INSTRUCTION MANUAL

Speedmaster®
3000 & 4000 Series

HIGH·SPEED UNITS

WESTERN GEAR CORPORATION
Power Transmission Division

CONTENTS

INSTALLATION

HANDLING

The unit should always be moved by slinging from lifting lugs provided, or by rolling on bars or skates. AT NO TIME should the shaft extensions be used to support the unit, and care should always be used as not to damage machined surfaces.

MOUNTING OF COUPLINGS, ETC.

We recommend that all couplings turning 8000 RPM and over have hubs balanced in place on the pinion shaft. Inspect key for proper fit before attempting to install coupling on shaft. *Make certain there is clearance at the top of the key.* It is important that the key seats to the bottom of the shaft keyway. Measure the shaft and coupling bores with a micrometer to determine that there is interference. Interference should be approximately .0005 inch per inch of diameter. Coat the shaft with white lead. Heat the coupling *uniformly* until it measures oversize enough to be installed with a light drive.

Caution: Do not heat over 500° F maximum. Be careful not to overheat localized spots. Do not pound directly on coupling with steel hammers; use lead or rawhide mallets, bronze block or drift.

The amount of heat required varies with the shaft diameter and the amount of interference; therefore, it is necessary that the bore size be watched closely during heating. A temporary block should be used as a stop to prevent the coupling from sliding too far on to the shaft. Sprockets or gear mounted on shaft extensions should always be mounted as near as possible to the face of the unit to minimize overhung loads.

Units ordered with coupling guards are often shipped without guards installed. Depending on size, the guards will either bolt directly to the shaft bearing cover or to an adapter plate installed at the factory. Two piece couplings guards have a bolt circle in the flange of the lower half only, for bolting to the unit. The upper half is then bolted to the lower and is easily removed for maintenance of the coupling.

Stem type thermometers are usually shipped separately to avoid breakage and must be installed at the jobsite.

FOUNDATION & ALIGNMENT

Rigid, secure mounting and accurate alignment of the high speed unit is necessary to minimize wear, abnormal bearing temperatures, vibration and coupling problems. Although some form of flexible coupling must be used, it is essential that accurate alignment between the coupling hubs of connecting shafts be achieved. The maximum degree of alignment error should be no greater than .005 total indicator reading of the shaft true running position. Two mounting methods are commonly used:

Common Bedplate: When the unit is placed on a structural steel bedplate common with driving/or driven machinery, the high speed unit may be shimmed under each hold down bolt. The size of the shim is dependent on the unit size, but should be large enough to give a generous area for substantial support of the weight of the gear unit. The alignment of machinery should start from the driving/or driven machine (which ever is most permanently settled in position.) The gear unit will then be aligned to it followed by the aligning of the third machinery component to the gear. Jacking screw holes are provided to move unit vertically.

Concrete Foundation and Soleplates: A concrete foundation should allow for final grouting of the machinery. Vertical positioning of the unit and its soleplates can be done by using jacking screws. After accurate alignment of all machinery components to one another, each should be grouted to the concrete foundation. Use of soleplates will allow for removal of the gear housing at a later date and retain a permanent mounting pad.

Note: It is recommended that a minimum 1/16" shim should be used between the gear and bedplate or soleplates to provide latitude for final alignment.

METHOD OF CHECKING ALIGNMENT

The most accurate method of checking alignment is by fixing a dial indicator to one of the shafts or coupling hubs. Span the indicator arm across to the mating shaft or coupling hub (fig. 1). Proceed in the following manner:

1. Rotate shaft "B" to check coupling hub (or shaft) concentricity. Set indicator at the top and pointer at zero.
2. Rotate shaft "A" and take indicator readings at shaft "B" at top, bottom and each side at 90 degrees (angle).

A typical example of readings and correction requirements are shown in fig. 2.

The spanner device to which the indicator is fixed must be custom made for the application and become part of the tooling for the operation. It must be made rigid enough so as not to deflect due to the weight of the spanner and indicator. A deflection check can be made by attaching the spanner and indicator to a tube or pipe. Set the indicator to zero at the top and rotate the pipe to the bottom. If deflection is noted, the spanner should be reinforced to eliminate it.

The coupled shafts in the system may likely change position when operating under full load and normal operating temperatures. When final alignment is made, it is necessary to consider the operating shaft positions.

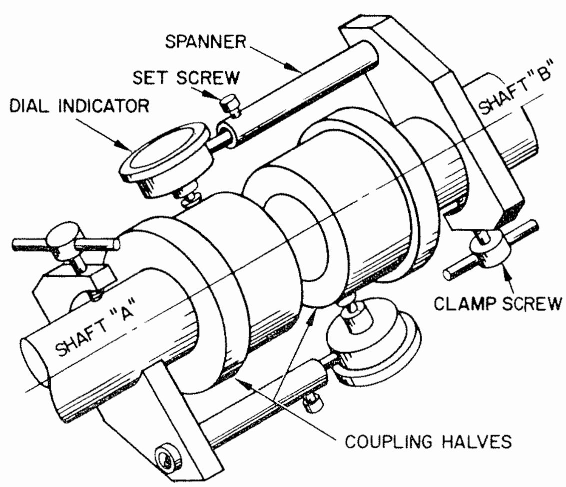


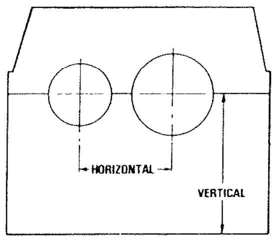
FIG. I – Suggested method of spanning coupling halves for indicating alignment. Other types of couplings may require set-up variations.

Thermal Expansion with 100° Temperature Rise

The accompanying tables show the anticipated thermal expansion of Western high speed units vertically and horizontally for 100 degree of temperature rise. Normal temperature rise is usually 40 to 70 degrees and a percentage of the figures shown in the table can be used.

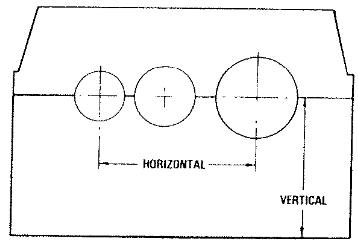
The position of the shafts in the bearings will also affect alignment under operating conditions. The position of the shafts is dependent upon direction of rotation, loading and bearing clearances. Figure 3 illustrates the approximate positioning of the shafts under each condition.

Single Reduction

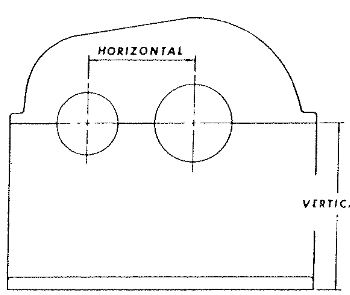


UNIT	IRON VERT.	IRON HORIZ.	STEEL VERT.	STEEL HORIZ.
4103	.0052	.0026		
4104	.0059	.0031		
4105	.0066	.0036		
4106	.0075	.0041		
4107	.0082	.0046		
4108	.0088	.0052		
4109	.0095	.0059		
4110	.0102	.0066	.0098	.0063
4111	.0111	.0072	.0108	.0070
4112	.0121	.0079	.0117	.0076
4113	.0141	.0085	.0136	.0082
4114	.0146	.0092	.0141	.0089
4115	.0152	.0098	.0146	.0095
4116	.0157	.0105	.0152	.0101
4118	.0170	.0118	.0165	.0114
4120	.0182	.0131	.0176	.0127
4122	.0195	.0144	.0188	.0139
4124	.0206	.0157	.0199	.0152
4126	.0218	.0170	.0211	.0165
4128	.0229	.0183	.0222	.0177
4130	.0241	.0197	.0233	.0190
4133	.0259	.0216	.0250	.0209
4136	.0272	.0236	.0263	.0228
4140	.0301	.0262	.0291	.0253

Double Reduction



UNIT	IRON VERT.	IRON HORIZ.	STEEL VERT.	STEEL HORIZ.
4206	.0075	.0072	.0073	.0070
4207	.0082	.0077	.0079	.0074
4208	.0088	.0088	.0086	.0086
4209	.0095	.0095	.0092	.0092
4210	.0102	.0106	.0098	.0103
4211	.0111	.0113	.0108	.0109
4212	.0121	.0124	.0117	.0120
4213	.0141	.0138	.0136	.0133
4214	.0146	.0144	.0141	.0139
4216	.0157	.0164	.0152	.0158
4218	.0170	.0183	.0165	.0177
4220	.0182	.0203	.0176	.0196
4222	.0195	.0229	.0188	.0222
4224	.0206	.0249	.0199	.0241
4226	.0218	.0269	.0210	.0260
4228	.0229	.0288	.0222	.0279
4230	.0241	.0314	.0233	.0304
4233	.0259	.0347	.0250	.0335
4236	.0272	.0380	.0263	.0367
4240	.0301	.0419	.0291	.0405



UNIT	VERTICAL	HORIZONTAL
60 HS	.0077	.0019
75 HS	.0077	.0024
90 HS	.009	.003
115 HS	.011	.0036
140 HS	.0142	.0048
160 HS	.0155	.0052
200 HS	.0175	.0065
250 HS	.0194	.008

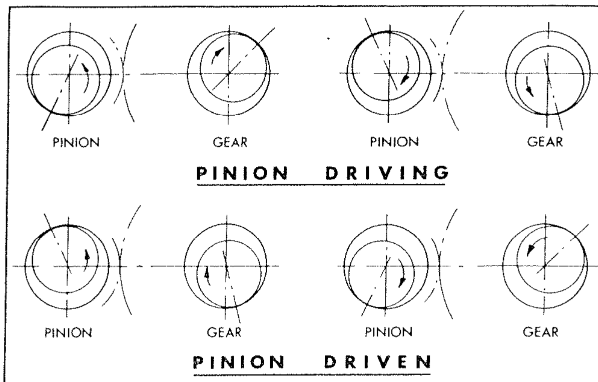
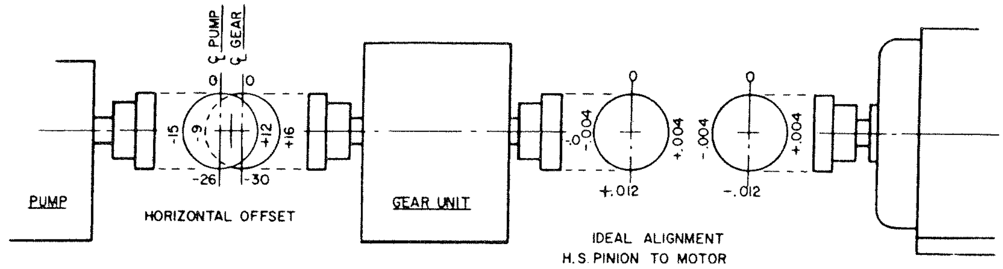


Fig. 3 – Approximate running positions of shaft in bearing under operating conditions.



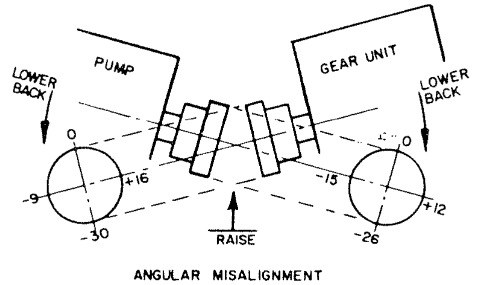


FIG. 2 -- IDEAL COLD ALIGNMENT, MOTOR TO GEAR.

Assume .004 thermal rise in gear and .002 horizontal expansion of housing. Bearing clearance is .006. Pinion should ride on bearings at 7:30. Motor shaft to remain in its ambient position. Set pinion shaft low .006 for vertical rise and .004 toward center to allow for horizontal movement.

Hot Alignment Check

After all components of the system have reached their normal operating temperatures, a hot alignment check must be made as quickly as possible. A spanner device for the high speed and/or low speed coupling should be made so that the coupling sleeves and/or spacer can be bridged and the alternate hub readings can be made without disconnecting the coupling (Fig. 1). Readings and correction requirements should be noted as quickly as possible before temperatures attain ambient conditions. Correction can then be made to suit hot alignment requirements.

Axial Positioning

The low speed shafts of standard units are located axially by babbit face tapered land thrust bearings. Clearance is provided to allow for thermal expansion of both the high and low speed shafts and other operating characteristics which might impose excessive thrust load on the locating bearing.

Normally the locating bearing should be set against the limiting face adjacent to the driven equipment. If Thomas or diaphram type couplings are used, it is usually desirable to increase the clearance for the locating bearing. Additional clearance can be allowed at the factory if excessive thermal expansion is anticipated prior to manufacture of the unit.

In applications requiring high external thrust loads, self equalizing, tilt pad thrust bearings are used.

Final Anchoring of Base

The base and soleplate should now be drilled and reamed together and fitted with tapered dowel pins. The bases are drilled for dowel pins in two diagonally opposite corners. These holes are to be drilled and reamed on the jobsite after thermal check is completed.

Tooth Contact Pattern Check

After the high speed unit has been aligned and grouted on to its foundation, a tooth pattern check should be made to be certain that the contact is the same as during testing at Western Gear (partial or full load) prior to shipment. This can be done in two ways:

A) The oil should be carefully cleaned from both the gear and the pinion and the pinion teeth coated with a light coat of Prussian Blue. Apply a drag to the low speed shaft by wrapping several turns of rope around the shaft extension. Turn the pinion several turns to provide a contact marking on the gear tooth. Note the impressions of Prussian Blue on the bull gear teeth as well as contact marking shown in the blue pattern on the pinion teeth. Tooth contact should be evenly distributed across the face of both helixes with approximately a 70-75% contact noted.

B) Clean the teeth on the high speed pinion and apply a coat of Layout Blue to approximately eight (8) or ten (10) teeth. The tooth contact pattern can then be checked after approximately twelve (12) hours of operation by shutting the unit down and removing the inspection cover and observing the areas on the pinion teeth where the Layout Blue has worn off. (Caution — All articles must be removed from shirt or jacket pockets such as cigarettes, lighters, pencils, etc.) Contact should be approximately 70-75% on each helix for light loads and 80-90% for full loads. Further information on tooth contact patterns is given in section titled, "Gear Tooth Inspection."

WIRING OF ACCESSORIES

Oil immersion heaters may be necessary in cold climates. Pre-heating the oil before start-up is usually necessary since recommended minimum starting temperature is 80° F. Any deviation from this should be cleared with the factory. The unit will maintain the proper temperature level during operation by an adjustment to the water flow through the heat exchanger. The heaters should be combined with an auxiliary pump to keep the oil circulating when a gear unit is not running. This arrangement inhibits local oxidation. Heating units are thermostatically controlled. (Refer to Fig. 4 for a typical wiring schematic.)

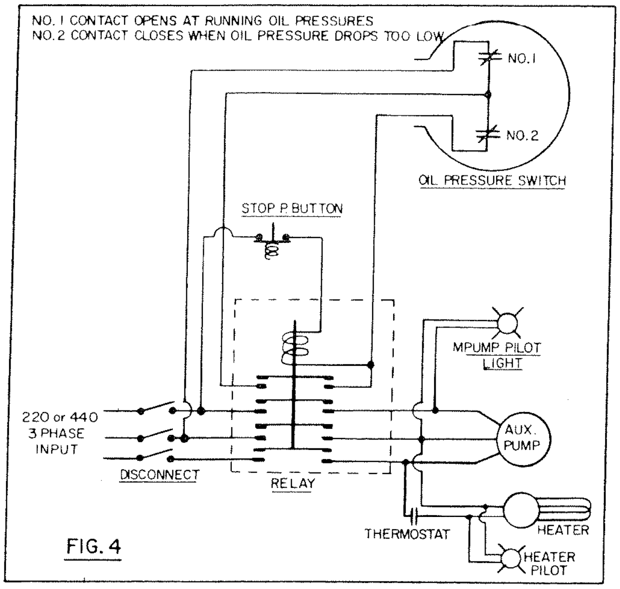


FIG. 4

For protection against low oil pressure a switch should be installed which will sound an alarm and/or a light on the control panel when the oil pressure drops below a specified minimum. An electric driven auxiliary oil pump is recommended for variable speed applications to maintain required minimum oil pressure and to provide insurance against main lube pump failure or a lube line failure. It should be wired into the system so that the low pressure alarms start the pump and must be manually shut down.

PREPARATION OF GEARCASE

Units are shipped dry from the factory, but if a long term storage preservative has been added, this should be flushed out completely before filling with proper lubricant. Flush with flushing oil and drain thoroughly before filling with specified lubricating oil.

Standard factory test procedures involve the use of preservative oils which contain rust inhibitors. Under normal protected storage at reasonably constant temperature, this oil will prevent rust for a period of six months. Western Gear Corporation assumes no responsibility for weather damage when unit is stored before being put into service. No solvents or special treatment are required to place unit in service except when special long term storage has been specified by the contract.

Console type Lubrication oil systems should be thoroughly flushed. A by-pass should be connected immediately ahead of the gear unit with the gear unit isolated to prevent the possibility of accumulating dirt or foreign material in the gear unit. Special preservation for long-term storage or export shipping may dictate the need for a special coating of all parts with Cosmoline or similar preservative. Special cleaning instructions are necessary. The unit will be so marked and it may then be necessary to make a complete disassembly to wash all preservative from unit and parts.

PIPING

Standard integral lubrication involves the use of a heat exchanger which must be connected to a source of cool water or other coolant. A shut-off and regulating valve should be installed in the coolant line on the inlet side to avoid high back pressure on the heat exchanger.

Gear units furnished without integral lubrication must be connected to oil lines supplying oil in the amount, temperature and pressure specified on the certified drawings at the time of purchase.

STORAGE PREPARATION

Short Term

For inside storage, where there is no great temperature change which would tend to cause the gearcase to sweat, the unit should have ample protection on the inside as shipped. Western gear high-speed units are tested with a preservative oil with high rust resisting qualities.

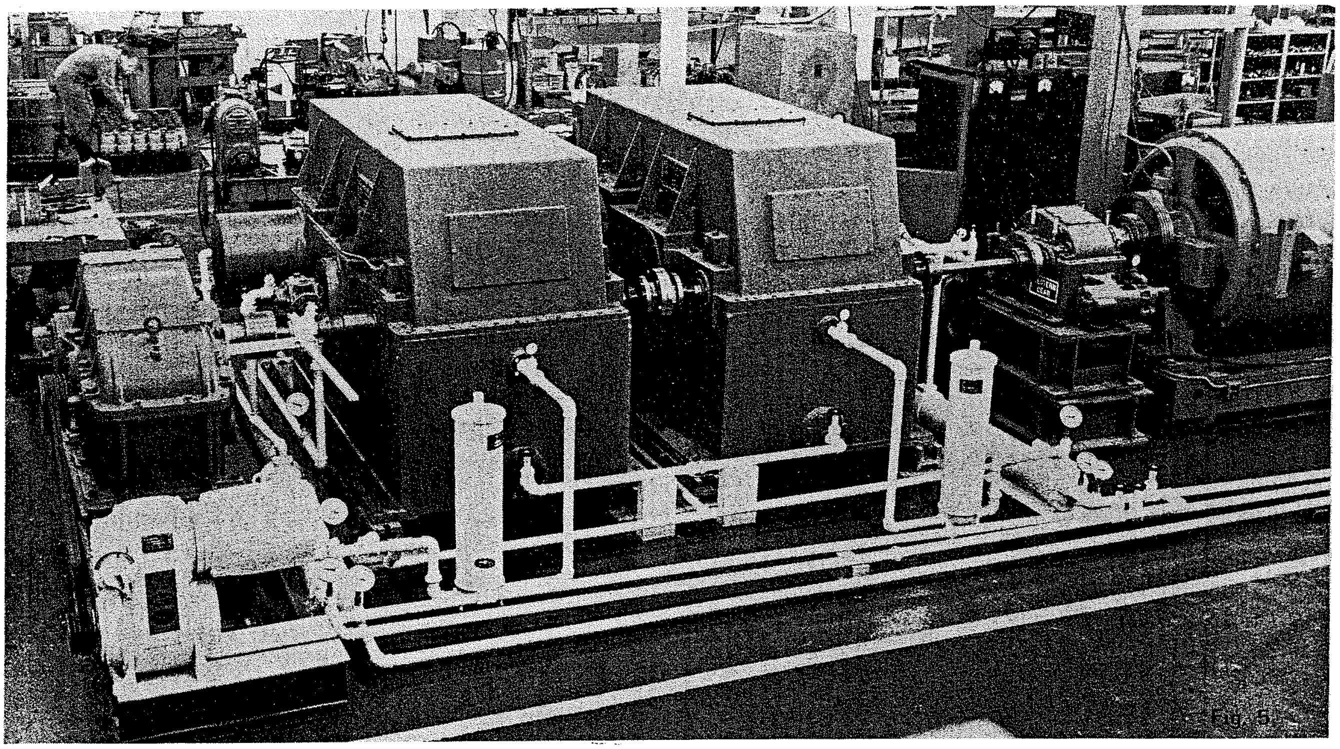
A periodic inspection inside the unit thru the inspection opening should be performed at some predetermined interval and any indication of sweating or rust must be remedied by flushing with a preservative oil. If rust is present and a much longer storage period is required, other protective measures must be taken as outlined under "Long Term."

Long Term

For long term storage or unusual conditions or for the utmost protection under ideal conditions, all openings such as breather and shaft openings can be sealed and the unit filled with a preservative oil, or with oil which is to be eventually used as lube oil. To seal shaft openings; remove open covers and seals and replace with a can-type cover which is bolted in place of the open covers. This will also insure protection for the shaft extensions.

A second and more costly method is to disassemble the unit and protect each item. Coat each part with cosmoline or equivalent. The pinion, gear and bearings should be boxed in addition to coating, to prevent accidental damage. Split-line surfaces should be coated with cosmoline and housings mated to prevent possible housing warpage.

NEW UNIT CHECK-OUT



FACTORY TEST

Every Western Gear High Speed unit is thoroughly inspected and tested in accordance with approved quality control procedures. Testing includes operation at rated speed and normally 10% overspeed. Sound and vibration characteristics are carefully monitored, recorded, and evaluated. The lube system is checked for proper flow, and temperatures at various points in the system are recorded. Following the operation test, a final check is made of the tooth contact pattern. Unusual conditions are corrected prior to shipment.

BEFORE STARTING

Upon receiving the unit and prior to operation, make the following inspection:

1. Check the unit to be sure it is in accordance with other requirements and is correct for the job.
2. Check the atmosphere at the installation site. Excessive dust or dirt, moisture, chemical contaminants, high or low ambient temperatures, or adverse weather conditions may affect the operation of the unit.
3. Check for free turning of the shafts.
4. Check for proper alignment and foundation bolt tightness.
5. Check that all necessary piping and wiring of accessories is completed.
6. Check the oil sump or lube system for proper type and quantity of oil.
7. Check that the lube system is pre-filled to minimize time of build up of positive oil pressure. When oil pressure is available from an electric driven pump or other remote source the operation of the spray jets should be checked. Spray jets cannot be practically checked when shaft driven pumps are used because of spray from the revolving gears.
8. Check that the breather is clean and free from obstruction.

AFTER STARTING

1. Check initially at light load and/or low speed (¼ operating speed) for free running and proper lubrication.
2. Check operation under load for vibration, unusual noise, oil leaks and hot spots. Normal vibration limits are shown in Fig. 6.
3. Check operation of the oil pressure relief valve.
4. Check operation of the low oil pressure alarm and auxiliary oil pump.
5. Check and correct alignment after 6 hours of normal running with load.

After the first week of operation, a thorough check should be made for unusual noise, oil leaks, and excessive heating. All bolts should be tightened. Inspection for the most likely problems should be made against the chart in Fig. 20A.

WARNING – DO NOT OPERATE THE UNIT WITH THE INSPECTION COVER REMOVED. Serious accidents have been known to occur by accidental ignition of the oil vapor, which under some conditions, may be present in a gearcase. It is prudent to keep flames, sparks, and lighted cigarettes away when the gearcase is open.

RPM	NORMAL VIBRATIONS ON HOUSING	MAXIMUM VIBRATION LIMITS
0-3000	1	2.5
3000-8000	.8	2
8000-12000	.7	1.5
over 12000	under .5	under 1.5

Note: Special contract or operating conditions may require different values.

Fig. 6

LUBRICATION

Lubricating oil serves a two fold purpose in a high speed gear unit. First to reduce friction at the bearings and mating gear teeth and second to carry away generated heat.

Friction is reduced because an oil film actually separates the moving parts. The oil's resistance to flow which is its viscosity prevents it from being squeezed out from between the mating surfaces. The higher the viscosity of the oil the thicker will be the oil film. Conversely, the higher the pressure on the surfaces the thinner the oil film. When almost all the oil is squeezed away the condition is called boundary lubrication. During boundary lubrication microscopic high spots on the gear teeth meet metal-to-metal and weld together. The result is initial pitting.

Oil is usually applied to the gears with spray jets which cool the teeth as they come out of mesh. The oil is not sprayed into the incoming mesh where high pitch line velocities and/or high efficiencies are involved. Excessive heating may be caused by using too high a viscosity. (Refer to Manufacturers recommendations.)

If lubricating problems are suspected, advice should be obtained from the local oil supplier or representative. Many oils, now available, will correct specific problems. [Caution—Do not change brands or grades of oil without approval of Western Gear Corporation.]

TYPE AND GRADE

It is recommended that HIGH SPEED units be lubricated with high quality turbine oil which contains oxidation and corrosion inhibitors and a defoamant. This oil should have a viscosity index of not less than 95, and it should contain a mild EP additive. In event of low ambient temperatures, the bulk oil viscosity must not be greater than the limiting viscosity of the pump. If the addition of a pour point depressing compound appears to be necessary it should be specifically approved by the lubricating oil manufacturer. Normal lube oil viscosity required for single stage high speed units is 150-240 SSU at 100° F. For the specific requirements of any unit refer to the unit nameplate.

A mild extreme pressure lubricant may be advisable where heavy tooth loads or shock loads are anticipated. Normal service life can be expected from mild EP lubricants providing the maximum recommended bulk oil temperature is not exceeded. The lubricant supplier should be consulted when bulk oil temperature exceeds 170° F. at the sump.

OPERATION OF LUBE SYSTEM

Standard integral lubrication provides a positive displacement pump driven from one of the shafts. When a cold unit is started the oil pressure must be verified at the pressure gauge before a load is applied. If oil pressure does not begin to build up in 3 to 5 secs., stop the unit and prime the pump. Normal operating pressure will vary, depending on temperature and oil types. The relief valve is set in factory tests at 20-25 PSIG and does not normally require adjustment.

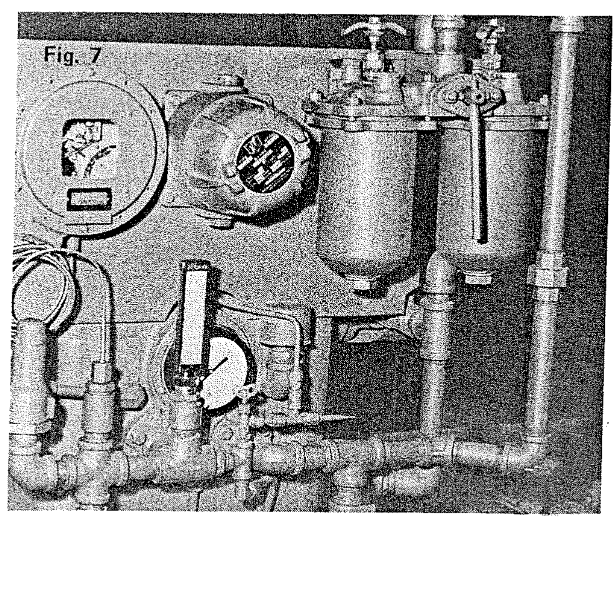
The amount of cooling water required at the heat exchanger will depend on water temperatures, duration and amount of load. An ideal inlet oil temperature is 100 to 120 degrees F. The oil sump temperature should not exceed 170 degrees F. and the measured temperatures at bearings should not exceed 190 degrees F. unless specifically approved by Western Gear Corporation.

Normal operating temperatures and pressures will soon be established in any installation and any large variation should be investigated immediately. The following precautions should be observed to obtain maximum performance from the heat exchanger:

1. Exchanger must be full of liquid in both shell and tube side. (Oil and water.)
2. Provide periodic venting if air tends to accumulate in the system.
3. Maintain rated flow of both mediums.
4. Avoid excessive flow of cooling water. It is a frequent cause of tube failure through erosion, and may decrease cooling efficiency.

When a unit is commonly started several times a day and ambient temperatures are below 80° F. the use of oil heaters are recommended.

Some applications require that a unit be kept running continuously even during minor maintenance. These units have twin filter, cooler and transfer valve arrangements (Fig. 7). The handles of the transfer valves indicate which filter or cooler is in operation. At start up be sure that transfer valves indicate a minimum of one filter and one cooler in use. Transfer of oil flow to the idle units during operation must be done carefully. First make sure that shut-off valves on unused filter and cooler are closed, then rotate transfer valve handles 90°. Open shut-off valves slowly allowing these units to prefill. Close the shut-off valves on the units previously carrying the flow and rotate the transfer valve handles the remaining 90° thus completing the cycle.



MAINTENANCE

SCHEDULE

A positive inspection and maintenance schedule will prolong the life of the machine and lead to the detection of trouble spots before producing serious damage. The schedule below is recommended for most operating conditions.

INSPECTION AND MAINTENANCE SCHEDULE

DAILY CHECK

1. Check pressure & temperature gauges readings and compare with established normal operating pressures and temperatures.
2. Check for unusual noises in gears, bearings, couplings and pumps.
3. Check for excessive vibration of couplings, shaft extensions and housing.
4. Check for oil leaks in lube system and around shaft extensions.
5. Check oil level.

WEEKLY CHECK

1. Clean outside of case to improve heat radiation to the atmosphere.
2. Clean breather.
3. Turn handle on oil filter.

MONTHLY CHECK

1. Check condition of oil.
2. Check operation of pressure switch, auxiliary oil pump and/or alarm.
3. Check operation of temperature switch and oil immersion heater.
4. First month of operation check contact pattern of gear teeth.

SIX MONTH CHECK

1. Change oil (if filter not used).
2. Check pressure.
3. Check gear tooth wear.
4. Check zincs in heat exchanger.

ANNUAL CHECK

1. Check tooth pattern.
2. Check bearing clearances.
3. Check end play.
4. Change oil.
5. Check alignment.
6. Check foundation.
7. Clean oil heater element.

MAINTENANCE OF LUBRICATING OIL

The principal contaminants of the oil are metal particles from the bearings and gear teeth, water condensation inside the gearcase and/or foreign debris. This is a condition which is unavoidable in any gear unit and the most practical means of correction is periodic oil changes.

The frequency of oil changes depends on the temperature, humidity, type of load and hours of operation. Intermittent service with high peak loads will result in faster contamination than continuous operation with uniform loads. The only sure way to determine the condition of the oil is to have samples tested periodically by a laboratory. This service is furnished as a courtesy by most suppliers.

In adding oil, it is important to avoid mixing oils of different brands and grades because of the danger of increased sludge formation and chemical reactions.

The air breather should not be plugged in an attempt to prevent oil contamination as this will result in pressure build up inside the case and may result in leakage of the seals at the exposed shafts. Actually very little dust can get inside the unit through the breather because of its size and design.

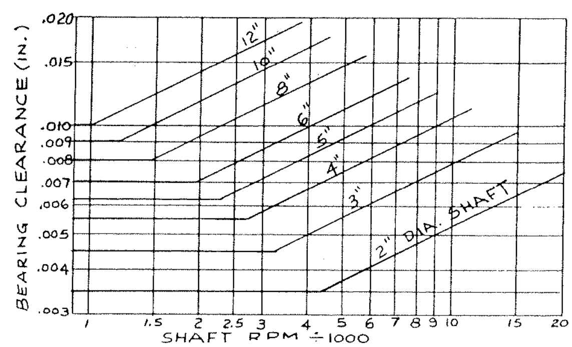
MAINTENANCE OF GEAR UNIT

The outside of the gearcase and the air breather should be kept clean to maintain maximum heat radiation from the case. All other maintenance is simply a series of inspections to determine wear rate and proper functioning of accessory equipment.

BEARING CLEARANCE

High speed gear units use sleeve type bearings which must operate with a specific clearance over the shaft. This clearance is calculated to allow the proper flow of oil through the bearing with consideration for the shaft speed and load.

Measurement of bearing clearance is easily done by lifting the uncoupled shaft to the top of the bearing and measuring the distance of travel with an indicator. Measure as close to the bearing as possible.



Based on 150 SSU @ 100°F. oil with inlet temperature of 110°F. to 120°F. at 20 PSIG pressure. The above clearances are for standard bearings under normal operating conditions. Consult factory for sizes and speeds not shown and special conditions. Tolerance ± .001 for 2" diameter through 6" diameter - ± .015 for over 6" diameter.

END PLAY

A certain amount of end play of the shafts is necessary to allow for thermal expansion. The limits of end play are not critical unless excessive axial movement affects the unit or other components in the system. The axial end play measurement of the low speed shaft can be made by moving the shaft from one extreme to the other. This will give the thrust bearing clearance. The axial movement of the high speed pinion is a function of the backlash of the gear set and can be compared to the axial movement built into the gear train at the time of manufacture. Unless externally restricted the H.S. pinion will operate in the center of its axial float-range.

GEAR TOOTH INSPECTION

The normal service life of the gear set in high speed gear drives is dependent upon:

1. Adequate lubrication.
2. Correct tooth contact pattern.
3. Having a minimum of backlash to allow for thermal expansion.
4. Normal operation at no more than design load.
5. Cleanliness.
6. Axial growth allowance in the drive, driven shaft and couplings.
7. The system being free of frequent shock or torsional loads.
8. Maintenance of good alignment and rigid mounting.

When Western Gear high speed units are manufactured, a careful check of backlash, bearing clearance and tooth contact pattern is a part of the inspection and test procedure. Ideal tooth contact covers a minimum of 75% of each helix longitudinally and approximately 70% vertically starting from just above the root to an area slightly below the tip. Contact ideally, will be closely centered on the helix and will not extend completely to either end of the tooth. Fig. 8 shows tooth nomenclature. Fig. 9 shows an ideal tooth contact pattern. The procedure for making a tooth contact pattern check is given in section titled, "Tooth Contact Pattern" page 3.

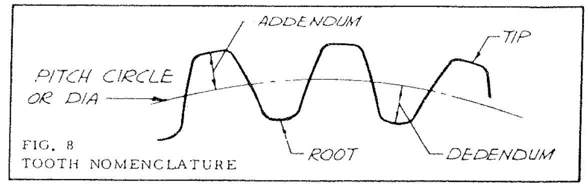


FIG. 8
TOOTH NOMENCLATURE

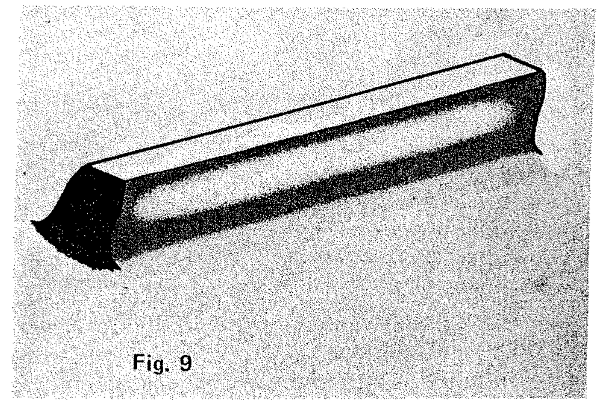
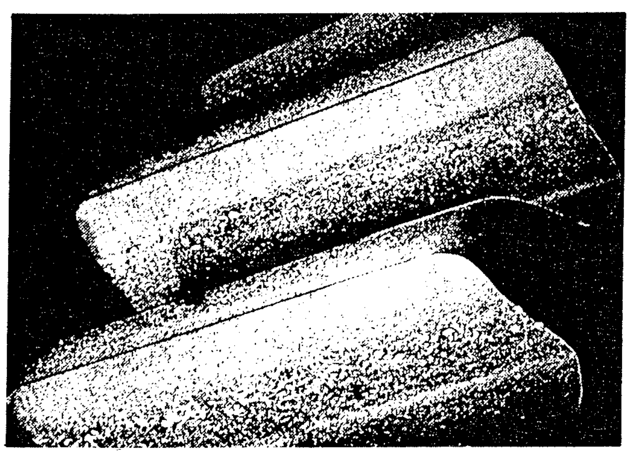


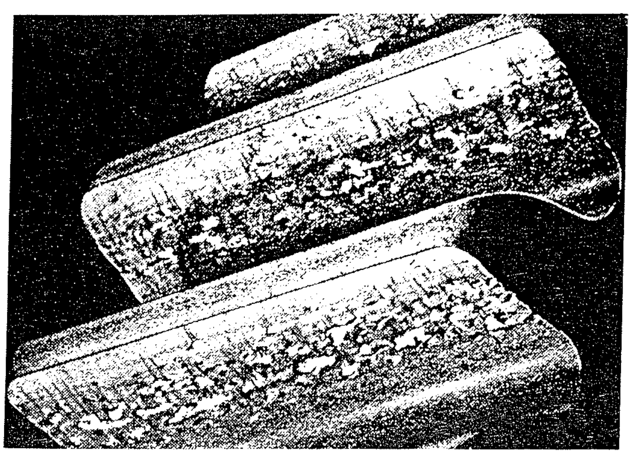
Fig. 9



Corrective Pitting (fig. 10)

During initial operation of a new gear set, it is not unusual to have fine pitting occur on the loaded side of the tooth. Although machined surfaces are smooth to the eye, the machining operation actually leaves microscopic high and low spots. Thus, in early stages of operation, tooth load will be carried on high spots which will be overstressed. High spots will then fatigue and break out in fine pits, reducing the high spots, to give a broader contact area. The surface will gradually smooth and work harden with no further pitting occuring.

If there is insufficient tooth contact initially, pitting may occur in the area of contact and will gradually disappear as the slight wear creates a fuller contact. The characteristics of the lubricant and the oil film strength does have a decided influence on the occurrence of pitting and degree of severity.

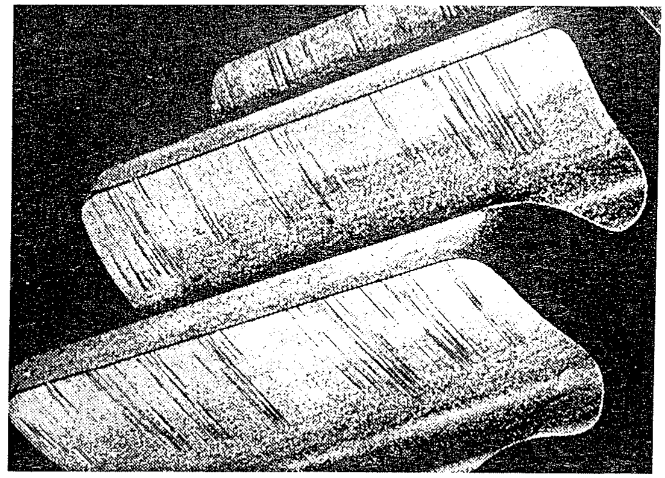


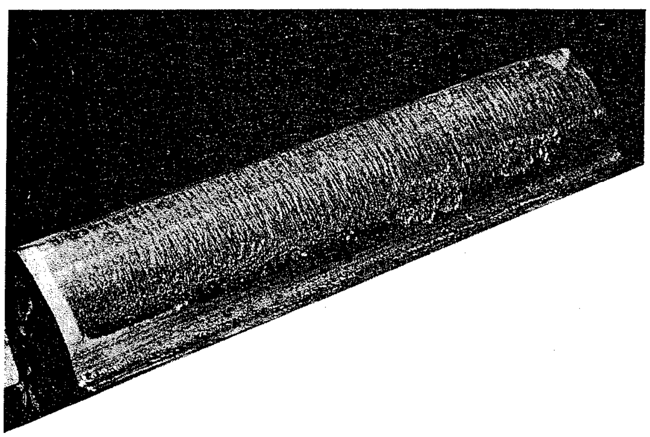
Destructive Pitting (fig. 11)

Overload and/or poor lubrication may cause pitting which can start similarly to corrective pitting, but where larger pits will occur. If the number of large pits seriously reduces contact area, the pitting will eventually destroy the tooth. If this condition begins, check for possible overload or inferior lube oil quality.

Scoring (fig. 12)

Scoring results from improper or insufficient lubrication for the loading conditions that occur. Scoring produces vertical scratches and groves which run from the pitch-line to tip of tooth. Check oil spray nozzles making certain they are open and the flow of oil is unimpeded in the system. Also check quality and condition of lube oil and possible overloads.



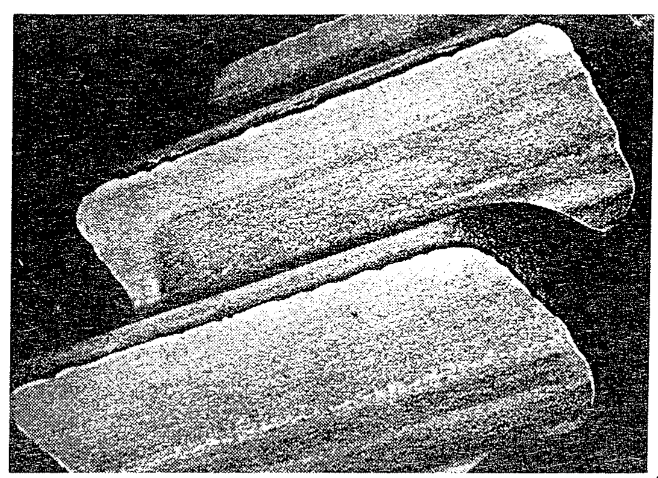


Galling and Plastic Flow (fig. 13)

This condition occurs when loading is too great for maintenance of the oil film. This can be a fault of the oil or existence of an overload. Galling is usually preceded by scoring and its continuation will lead to plastic flow. Plastic flow is a condition where tooth pressures actually cause a flow of metal from the pitch line toward the tip of the tooth. In these instances a wire edge will appear at the tip. Again check the lubrication passages. It is essential to retard the problem and promote healing. Be sure to check for possibility of overload.

Abrasive Wear (fig. 14)

When abrasive particles larger than the thickness of the oil film contaminate the lube oil they will cause wear and pitting. This pitting differs from corrective pitting in that pits will be shiny and will be spaced at random across the tooth, even showing in the no-contact areas. If abrasion appears, a thorough cleaning of the unit and lube oil system is necessary.



LUBE SYSTEM MAINTENANCE

Pump — Standard integral lubrication is normally provided with a rotary gear type pump. One style of pump (fig. 15) is coupled directly to the low or intermediate speed shafts. Another style frequently used in (fig. 16) is driven through a small reduction gearset. In either case they are positive displacement pumps which are lubricated by the oil they pump. Under normal conditions there is no service or maintenance required during the life of the pump. Pumps equipped with compression or cheveron type packing require occasional adjustment. Do not tighten the gland too much since a slight leakage is necessary for lubrication of the stuffing box. If problems are encountered with a pump refer to the oil pump trouble shooting section of page 14. It is usually impractical to overhaul a worn out pump, however, repair parts can be purchased direct from the pump manufacturer. New replacement pumps can be ordered through Western Gear sales offices or representatives. If it becomes necessary to remove pump to return to manufacturer, plugs should be inserted in the ports to prevent foreign material from entering the moving parts.

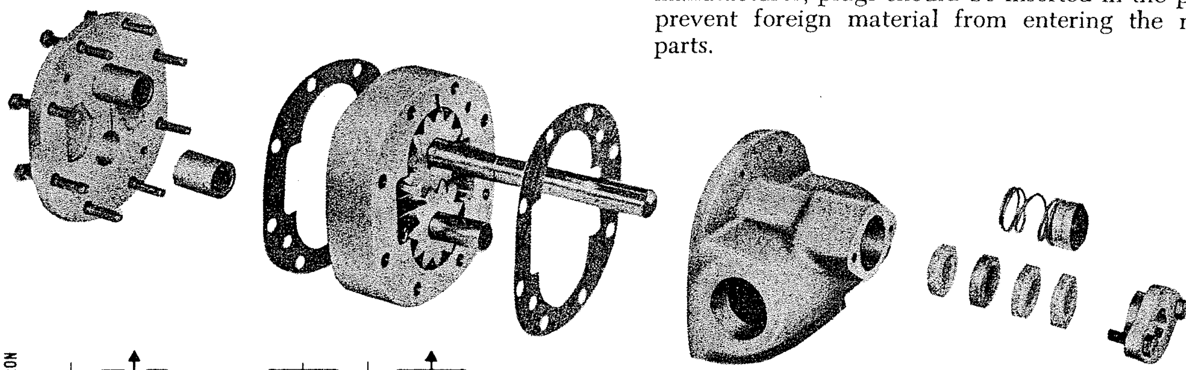
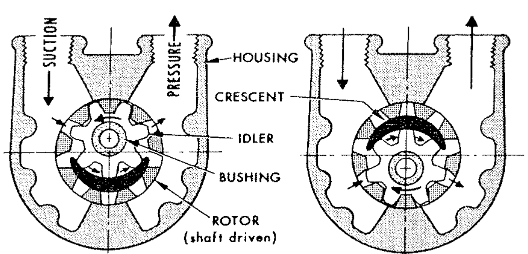


Fig. 16

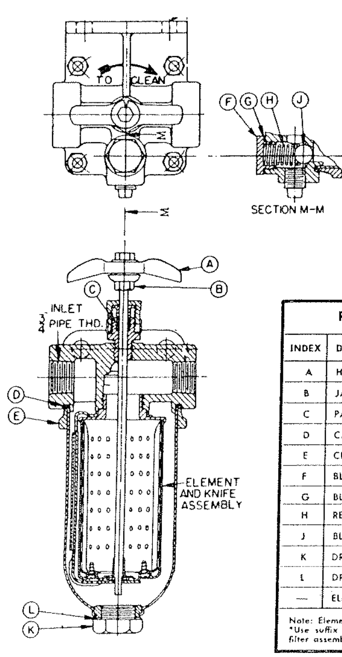


Counter-Clockwise Rotation *Clockwise Rotation*

Fig. 15

Filter (fig. 17)

Filters furnished will remove all foreign material down to 40 microns. The handle on top of the unit rotates the strainer element against a stationary knife which scrapes off the accumulated material. This handle should be turned at least one revolution weekly. A plug in the bottom of the filter should be removed periodically and the accumulated material drained. Fitting a valve to the drain connection permits convenient blowdown while system is under pressure. Every six months, under normal operative conditions, the strainer should be removed and thoroughly washed in a petroleum solvent.

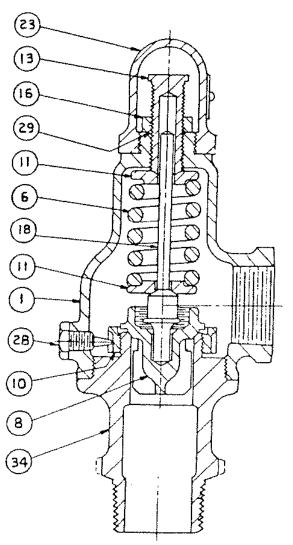


REPLACEMENT PART NUMBERS		
INDEX	DESCRIPTION	NUMBER
A	HANDLE	14113-1
B	JAM NUT	9218
C	PACKING	17433
D	CASE GASKET	21016
E	CLAMPING RING ASSEMBLY	14798
F	BLOW-OFF SCREW	21370
G	BLOW-OFF COVER SCREW GASKET	6270
H	RELIEF VALVE BLOW-OFF SPRING	63117
J	BLOW-OFF BALL	8388
K	DRAIN PLUG	11216
L	DRAIN PLUG GASKET	11217
—	ELEMENT ASSEMBLY	63103-(*)

Note: Element and knife are one assembly.
*Use suffix numbers -0 to -9 to indicate spacing as shown in filter assembly number table on reverse side.

Pressure Relief Valve (fig. 18)

No maintenance is necessary. The recommended setting of 20-25 PSIG is set at the factory and does not normally require adjustment. The setting can be changed by removing the cap, releasing the locknut on the stem and adjusting the regulating screw with a wrench.



1 Body
6 Spring
8 Disc
10 Regulating Ring
11 Spring Washer
13 Adjusting Screw
16 Adj. Screw L'nut.
18 Stem
23 Cap
28 Locking Plug
29 Packing
34 Base

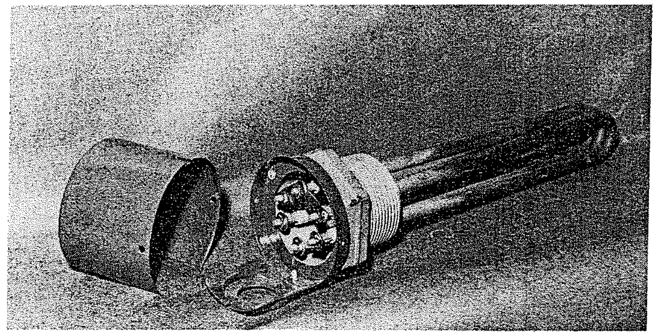
Immersion Heater (fig. 19)

It is important that the entire heating element be covered with at least 2 inches of oil during operation. Burn out from overheating is the likely result if any portion of the element is not covered. The only required maintenance is periodic cleaning of heating element.

Heat Exchanger (fig. 20)

A heat exchanger needs little attention, but to insure continued satisfactory performance it should be inspected at regular intervals.

1. Remove the bonnets. Inspect all tubes carefully for possible erosion, corrosion, or foreign matter.
2. Inspect all zincs, if used, to be sure they are neither excessively corroded nor insulated with scale. Scrape to a bright surface or replace if excessively deteriorated.



When the interior of the shell and tubes become fouled with scale it is recommended that the cleaning be done by specialists i.e., a radiator repair shop.

TROUBLE SHOOTING

Chart – The chart on page 14 is a guide for diagnosing and correcting most abnormal conditions in performance.

Gear Teeth – see page 10 - For types and causes of gear problems.

Bearings – see page 15 – For types and causes of bearing problems.

Vibration – Special attention is given the subject of vibration because it is the most easily observed sign of trouble. If vibration is excessive in spite of corrective action described in the trouble shooting chart, measurements should be taken with a vibration analyzer at operating speed and load. Take vertical and horizontal housing vibration readings by holding the pick-up against the bearing caps at each shaft extension. Ideally the vibration amplitude should be less than one mil at all points. Any vibration of 1.5 mils or over can be considered excessive and operation should be suspended pending investigation and correction. See table page 7.

Experience has shown that a gear unit can check out perfectly on the factory test stand and seem to perform badly when installed in the field. Such vibration problems are the unforseen result of incompatible units coupled together.

System vibration problems are highly complex and are not within the capability of the average user to diagnose. Therefore, it is recommended that the services of a VIBRATION TEST ANALYIST be obtained. System analysis is not a courtesy service of Western Gear Corporation, however, representatives will investigate units suspected of being faulty. See items of guaranty on the back of this manual.

When vibration is experienced, it may be one or a combination of types: (a) Torsional vibration, (b) Mechanical vibration, or (c) Flexural vibration.

Torsional vibration is normally associated with systems where reciprocating equipment is used for the driver (internal combustion engines) or for the driven equipment (reciprocating pumps or compressors). Some types of electric motors, turbines, and centrifugal pumps have also been known to have torsional vibration characteristics. If gear hammering (tooth separation or torque reversals) occurs in the operating speed range, operation should not be permitted until an investigation is made to determine the cause and correction is completed.

Mechanical vibrations can be caused by inadequate foundation, loose bolts, faulty alignment, system unbalance, eccentric shafting or vibrations from sources outside the unit.

All shafts in a system have their own natural resonant frequencies like a tuning fork which vibrates at a certain frequency when struck. When a shaft is rotated at a speed equal to its resonant frequency "Flexural vibration" sometimes occurs and the speed is called the "critical speed." Operation at or near critical speeds can quickly destroy a gear set, therefore Hi-speed units are designed to have critical speeds well above the normal operating speed range. The resonant frequency of a given shaft is a function of its diameter, length, distribution of weight or mass along its length, and the support locations.

Oil Pump – If any pump does not perform properly in the installation, the following are some of the things to look for when:

1. **Pump fails to prime or deliver liquid**
   - A. Suction lift too high for vapor pressure of liquid pumped.
   - B. Leak in suction line.
   - C. Viscosity of liquid is too high for size of suction pipe used.
   - D. Pump drains completely during the idle period.
   - E. Excessive wear of pump parts.
   - F. Suction line obstructed.
   - G. Pump shaft not rotating due to defective coupling.
   - H. Suction line not immersed deep enough in liquid.
2. **Capacity is too low**
   - A. Suction lift too high.
   - B. Air leaks in suction line.
   - C. Suction line too small or obstructed. Can be detected by installing a vacuum gauge directly at the pump suction. The maximum vacuum at the pump suction should never exceed 15 inches of mercury. It is necessary to keep below 15 inches not because of the inability of the pump to handle a higher vacuum, but primarily because of the vaporization that is liable to take place at a higher vacuum. Vaporization caused by higher vacuum will generally result in capacity drop-off.

D. Pump speed too slow.
E. Relief valve setting too low.
F. Suction inlet not immersed in the liquid deep enough.
G. Piping improperly installed permitting air pocket to form.
H. Increased clearances due to wear in the pump will sometimes cause a decrease in capacity of the pump.

3. Pump works spasmodically

A. Leaky suction lines.
B. Suction lift too high.
C. Air or vapor in liquid.
D. Coupling slipping on pump shaft.

4. Pump wastes power

A. Pressure too high.
B. Liquid more viscous than assumed.
C. Suction or discharge lines obstructed.
D. Mechanical defects:
Drive shaft and pump shaft misaligned. Pump shaft bent. Misalignment within pump due to strains built up by improper piping or installation of pump into equipment.

5. Pump is noisy

A. Machine or part of it is acting as a sounding board.
B. Misalignment or poor coupling design.
C. Excessive aeration of liquid in reservoir.
D. Leaky suction line.
E. Suction in lift so high that vapor forms within liquid.
F. Suction line not submerged deep enough.
G. Suction line obstructed.

Fig. 20 A

TROUBLE SHOOTING CHART

Observation	Frequency of Inspection	Cause	Correction
Noisy operation	Weekly	1. Worn or damaged parts	Replace or repair
		2. Misalignment	Realign — See coupling mfgr. instructions.
		3. Overloading	Investigate — eliminate
		4. Faulty lubrication	Check oil pumps, oil pressure, filter.
		5. Worn or improperly installed or maintained couplings	Inspect couplings. Check correct type and quantity lubricant. Check for wear. Check for operational limitations as specified by manufacturer
		6. Excessive vibration	See below — "Vibration"
		7. Resonant foundation or other installation characteristics	Investigate with suitable instruments IRD, Raydata or equal, to determine source and frequency.
Low oil pressure		1. Excessive oil temperature	Investigate cooling. See below "Abnormal Heating."
		2. Clogged Filter	Investigate and clean.
		3. Worn bearings	Check clearances — replace bearings if clearance excessive.
		4. Excessive suction head on pump	Check suction piping and fittings. Clean suction strainer, if used.
		5. Incorrect Relief Valve setting	Investigate and correct
Abnormal Heating	Weekly	1. Inadequate or incorrect water supply	Check water lines for fouling or restrictions. Check water temperature and flow.
		2. Insufficient oil circulation	Check filter, check oil pressure — if low adjust relief valve. Check oil lines for restrictions or foreign material.
		3. Incorrect oil	Replace with recommended oil.
		4. Incorrect bearing clearances	Check for high spots in babbitted bearing surfaces — check clearances. Refer to spec. sheets in front of manual.
		5. Excessive vibration	Investigate and correct (see below "Vibration").
		6. Unusual ambient conditions	Sun or other radiant heat sources may cause capacity of cooler to be exceeded. Insulate or provide a radiant barrier.
		7. Improper oil level	Remove excess oil. Obtain proper level.
Excessive Vibration	Monthly	1. Misalignment	Investigate and correct. Allowances must be made for thermal expansion in all drive train elements and supports. Check axial freedom of HS pinion.
		2. Unbalance	Investigate couplings, unnecessary extension of keys or hollow portion of keyways, other rotating elements in system.
		3. Resonant support	Check plane of vibration with instruments and stiffen support or provide suitable dampening.
		4. Torsional excitation	Check characteristics with suitable instruments and correct.
		5. Flexural excitation	Check characteristics, noting frequencies amplitudes — correct.

OVERHAUL

DISASSEMBLY

During disassembly refer to appropriate cross sectional assembly drawings, pages 18 thru 27. The first step is to remove the top half of the gearcase. Any pipe line, wiring, etc. that cross the split-line must be disconnected or removed. Remove all bearing covers, shaft driven pump, and pump adapter. Next remove all bolts or nuts at the split-line and also the dowel pins located at opposite corners of the case. Attach slings to the eyebolts and free the cover. Care must be exercised so that no damage will occur to either the gearcase contact surfaces, the bearings or gear teeth. If difficulty is encountered in breaking the joint, use the eyebolts as jacking screws. First, remove the eyebolts, drop a piece of metal in the hole and replace the eyebolt. Tighten, using a bar through the eyebolts, until free. The upper bearing halves may stick in place, and should be carefully pryed loose before they fall out and become damaged.

The gear set may now be removed. Be sure adequate padding is used under slings to prevent damage to carefully finished surfaces. If possible, remove the pinion first, then the gear assembly. After removing, do not allow these parts to rest on their tooth surfaces except on wood planking.

When the gear set is removed the lower bearing halves may be removed by prying between the bearing and gearcase in the oil groove. If bearings are to be reused identification marks should be made on the ends of bearings and the gearcase to insure replacement in their original positions.

After all components are removed, the lower half of the gear case should be thoroughly cleaned making sure all drain holes and oil passages are flushed with solvent. After cleaning, exposed oil passages should be plugged to prevent foreign material from entering while working about the unit.

Gear tooth contact, backlash, end float, and bearing clearance must be checked each time a unit is disassembled. Unless a person specially trained in gear adjustments is available, it is recommended that a Western Gear service representative be consulted.

PUMP DISASSEMBLY

To remove the pump only; first disconnect the two unions on the suction and discharge lines and swing them away. Remove the four long bolts from the back end of the pump housing and the entire assembly can, then be withdrawn from the adapter flange. The pump drive coupling consists of three pieces; a hub attached to the gear shaft, a hub attached to the pump shaft, and a nylon driving ring connected to two hubs. The driving ring floats, it can be easily taken out with the fingers. Small reducers require the removal of the adapter flange for removal of the driving ring as it is too large to remove thru the pump pilot hole. When reassembling the pump to the unit, mount the coupling hubs flush with the ends of their respective shafts. Place the driving ring over the teeth of the gear shaft hub and push the pump into place, rocking it slightly, to engage the coupling gear teeth.

Pumps which are driven by a small reduction gear set are bolted to the adapter from the inside. Therefore the adapter must be unbolted from the gearcase first. A small plug in the upper part of the adapter may be removed for inspection of the pump drive gear set.

BEARING INSPECTION

BEARING INSPECTION

The condition of sleeve bearings at inspection, during overhaul or disassembly is an important consideration for future operation. Correct evaluation of the conditions can save costly and unnecessary replacement.

WORN BEARINGS (fig. 21)

In order to asecertain the condition of worn or damaged bearings, use the following:

New bearing radial clearances vary, depending upon bearing size, journal velocity and other factors. The amount of wear can be determined by measuring the movement of the uncoupled shafts when located in their assembled housing.

The appearance of bright spots shows evidence of high spots or hard bearing area on a localized surface of the bearing metal. These should be lightly scraped and polished and the bearing contact area checked by rolling the shaft journals in the installed bearing halves. Apply a light coat of prussian blue to the shaft journals to show contact pattern. Optimum bearing contact should be approximately one third the circumference of the shell with 90% contact length in that area. Scrape high spots with a bearing scraper and polish with fine steel wool.

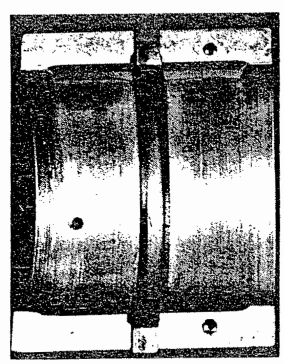


fig. 21

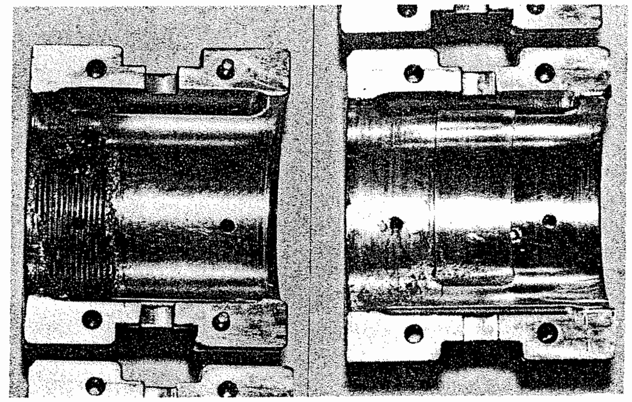
fig. 22

Corrosive Pitting (fig. 22)

Corrosive pitting is caused by chemical reaction of impurities in the lube oil. An extreme condition, which requires replacement, is shown in Fig. 22. Less extreme conditions can be corrected if a 90% contact area can be established and if bonding of the greater portion of the babbitt surface is not impaired. However, the bearing surface must be polished and blued as described above.

Hammering and Vibration (fig. 23)

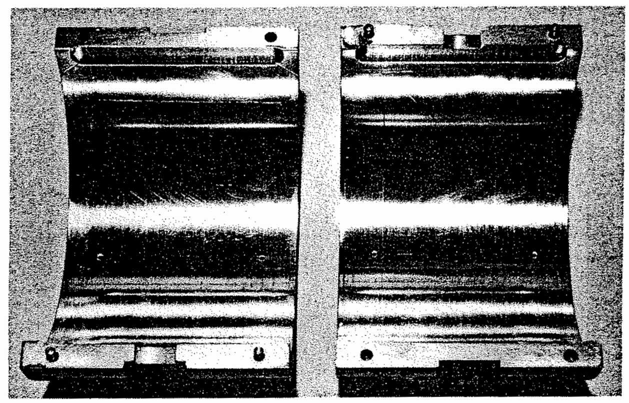
Hammering and vibration will cause the bearing material to fatigue and break loose from its bond, breaking into small particles along the bearing surface. Advanced cases will reduce the bearing area so as to make it unsuitable for satisfactory operation. Likewise other areas will continue to break out as will be evidenced by visible cracks in the bearing material. The pieces that break out will also cause scoring and oil contamination. Hammering and vibration can be caused from misalignment, unbalance, improper installation, or a system problem. Bearings must be replaced, but a thorough investigation and correction of the cause must be made if satisfactory service of the new bearings is to be expected.

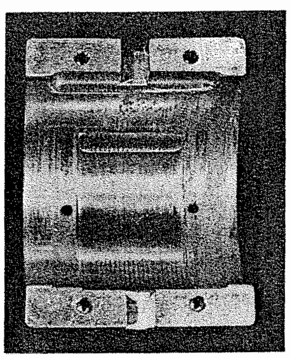


Scoring (fig. 24)

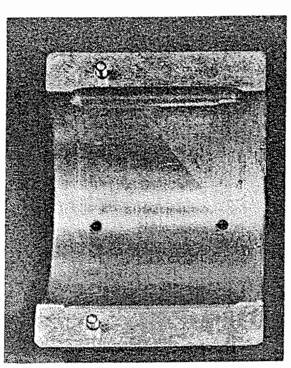
Scoring is usually a result of dirt or metal particles in the lube oil, but can also result from scratches or blemishes on the shaft journal. With even the most tidy housekeeping, during the prepartion and assembly of the unit, particles may remain which will cause light scoring. Scoring, as such, is not detrimental to the operation of the unit as long as the bearing area is not seriously reduced. However, bearings should be carefully cleaned to smooth rough edges, left by scoring, and then polished with steel wool.

The shaft journals must always be carefully inspected for blemishes and should be polished with crocus cloth or very fine emery cloth before placing the shaft in the bearings. A heavy coat of clean lube oil should also be spread across the bearing to provide initial lubrication.





Clean & Reuse



Not Useable

Wiping (fig. 25)

A wiped bearing is the result of momentary bearing temperature which exceeds the pour point of the bearing metal. This may be localized in one spot in the bearing leaving a small blemish which can be cleaned satisfactorily. However, a wiped bearing starting in a particular area, may cause sufficient bearing metal flow to impair future operation of the bearing. Some of the causes of bearing wiping are: (a) Lack of lube oil/or lube oil pressure, (b) insufficient bearing clearance, (c) excessive lube oil temperature, (d) insufficient bearing contact on the journal, (e) severe misalignment or extreme radial load caused by failure or jamming of foreign material in the gear mesh.

Before a wiped bearing is replaced the cause of wiping should be determined. First, check the lube oil system to be certain that the condition of the gear and pinion is not damaged. Carefully check the housing bores for rough edges or high spots which might cause distortion of the bearing halves. Likewise check the O.D. and I.D. of the bearing as well as the bearing split-line for projections or sharp edges and remove as necessary. Install the bearing halves in their respective fits in the housing bores and check bearing contact area by coating the journals lightly with prussian blue. Check that approximately 90% contact length is obtained on the center one third of each bearing shell. After establishing bearing contact, assemble the unit. Check bearing clearances by attaching a dial indicator adjacent to the bearing and, with the stylus on the shaft, lift the shaft vertically.

ASSEMBLY

ASSEMBLY

The installations and fitting of bearings in preparation for assembly of the unit is important for optimum bearing life. All new bearing shells should be examined for any burrs or blemishes on the back of the shell as well as the split-line and bearing metal. All edges of the back of the shell can be lightly chamfered with a mill file. The edges of the bearing metal must be smoothed with a bearing scraper.

The housing bores must also be free of burrs, raised edges, or nicks. The shells can then be placed in the housing. All shells are precision bored and any new half is interchangeable with another half except that one anti-whirl shell mates with a plain shell for the high speed pinion.

Anti-whirl bearings may be used under certain conditions. When installing these bearings the anti-whirl groove should be positioned on the top of the high speed pinion.

Units which were originally equipped without anti-whirl bearings should not have anti-whirl bearings installed without factory approval.

> **Caution:** In the event anti-whirl bearings are used, care should be taken to install them according to the direction of shaft rotation. The bearing oil dam is designed to wipe oil off of the rotating shaft, therefore, the shaft should be rotating toward the oil dam.

Be sure that the oil groove, provided in the bearing shell, comes in line with the oil channel provided in the lower half of the gear case.

The lower half of the bearing must fit over the dowel in the bottom of the housing bore. After the bearing half is in place, check between the housing bore and shell with a .001" to .002" feeler gauge to be certain that the shell is seated.

Although new shells are precision bored, small high spots may prohibit a good bearing contact. A good check of contact can be made by carefully polishing the shaft journals with crocus cloth or fine emery cloth and apply a light coat of prussian blue. NOTE: Journals must be clean and dry before applying the blue.

With the bearings in place in the housing, install the shaft and roll it several times in the bearing shell. An acceptable contact will give a transfer of blue in the center 1/3 of the shell approximately 90% of the length. If the contact shows high spots, these can be lightly scraped down to provide a spread of the contact. After scraping, polish the shell with fine steel wool. Take care that all steel wool particles are cleaned out of the bearing.

Bearings which have been in service and show a good wear pattern with full contact and limited amount of scoring can be polished and replaced without checking area with blue. Before placing the gears back in the housing, flood the babbitt surfaces of the bearings with clean lubricating oil.

Caution should be taken to prevent dirt from slings or hoist from falling on journal or bearings, when lowering gear assembly or pinion in place.

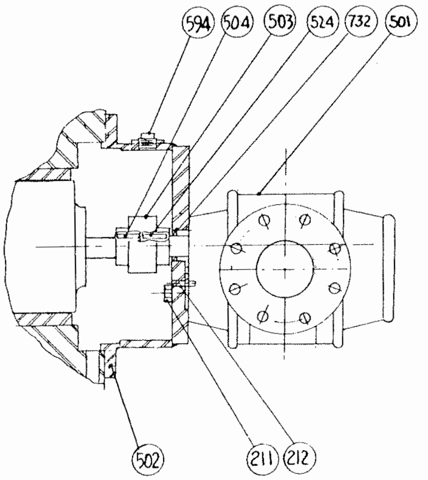
Position the gear assembly in its proper location before installing the pinion. Recoat split-line surfaces with non-hardening sealing compound. (Make sure sealing compound is compatible with type of oil being used.) The upper housing can now be swung into position and lowered onto the lower housing. Exercise caution to prevent the upper housing from bumping or touching gears while it is being lowered into position.

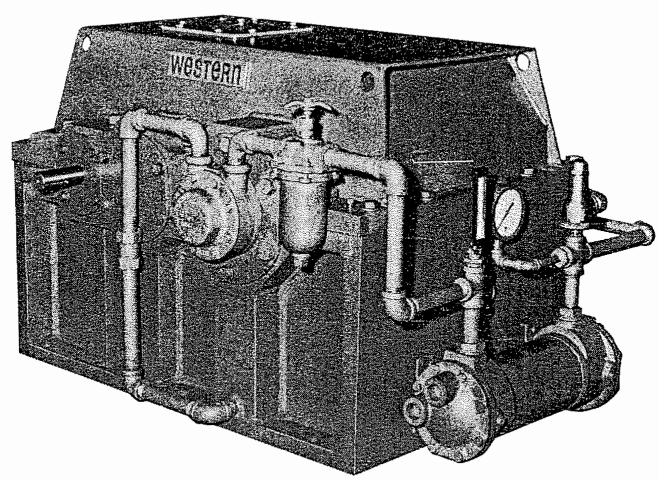
Locate the top half of housing in relation to the lower half by inserting dowel pins. Care should be taken when tightening the main-hold bolts, to prevent the upper half of the housing from shifting. When fully tightened there should not be a step in the bores or on the side of the housing. Complete the assembly by bolting up covers, oil lines and accessories.

It is advisable to replace all gaskets with new ones when reassembling the unit.

Fill lubricating oil to the level indicated on the dipstick or gauge.

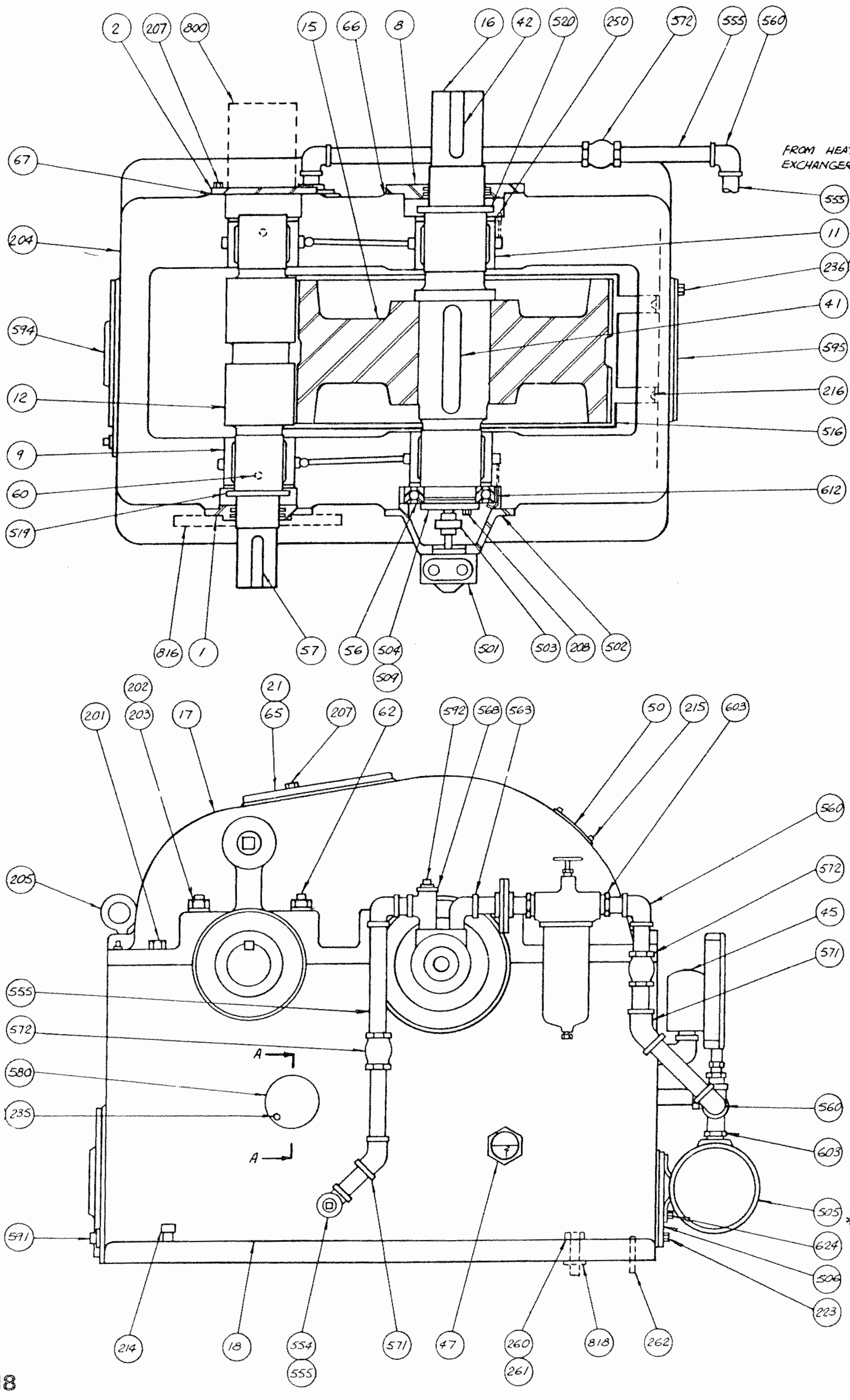
PUMP DRIVE (direct coupled)



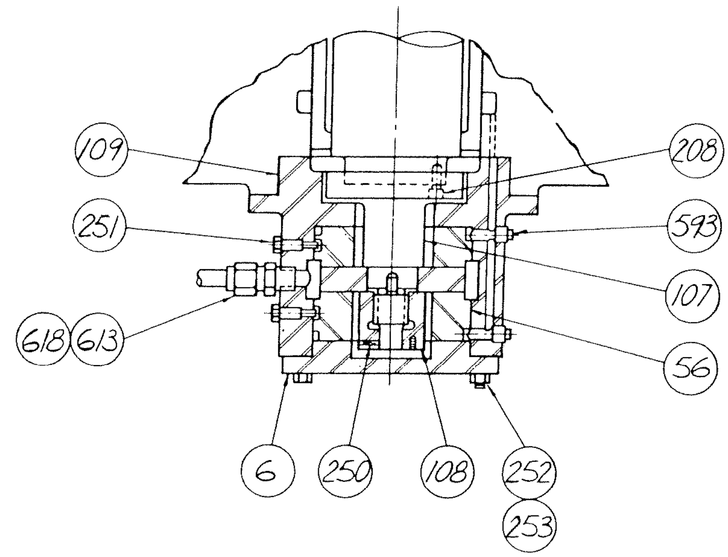


3000 Series

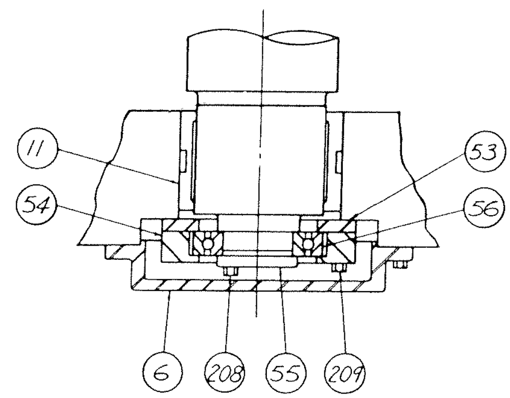
SINGLE REDUCTION



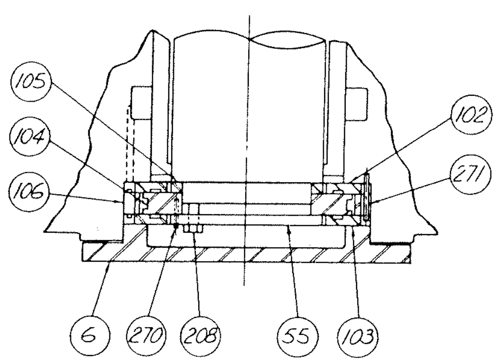
	PART NO.	DESCRIPTION
	1	H.S. Bearing Retainer
	2	H.S. Bearing Retainer
	6	L.S. Bearing Retainer
	8	L.S. Bearing Retainer
*	9	H.S. Bearing
*	11	L.S. Bearing
**	12	H.S. Pinion
**	15	L.S. Gear
**	16	L.S. Shaft
	17	Gearcase (upper)
	18	Gearcase (lower)
	21	Inspection Cover
	37	Key (H.S. Shaft Ext.)
	41	Key (L.S. Gear)
	42	Key (L.S. Shaft Ext.)
	45	Air Vent
	47	Oil Level Sightgage
	48	Oil Level Plate
	50	Nameplate
	53	Thrust Bearing-Spacer Ring
	54	Thrust Bearing-Retaining Ring
	55	Thrust Bearing-Retainer Cap
*	56	Thrust Bearing
	60	Bearing Dowel
	62	Stud
	64	Thrust Bearing-Spacer
	65	Gasket-Inspection Cover
	66	Gasket-L.S. Retainer
	67	Gasket-H.S. Retainer
	101	Hydrostatic Thrust Brg. Assy.
	102	Stationary Brg. Plate (inner)
	103	Stationary Brg. Plate (outer)
	104	Bearing Thrust Collar
	105	Thrust Collar Spacer
	106	Bearing Plate Spacer
	107	Thrust Bearing-Stub Shaft
	108	Thrust Bearing-Nut
	109	Thrust Bearing-Housing
	200-499	Hardware
*	501	Oil Pump
	502	Pump Adapter
	503	Pump Coupling
	504	Key-Stub Shaft
**	505	Heat Exchanger
	506	Heat Exchanger-Bracket
	507	Temperature Switch
	508	Temperature Well
*	509	Shaft-Pump Drive
	510	Oil Filter
	511	Temp. Switch-Bracket
	512	Pressure Relief Valve
	513	Pressure Switch
	514	Pressure Guage
	516	Oil Pan
	517	Thermometer
	518	Spray Tube
	519	Oil Slinger- H.S.
	520	Oil Slinger- L.S.
	535	Transfer Tube
**	536	Thermometer-Bearing
	550-650	Lube System Hardware
	800	Shaft Ext. Cover-H.S.
	808-809	Coupling Guards
	810	Sole Plate
	816	Adapter-H.S. Cplg. Guard
	818	Shims



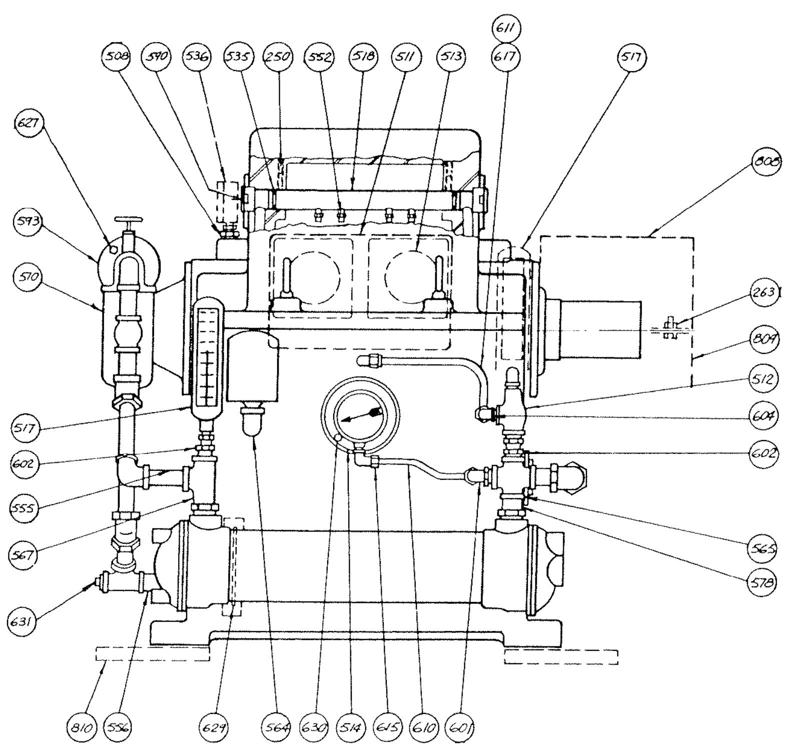
KINGSBURY THRUST BEARING ASSEMBLY

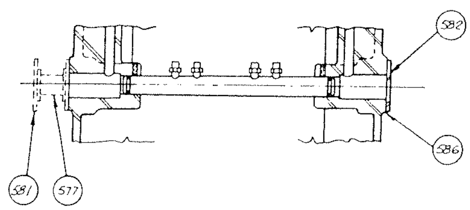


THRUST BEARING ASSEMBLY
WITHOUT PUMP



HYDROSTATIC THRUST BEARING ASSEMBLY
ITEM #101

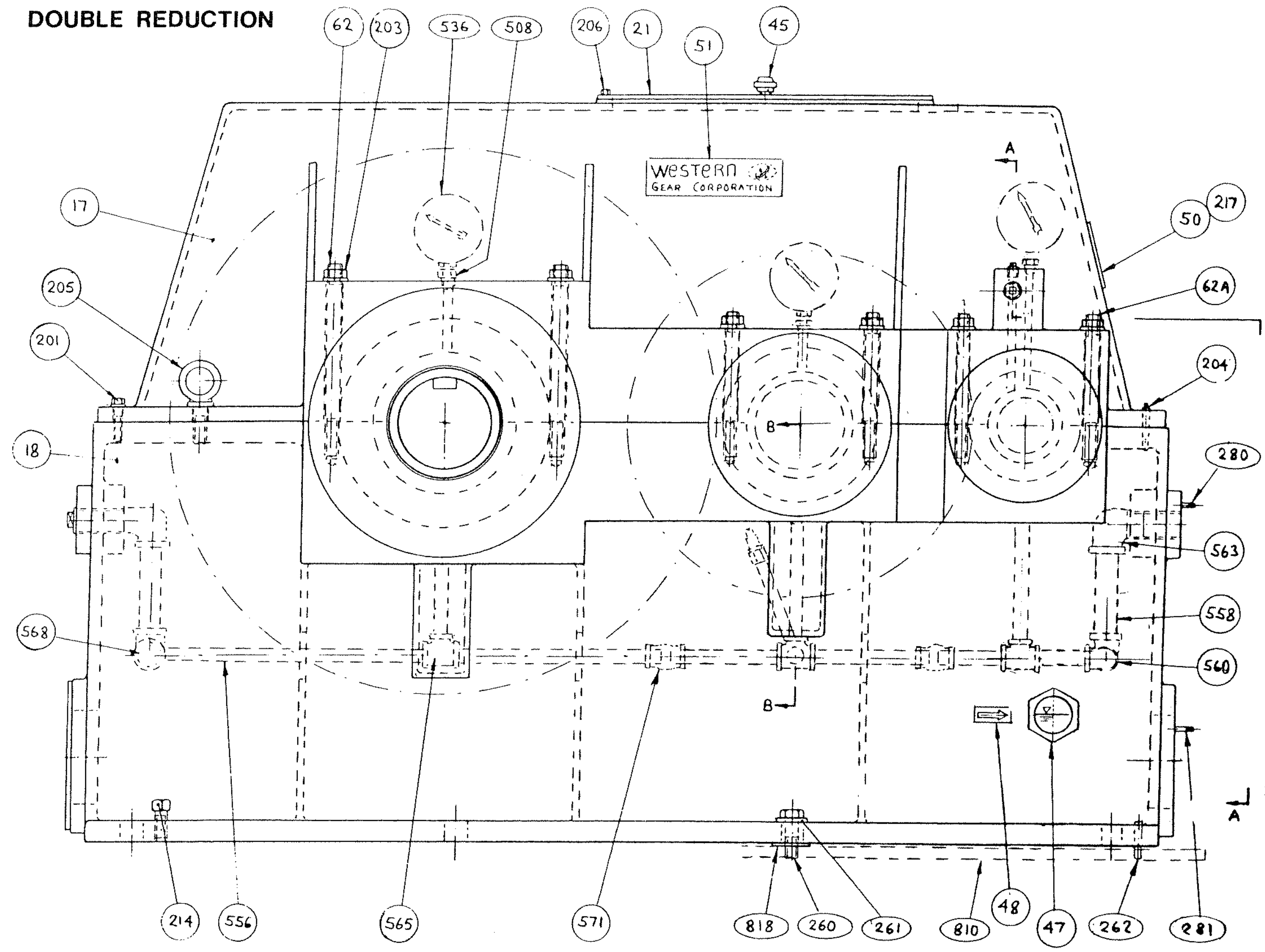


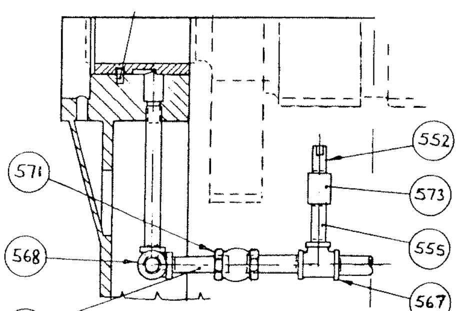


SECTION 'AA'

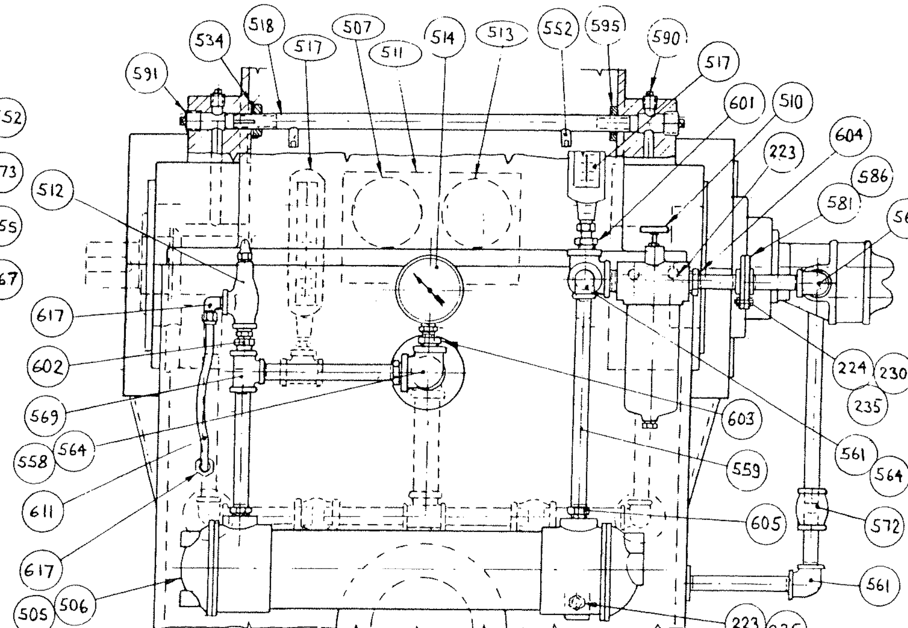
WHEN ORDERING, SPECIFY PART NUMBER , DESCRIPTION AND SERIAL NUMBER OF UNIT.
(Recommended Spares: *Minimum protection - **Full Protection)

3000 Series
DOUBLE REDUCTION





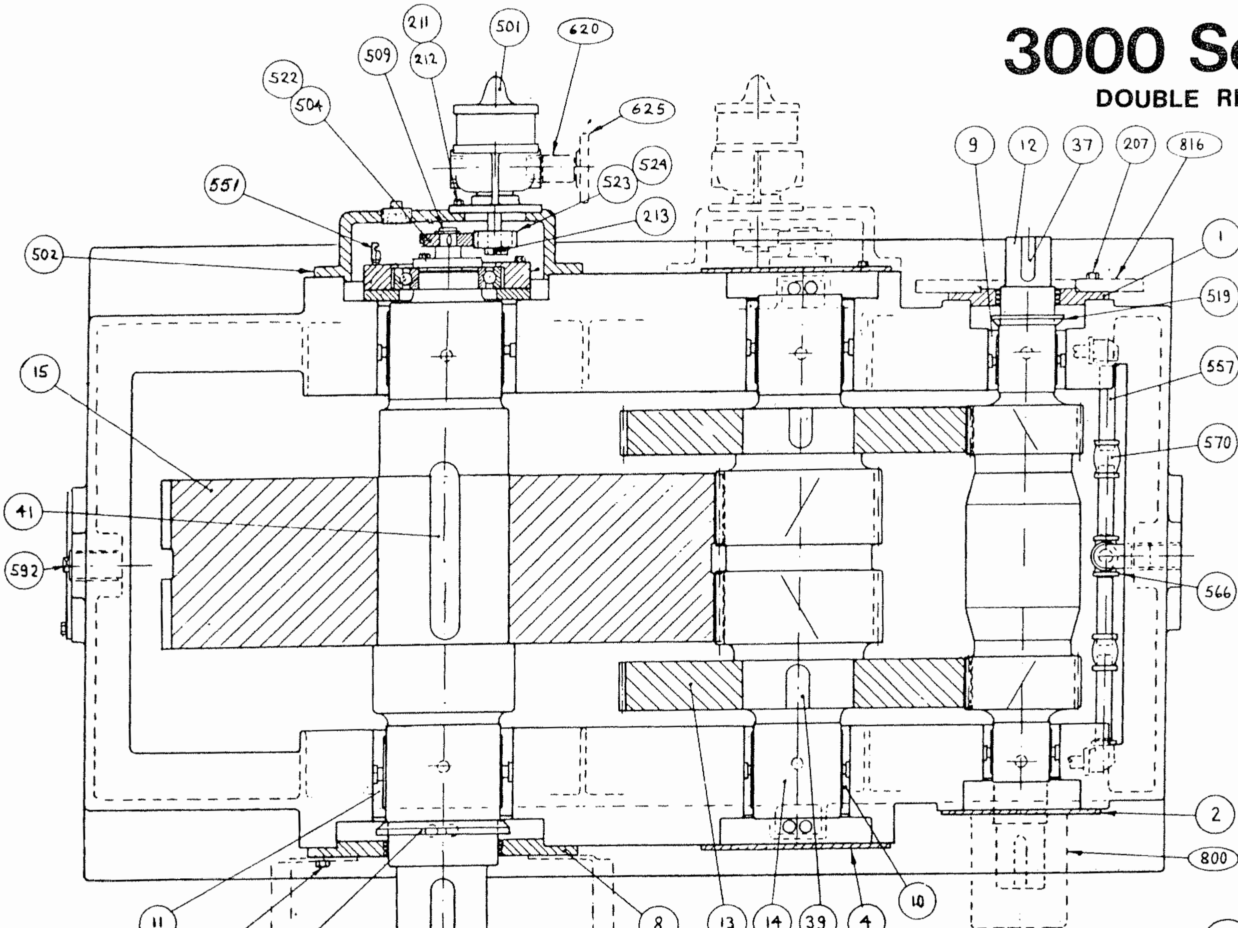
SECTION 'BB'

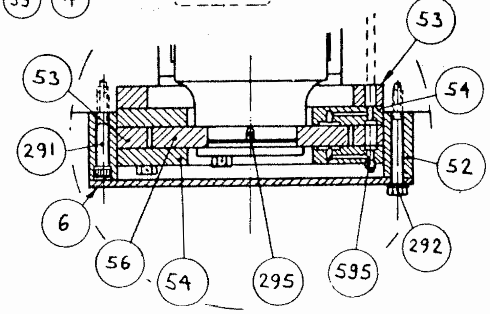


SECTION 'AA' - INTEGRAL LUBE SYSTEM

3000 Series

DOUBLE REDUCTION



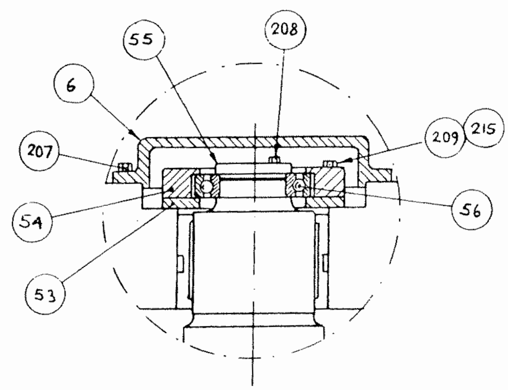


HYDROSTATIC THRUST BRG.

PART NO.	DESCRIPTION
1	H.S. Bearing Retainer
2	H.S. Bearing Retainer
4	L.S. Bearing Retainer
8	L.S. Bearing Retainer
* 9	H.S. Bearing
* 11	L.S. Bearing
** 12	H.S. Pinion
** 13	H.S. Gear
** 14	L.S. Pinion
** 15	L.S. Gear
** 16	L.S. Shaft
17	Gearcase (upper)
18	Gearcase (lower)
21	Inspection Cover
37	Key (H.S. Shaft Ext.)
39	Key (H.S. Gear)
41	Key (L.S. Gear)
42	Key (L.S. Shaft Ext.)
45	Air Vent
50	Nameplate
53	Thrust Bearing-Spacer
54	Thrust Bearing-Retaining Ring
55	Thrust Bearing-Retainer Cap
* 56	Thrust Bearing
60	Bearing Dowel
62A	Stud
62B	Stud
200-499	Hardware
* 501	Oil Pump
502	Pump Adapter
503	Pump Coupling
504	Key-Stub Shaft
508	Temperature Well
* 509	Shaft-Pump Drive
517	Thermometer
518	Spray Tube
519	Oil Slinger-H.S.
520	Oil Slinger-L.S.
* 522	Gear-Pump Drive
* 523	Gear-Pump
524	Key-Pump Shaft
551	Spray Jet-Thrust Brg.
552	Spray Jet-Gears
810	Sole Plate
818	Shims

WHEN ORDERING, SPECIFY PART NUMBER, DESCRIPTION & SERIAL NUMBER OF UNIT.

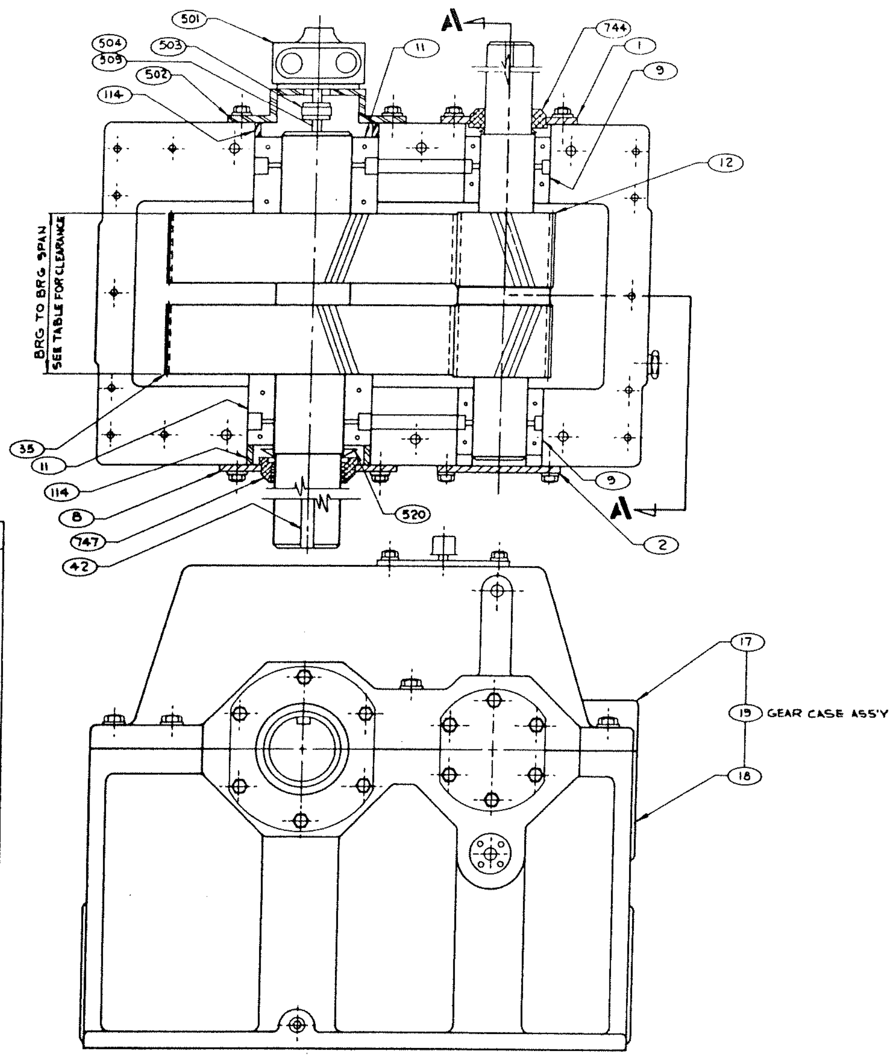
Recommended Spares:
* Minimum Protection
**Full Protection



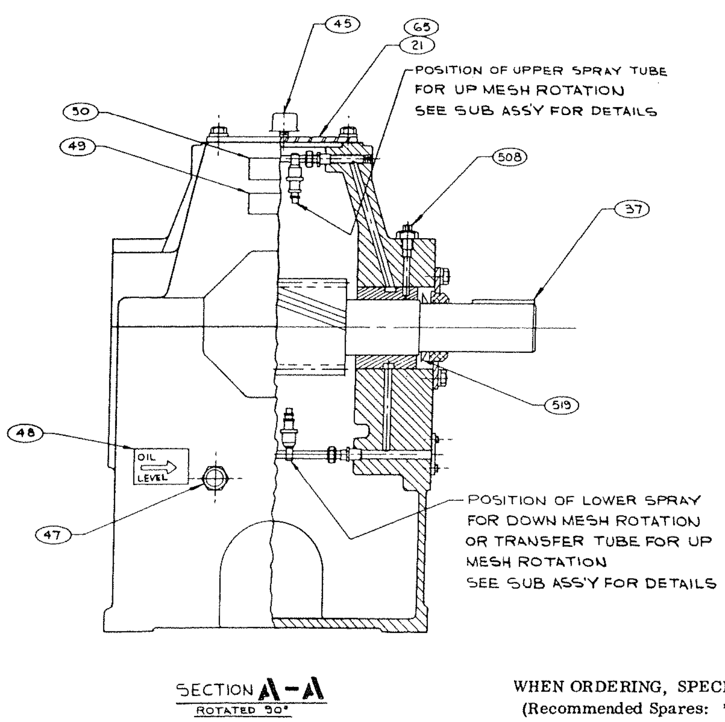
THRUST BRG ARRANGEMENT ON UNITS WITHOUT PUMP

4000 Series

SINGLE REDUCTION



PART NO.	DESCRIPTION
1	Bearing Retainer - H.S. Open
2	" " - H.S. Closed
4	" " - L.S. Pinion, Cl
6	" " - L.S. Closed
8	" " - L.S. Open
* 9	Bearing - H.S. Shaft
* 10	Bearing - L.S. Pinion
* 11	Bearing - L.S. Shaft
** 12	Pinion - H.S.
19	Gearcase Assembly
** 35	L.S. Shaft & Gear Assembly
45	Air Vent
47	Oil Level Sight Gage
65	Gasket - Inspection Cover
114	Bearing Spacer - L.S.
** 139	L.S. Pinion & Gear Assembly
* 501	Oil Pump
502	Pump Adapter
503	Coupling - Pump
504	Key - Pump Drive
508	Thermometer Well
509	Shaft - Pump Drive
744	Labyrinth - H.S.
747	Labyrinth - L.S.



SECTION A-A
ROTATED 90°

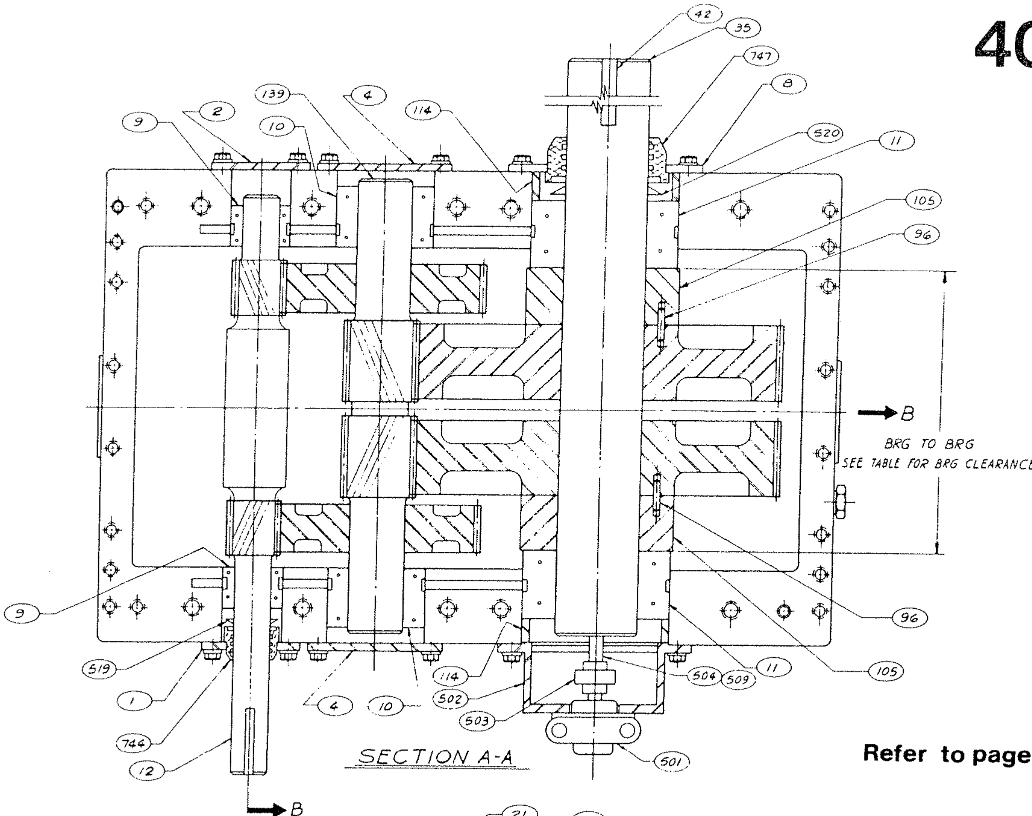
AXIAL CLEARANCE OF L.S. SHAFT ASSEMBLY BETWEEN BEARINGS

FRAME SIZES		AXIAL CLEARANCE
SINGLE REDUCTION	DOUBLE REDUCTION	
4103 to 4111		.006 - .010
4112 to 4130	4206 to 4216	.010 - .015
4133 to 4140	4218 to 4240	.015 - .020

NOTE: The axial clearance of L.S. shaft assemblies on all units fitted with York-Flex H.S. couplings should be .020" to .030" instead of the axial clearance values shown above.

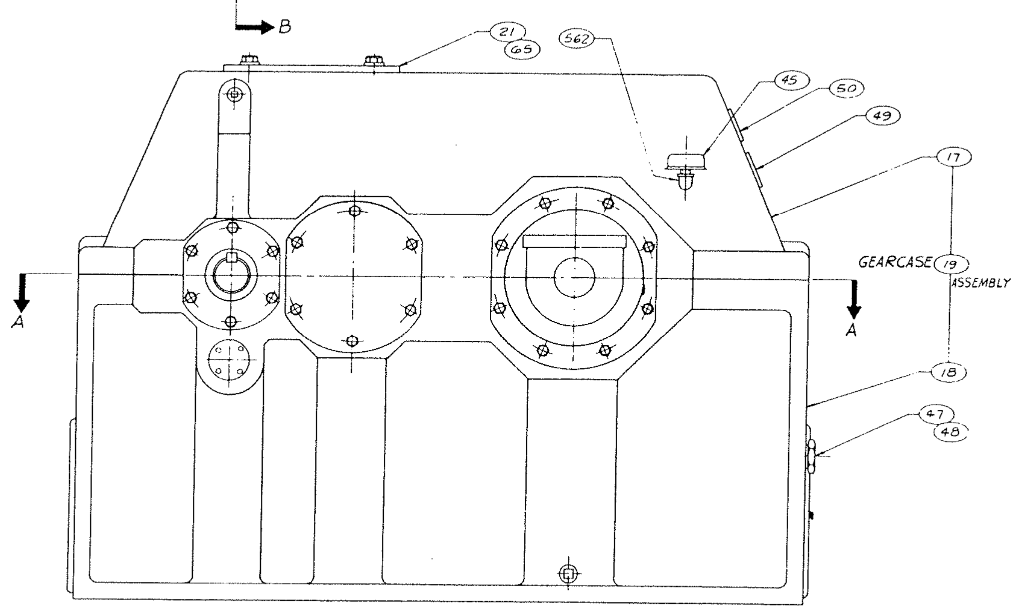
WHEN ORDERING, SPECIFY PART NUMBER, DESCRIPTION AND SERIAL NUMBER OF UNIT.
(Recommended Spares: *Minimum protection - **Full Protection)

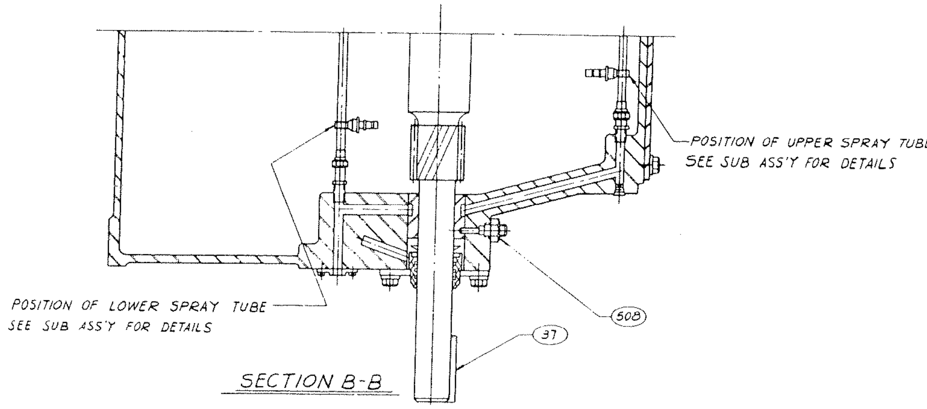
4000 Series
DOUBLE REDUCTION



SECTION A-A

Refer to page 22 for parts list.





SECTION B-B

END PLAY (Kingsbury Horizontal Thrust Bearing)

KINGSBURY HORIZONTAL THRUST BEARING END PLAY

Some end play or clearance is always necessary for Kingsbury horizontal thrust bearings. This type of bearing is not easily damaged, even by considerable end play, and for most applications, the amount of end play is not an exacting matter. Usually the nominal amount, plus or minus a few thousandths, is quite satisfactory.

In Western Gear units end play is fixed by the insertion of filler pieces or shims (See examples below). These may be located inside a housing bore or under the flange of an end cover (See Fig. 31.: P/N 253). Usually the final thickness of filler pieces is obtained by grinding, after all parts have been assembled and the axial location of the shaft is known.

In order to ascertain the nominal end play allowance for a specific Kingsbury horizontal thrust bearing application, refer to the chart shown on this page. With the Kingsbury bearing size number in mind, find that number on the horizontal scale at the bottom of the chart. It should be understood that the Kingsbury size number corresponds exactly to the number of inches in the nominal diameter of the bearing. Directly above the size number is a vertical line. Follow this line upward to the point where it cuts the diagonal line. Read the end play nominal setting on the vertical scale at the level directly and horizontally to the left of the intersection point. Establish the range of setting variation by adding .002″ to this nominal and subtracting .002″ from it.

For example, in referring to the chart it may be observed that the vertical line above 9, the size number of a Kingsbury No. 9, cuts the diagonal line at a point which corresponds to .016″, the nominal end play setting. Adding .002″ to, and subtracting .002″ from, this nominal dimension obtains the limits .018″ - .014″, the axial clearance.

Measuring Kingsbury horizontal thrust bearing end play is a relatively easy task if the L.S. shaft assembly, upon which the bearing is mounted, may be conveniently moved axially within the housing. Simply move the shaft assembly from one axial extreme to the other, measuring the amount of axial movement with an indicater. Filler pieces or shims with the proper thickness may then be prepared to provide the desired end play clearance.

Both for installing and for later checking, another method of measuring end play to determine filler thickness is illustrated in Fig. 29. If the filler piece is located under the flange of the end cover (right-hand view), the matter is simple. Remove the filler (if it is in place) and draw up the end cover bolts. The required thickness *F* will equal the air gap *C* plus the specified end play *E*.

If the filler is in the housing bore (left-hand view), remove it and replace with a somewhat thicker dummy filler *B*, making an outside air gap *C*. Then the required thickness *A* will be the dummy filler thickness *B*, minus air gap *C*, minus the specified end play *E*.

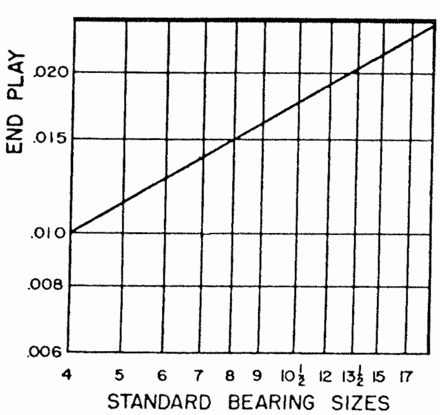


Fig. 28 · Recommended nominal dimensions for end play.

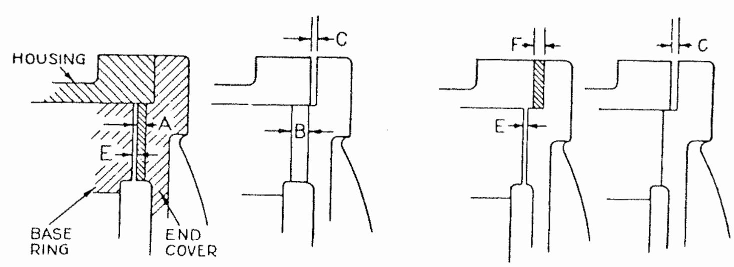


Fig. 29 · Measuring end play in bearing. A, regular filler plate. B, dummy filler. C, air gap. E, end play. F, regular filler ring.

LEFT; A = B − C − E RIGHT; F = C + E

Self-Equalizing Tilt Pad Thrust Bearing Arrangements

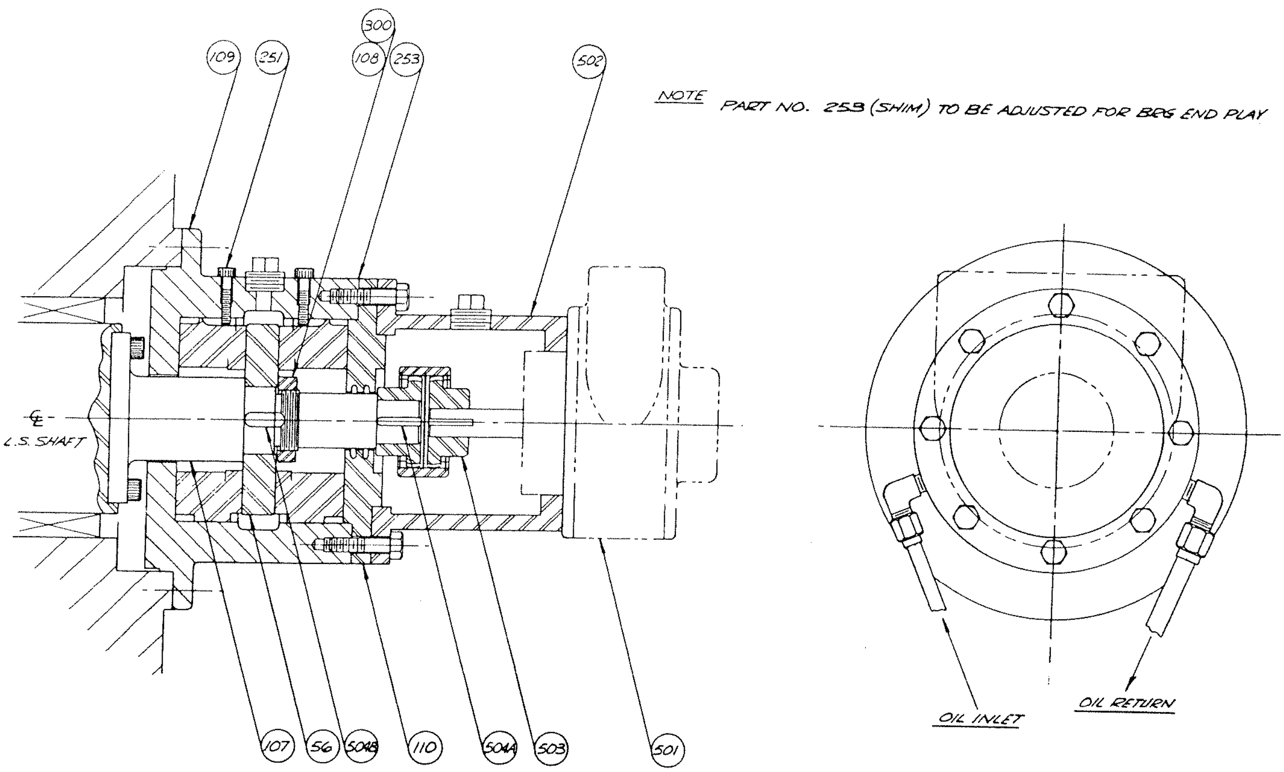


Fig. 30

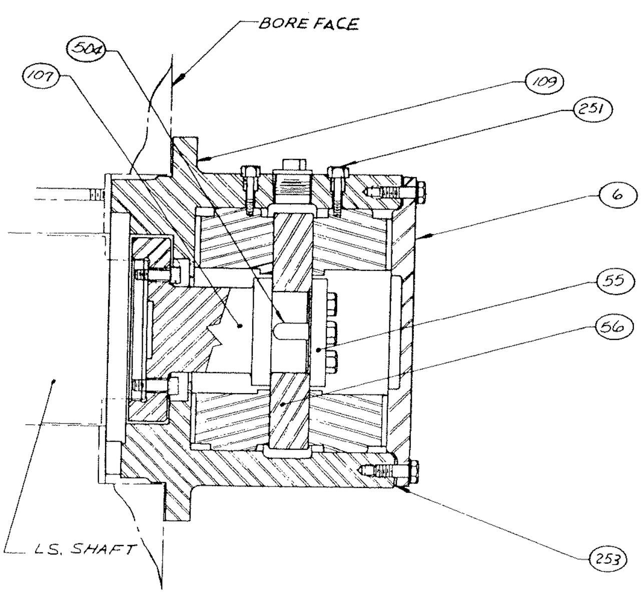


Fig. 31

PART NO.	DESCRIPTION
6	Bearing Retainer
55	Clamping Plate
56	Thrust Bearing
107	Stub Shaft
108	Nut - Retaining
109	Housing
110	Adapter
501	Oil Pump
502	Pump Adapter
503	Coupling - Pump
504a	Key - Thrust Bearing
504b	Key - Pump Drive
251	Set Screw
253	Shims
300	Lockwasher

LUBRICATION ASSEMBLY & DETAILS

PART NO.	DESCRIPTION
* 501	Oil Pump
* 505	Heat Exchanger
* 510	Oil Filter
512	Pressure Relief Valve
514	Pressure Guage
517	Temperature Guage
521	Aux. Pump & Motor
525	Check Valve
564	Tube Connector
571	Bushing
572	Spray Nozzle
573	Eyelet Connector

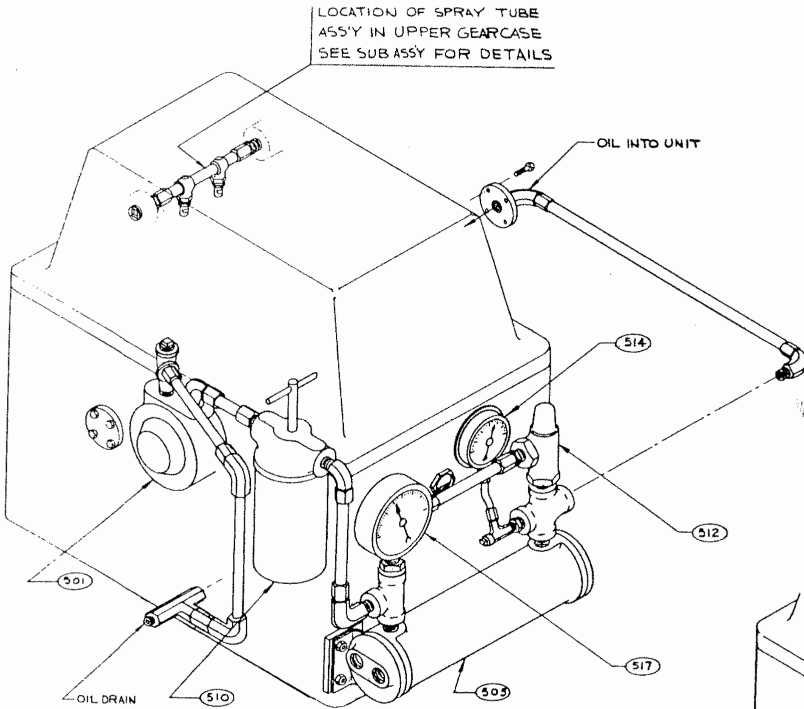


Fig. 32
Integral Lube System

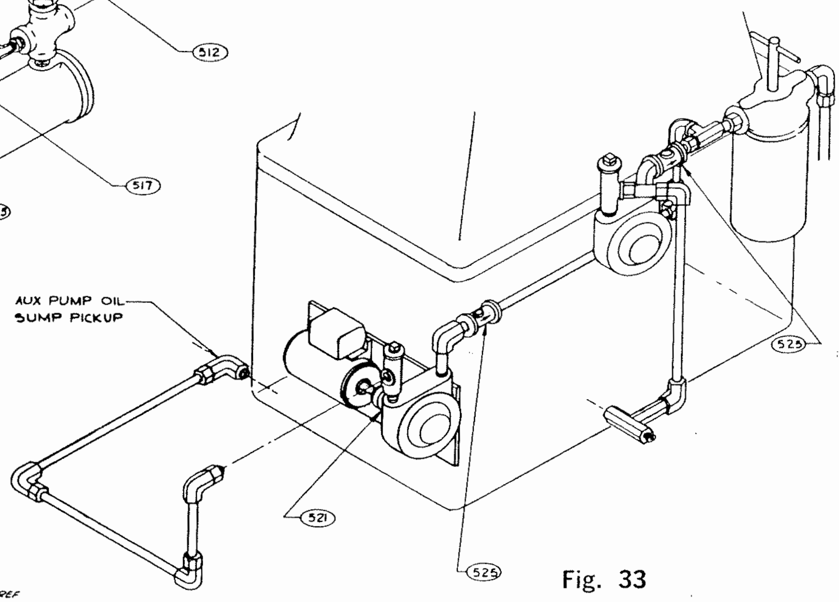


Fig. 33
Integral Lube System
With Aux. Motor Driven Pump

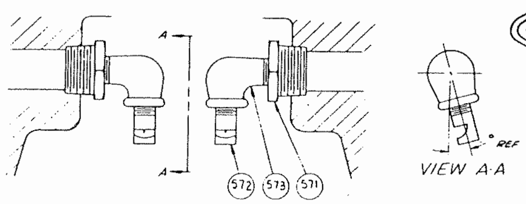


Fig. 34 **Spray Jet Assembly**

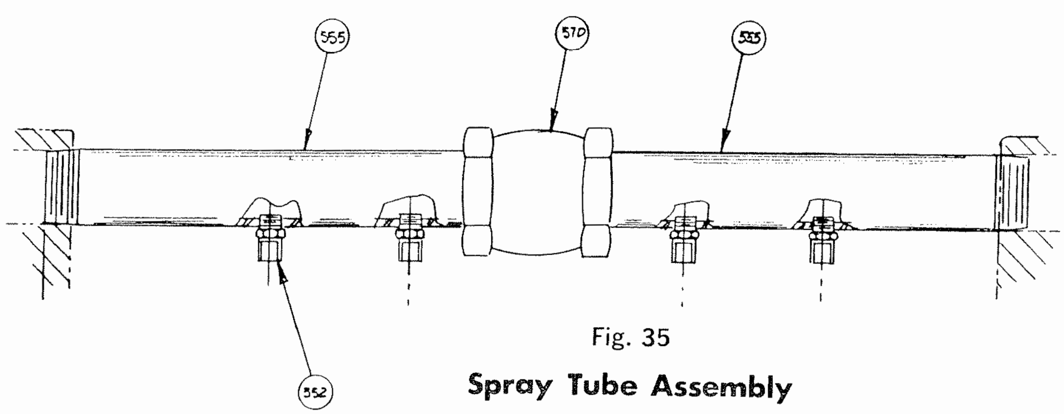


Fig. 35
Spray Tube Assembly

WHEN ORDERING, SPECIFY PART NUMBER , DESCRIPTION AND SERIAL NUMBER OF UNIT.
(Recommended Spares: *Minimum protection - **Full Protection)

DUAL LUBE SYSTEM
- -Panel Mounted

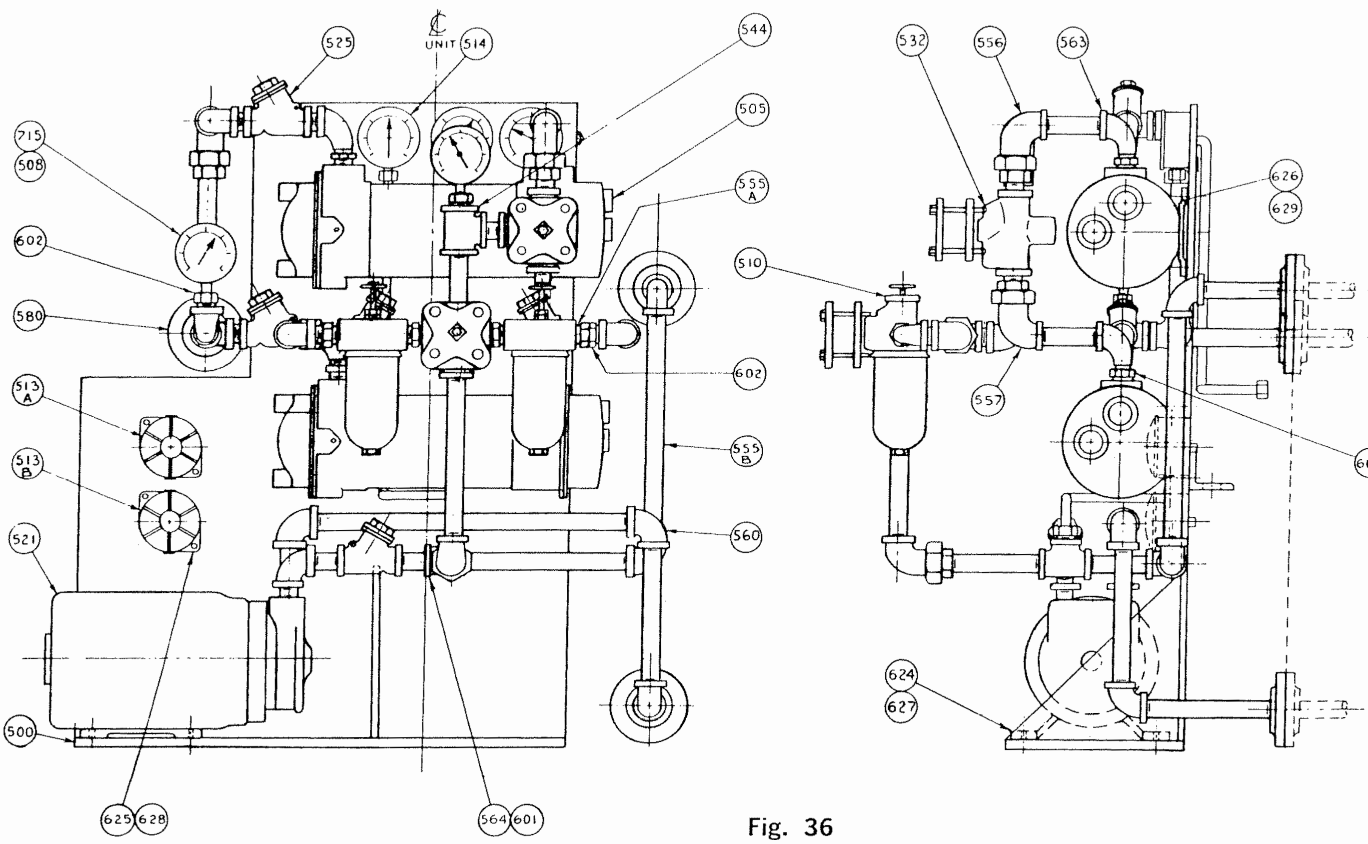


Fig. 36

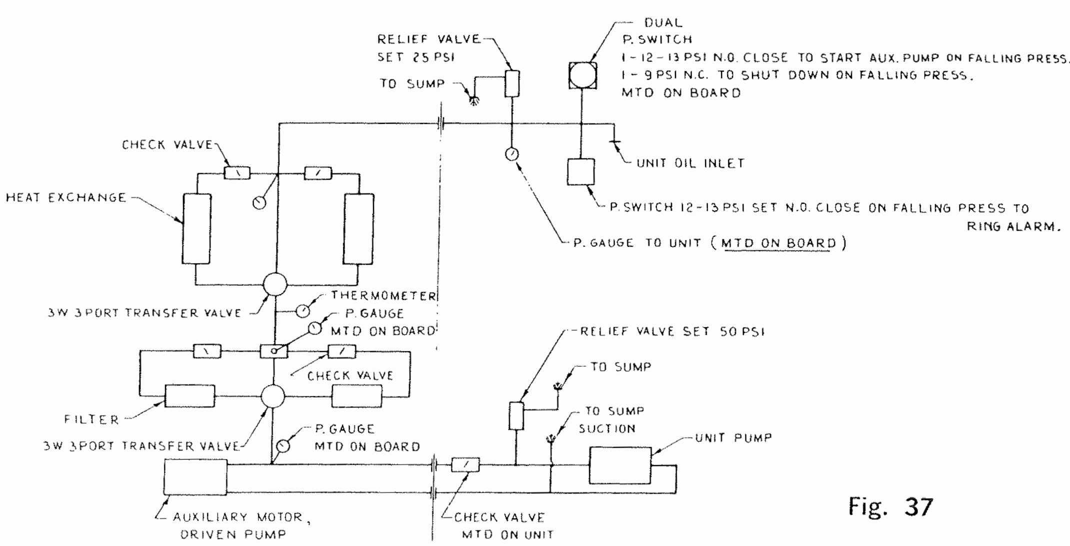


Fig. 37