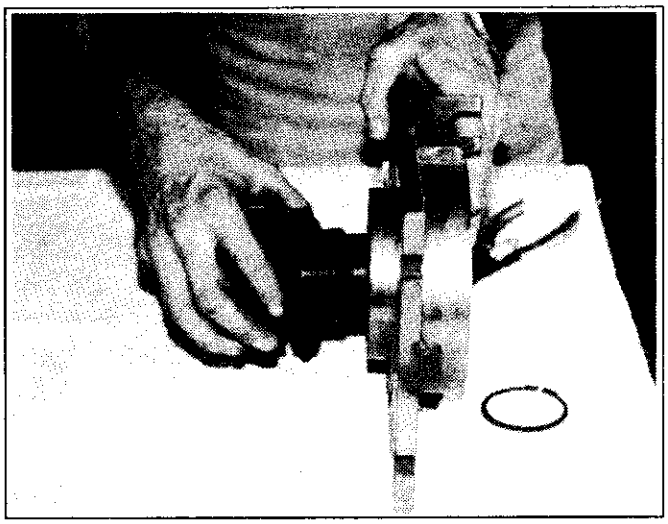


Figure 6-9

16. Push bearing out drive motor side of plate. (Use new O-rings and adequate silicone sealant for reinstallation.)
17. For installation reverse procedure.

NOTE: Adjust brake puck take up belt before installing brake cable. Tighten bolt until pucks are firmly pressed against brake disc, then loosen bolt 1/6 to 1/3 turn (1 to 2 flats) and secure jam nut.

18. Tighten chain using push bolt to remove slack. Torque mounting bolts before securing jam nut. (See Chain Adjustment procedures on page 6-7 and 6-8.)

CHAIN CASE

DRIVE CHAIN

Adjustments with Chain Case Covers Removed

Both the primary and secondary chains are adjustable by using "push bolt" type adjusters. Tension is achieved by sliding the drive motor mounting assembly rearward for primary chain adjustment and sliding an idler sprocket assembly forward for the final (secondary) drive chain. The final drive chains may be adjusted by removing the chain case covers as follows **OR** by using the procedure on the following page and leaving the covers in place.

TO ADJUST CHAINS:

1. Raise and block the machine off the ground.
2. Remove the T-Bar panel, chain case cover and front wheel.

Primary Chain (#60 HK)

3. Loosen the four (4) 1/2 inch flanged nuts securing drive motor assembly to inner chain case wall. (Machines with internal brakes have removable access panels on the bottom for easier access to the bottom nuts.) (See figure 6-10)

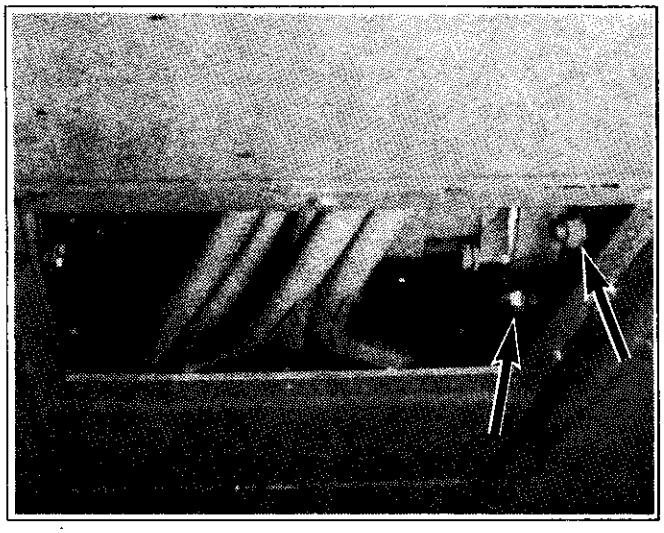


Figure 6-10

4. Using two (2) wrenches, hold "push bolt" and turn adjusting (jam) nut until chain slack is removed. **DO NOT OVER TIGHTEN CHAIN.**
5. Torque four (4) 1/2 inch flanged nuts 75 ft. lbs. (102 Nm)

Secondary chain (#80 HK)

7. On outside of chain case, behind the front wheel, loosen two (2) one inch nuts.
8. Hold "push" bolt and turn, adjusting (jam) nut to remove chain slack. **DO NOT OVER TIGHTEN!** Proper tension is 1/8" (3.2 mm) deflection with 12-15 lbs (5.4 - 6.8 kg) of pull measured in the center of the chain case opening.
9. Torque two (2) one inch nuts to torque as shown. (See figure 6-11)

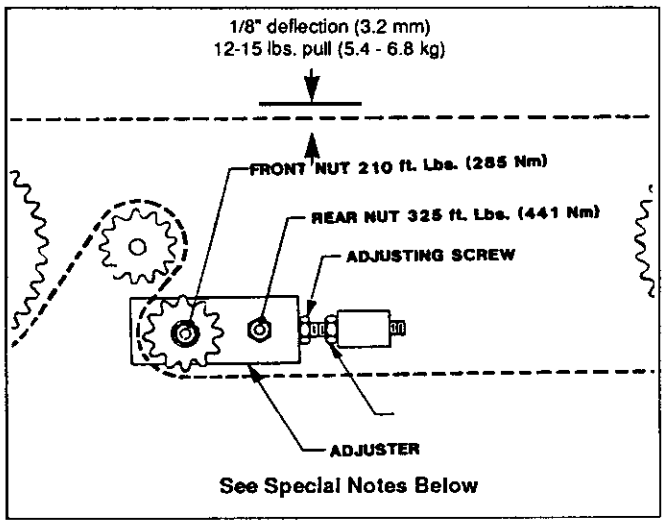


Figure 6-11

10. To insure adjustment is maintained, preload "push" bolt to 1/4 turn or 75-100 ft. lbs. (102-136 Nm)

NOTE: Illustration is of Model 960. Idler sprocket is on rear bolt on Model 930 and 940 and torque specifications should be reversed.

NOTE: Tightening the idler sprocket nut MORE than the specified torque will cause bearing and chain failure.

CHAIN CASE

DRIVE CHAIN

Adjustments with Chain Case Covers In Place

1. Block machine up so all 4 wheels clear the ground and remove the front tires.
2. Loosen the two one inch idler retaining nuts 1/2 turn (3 flats).
3. Tighten push bolt to 20-25 ft. lbs. (27-34 Nm).
4. Torque one inch retaining nuts to 60-70 ft. lbs. (80-94 Nm).
5. Loosen pusher bolt 1-1/2 turns.
6. Start engine and idle. GENTLY stroke the T-Bar to rotate the wheels 5-6 revolutions. This will allow any high spots on a sprocket to pull the idler to an acceptable position.

NOTE: If the idler makes contact with pusher bolt, the chain case cover must be removed and the axle sprockets checked for excessive run-out causing a "tight-loose" condition. Using a spacer block approximately 1/4 inch (6.35 mm) thick and a feeler gauge, check the distance from the chain to the bottom of the chain case. Rotate sprocket and repeat at 90°, 180°, and 270°. The maximum allowable TIR is .027" (.70 mm). Replace sprockets if necessary. (See figure 6-12)

7. Tighten push bolt until it makes contact with idler, and then an additional two flats.
8. Tighten retaining nuts to 325 ft. lbs. (440 Nm) on the thick nut and 210 ft. lbs. (284 Nm) on the thin one.

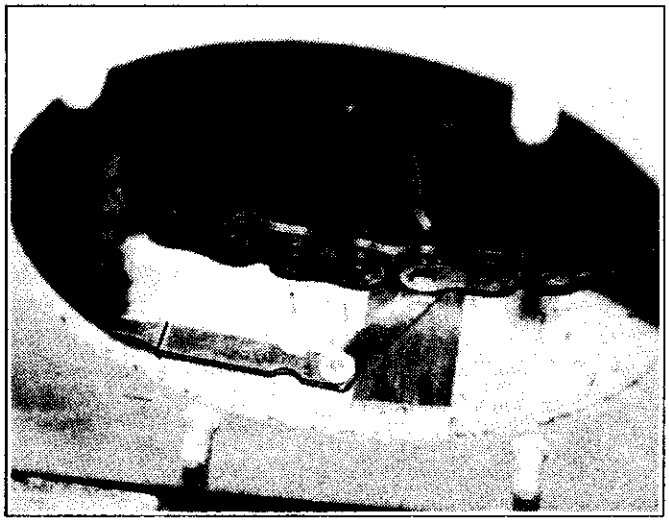


Figure 6-12

9. Tighten push bolt an additional 1/4 turn or 75-100 ft. lbs. (102-136 Nm) to insure adjustment is maintained.

NOTE: If excessive chain slap is noticed during sudden direction changes, an additional 1-2 flats at step #7 should eliminate the problem.

DO NOT exceed 4 flats at step #7, as this will over tension the drive chain and cause reduced drive life.

A slight click during direction changes is normal and in fact desirable as this indicates that the chains are properly tensioned and not too tight.

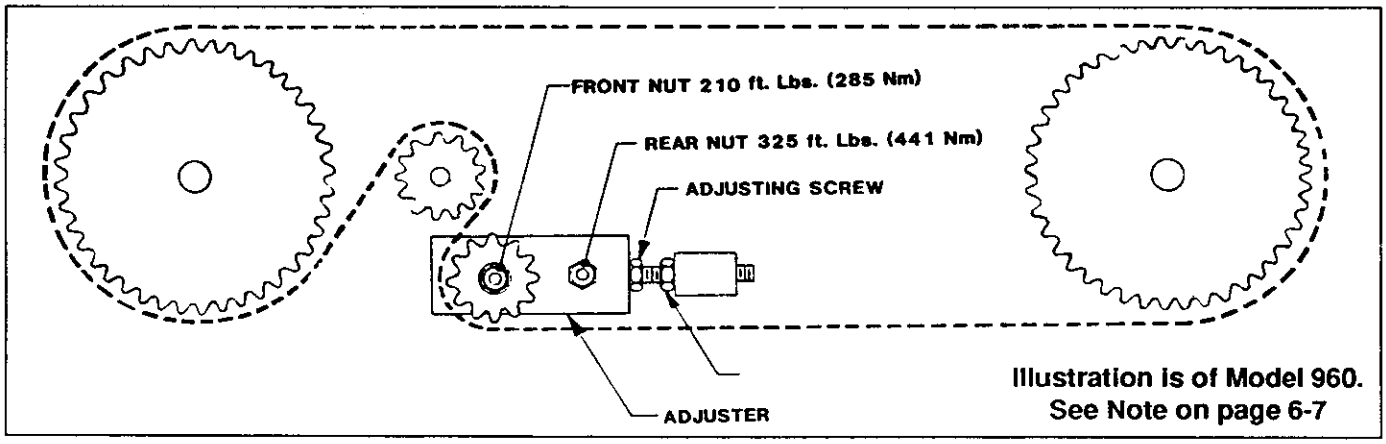


Illustration is of Model 960.
See Note on page 6-7

CHAIN CASE

DRIVE CHAIN

Removal and Installation

1. Block machine off the ground.
2. Remove T-Bar panel and chain case covers.
3. Drain chain case.
4. Stroke pump arm and jog starter to rotate Primary Drive Chain Connector to top of center reduction sprocket.

   NOTE: To prevent engine from starting when engaging starter using the ignition switch, disconnect fuel shut-off solenoid on Isuzu (Model 960) or pull manual shut-off on Yanmar diesel (Models 930 and 940). Attach a jumper wire across the Neutral Start Switch on the same side of the machine as the chain being replaced.

   Be sure to remove jumper wire before continuing to step 5.

5. Remove connector link and discard. DO NOT REUSE.
6. Rotate secondary (final) drive chain connector to center of chain case cover opening and remove connector link. DO NOT REUSE.
7. Connect new chain to old chain - use old chain to feed new chain around sprockets.
8. If secondary chain is not intact, remove axle cover plates to feed chain around axles.

   NOTE: On units with brake disc inside chain case. . . removal of brake caliper and brake disc will provide greater access to sprockets. (For use when secondary chain is broken.) See Brake Section for removal instructions.

CHAIN CASE
DRIVE AXLE AND SPROCKET
Removal and Installation

All 900 Series *MUSTANGS* have axle nut access plates bolted to the inner wall of the chain case. On some models, the lower side panel of the sound barrier must be removed before removing the rear axle access cover. Sound barrier panels are secured to the center section of the sound barrier with two (2) 5/16 inch nuts.

REMOVAL

1. Block machine up and remove tire.
2. Drain chain case fluid.
3. Remove axle access cover.
4. Loosen secondary drive chain, and remove drive chain from axle sprocket.
5. Remove cotter pin and remove sprocket retaining nut by holding nut and turning axle. (See figure 6-13)

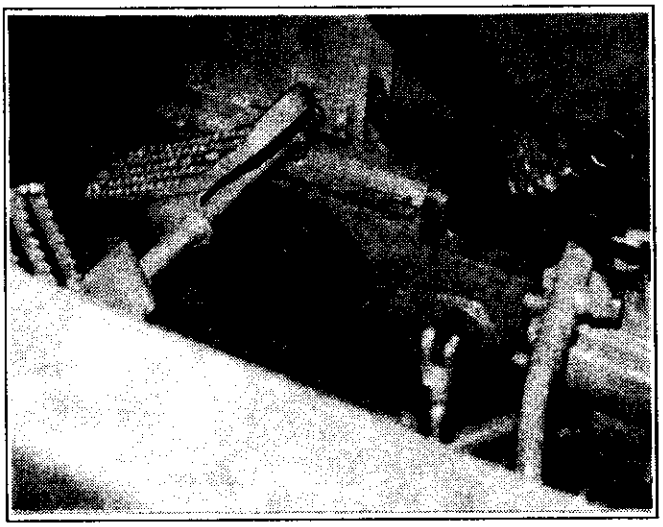


Figure 6-13

6. A slight impact is usually needed to remove the axle from the inner bearing. A slide hammer mounted to the axle hub works best. A hydraulic jack or porta power may be used to push the axle out of the bearing. (See figure 6-14)

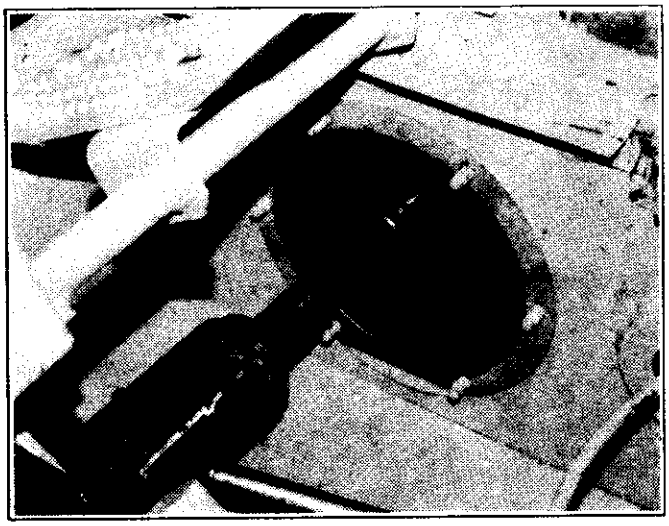


Figure 6-14

7. The outer axle bearing must be pressed or cut off to remove bearing and seal.
8. The center reduction sprocket must be removed to remove front axle sprocket from the chain case.

CHAIN CASE

DRIVE AXLE AND SPROCKET

Removal and Installation (continued)

INSTALLATION

1. Install a new seal on the axle and reverse steps for removal.
2. Tighten axle sprocket retaining nut by holding nut with wrench and rotating axle.
   a. Tighten the nut to 100 ft. lbs. (136 Nm) to press bearings in place. (See figure 6-15)

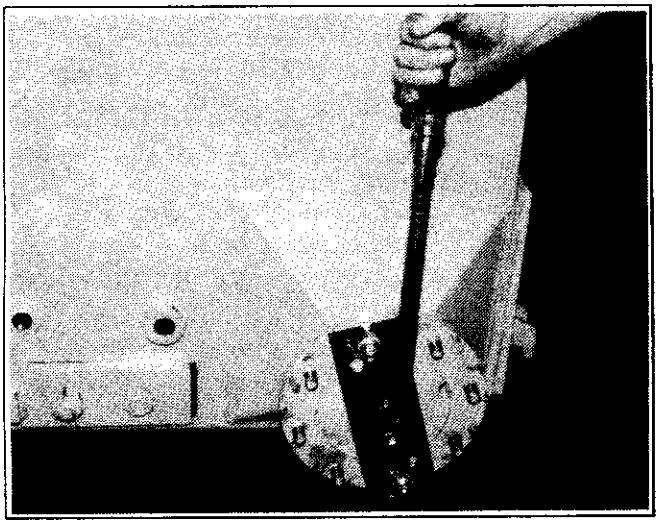


Figure 6-15

   b. Rotate axle 5-10 revolutions to help seat bearings.
   c. Strike outer end of the axle with lead shot or similar soft hammer to insure bearings are seated and recheck for 100 ft./lbs. (136 Nm).
   d. Back nut off until free from pressure.
   e. Re-tighten nut to 30 ft. lbs. (41 Nm) and then increase to nearest alignment slot with cotter pin hole. If nut slot lines up with hole at 30 ft. lbs. (41 Nm), then use that slot.
   f. Install cotter pin.

CHAIN CASE
CLUSTER SPROCKET
Removal and Installation

REMOVAL

1. Block machine off the ground and remove front wheel.
2. Remove T-Bar panel and chain case cover.

   NOTE: Removal of the ROPS will allow easier access to chain case components.
3. Disconnect the primary (60HK) and secondary (80HK) drive chains.
4. Remove the cotter pin and hex nut at the inner wall of the chain case and retaining bolt at the outer wall.
5. Slide the shaft outward to expose and remove the outer O-ring from shaft. (See figure 6-16)
6. Slide the shaft in through inner chain case wall to remove the shaft and large bearing retaining sleeve. Retain shims located between the sprocket and outer chain case wall. Shims are necessary to maintain alignment with axle sprocket. (See figure 6-17)

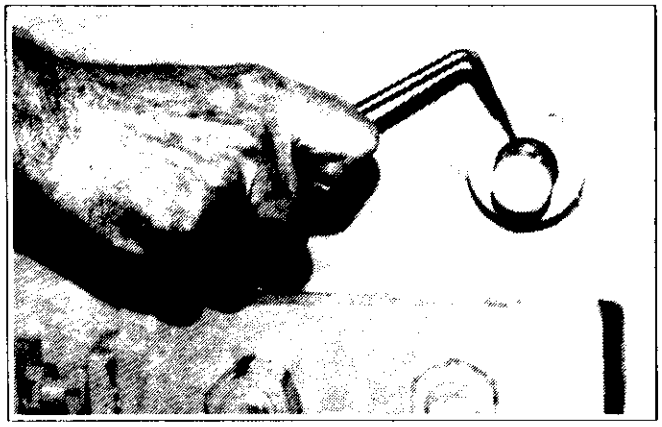


Figure 6-16

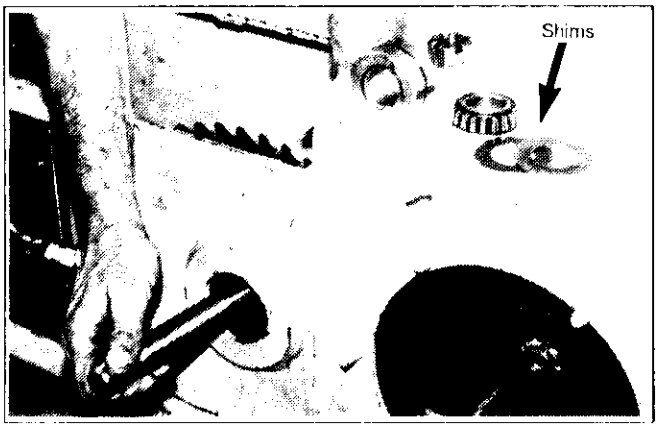


Figure 6-17

INSTALLATION

1. From the outside of the machine, install "pilot shaft" through the outer wall, alignment shims, and cluster sprocket with bearing installed.
2. Wedge two (2) 3/4 inch (19 mm) wood blocks between the cluster sprocket and inner chain case wall to prevent sprocket and shims from shifting when installing bearing spindle shaft. (See figure 6-18)
3. Check alignment by using a 36 inch by 1 inch straight edge, lining up the axle drive sprockets and the small sprocket on the cluster sprocket. Re-shim if necessary. (See figure 6-19)

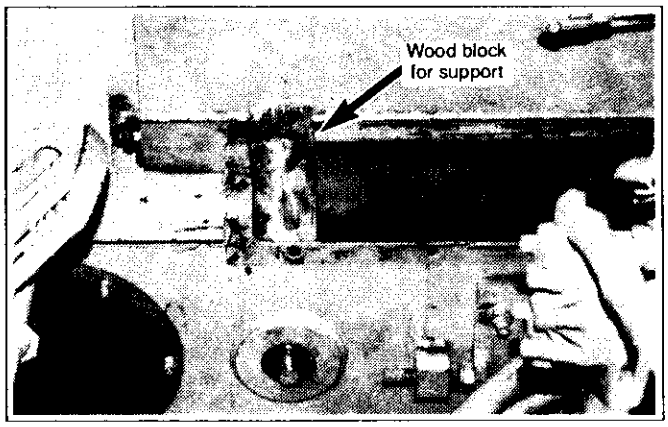


Figure 6-18

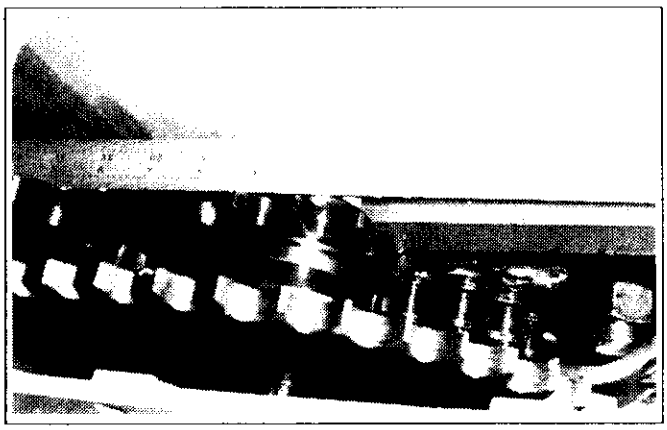


Figure 6-19

(continued on next page)

CHAIN CASE
CLUSTER SPROCKET
Removal and Installation (continued)

4. Lube cluster shaft with light grease and install outer O-ring.
5. From outside of the machine, install the cluster shaft by forcing the pilot shaft through to the inside. (See figure 6-20)
6. Align cross bolt holes and install retaining bolt.
7. From inside the machine, install the small pre-loading ring on the cluster shaft.
8. Install the remaining spacer sleeve on the cluster shaft. (See figure 6-21) (2 bearing system only)
9. Slide the remaining bearing cone in on the cluster shaft. (See figure 6-22)
10. Install O-ring on shaft.
11. Lube the bearing retaining sleeve. Install O-ring.
12. Install the retaining sleeve. (See figure 6-23)
13. Remove wood blocks.

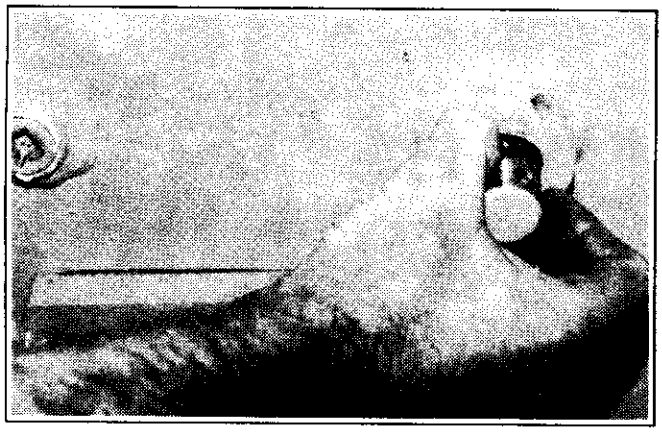


Figure 6-20

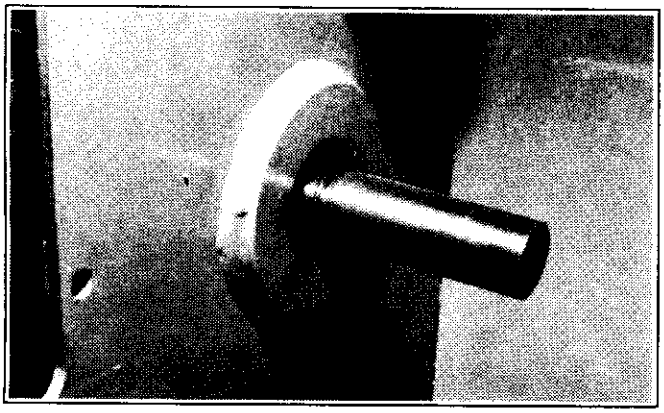


Figure 6-21

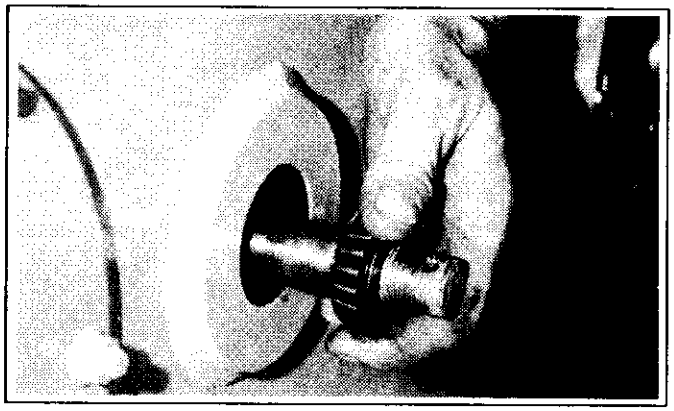


Figure 6-22

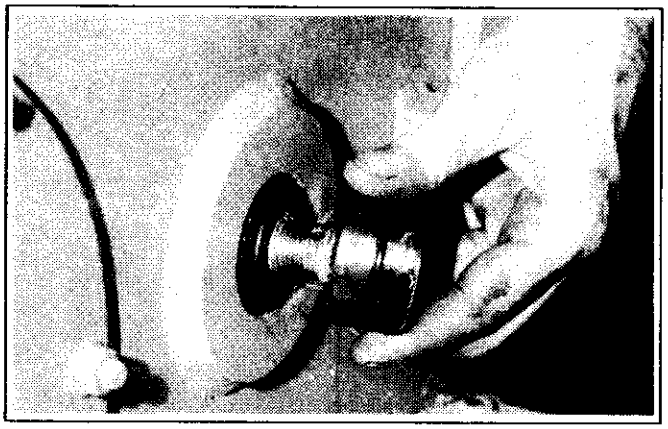


Figure 6-23

CHAIN CASE

CLUSTER SPROCKET

Removal and Installation (continued)

14. If re-installing the original sprocket with a machine shoulder for the bearing cup to rest on (no spacer tubes used) bearing pre-load is measured under rolling resistance and utilizes a castellated nut.

    Bearing pre-load: Sprocket turns with slight resistance, 15-20 lbs. (6.8 - 11.3 kg) pull required at hub O.D. (See figure 6-24)

15. Install new locknut P/N 210-32145 and torque to 70 ft.-lb. for Model 940 prior to S/N 3444547 and Model 960 prior to S/N 3616557. All others with 3/8 inch cross bolt are torqued to 90 ft.-lbs.

It is helpful to grease the alignment shims and fill the O-ring groove on the cluster shaft with grease. This will prevent the shims and small pre-loading ring from falling into the O-ring groove during installation.

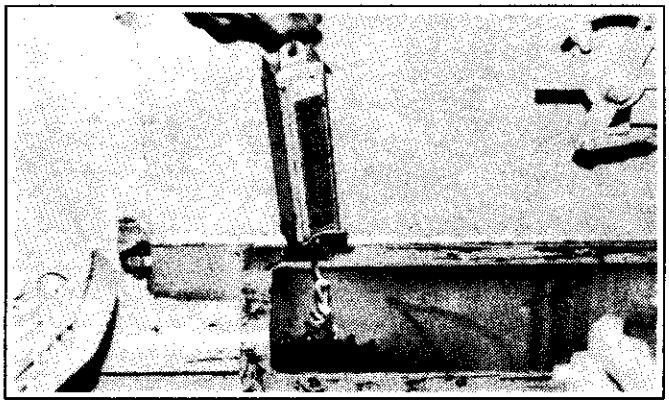


Figure 6-24

CLUSTER SPROCKET

Model 940 S/N 142809N and Prior to Model 960 S/N 161104D.

The cluster sprocket had a machined shoulder on the inside of the hub and did not utilize a spacer set.

This was replaced by a cluster sprocket with no machined shoulder in the hub. It utilized a two spacer set for bearing location and used two bearings.

This cluster sprocket has been improved by using one spacer and four bearings. It will fit all machines with wide chain cases and spacers in the cluster sprocket. Starting with Model 960 S/N 9603401 and Model 940 S/N 9405759.

INSTALLATION OF THE BEARING AND SPACER SET IN THE CLUSTER SPROCKET

SPECIAL TOOLS NEEDED

Arbor Press
1 inch by 4 1/2 inch long shaft
Safety Glasses must be worn

All bearings should be coated with a light bearing grease prior to assembly.

All bearings and spacers come as a matched set and must be installed as a set.

1. Place the cluster sprocket with the small sprocket facing down.
2. Install the larger pre-loading ring into the ring groove of the cluster sprocket.
3. Using an arbor press, press the bearing cup into the cluster sprocket with the bearing cup facing up until it contacts the pre-loading ring.
4. Turn the cluster sprocket over.
5. Install the larger of the two spacer sleeves.
6. Press a bearing cup into the cluster sprocket with the cup facing up, make sure it sits against the spacer sleeve.
7. Install the bearing cone facing down.
8. Install assembly in chain case. See page 6-12.

INSTALLATION INSTRUCTIONS

Model 940 & 960 Cluster Sprocket Bearing & Spacer Set

Model 940 - For units S/N 9405759 through 142809N it is required that a cluster sprocket be purchased: P/N 370-32169

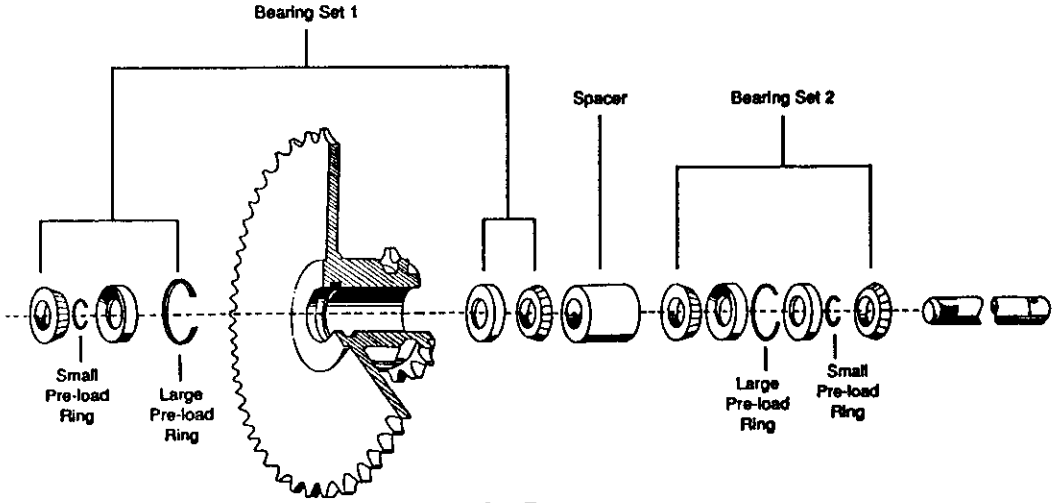
Model 960 - For units S/N 9603401 through 161104D it is required that a cluster sprocket be purchased: P/N 370-32167

Special Tools Required:
Arbor press
Pilot shaft - 1" diameter by 4 1/2" long shaft
Safety glasses must be worn

Special Tips:
All Bearings should be coated with a light bearing grease prior to assembly.
The bearings and pre-load rings come as matched sets and must be installed as sets.

INSTALLATION PROCEDURE
Please read all instructions before beginning the task in order to be familiar with the procedure.

1. If using old cluster sprocket, remove old bearings and pre-load rings.
2. Place the cluster sprocket with the small sprocket facing down.
3. Install the large pre-load ring from Bearing Set 1 in the ring groove on inside the cluster sprocket.
4. Using the arbor press and proper arbor tool, press the bearing cup from Bearing Set 1 facing up until it contacts the pre-load ring. Reserve the small pre-load ring and one of the bearing cones for installation later.
5. Turn the cluster sprocket over. The larger sprocket will now be facing down.
6. Press the remaining bearing cup of Bearing Set 1 facing up. Ensure that it sits against the pre-load ring.
7. Install the bearing cone of Bearing Set 1 facing down.
8. Install spacer (P/N 360-32585).
9. Install a bearing cone from Bearing Set 2 facing up.
10. Press in a bearing cup from Bearing Set 2 facing down until it presses firmly against the bearing cup. Care must be taken at this stage so as not to press too hard. Damage to the bearing cones can occur.
11. Install larger pre-load ring from Bearing Set 2. (Note: There is no groove for the pre-load ring to sit into.) Press firmly against bearing cup installed in step 9.
12. Press the remaining bearing cup of Bearing Set 2, facing up, firmly against pre-load ring, again make sure damage to the bearing cones has not occurred.
13. Insert the pilot shaft through the cluster bearing assembly. Place the small pre-load ring of the Bearing Set 2 over the shaft. Slide the remaining bearing cone, facing down, over the shaft.
14. Install assembly in chaincase. See page 6-12.



INSTALLATION INSTRUCTIONS

Model 940 Idler Bracket Assembly P/N 240-32095

Model 960 Idler Bracket Assembly P/N 240-32094

THIS ASSEMBLY IS A DIRECT REPLACEMENT FOR P/N 240-32080.

For Model 940 starting S/N 445800N.

For Model 960 starting S/N 3620505.

1. Block machine off ground, remove tires, chaincase covers, and disconnect final drive chain.
2. Remove primary drive chain, cluster sprocket shaft and cluster sprocket weldment.
3. Remove old idler assembly and shims (if used) from chaincase and discard. Retain clamp bolt and both nuts for reuse.
4. Check outer chaincase wall for any signs of distortion or other damage.
5. Coat the shaft of the clamp bolt and idler bolt threads with a "Loctite" - PST sealant or equivalent. Install the idler assembly with the idler sprocket toward the front of the machine. Install the clamp bolt from the outside and hold the nut in position on the inside. Tighten just enough to secure in position.

NOTE: DO NOT PLACE ANY SHIMS BETWEEN THE IDLER BRACKET AND THE CHAINCASE WALL.

6. Using a 36" x 1" straight edge, align the idler sprocket to the axle sprockets. Install shims as needed between the idler lock nut and idler bracket. (See figure 6-25)
7. Reassemble the rest of the machine in the reverse order of disassembly.
8. Tension drive chains following normal procedure as outlined on pages 6-7 and 6-8.

SHIM P/N	360-32587	16 Ga.
	360-32588	18 Ga.
	360-32589	20 Ga.

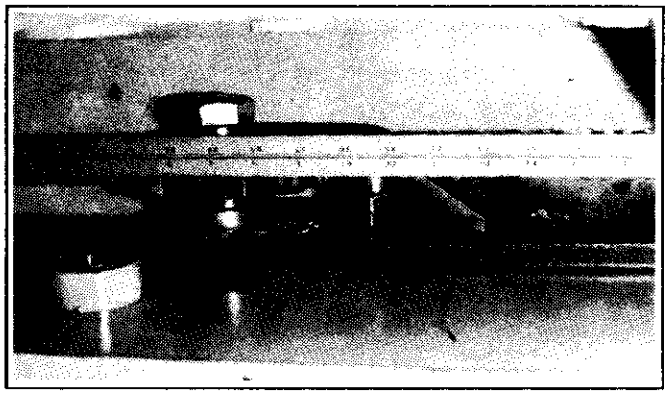
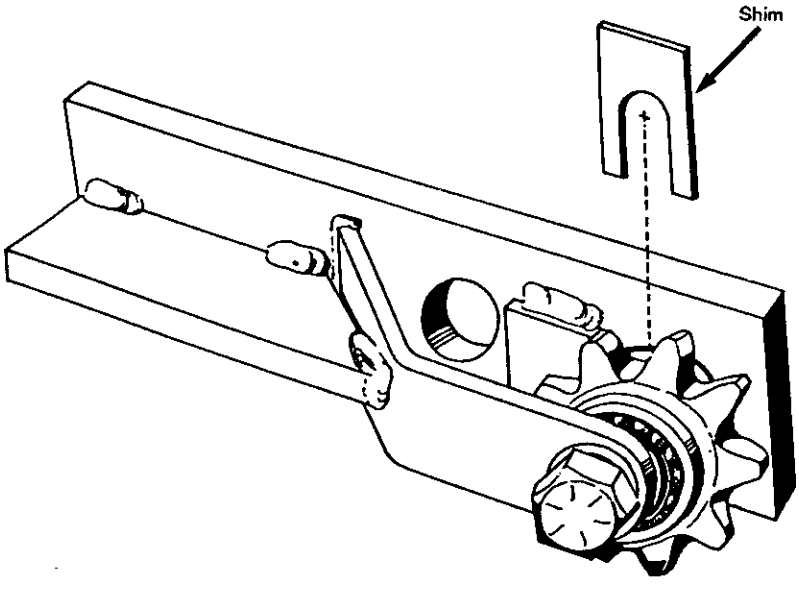
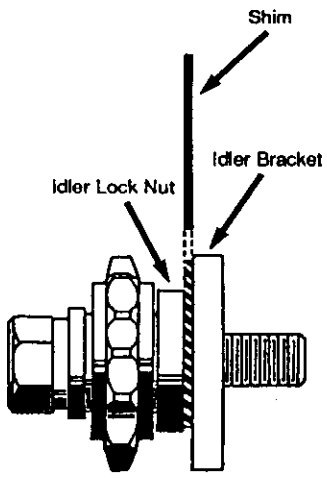


Figure 6-25





MODEL 940, 960, IDLER BRACKET ASSEMBLIES

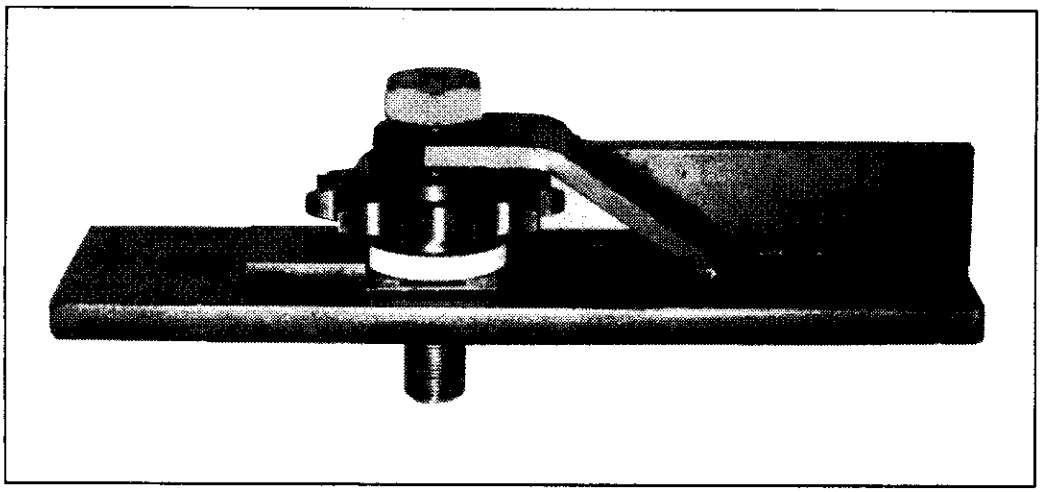


Figure 6-26
MODEL 940

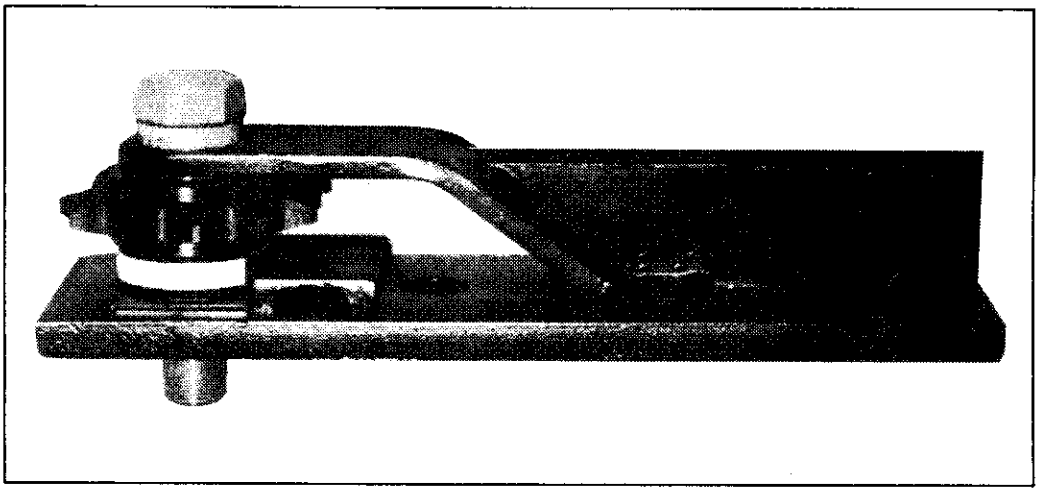


Figure 6-27
MODEL 960

CHAIN CASE
IDLER SPROCKET

1. When reinstalling the idler sprocket, alignment with the axle sprockets must be maintained. This is done by placing a 36 inch by 1 inch steel straight edge between the axle sprockets and the edge of the idler sprocket. Add or delete shims as needed. (See figure 6-28)
2. Grease outside adjuster plate, install O-ring and regrease.
3. Use non-hardening thread sealant on one inch bolts and install nuts (leave loose).
4. Slide adjuster toward rear of machine and connect drive chain.
5. Adjust chains per adjustment procedure on page 6-7 and 6-8.

   NOTE: The final drive idler (adjustment) sprocket is subject to very heavy loads applied by chain drive system. Bearing preload and assembly procedures are very critical. For this reason the idler sprocket, bearings, and mounting plate are sold and to be serviced as a complete assembly only. (See figure 6-29)

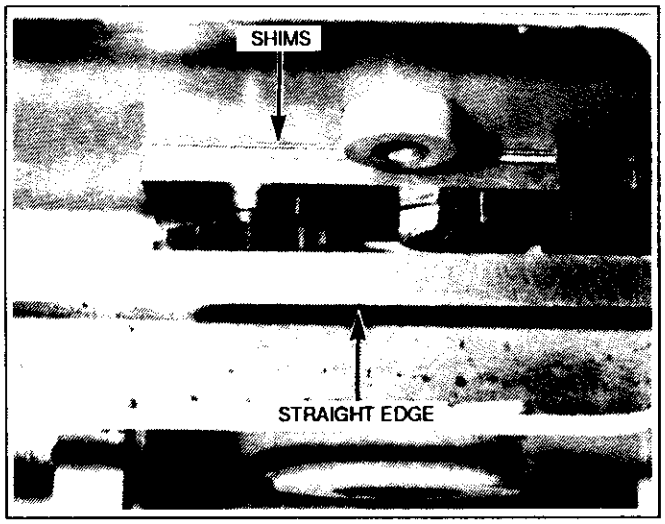


Figure 6-28

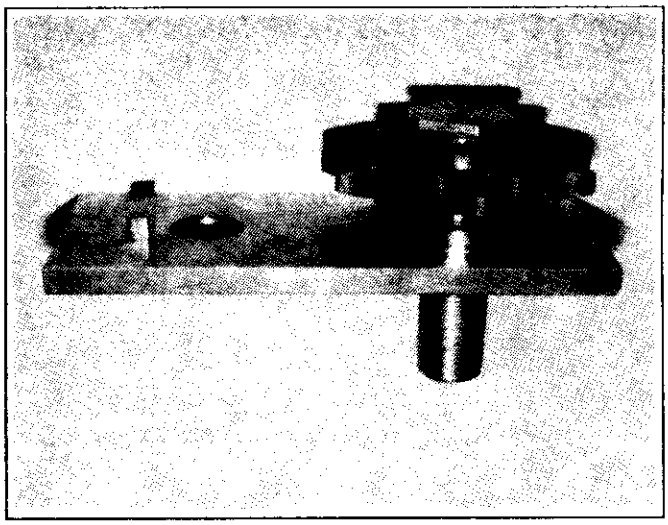


Figure 6-29

ENGINE

This section will cover information pertaining to the air cleaner, cooling system, fuel system, tips for engine removal and installation, basic troubleshooting, maintenance, and service adjustments.

In depth troubleshooting guides and specific instructions on the inspection, repair, and/or replacement of engine components including the starter, alternator, and other attaching parts are found in the engine manufacturer manuals.

Isuzu Workshop Manual (4JB1) - P/N 087-00206
Yanmar Service Manual (TN series) - P/N 087-00207

Additional copies of these manuals are available from the *MUSTANG* Parts Department.

SPECIFICATIONS

	960	940	930
Manufacturer	Isuzu	Yanmar	Yanmar
Model	4JB1	4TN82E-S	3TN82E-S
Serial Number Location	On side of block above starter	On data plate located on top of rocker arm cover	
Displacement	169 cu. in. (2.7 L)	111 cu. in. (1.8 L)	83 cu. in. (1.3 L)
Rotation (view from flywheel end)	Counterclockwise	Counterclockwise	Counterclockwise
Firing Order	1-3-4-2	1-3-4-2	1-3-2
#1 Cylinder Location	crankshaft pulley end	flywheel end	flywheel end
Valve clearance (cold) Intake Exhaust	0.016 in. (0,40 mm)	0.0079 in. (0.2 mm)	0.0079 in. (0.2 mm)
High Idle Speed	2650 +/- 50 rpm	2900 +/- 50 rpm	2800 rpm
Engine Oil Capacity	7 quarts (6.6 L)	6 quarts (5.8 L)	5 quarts (4.7 L)
Oil Filter Part Number	425-34584	425-34635	425-34635
Fuel Filter Part Number	420-34746	425-34636	425-34636
Air Filter Part Number	420-34257	420-34599	420-34599
Air Filter Safety Element	420-34252	420-34601	420-34601
Fuel Injection Timing (BTDC) Degrees	17	16	16
Timing Mark location	Crankshaft damper pulley	flywheel	flywheel
*Engine Gradability	30° (intermittent) all directions	25° (continuous) 30° (intermittent) all directions	25° (continuous) 30° (intermittent all directions

***CAUTION:** Engine Gradability is rated with engine oil level full, and is greatly reduced by lower oil level.

ENGINE
TROUBLESHOOTING

SYMPTOM	POSSIBLE CAUSE
White smoke (dissipates quickly) Steam	Water in fuel water in combustion chamber
White smoke (lingers) Low combustion temperature	Delayed timing Low combustion pressure Ring problems Piston problems Valve leakage
Black smoke Unburned fuel	Air intake restricted Improper injection timing Injection pump or nozzle problem
Blue/Gray smoke	Excessive oil in combustion chamber
Engine stops	Lack of fuel in tank Contamination in fuel filter Contamination of fuel feed pump Improper adjustment of manual Shut off
Engine does not shut off (960 only)	Weak spring in shut off valve Defective shut off valve
Engine overheats Temperature warning switch 225-235° F	Low coolant level Restricted coolant flow Loose or broken fan belt Faulty temperature sender Restricted air flow Low coolant pressure

ENGINE

ENGINE / HYDROSTATIC PUMP

Removal and Installation (complete assembly)

The engine and the hydrostatic pump are mounted as one unit to a removable subframe (Engine Cradle). Whenever it is necessary to remove either the engine or the hydrostatic pump, labor can be reduced by removing the engine cradle with the engine, radiator and hydrostatic pump as a complete assembly.

Removal and installation of the necessary components can then be accomplished without being hindered by confined space or inaccessible bolts. (See figure 7-1)

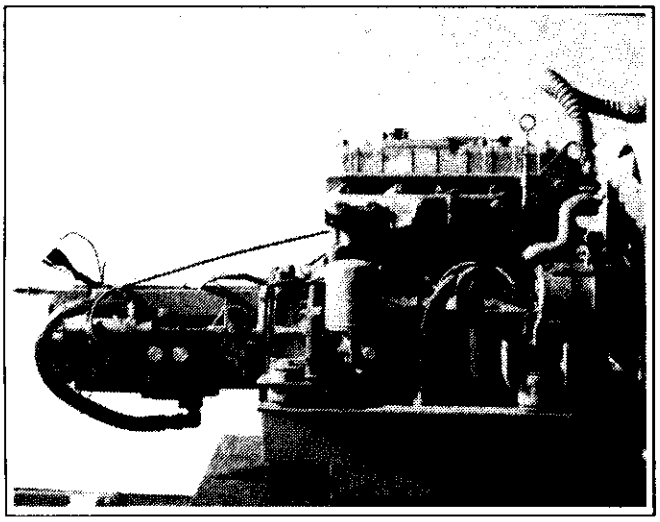


Figure 7-1

NOTE: If the double gear pump does not require servicing, leave the suction tube and the two (2) pressure hoses attached to the gear pump. Remove the two (2) bolts attaching the double gear pump to the hydrostatic transmission and pull the gear pump forward slightly to release the O-ring seal. Leaving the gear pump in the machine will save time and reduce the risk of contamination. This will also eliminate the need to drain the hydraulic reservoir, but expect to loose approximately 1 gallon of oil from the case drain. (See figure 7-2)

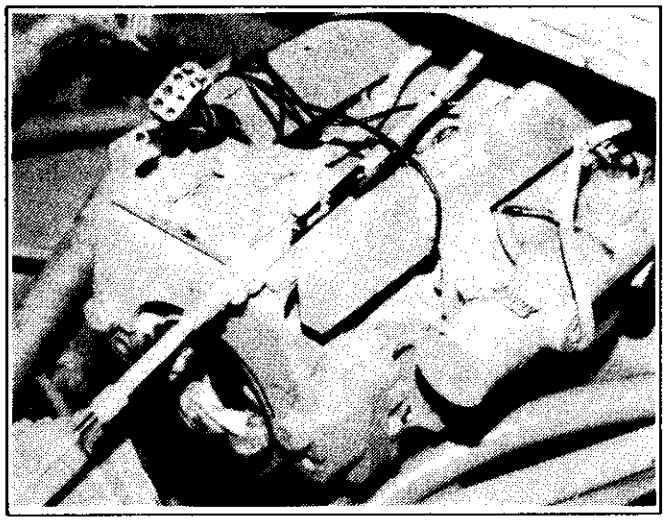


Figure 7-2

REMOVAL

1. Raise and block machine off ground.
2. Fully extend lift arm and tilt cylinders and extend Lift Arm Stops.

CAUTION! The seat belt lock-out is not meant to prevent movement of the Lift Arm when people are under it.ALWAYS USE THE LIFT ARM STOP FOR THIS PURPOSE.

3. Remove seat, side panels, front floor plate and T-Bar panel.
4. Disconnect the four (4) high pressure, charge pressure and case drain lines from the hydrostatic pump. CAP AND PLUG all hoses and fittings immediately after removal.
5. Unplug the wiring harness connection located in the left rear corner of the trans-mission compartment.
6. Disconnect the throttle cable at the control lever and cable mounting bracket.
7. Tie the throttle cable, manual shut-off cable (Yanmar engine) and the wiring harness to the transmission mounting frame to avoid damage to the cables and harness when moving the transmission through sound barrier opening.
8. Remove the battery cables.
9. Remove and plug the fuel supply and return lines.
10. Remove the air intake hose and exhaust pipe at the manifolds.

ENGINE

ENGINE / HYDROSTATIC PUMP

Removal and Installation (complete assembly) (continued)

Engine Removal continued

11. Unplug the fuel sender wiring connection from the engine wiring harness.

    Location:
    Model 960 - right front corner of engine compartment.
    All models except 960 - left front corner of engine compartment.

12. Locate and remove the four (4) 1/2 inch carriage bolts securing the engine cradle to the main frame. (See figure 7-3)

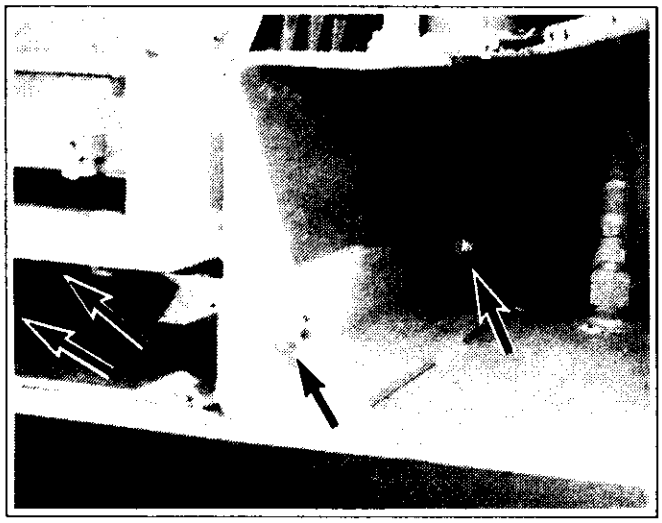


Figure 7-3

13. Remove the hydraulic oil cooler. It is NOT necessary to remove the hydraulic hoses to remove the cooler.

    a. Remove the four (4) 3/8 inch bolts securing the oil cooler mounting brackets to the radiator mounting frame.

    b. Lift the oil cooler out of the radiator mounting frame and set the cooler on the ground at the left rear of the machine. (See figure 7-4)

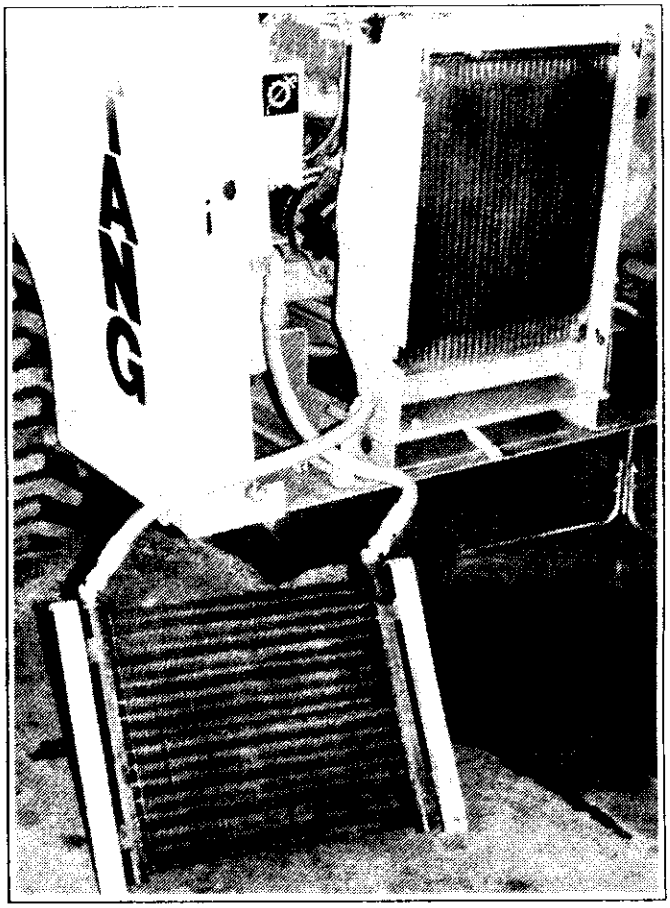


Figure 7-4

14. Hoist the engine and transmission assembly slightly and pull rearward until clear of the machine.

INSTALLATION INSTRUCTION

1. Follow removal steps 4-14 in reverse order.
2. Install T-Bar panel.
3. Follow Start-up Procedures located in the HYDROSTATIC DRIVE SECTION, to prevent damage to the hydrostatic transmission (caused by dry start-up).

ENGINE
COMPONENTS
Removal and Installation

HYDROSTATIC PUMP AND MOUNTING FRAME

REMOVAL

1. Remove the four (4) 10 mm cap screws securing the pump mounting frame to the flywheel housing.

2. Remove the two 1/2 inch cap screws securing the pump assembly to the flywheel housing. (See figure 7-5)

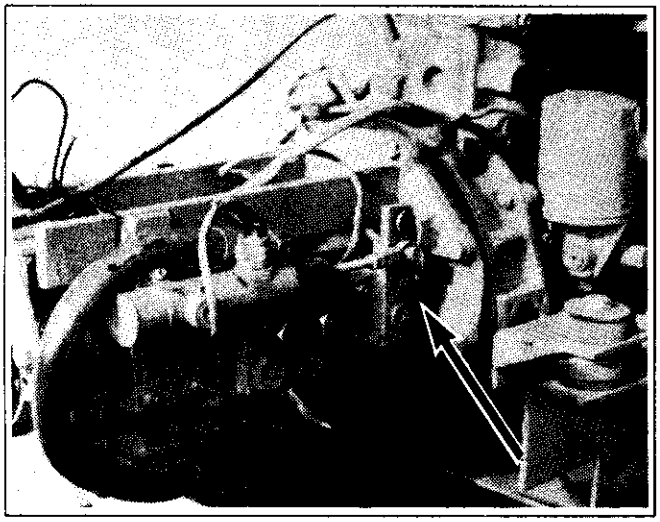


Figure 7-5

3. Lift and slide pump assembly away from engine.

4. Inspect the input shaft of the hydrostatic pump for any sign of wear at the splines or leakage at the seal and replace as necessary.

For service information of the hydrostatic pump refer to VICKERS TA1919 OVERHAUL MANUAL.

INSTALLATION

1. Coat the splines of the pump shaft with Molybdenum Disulfide "Moly" grease.

2. Install the hydrostatic pump assembly to the flywheel housing and tighten the two (2) 1/2 inch mounting bolts.

3. Install the pump mounting frame to the flywheel housing and the hydrostatic pump.

SPECIAL NOTE: Tighten the mounting frame to the hydrostatic pump (at gear pump end) last. This will allow the mounting frame and pump assembly to self-align with engine and flexible drive plate.

ENGINE
COMPONENTS
Removal and Installation

FLEXIBLE DRIVE PLATE

The flexible drive plate is bolted to the engine flywheel and drives the hydrostatic pump through a torsional dampened splined hub.

The drive plate should be inspected and replaced, if necessary, whenever the engine or hydrostatic pump are removed. Replace the drive plate if any of the following conditions are present:

Worn splines
Loose or missing springs (Note: the 960 drive plate only uses 4 springs).
Spring retaining tabs worn
Loose rivets
Fatigue cracks

Installation Tips

Model 960

Note: Alignment pins are located on the flywheel to center the drive plate with the crankshaft.

Special Note: The drive plate MUST be installed with the hub and spring retaining plate facing the engine and the flat side of the drive plate toward the hydrostatic pump. (See figure 7-6) Any marking indicating direction of installation is NOT for use in this application and NOT necessarily correct.

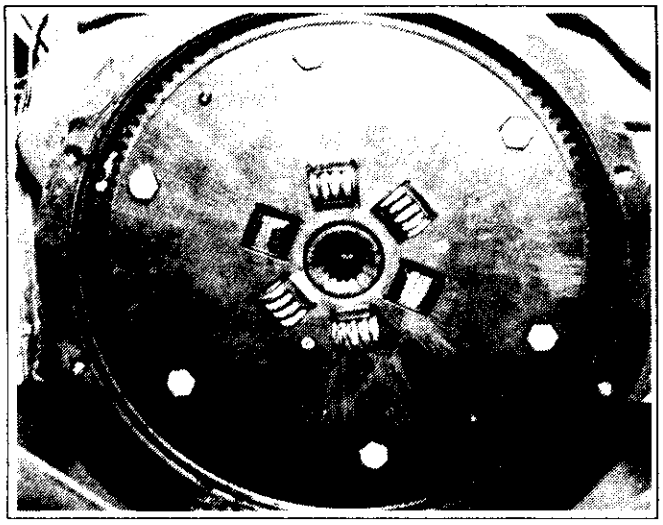


Figure 7-6 (Model 960)

Model 930 and 940

Note: The flywheel has a stepped (recessed surface for mounting and centering the drive plate.

Special Note: The drive plate MUST be installed with the hub and spring retaining plate facing the hydrostatic pump and the flat side of the drive plate toward the engine. (See figure 7-7)

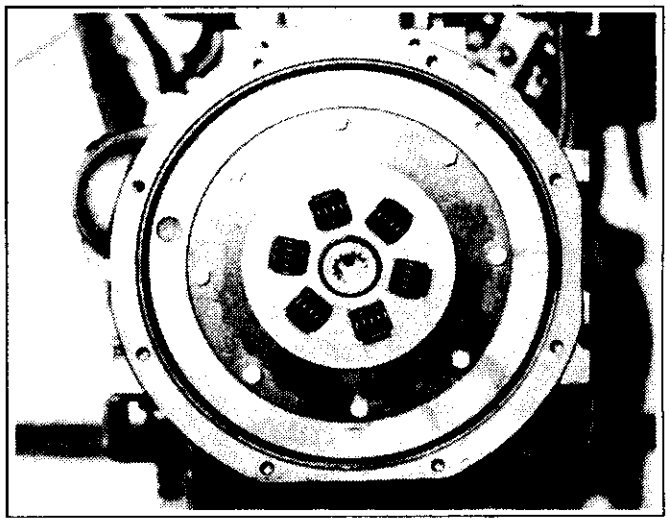


Figure 7-7 (Model 930/940)

All Models

1. Install drive plate with center hub facing proper direction (see special note above).
2. Install bolts with thread sealant (LOCTITE 290 "green" or equivalent) and torque to standard value using a diagonal pattern to avoid twisting drive plate.
3. Install flywheel housing cover and rotate engine to check for contact with drive plate.

NOTE: To ensure proper hole alignment for pump mounting frame: Install all eight (8) bolts in the flywheel housing cover, torque the lower four bolts the remove the top four bolts for pump mounting frame installation.

ENGINE
COOLING SYSTEM

The cooling system is designed with a vertical flow radiator and hydraulic oil cooler mounted at the rear of the engine compartment; and a "pusher-type" cooling fan mounted to the water pump of the engine. Air is drawn from around the engine and expelled through the radiator and the oil cooler out the rear door.

Specifications

Radiator Cap -
7 Lb. PSI/Coolant Recovery Type (960)
13 Lb. PSI/Coolant Recovery Type (940)

Thermostat -
Initial opening temperature:
Model 960 - 180° F. (82° C.)
Model 930 & 940 - 160° F. (71° C.)
Full opening temperature:
Model 960 - 203° F. (95° C.)
Model 930 & 940 - 185° F. (85° C.)
Valve lift at full opening: All models .31 in. (8.0 mm)

Temperature Warning Switch ON: 225°-235° F. (107° - 113° C.).

Maintenance

The cooling system should be checked **daily by operator** for coolant level, condition of hoses, belt, and radiator fins. A 50/50 mixture of ethylene glycol antifreeze and water is recommended for maximum cooling efficiency year round.

!! WARNING

DO NOT TOUCH HOT ENGINE COMPONENT PARTS UNTIL ADEQUATELY COOLED OR SEVERE BURNS MAY RESULT.

Coolant level in the overflow/recovery tank should be 1/3 to 1/2 full when engine is cold. If the tank is empty check the coolant level in the radiator. An empty overflow tank usually indicates a serious leak in the cooling system.

IMPORTANT: Engine overheating can occur without activating the temperature warning switch if operated with the coolant below the level of the warning switch.

The cooling system should be flushed, cleaned, and new antifreeze mixture (50/50) installed every **500 hours** or **once a year.**

If radiator fins become plugged with debris, use the following procedure.

1. Park machine, shut off engine, and lower lift arm to ground. Set parking brake and allow machine to cool off.
2. Open rear door, lift top door. Remove top two hydraulic oil cooler mounting bolts and swing oil cooler out and down to expose radiator cooling fins.
3. Clean radiator and oil cooler by blowing inward through fins with low pressure water or air.

ENGINE
COOLING SYSTEM TROUBLE SHOOTING

SYMPTOM	POSSIBLE CAUSE
Coolant level in recovery tank stays above normal after engine cool-down, and coolant level in radiator drops below filler neck.	1. Faulty radiator cap or wrong radiator cap. Coolant is discharged into recovery tank as usual during engine heat-up, but radiator cap allows air to be sucked in during cool-down instead of coolant. Check to make sure cap is correct part number, that seals are in good condition, and that the radiator fill-neck is clean and undamaged. 2. Leaking connection in coolant recovery system. A faulty connection may let water into recovery tank during heat-up but allow air to be sucked into the radiator during cool-down. Check hoses, hose clamps. and hose nipple on radiator fill-neck. All must be air tight. 3. Leaking head gasket or cracked head. This situation allows combustion gases into water jacket which forces excess coolant into recovery tank. Coolant will eventually fill and overflow recovery tank. Excessive coolant loss will then cause overheating. Use a cooling system tester to check for combustion pulses at low engine speed (follow the tester instructions). 4. Maximum engine temperature exceeds boiling point of coolant. This type of situation should cause the instrument panel warning light and buzzer to come on. If coolant boils with no light or buzzer, check for faulty wiring or engine temperature switch, defective radiator cap or radiator fill-neck (not building pressure), or improper mix of anti-freeze and water. If warning light and buzzer do not indicate overheating, check for plugged radiator fins, damaged or obstructed fan, obstructed fan intake or plugged or corroded radiator core tubes.
Coolant level in recovery tank falls below normal after engine cool-down.	1. Leak in cooling system hoses or radiator. Lost coolant is replaced during cool-down with coolant from recovery tank. Use a cooling system tester to pressurize system to 7-10 PSI (.5 - .6 bar), then check for leaks. Note that a pressure drop with no visible leak may indicate an internal leak in the engine block.

ENGINE
FUEL SYSTEM

FUEL FILTER

The fuel filter is the only maintenance item in the fuel system.

!! WARNING

DO NOT TOUCH HOT ENGINE COMPONENT PARTS UNTIL ADEQUATELY COOLED OR SEVERE BURNS MAY RESULT.

Model 930 & 940 (Yanmar)

1. Shut off the valve at the fuel filter.
2. Remove the sediment bowl and discard filter element.
3. Clean sediment bowl and install a new filter element and O-rings.
4. If contaminated fuel is suspected, the fuel feed pump may also be contaminated. Fuel feed pump service is covered in the Yanmar service manual.

Model 960 (Isuzu)

1. Shut off the fuel supply by unscrewing pump knob on top of fuel filter and lifting it up as far as possible.
2. Loosen vent plug and drain the bowl.
3. Remove filter element and bowl, clean bowl, O-ring and O-ring groove. Lubricate O-ring with diesel fuel and place in groove.
4. Spin bowl onto new element, do not over-tighten.
5. Lubricate element gasket and install bowl/ element assembly onto filter head.
6. Prime filter assembly by stroking the pump knob until fuel flows from vent plug. Tighten vent plug, stroke pump knob until slight resistance is felt. Close and tighten pump knob.

PRIMING DIESEL FUEL SYSTEM

When the filter is changed or if the diesel engine is run out of fuel the system must be primed.

Model 930 & 940 (Yanmar)

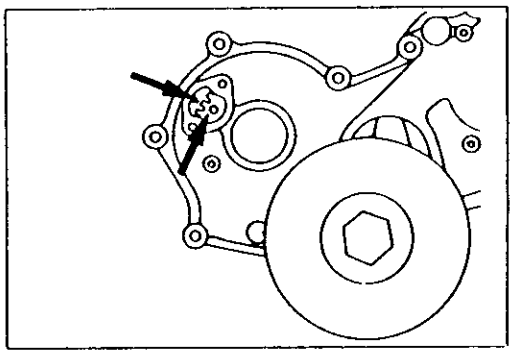
1. The manual priming lever is located on the fuel injection lift pump. Push down and release repeatedly to prime.
2. Air is vented through the excess fuel return line to tank. There is no vent plug to open.
3. Stroke priming lever until air is no longer heard being released in tank.

Model 960 (Isuzu)

1. Prime the filter assembly by stroking the pump knob until fuel flows from the vent plug. Tighten vent plug and stroke pump knob until a slight resistance is felt. Close and tighten the pump knob.
2. If the engine still runs rough, priming of the injection pump is necessary.
   a. Shut off engine.
   b. Loosen banjo fitting on inlet pipe and stroke pump knob to release air.

INJECTION TIMING

INJECTION TIMING CONFIRMATION PROCEDURE

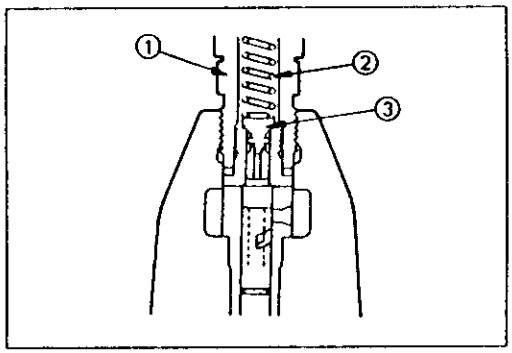


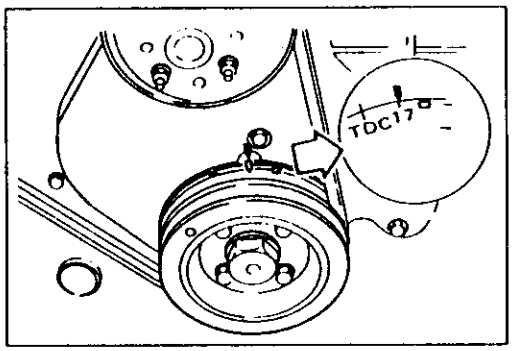
1. Rotate the crankshaft clockwise to align the camshaft gear timing mark "O" with the timing gear case cover pointer.

   The No. 1 cylinder will now be at the point where nearly injection timing.

2. Remove the No. 1 fuel injection pipe.
3. Remove the delivery valve holder ①, the delivery valve spring ②, and the delivery valve ③.
4. Tighten the delivery valve holder to the specified torque.

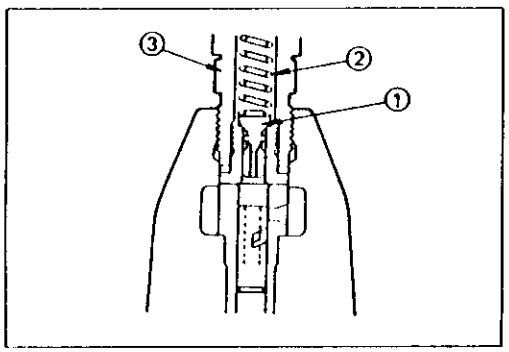
Delivery Valve Holder Torque	kg·m (lb.ft/N·m)
4.25 ± 0.25 (30.7 ± 1.8/41.7 ± 2.5)	





5. Operate the injection pump priming pump while slowly rotating the crankshaft until fuel stops flowing from the delivery valve holder.
6. Conform that the crankshaft damper pulley notched line is aligned with the timing gear case cover pointer.

Injection Timing (Static BTDC)
17°



7. Remove the delivery valve holder.
8. Install the delivery valve ①, the delivery valve spring ②, and the delivery valve holder ③.
9. Tighten the delivery valve holder to the specified torque.
10. Install the fuel injection pipes and tighten them to the specified torque.

Fuel Injection Pipe Torque	kg·m (lb.ft/N·m)
3.0 ± 1.2 (21.7 ± 8.7/29.4 ± 11.8)	

11. Operation to air breeding.

ENGINE
AIR CLEANER
All Units

The Air cleaner is of the dry type and has a removable element that can be cleaned or replaced (replace element with ONLY *MUSTANG* replacement element, **do not install a shorter element!**).

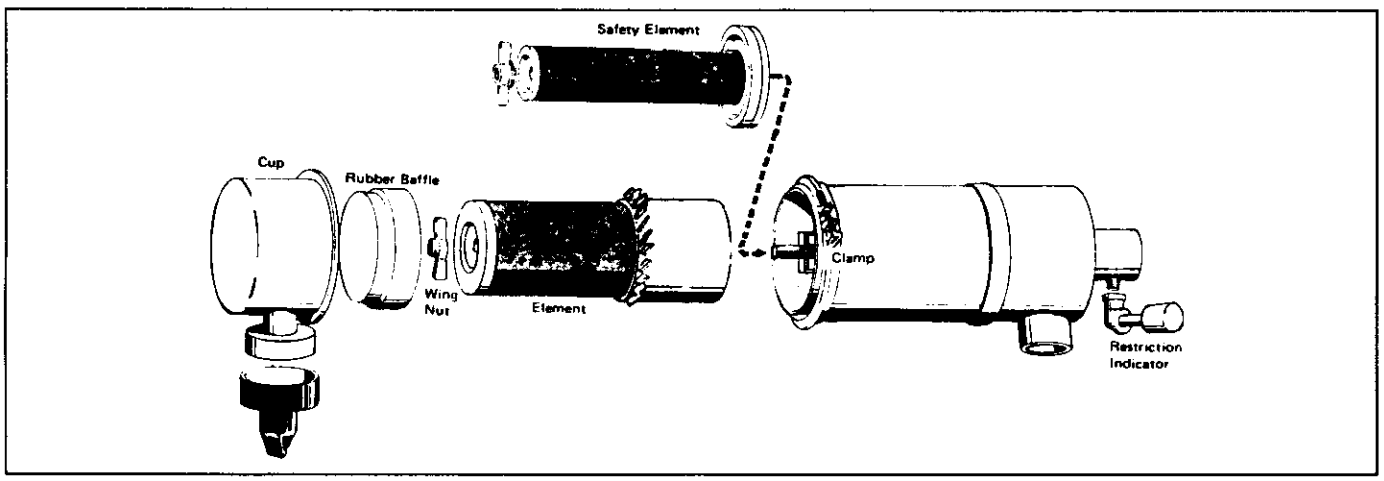
NOTE: The air cleaner should not require frequent cleaning except under abnormal, very dusty conditions.

For inspection purposes, the air cleaner is provided with a restriction indicator as standard equipment. It measures the restriction of air within the air cleaner itself and provides a warning for the operator when it becomes necessary to service the air cleaner. Service the air cleaner **ONLY** when the indicator stays locked up (red signal visible in indicator window) after the engine has been stopped. A portion of the red signal may be visible at times during operation (this is normal). Excessive smoke or loss of power may also indicate a restriction.

CLEANING AND INSPECTION

1. Clean the surrounding area and loosen the clamp attaching the sediment cup to the air cleaner assembly.
2. Remove the cup and dump dirt, wipe cup clean with a dry cloth.
3. Remove the wing nut at end of element and remove element from cleaner assembly. Be sure rubber sealing gasket is replaced under wing nut washer.
4. Tap the element on the palm of your hand to remove dust. **Do not tap on a hard surface.** This will provide temporary service of the element.
5. If tapping doesn't remove dust, use compressed air (under 100 PSI {6.9 bar}) to clean element. Direct clean, dry air up and down the pleats, blowing from the inside to the outside. Do not rupture the element.
6. If element is oily or sooty, soak and wash element in solution of warm water (no hotter than your hand can stand), with Donaldson D-1400 filter cleaner or its equivalent (non-sudsing detergent).
7. Rinse element thoroughly with clean water and allow to air dry (usually this requires 24 hours). Protect element from freezing until dry.

   IMPORTANT! Never wash element in fuel oil, oil, gasoline or solvent. Never use compressed air to dry the element. **DO NOT OIL ELEMENT!**
8. After cleaning, inspect element for damage by placing a bright flashlight inside the filter. Discard any filter that shows the slightest rupture. Replace element with **only** *MUSTANG* replacement element.
9. Inspect filter element gasket for damage. Replace element if gasket is missing or damaged.



ELECTRICAL SYSTEM
EXPLANATION

The electrical system is 12 volt negative ground. There is a totally enclosed brush type alternator with IC (integrated circuit) regulator.

When the ignition switch is turned to the "start" position, current is sent from the "ST" terminal of the switch to two neutral start switches located on top of the neutral start and centering assemblies. These are connected in series so both hydrostatic pump controls must indicate to the electrical system that they are in neutral before current will flow to the starter solenoid. If either or both of the hydrostatic pump controls (the T-Bar Steering System) are not in neutral, the circuit will be broken at this point and the starter will not turn.

The ignition switch, warning lights, work lights and all instruments are fed from the battery through a 30 Amp fuse located in the instrument panel. If this fuse is removed or blown - all systems will be non functional.

The electric hourmeter is connected to the "Accy" terminal of the ignition switch. The hourmeter will accumulate hours anytime the switch is in the "on" or "accy" position, regardless if the engine is running.

There are two audible buzzers connected to the warning lights. One will indicate high engine coolant temperature and/or low engine oil pressure (with the light) and the other will indicate high hydraulic oil temperature (with its light).

There is an 8 watt, 10-15 OHM in line resistor located in the brown wire connected to the "ACCY" terminal of the ignition switch. In order for an alternator to work, it must have an exciter wire (current fed to it). This can be done through the indicator lamp, however, if the lamp should burn out, the alternator would not charge. The resistor allows charging without the lamp in place. If a resistor should burn out, the indicator lamp would be very short lived. When both are burned out, the alternator will not charge. (See figure 8-1)

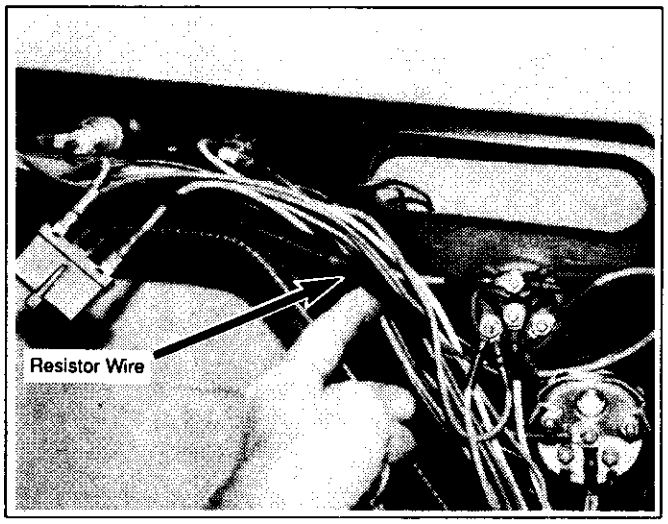


Figure 8-1

The hydraulic temperature indicator is connected in such a way that it does not come on with the ignition switch. The circuit can only be checked by removing the wire from the sender unit and grounding it. If the light comes on with the wire grounded, and the switch on, the electrical circuit is working properly.

ELECTRICAL SYSTEM
TROUBLE SHOOTING

SYMPTOM	POSSIBLE CAUSE
BATTERY	
Undercharged battery	Excessive loads from added accessories Excessive engine idling Lights or accessories left on Low charging system output Continuous drain on battery
STARTING CIRCUIT	
Starting motor will not spin - engine will not crank	Defective battery Burnt magnetic switch Open or shorted solenoid switch Open circuit at "N" start switche(s) Poor contact of brush or worn out brushes Burnt commutator Open or grounded field windings Open or shorted armature Poor brush tension or grounded positive side of brush holder
Solenoid switch chatters	Low battery condition Poor connection
Starting motor spins but will not turn engine	Damaged clutch drive Broken drive lever Broken solenoid switch plunger hook
Starting motor keeps running	Defective solenoid Defective key switch Short in wiring

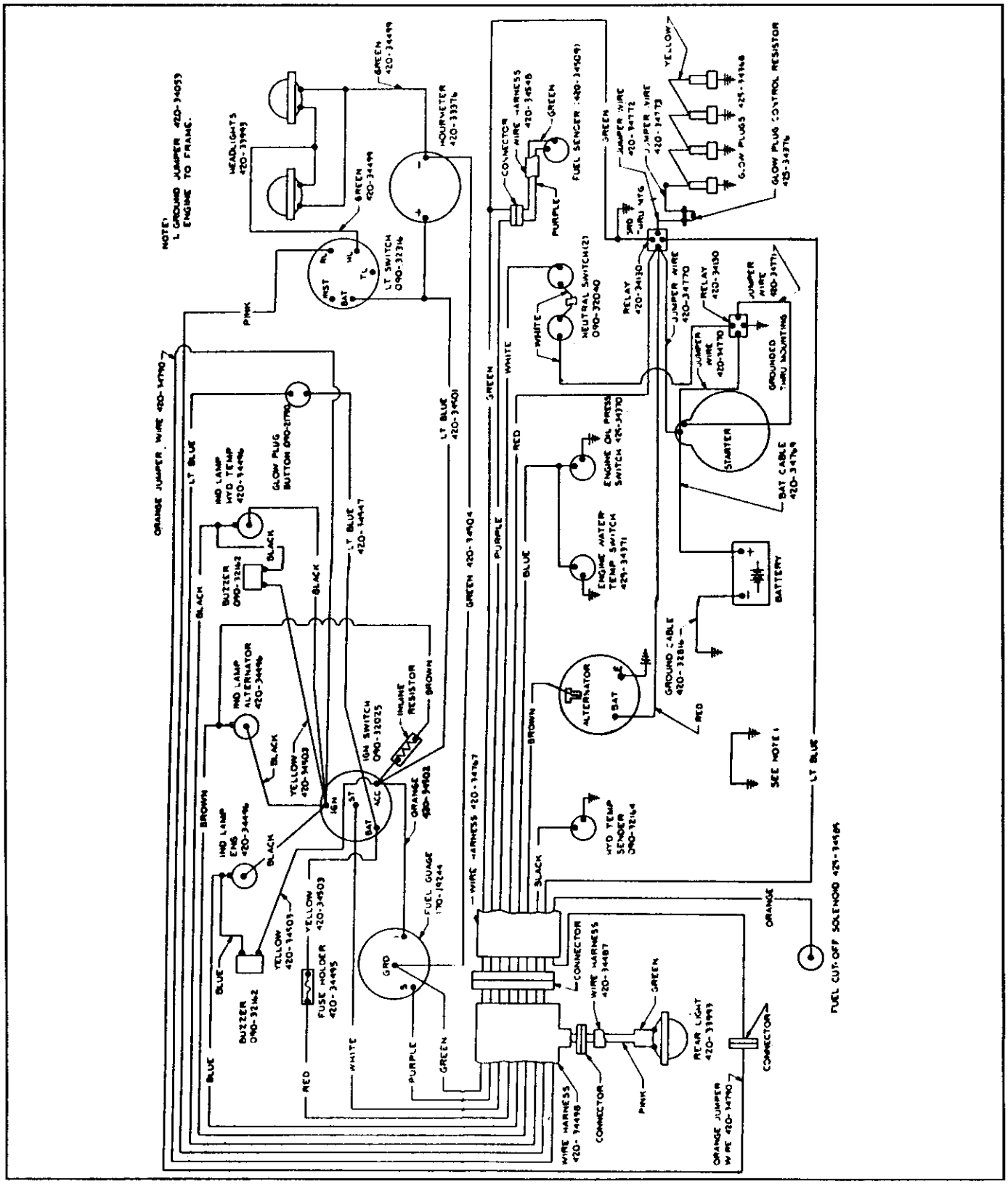
ELECTRICAL SYSTEM
TROUBLE SHOOTING
(continued)

SYMPTOM	POSSIBLE CAUSE
Starting Circuit (continued)	
Engine cranks slowly	Burnt or poor solenoid switch contacts Poor contact or worn out brushes Burnt commutator Shorted or grounded armature Poor tension on brushes Low battery charge High resistance in cables
CHARGING SYSTEM	
Low system voltage	High resistance in circuit Defective wiring Low amperage output of alternator Defective regulator Defective battery
Low alternator output	Slipping alternator drive belt Defective alternator Defective regulator
High alternator output	High resistance at regulator connections Defective regulator
Noisy alternator	Defective or loose alternator drive belt Worn or defective bearing Loose alternator mounting Drive pulley not aligned properly

ELECTRICAL SYSTEM

WIRING DIAGRAM (DIESEL)

960



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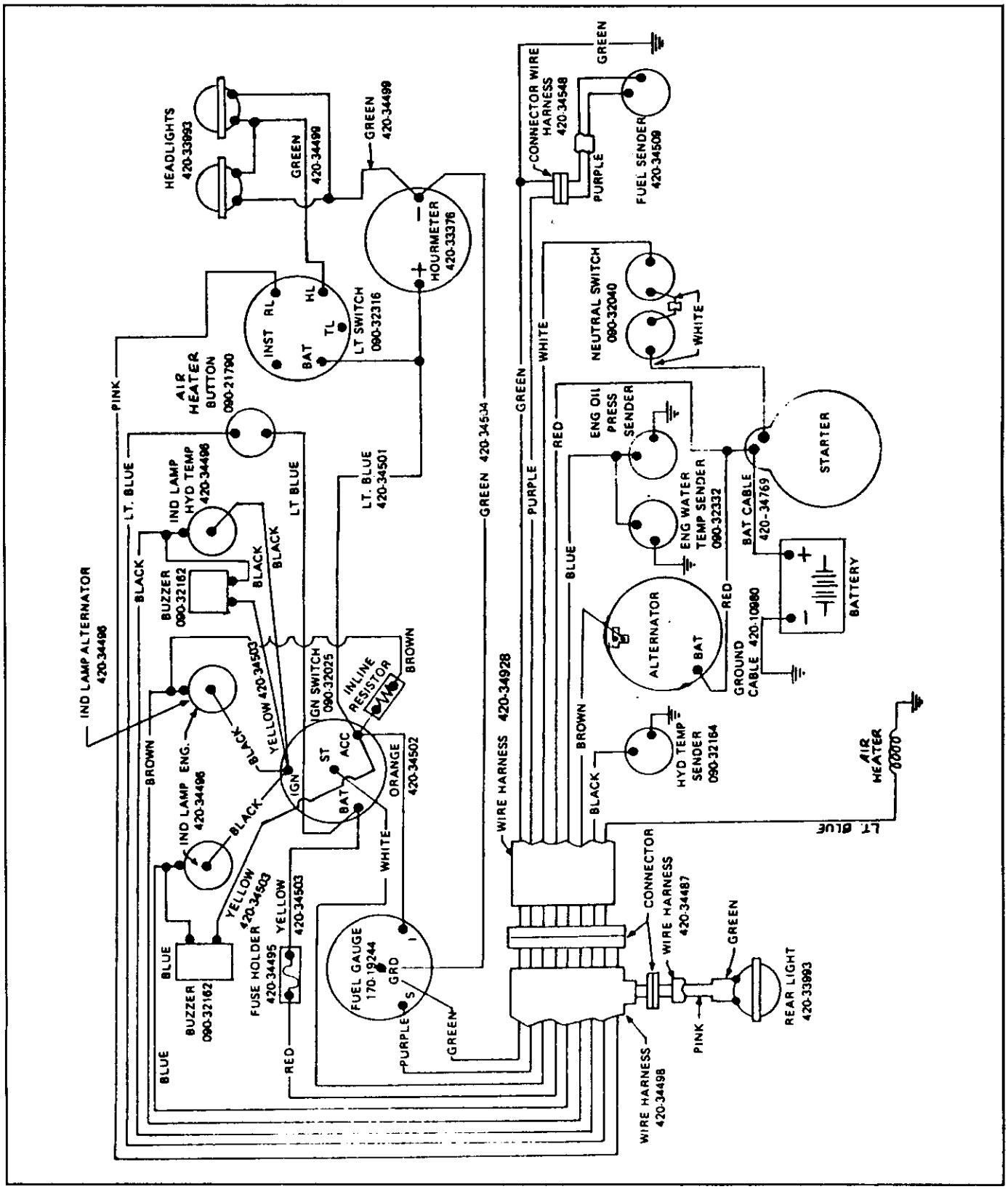
ELECTRICAL SYSTEM

WIRING DIAGRAM (DIESEL)

930 & 940



ELECTRICAL SYSTEM
INSTRUMENT PANEL

The instrument panel for all 900 series units is basically the same. There are warning indicator lights for engine oil pressure, coolant temperature, hydraulic oil temperature and the alternator (charging system). The engine oil pressure and coolant temperature are combined. There are separate sensors, however, only one warning light for both functions. (See figure 8-2)

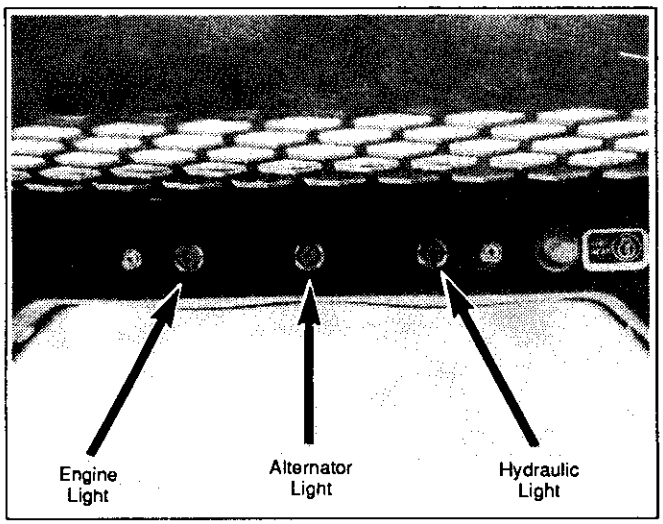


Figure 8-2

ENGINE light will glow whenever the key switch is on, or when the engine is running, if there is an indication of low oil pressure or hot engine coolant. There is also an audible buzzer connected to warn the operator of a problem.

HYDRAULIC light will glow only when there is an indication of hydraulic oil temperature of **225° F. (107°C)** or greater in the oil reservoir. This light DOES NOT glow when the key switch is in the on position. To test this system you must ground the wire attached to the sender unit. There is also an audible buzzer connected to warn the operator of a problem.

ALTERNATOR light will glow when the key switch is in the on position or when the engine is running if there is no current flowing from the alternator. There is no buzzer connected to this warning system.

The instrument panel also contains the key switch, light switch, fuel gauge, electric hour meter, preheat button, and a 30 amp fuse to protect the above components.

If any of the warning lights indicate a problem the machine should be shut down and the fault corrected.

ELECTRICAL SYSTEM
STARTING CIRCUIT

Battery condition should be determined before any components are removed for testing. Use the following test to determine voltage available at the battery.

1. Using a voltmeter, attach the positive lead to the positive (+) battery post. Attach the negative lead to the negative (-) battery post.

2. Crank the engine. The volt meter reading should be at least 9 volts. If the voltage available for starting the engine is less than 9 volts replace or recharge the battery before doing any further testing.

   For battery replacement use BCI Group 31 (625 Cold Cranking Amps)

The battery starting circuit can be divided into two areas. The power circuit consists of the battery and starting motor. The control circuit consists of the key switch, 30 amp fuse, wiring, neutral start switches and starter relay (magnetic switch).

When trouble shooting the starting circuit it is important to determine which part of the system the problem is in.

If there is no current at the starter relay when the key switch is in the start position, the problem is somewhere in the control circuit.

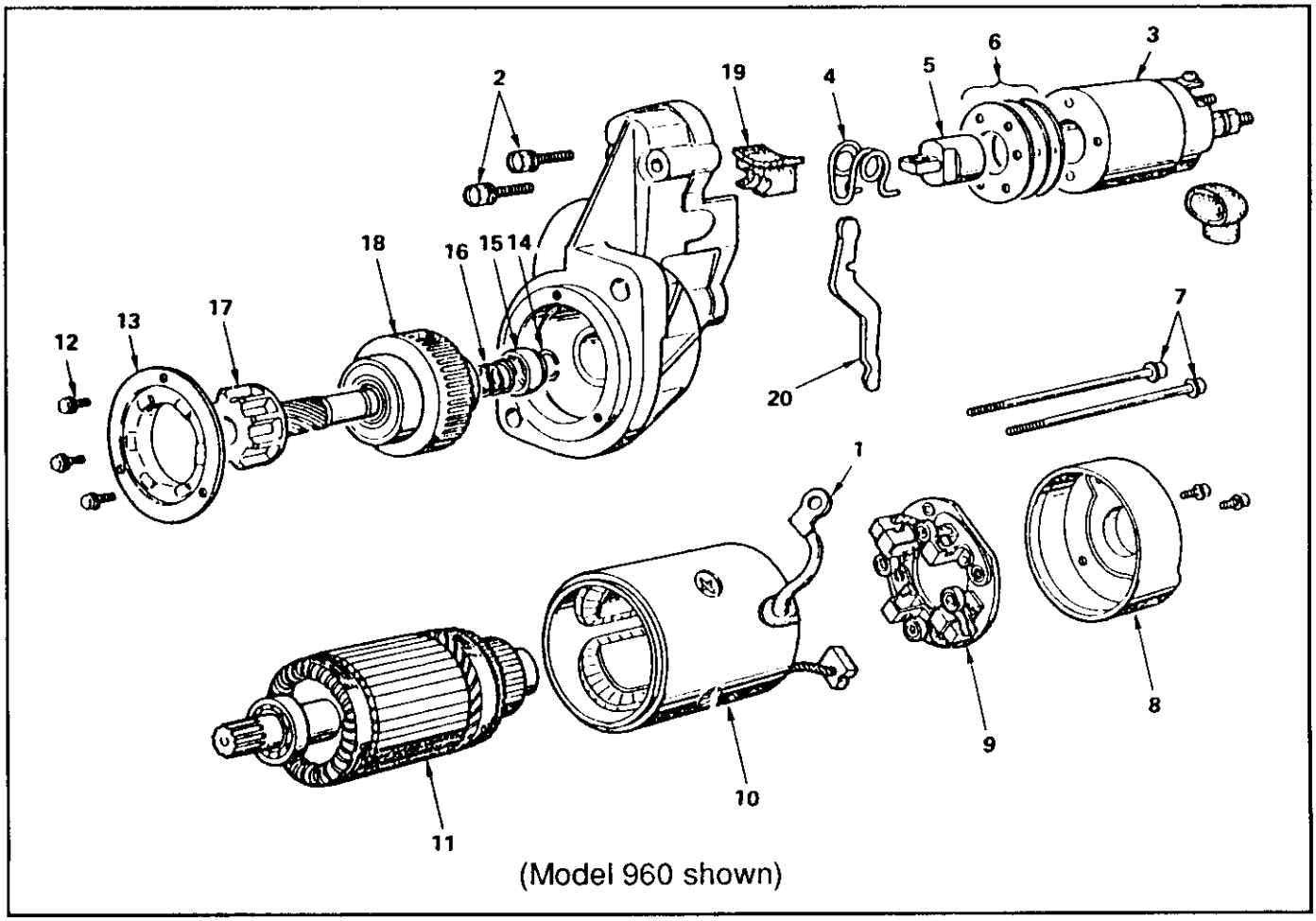
If there is current at the starter relay but the starter does not turn, the problem is in the power circuit.

To trace a problem in the control circuit connect a jumper wire to both neutral start switches (make sure the T-Bar is in neutral and the brakes are set) and turn the key to start. If the starter turns, there is a defective neutral start switch and it must be replaced. If there is no current flow, the problem is farther upstream toward the key switch.

ELECTRICAL SYSTEM

STARTER MOTOR

Disassembly



(Model 960 shown)

This starter motor is equipped with a reduction gear between the armature shaft and the flywheel ring gear drive pinion.

This construction enables the starter motor to reduce 27% of the armature shaft revolution speed at the pinion contributing to achieve more compact size and higher cold engine starting ability than the non-reduction gear type starter motor.

1. Lead wire
2. Bolt
3. Magnetic switch
4. Torsion spring
5. Plunger
6. Shim
7. Through bolt
8. Rear cover
9. Brush holder
10. Yoke
11. Armature
12. Screw
13. Bearing retainer
14. Snap ring
15. Pinion stopper
16. Return spring
17. Pinion shaft
18. Overrunning clutch
19. Dust cover
20. Shift lever

ELECTRICAL SYSTEM
CHARGING CIRCUIT

Trouble in the charging system will show up as:

1. Abnormal indicator lamp operation.
2. Abnormal charging system operation

ABNORMAL INDICATOR LAMP OPERATION

The indicator lamp should glow with the key switch in the on position without the engine running. When the engine is started the lamp should go out. If the indicator lamp stays on:

1. Disconnect the brown wire from the rear of the alternator. If the light stays on there is a short in the wiring harness or the instrument panel.
2. If the lamp goes out when the brown wire is disconnected but stays on while the engine is running (with the wire connected) there is a problem with the alternator.
3. If the lamp does not light at all, the problem is likely a bulb or a connection in the instrument panel.

ABNORMAL CHARGING SYSTEM OPERATION

1. If there is an under charging condition, assure that it is not being caused by excessive accessory loads.
2. Check the drive belt for proper tension.
3. Check the battery for proper condition.
4. Inspect the wiring for defects. Check all connections at the battery and in the wiring harness.
5. With the key switch on and all leads connected, use a volt meter and check for zero readings from:

   a. Generator "Bat" terminal to ground.

   b. Generator brown wire to ground.

A reading of zero will indicate an open circuit and the fault will have to be located and corrected.

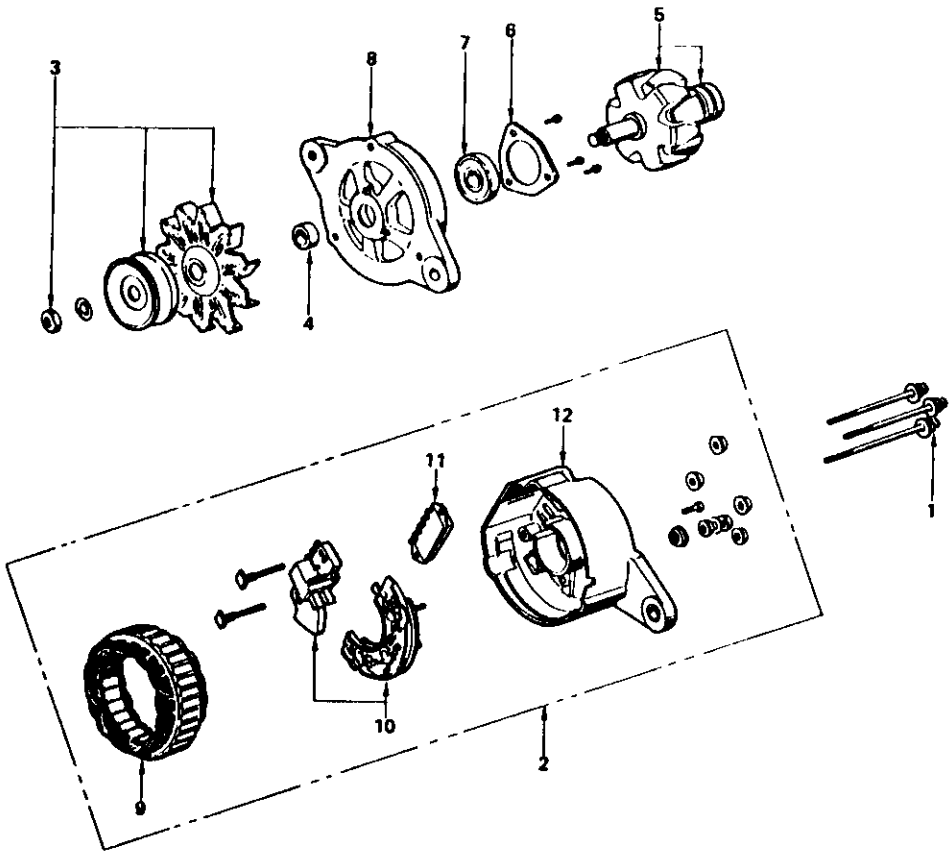
6. Connect a volt meter across the battery. Run the engine at 1/2 throttle. A reading of less than 13.5 volts or more than 15.5 will indicate an under or over charge condition and the alternator must be removed for testing and repair.

If alternator repairs are needed refer to the engine service manual.

ELECTRICAL SYSTEM

ALTERNATOR

Disassembly



(Model 960 shown)

The alternator consists of the front cover, the rotor, the stator, the built-in IC regulator and the rear cover.

This small size and light weight alternator provides excellent reliability. Its simple construction makes it very easy to service. The built in IC regulator minimizes circuit wiring.

Disassembly Steps

1. Through bolt
2. Rear cover and stator
3. Pulley and fan
4. Spacer collar
5. Rotor with bearing
6. Bearing retainer
7. Ball bearing
8. Front cover
9. Stator
10. Rectifier with brush holder
11. IC regulator
12. Rear cover