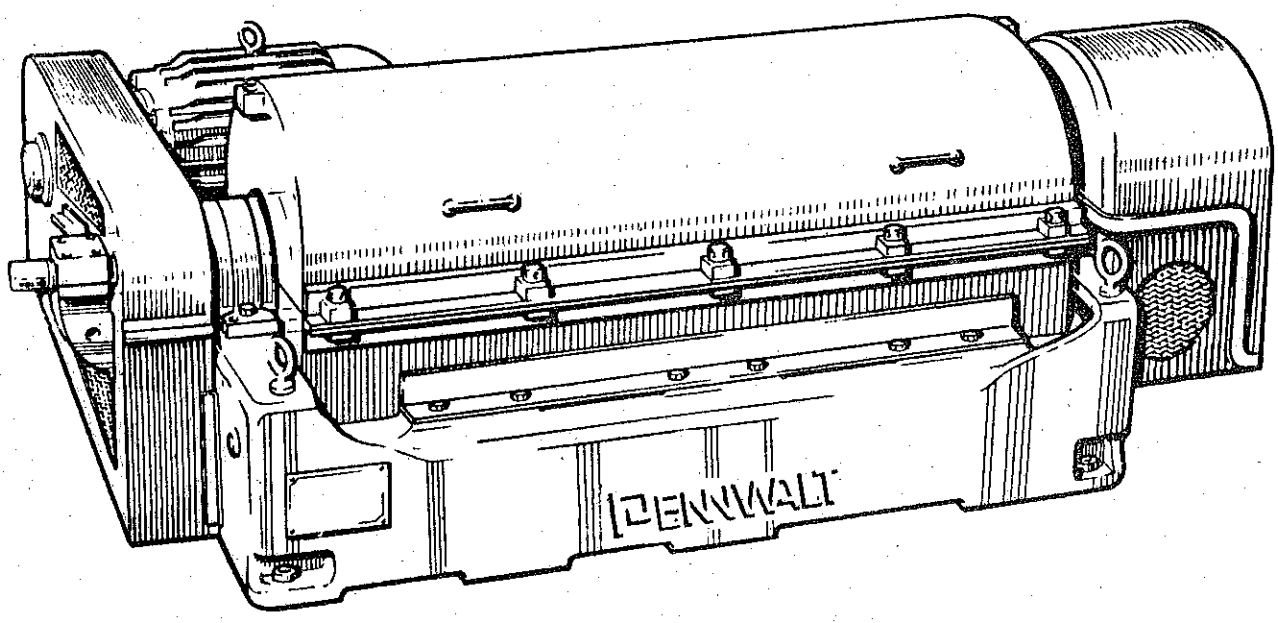
PENNWALT SUPER-D-CANTER



Customer :

Process :

Serial Number(s) :

Machine Order Ref :

PENNWALT

PENNWALT

SAFETY PRECAUTIONS FOR PENNWALT CENTRIFUGES

PENNWALT BUILD CENTRIFUGES WHOSE PARTS ARE PRECISION MACHINED AND ACCURATELY BALANCED. MANY YEARS OF EXPERIENCE HAVE RESULTED IN THE COMPILATION OF THE FOLLOWING RULES:

FAILURE TO FOLLOW THESE RULES MAY RESULT IN SEVERE PERSONAL INJURY OR PROPERTY DAMAGE

FAILURE TO FOLLOW THESE RULES MAY RESULT IN SEVERE PERSONAL INJURY OR PROPERTY DAMAGE

THE CENTRIFUGE:

1. Read manual before attempting to install or operate equipment, and follow all recommendations.
2. Do not operate machine if excessive vibration is noticed.
3. Do not exceed the maximum speed, process material specific gravity, process pressure, or temperature specified on the centrifuge nameplate.
4. Replace worn or damaged parts with only Pennwalt parts.
5. Do not operate machine without a belt guard or other guards provided. If machine was purchased without guards, user is responsible for providing guards that meet all applicable codes.
6. Periodically inspect and operate all of the automatic shut-off devices and monitoring systems provided.
7. Do not attempt disassembly until centrifuge has come to a complete stop and power is shut off.
8. Do not use a pipe wrench on any part of the centrifuge.
9. Do not operate the centrifuge if the bowl, motor, or supporting structures show cracks, pitting, holes, or grooves.
10. Do not use tools other than those recommended by Pennwalt to assemble and disassemble centrifuge.
11. Do not attempt to use the centrifuge for any other application or process than that stated on the original purchase order without first consulting Pennwalt Service Department.
12. Follow all lubricating and/or greasing procedures and schedules.
13. Make periodic checks for loose bolts on foundation and supporting structures, covers, hatches and pipe connections of centrifuge and motor.
14. Do not get rags or loose clothing near rotating parts.
15. At all times follow the recommended sequence and procedures for assembly, disassembly, operation, and maintenance. Do not introduce new procedures without first consulting Pennwalt Service Department.

THE BOWL:

1. Do not interchange bowl parts, since specific parts are balanced as a unit.
2. Do not operate the centrifuge unless the direction of the bowl rotation conforms to that of the Instruction Manual.

THE MOTOR:

1. Do not operate a centrifuge equipped with flame proof motor and control unit until all enclosures have been assembled in accordance with the appropriate standards.
2. Do not neglect to check that the line voltage applied to motor controller is the same voltage for which the motor is wired.
3. If motor should become inoperative, immediately shut off power.
4. Always follow motor manufacturer's specifications on bearing lubrication.
5. Do not attempt to operate motor that is overheated due to frequent starts and stops. Allow motor to cool to ambient temperature (as designated on motor nameplate) before each restart.
6. Do not attempt to start motor unless rotating elements turn freely.

THE ELECTRICS:

1. Install and earth all equipment in accordance with requirements of the Local Electricity Authority.
2. Use an "on-load" isolator between equipment and power source.
3. De-energize all equipment before connecting and disconnecting test equipment.

THE REPAIRS :

1. Do not make any repairs unless the power is shut off, and a safety lockout or other padlock is installed on the disconnected circuit. The locking device should be tagged to identify the working party.
2. Major repairs to centrifuge must not be made without first consulting with the Pennwalt Service Department. In no circumstances should weld repairs or other alterations be made to bowl shells, bowl tops, bowl hubs, coupling ring, shafts, spindles, or other rotating parts without prior written approval and instructions from Pennwalt Service Department. Failure to obtain this approval may result in rupture of parts involved with possible serious damage to equipment or personnel.

CORROSION, EROSION AND PITTING OF CENTRIFUGE EQUIPMENT

a. To insure a high factor of safety under severe operating conditions, high speed centrifugal equipment manufactured by Pennwalt is designed after a careful stress analysis has been made of highly stressed parts. A thorough control of metallurgical properties is maintained throughout manufacture, and all material is warranted as free from defects at time of shipment. The equipment is designed and built for a long useful life.

b. It should be recognized, that equipment subjected to severe erosive or corrosive environments may deteriorate over a period of time, depending upon the severity of exposure and/or possible misuse. Users of high speed centrifugal equipment should be aware of this fact and also that extremely high forces are brought into play when their equipment is in operation. Any weakening of highly stressed members by misuse, erosion, corrosion, chemical pitting, or stress cracking must be guarded against to prevent possible metal failure.

c. In the interest of longer and safer operation of customer equipment, Pennwalt recommends that the customer maintain a periodic (monthly) inspection on highly stressed moving parts such as bowls, shafts, spindles, etc., which are subjected to corrosive or erosive wear.

d. The following points should be noted and the recommended action taken:

1. Do not operate equipment when:
   (a) Holes are worn through moving parts.
   (b) Grooves greater than $^{1}/_{16}$" deep are worn in moving parts.
   Evidence of cracks is present in moving parts.
   (d) Chemical pitting of $^{1}/_{16}$" depth or greater is present on moving parts.

2. Chemical Pitting Observed:
   All cases of chemical pitting, even under $^{1}/_{16}$" depth, should be watched carefully. This action is almost always due to the breakdown of the passive film on stainless bowl shell walls, in the presence of chlorides. This often occurs under bowl cake that has not been cleaned from the shell wall. High temperature and high acidity accelerate the action.

e. Contact Pennwalt Service Department regarding the repair or replacement of pitted bowl shells or other parts.

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ILLUSTRATIONS

PREFACE

This Manual will describe all aspects of the Pennwalt Super-D-Canter and will give instructions for its installation, operation and maintenance.

The suggestions regarding the installation of the equipment have been made to serve as a guide only and Pennwalt India Limited assumes no responsibility in-so-far as the installation or maintenance of the equipment is concerned.

THE PART NAMES INCLUDED IN THIS MANUAL AND ON THE VARIOUS REFERENCE DRAWINGS ARE OUR STANDARD SYSTEM OF DESIGNATION AND SHOULD BE NOTED WHEN ORDERING SPARES. ALWAYS REFER TO THE MACHINE TYPE AND SERIAL NUMBER DISPLAYED ON THE CENTRIFUGE NAME-PLATE, QUOTING THESE WHEN MAKING ANY ENQUIRIES OR PLACING OF ORDERS.

Keep this Manual where it may be found in an emergency. Ensure that the machine operator is familiar with it and uses it when needed.

TECHNICAL DATA

The basic design and functioning principles of the three models--P-2000, P-3000 and P3400—are identical. The variances in the three models can be seen in the following table:

MODEL	MAX. GRAVITY	AT RPM	BOWL TYPE	OVERALL HEIGHT	FRAME WIDTH	OVERALL LENGTH	NETT WEIGHT LESS MOTORS
P-2000	3200 x G	4000	Cylin.	28" (711mm)	33½" (850mm)	64" (1625mm)	1500lb (680kg)
P-3000	3200 x G	4000	Cylin.	28" (711mm)	33½" (850mm)	73" (1854mm)	1950lb (885kg)
P3400	3200 x G	4000	Cylin.	28" (711mm)	33½" (850mm)	91" (2311mm)	2500lb(1135kg)

DESCRIPTION OF CENTRIFUGE

(See figures 32 and 33)

The use of the Super-D-Canter is suitable for those applications in which it is desired to separate a solid phase from a liquid phase by means of centrifugal force. In order to obtain a solid-liquid separation, it is necessary that the solid particles have a higher density than the liquid phase.

The Pennwalt Super-D-Canter consists of:

(a) A bowl, rotated about a horizontal axis, in which a slurry may be subjected to centrifugal force.

(b) A screw conveyor, rotated about the same axis as the bowl but at a lower RPM, to move the sedimented solids to one end of the bowl for discharge through proper ports.

(c) A casing which collects the discharge of solids from one end and liquid from the other end, and diverts them in separate streams away from the machine.

(d) A frame which supports the bowl and casing assemblies.

(e) A drive by which the bowl is rotated in a clockwise direction, as viewed from the pulley end, through 'V' belts, from an outboard motor.

(f) A gear box which is connected to the bowl hub opposite to the drive end, and drives the conveyor through a spline bushing at a speed lower than the bowl speed.

Provision is made to feed the slurry or product to be centrifuged into the bowl through an axial feed tube. Centrifugal force separates the slurry into its solid and liquid phases. The solids are sedimented against the bowl shell. The liquid level flows through openings in what is known as the 'plate dam' into the casing.

Relative motion between the conveyor and the bowl produces a screw action within the bowl. This action conveys the separated solids to the end of the bowl opposite the liquid discharge. The conveyed solids then pass into the casing through the solids discharge ports.

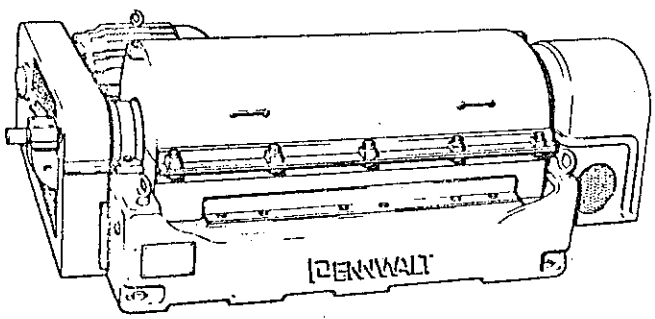
On many applications a torque arm is mounted on the gear box pinion. This arm trips a torque control unit when the conveyor is overloaded or jammed. When the torque control trips, the conveyor rotates at the same speed as the bowl, preventing any material from being discharged. A microswitch is supplied which may be used to shut off the feed or to actuate an alarm.

On other applications a conveyor differential control system is used. There are several types of conveyor differential control, but they are all designed to decrease the conveyor differential speed from the normal fixed differential. Some systems give one set speed and others are variable across a wide range. In all cases overload protection is incorporated in the conveyor differential control, thus eliminating the need for the torque arm.

PENNWALT SUPER-D-CANTER

Section 2

INSTALLATION



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1. Location

(a) Select a location where there is sufficient head room to lift the bowl out of the frame. Provide an adjacent area where the bowl may be disassembled. Plan to provide an overhead track and a one-ton hand hoist for lifting the bowl out of the frame. (P2000, P3000 ½ Ton Hoist will suffice)

(b) Provide a walkway around the centrifuge to facilitate maintenance. Be certain that each end of the machine has sufficient clearance for removal of the feed tube and gear box. These clearances are called for on the dimension sheet.

(c) Arrange a carefully levelled foundation. Figure 28 is a typical example of the dimension sheet but must not be used as a substitute.

2. Setting the Frame

(a) The machine can be mounted on a concrete floor, a concrete pedestal, or a structural steel support. It is strongly recommended that a sub-base and vibration isolators be used. In cases where the operating speed exceeds 3250 RPM, the use of a sub-base and vibration isolators is absolutely necessary.

(b) Set the foundation bolts for use with or without vibration mounts as shown on the installation drawing (Figure 28). On a concrete foundation pour in grout and allow to harden before installing the vibration isolators, if used. If other types of foundations are used, level the machine with an accurate machinists' level and be sure that the shims give even support at all corners and do not pull out of line when the bolts are tightened. If the frame is not evenly supported at each corner, rubbing of the bowl and casing, rubbing of the feed tube, and bearing failures will result.

(c) Place the vibration isolators over the mounted studs. Make certain they are positioned correctly and tighten in place with nuts.

(d) Lower the sub-base in place on the floor studs or vibration isolators, if used. Place the frame on the sub-base. Fasten the sub-base and frame to the studs with nuts or to the isolators with bolts.

3. Disassembling the Machine for Installation (figures 32 and 33)

The machine can be disassembled for installation if satisfactory handling equipment is not available. It can be partially disassembled by removing the rotating assembly.

(a) Unscrew the bolts that clamp the upper cover to the lower cover, ensure that bolts on both sides of the cover are undone. Swing the upper cover back on its hinge, or if no hinge is fitted lift off the upper cover.

(b) Remove the pillow block dowel pin assemblies by jacking them out, with the Dowel Extractor tool.

(c) Unscrew the pillow block bolts.

(d) Attach the bowl lifter to the front hub and bowl extension as shown in Figure 7 using the hardened steel bowl lifter screws supplied. Lift out the bowl and gear box assembly as a unit.

(e) Swing the upper cover shut so that it doesn't accidently shut when mounting the frame.

(f) Set the frame as explained in Section 1 above.

(g) Lift the gear box and bowl assembly and lower it towards the frame. When there is about ½" (12mm) clearance between the pillow block and frame, insert the dowel pin outer sleeve through the pillow block and into the frame.

(h) Lower the bowl assembly onto the frame, letting the dowel pin outer sleeve align the pillow blocks. Insert and tap home the taper portion.

(i) Insert and tighten the pillow block bolts.

(j) Check for freedom of rotation and make certain that there is a $^{1}/_{16}$" (1.5mm) clearance between the flingers and the casing.

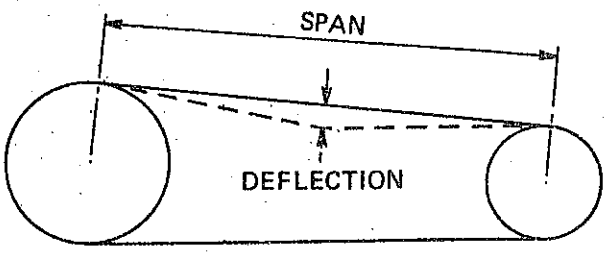


Figure 1. Pulley tension

(k) Advance the motor towards the centrifuge and slip the belts on the pulleys. Back the motor

off to the proper tension. Make certain that the motor pulley and the centrifuge pulley are aligned. To achieve the proper belt tension,

(i) Measure the span in metres.

(ii) At the centre of the span apply a force at right angles to the belt to deflect one belt 16mm per metre of span length.

(iii) This force should be 1.5–2.0 kgf.

(l) Push the feed tube into the bowl until the collar contacts the feed tube bracket.

(m) Set the feed tube holder in place on the feed tube. Three checks must be made to assure that the feed tube holder is not reversed. First the screw holes must line up; second, the numbers (one stamped on feed tube bracket, the other stamped on the feed tube holder) must be in line, one above the other; and third, when tightened down, the clearance between the holder and the feed tube bracket must be uniform all the way around.

(n) Tighten the feed tube bracket screws.

4. Piping

(a) Where there is a possibility of plugging the bowl or feed line with oversize particles present in the feed, a roughing out or pre-screening step may be required.

(b) Connect the feed pipe to the feed tube by means of a flexible hose. If rigid pipe is used, loads imposed on the feed tube will distort it and cause rubbing the inside of the bowl.

(c) A pressure gauge in the feed line is helpful to indicate approximate throughput rates.

(d) If desired, provide a line, connected into the feed line, for use in flushing out the bowl and conveyor when the run is completed. (Hot water or other suitable solvent which is compatible with the machine seals may be used for this purpose). Place a control valve close to the feed line so that solids from the feed do not plug off the flush line while it is not in use.

(e) Arrange piping to take away the liquid discharge. Use a duct to surround the liquid discharge with approximately 1" (25mm) clearance, or use a flexible connection so that forces from the pipe will not distort the casing. Allow at least ¼"/ft (20mm/m) pitch on this piping and make the line large enough to allow for foaming.

(f) Arrange for the solids discharge chute to deliver the solids directly into a suitable conveyor or to an agitated repulping tank from which the solids can be transported to the desired location by means of a pump.

(g) Do not attach anything directly to the casing. The reactive force of the piping after allowing for temperature variation should not exceed 50 pounds.

(h) If the machine has a casing rinse feature, it will be necessary to provide flexibility in the piping for the rinse connection.

(i) The slurry feed system to the centrifuge should be selected to suit the individual application requirements. Some acceptable systems are shown in Figure 31.

5. Wiring

Complete the wiring connections to the motor and starter in accordance with the wiring diagram supplied. Cable must be adequately sized to minimise voltage drop during the acceleration stage.

The starter when supplied by PENNWALT is not normally equipped with conventional thermal or magnetic overload protection, unless a fluid coupling is fitted or specifically requested by customer. In the event that conventional overload protection is fitted it may be necessary for the operator to hold the START push-button depressed in order to override the overloads during the initial acceleration period unless a delay timer is fitted to avoid this action.

The tripping of overload relays, the torque limit switch, will open all circuits.

To re-start after overload, allow time for the thermal elements and/or motor to cool, then use start and run buttons as described above. (When thermistors are fitted the motor cannot be restarted until the motor reaches the safe temperature level).

(a) Make temporary wire connections first and then momentarily start the machine to check the direction of rotation, which must be clockwise when viewed from the pulley end. If the direction is wrong, interchange any two incoming three-phase supply lines then make permanent connections.

(b) Connect the torque control limit switch in series with the holding coil circuit of the feed pump or to a solenoid valve in the feed line so that the feed will be cut off immediately if the torque control trips. Tripping is an indication that the conveyor may be overloaded or may be plugged with foreign material. This switch may also be used to shut off the driving motor at the same time or to actuate an alarm bell or light.

(c) It is advisable to connect an ammeter in the line to the motor. By checking the ammeter rating periodically, it is possible to determine whether the machine is overloaded or not. A higher than

rated running current would mean overloading and the feed should be reduced.

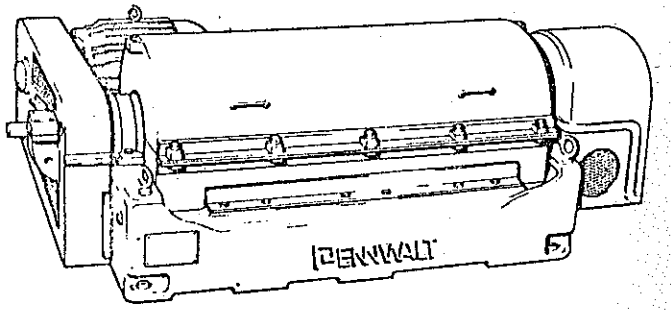
6. Initial Lubrication

(a) See "Operation" section for proper lubricating procedure.

PENNWALT SUPER-D-CANTER

Section 3

OPERATION



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1. Functioning (figures 32 and 33)

The feed slurry to be separated is introduced into the conveyor feed zone through an axially mounted feed tube. It then discharges from ports located around the periphery of the feed zone into the bowl.

As solids separate out of the slurry, they are carried by centrifugal force to the wall of the bowl. The solids are then moved along the bowl wall by the conveyor up the incline or beach. The solids then discharge through ports into the casing.

Clarified liquid flows to the front of the bowl where it discharges through ports in the plate dam. This plate dam can be shifted in position to vary the depth of the liquid in the bowl (known as the 'pond depth'). The dam positions are numbered. When the dam port carrying the highest number registers with the hub port, the pond is at its maximum depth.

2. Effect of Varying Pond Depth

The degree of sedimentation of solids which takes place in the centrifuge bowl for any specific application is a function of:

(i) The average retention time of the liquid phase in the bowl, and,

(ii) the effective centrifugal force acting on the slurry.

These factors can be controlled, within limits, to obtain the optimum results by making certain adjustments to the Super-D-Canter.

The bowl is equipped with an adjustable plate dam which may be set to control the liquid holding capacity over a relatively wide range. The greatest pond depth in the bowl will result in the maximum clarification of the liquid discharge and the maximum entrainment of mother liquor in the solids discharge for any given throughput rate of a given slurry. (This is represented by the use of a dam port, carrying the highest number, which is nearest the axis.) Conversely, the shallowest pond depth in the bowl will result in a reduced clarification of the liquid discharge and the maximum dryness of the solids discharge for any given throughput rate of a given slurry. Therefore, if maximum clarifying efficiency is of prime importance and the free moisture content of the solids discharge is secondary, the deepest pond setting should be used. The shallowest pond setting is used when the maximum dryness of the solids is of prime importance for easily sedimented solids, a clarified liquid discharge and maximum dryness of solids may be possible at even the shallowest pond setting, at the required throughput rate, and at operating temperature. It is obvious, therefore, that the optimum pond setting for each application can be determined only by taking into account the desired results and by actual experience with the application.

3. Effect of Speed Variation

The centrifugal force of a centrifuge bowl is a function of the product of the bowl diameter and the square of the rotational speed (RPM). Since the diameter of the Super-D-Canter is fixed, the centrifugal force of the machine can be varied only by changing the rotational speed of the bowl. Normally, for clarification work, the maximum bowl speed is used; however, when it is desired to classify, that is, to remove solid particles over a specific size and density, and to retain the smaller particles in suspension in the liquid discharge, it may be necessary to reduce the bowl speed below maximum. This bowl speed reduction can be done by changing the driving motor pulley to one of smaller pitch diameter.

4. Rinsing (figure 33).

It is sometimes desirable to displace, from the separated solids, as much mother liquor as possible by the use of a wash liquor. For some applications, a hot water wash may be sufficient. Although it is impossible to effect a complete displacement rinse in a centrifuge of this type, rinse nozzles and a special feed tube can be provided on a non-sanitary machine which will effect a partial displacement of mother liquor in the solids before they are discharged from the bowl. For some applications in which the maximum recovery of mother liquor is very important, for economic reasons, an effective system is one using two Super-D-Canters in series with a solids re-pulping step between them.

The conveyor has a series of tapped holes around its circumference located before the feed zone and be-

tween the flights. The first set of holes from the feed zone located 180° apart should be used for the two overflow plugs. The balance of the holes should be used for the insertion of two or four rinse nozzles which should always be placed 180° opposite one another to maintain balance. The quantity of nozzles used and their most effective position depends on experience or the application. The farther the nozzles are from the solids discharge end, the dryer the solids will be. The remaining holes should be plugged with the pipe plugs furnished which should also be located 180° apart.

5. Overload Release

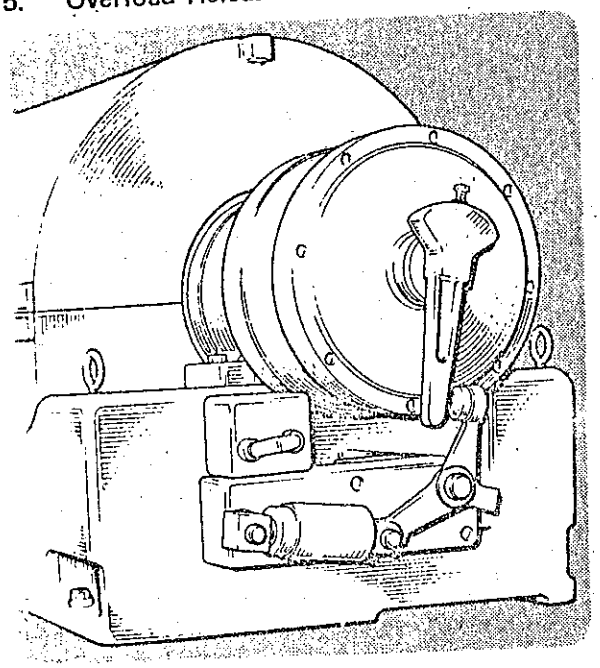


Figure 2. Overload Release Mechanism

The conveyor is protected from damage by means of an overload release mechanism which trips out at a predetermined torque limit on the conveyor (Figure 2). Several types of overload release mechanisms are used, depending on the machine supplied. The standard mechanism is described below. If the machine is supplied with special equipment, such as conveyor differential control or pressure transmitter assembly, the overload release mechanism is described in a supplementary bulletin supplied with the machine.

The operation of all types of overload release mechanisms depends on the principle that the force applied to the release mechanism is proportional to the load imposed on the conveyor when moving solids through the bowl. The standard overload release mechanism (Figure 2) uses a torque arm which contacts a resilient pad on the torque lever. This lever operates a compression link which, in running position, is held against the stop pin by spring force between the male spring compression link and the spring compression link adjusting nut on the female spring compression link.

When an overload occurs on the conveyor, the torque arm will force the link upward. The torque arm will then rotate past the torque lever, and the conveyor will turn at the same speed as the bowl and will no longer move solids out of the discharge ports. In order that solids will not continue to accumulate in the bowl and become tightly packed, arrangement is made for the motion of the link to trip a limit switch, which is connected as described under 'Installation', to cut off the feed. When such tripping occurs, proceed as follows:

(a) Stop the centrifuge
(b) Turn the torque arm clockwise by hand to make sure that the conveyor is not blocked by foreign material. If the arm turns without obstruction and the gear box does not rotate, reset the torque control by snapping the torque lever counter-clockwise until the link again rests against the stop pin.

Re-start the machine. The bowl will usually free itself of solids during the period of acceleration when centrifugal force is at a lower value than at full speed. If the torque lever does not trip under these conditions, it indicates that the solids have been cleared and the slurry feed can be turned on again.

If the conveyor is blocked, the gear box will rotate when the torque arm is turned clockwise by hand. If rotation of the gear box does occur or if the torque arm trips out immediately following the return of the machine to service, the bowl will have to be cleared. This procedure is described in paragraph 8 of this section.

6. Torque Control Adjustment (figure 30)

The gear reduction ratio is the number immediately following the letter 'P' of the group of figures stamped on the face of the gear box adjacent to the torque arm. The torque control must be set by tightening the spring compression link adjusting nut about 5lb (2.3kg) above the maximum allowable torque arm force on the gear box as shown below.

Gear Box	Maximum Allowable Force on Torque Arm	
P-52	60lb	27kg
P-125	30lb	14kg

The torque setting should be accomplished as described below:

(a) Apply a 75lb (35kg) hand spring scale to the upper end of the torque lever (item 18, figure 30). Pull on the spring scale and note the force required to trip the torque arm. Adjust the spring compression link adjusting nut (item 9, figure 30) to change this force. Repeat this procedure until the torque arm trips only at a force 5lb (2.3kg) above maximum.

(b) A stop nut pin (item 21, figure 30) locks the stop nut (item 11, figure 30) and prevents tightening beyond a 65lb (29.5kg) setting, which is maximum for the P-52 gear box. Note: The torque arm setting should never exceed 35lb (16kg) for the P-125 gear box.

(c) If the torque lever trips at the maximum setting, operate at a lower rate of feed.

(d) Manually trip the torque arm snubber linkage at least once a week to ensure that it will operate when needed.

(e) NEVER BLOCK THE TORQUE MECHANISM IN AN ATTEMPT TO PREVENT TRIPPING OUT.

7. To Start the Machine

(a) Start main motor (see Installation Section 2 for details).

(b) Start the flow of feed slurry and check the degree of clarification of the liquid or the dryness of the solids, whichever is the most important.

(c) If results are not satisfactory, stop the feed, shut down the machine, refer to paragraphs 2 and 3 above, and vary the pond depth, the speed, the temperature or the feed, whichever is needed, for the results desired.

(d) After necessary adjustments are made, start the machine. Wait until it comes up to speed and open the feed valve. If a rinse feature is provided with the machine, open the rinse valve and feed rinse at the correct temperature and proportion required for the particular application.

(e) Continue operation if results are satisfactory. Check the ammeter from time to time to make sure the machine is not overloaded.

8. Bowl Cleaning

(a) The bowl should be flushed with hot water or solvent before shutting down.

(b) Shut down the machine and continue flushing after it stops. Revolve the bowl both forward, and backward, by pulling on the belts. This flushing will deliver flushing liquid into the solid and liquid discharge and reversing the rotation of the bowl will push some solids into the liquid discharge. If the procedure is objectionable, arrangements should be made to divert this discharge to waste during the cleaning period.

(c) Remove the casing screws. Open the upper casing and flush out both the upper and lower casings with steam, hot water, or solvent.

(d) If this method of cleaning does not remove all deposits, the bowl should be disassembled as described in paragraph 6 of 'Maintenance'.

9. Lubrication

(a) Gear Box

The oil level in the gear box should be checked every six months unless otherwise specified and should be drained and replaced every year. Mild E.P. type Mineral oil such as Shell Macoma R71, is required, and must be of a non-corrosive nature. Any additives should be such that they will not separate out under continuous centrifuging.

The checking and filling procedure is as follows:

(i) Rotate the gear box until one of the $^1/_8$" pipe plugs on the front face is in the topmost position.

(ii) Remove this topmost plug and see if the oil is slightly less than this level. If not, add enough oil to establish this level using the oil provided. Care must be exercised to prevent chips or dirt from entering the gear box.

(iii) If consistent loss of oil is evident, check both the pinion shaft seal and the gear box adaptor area. The pinion shaft seal may be removed and replaced (see section 4 of 'Maintenance'). If leakage is evident around the adaptor, the gear box must be returned to Pennwalt India Limited for factory repair.

(b) Conveyor Bearings (figures 11 and 19)

The front and rear conveyor bearings *MUST* be lubricated once a week in normal operation. If the application requires frequent washing and/or steam cleaning, the conveyor bearings *MUST* be lubricated before the centrifuge is again put back into operation. Experience with your process will dictate the proper greasing schedule and, to avoid bearing failure, careful consideration of the problem is imperative.

(i) The conveyor bearing grease escape holes are located on the hub shaft between the pillow block and casing. These holes must be clear before greasing. Clear the holes, if required, by rodding them out.

(ii) Grease conveyor bearings with Shell Alvania R3 and introduce it through the fittings on the hub shafts. On the gear box end of the machine this fitting is located between the pillow block and the gear box adaptor. On the feed end of the machine, this fitting is located between the pillow block and the casing.

Keep greasing until grease emerges from the escape holes described above. If old grease, dirt or centrifuge product emerge, the conveyor bearing seals are damaged and must be replaced (section 6 of 'Maintenance'). If metal chips emerge with the old grease, bearing deterioration is indicated and must be checked.

(iii) During greasing of both ends of the conveyor, revolve the torque arm in either direction. This procedure will distribute the grease around the shaft and prevent rupture of the grease seals. Excessive grease requirements (usually more than 50 shots per fitting) show the need for new conveyor grease seals. If the seals are ruptured, it will be necessary to disassemble the bowl to replace them (section 6 of 'Maintenance').

(c) Pillow Block Bearings

These bearings are lubricated at the factory before shipment. After the initial filling, greasing is normally required at six months' intervals. If conditions are such that condensation can occur inside the bearing chamber, this interval must be reduced to two or three months, depending on the severity of the case.

To re-pack with grease, proceed as follows:

(i) Use Shell Alvania R3.

(ii) Remove both plugs and attach a grease fitting to one side. With the bowl running at normal speed, add grease in small amounts at sufficient intervals to allow the temperature to rise gradually.

(iii) If the escape passage is plugged with hardened grease, attach the grease fitting to the plugged opening and force grease in opposite direction.

(iv) Remove the grease fitting and leave the holes open for an hour or so while running to allow excess grease to be thrown out. Reinstall the two pipe plugs after this interval.

(v) When no slurry is being fed, or if the slurry feed is cool, the normal running temperature of the pillow block is less than 120°F (50°C). When the bearing is first filled, however, the temperature will rise above this point for a short period of time. However, it should not exceed 165°F (75°C).

If excessive temperature is encountered, take off the bearing end plate and remove enough grease to leave the cavity about one-half full.

For certain applications, such as high temperature or where corrosive vapours exist, an option of a spray mist oil lubrication system may be used to lubricate the pillow block bearings. The spray mist lubrication system may be installed on machine now operating. Further Information may be obtained from Pennwalt India Limited

(d) Torque Control (figure 30)

The inside of the female spring compression link and the outside of the projection of the male spring compression link should normally be greased every 6 months with Gredag ‡52. Certain applications may require a shorter interval between greasing. To accomplish this greasing, the machine should be shut down. Loosen the set screw and turn the compression link adjusting nut out all the way. Manually trip the torque control by pushing up on the female spring compression link (item 7, figure 30). Remove the cotter pin and slide the male spring compression link (item 12, Figure 30) from the female spring compression link. Apply grease to the extension inside the male spring compression link and reassemble.

(e) Lubrication Schedule for Normal Operation (See below)

PART	FREQUENCY	LUBRICANT
Gear Box	6 months - check 12 months - replace	Shell Macoma R71
Conveyor Bearings	1 week	Shell Alvania R3
Pillow Block Bearings	6 months	Shell Alvania R3
Torque Control	6 months	Gredag ‡52

This Lubrication Procedure must be followed closely, as failure to do so may result in serious damage to the machine.

10. Troubles

(a) Machine Vibration

It is normal to expect a slight periodic vibration in a machine of this type because of the speed differential between the bowl and conveyor. If vibration is severe, the cause may be found by the following:

(i) The machine is not properly lubricated.

(ii) The slip joint at the liquid discharge funnel may not be centrally located and something may be touching the centrifuge that might tend to amplify normal vibration.

(iii) A portion of the conveyor flights may be plugged with solids, causing bowl 'out of balance'. Flush out as described under paragraph 8 of this section.

(iv) The gear box adaptor may be bent. Indicate the gear box pinion with a reliable dial indicator by rotating the gear box and holding the pinion stationary. F.I.R. movement must not exceed .005" (0.13mm), remove the gear box and indicate the adaptor face and bore. Replacement of the adaptor is required if F.I.R. movement exceeds .001" (0.025mm).

(v) The pillow block bearings may be damaged. Remove the flinger covers, slide back the flingers, and remove the end plates to inspect the bearing. Replace if necessary.

(vi) The centrifuge frame may be warped or twisted by improper shimming. Check the level of the frame at the pillow block mounts with an accurate machinists' level.

(vii) The bearings in either the front or the rear conveyor insert may be damaged. Remove the conveyor as in paragraphs 7 and 10 of 'Maintenance' and check.

(viii) All parts should be tightly assembled.

(ix) The bowl may be out of balance. The unbalance may be in the gear box, which can be checked by interchanging gear boxes if a replacement is available. If not, the rotating parts should be returned to Pennwalt India Limited for re-balance.

(b) Incomplete Clarity or Dryness

(i) The plate dam may be set in the wrong position. To change the pond depth, remove the casing clamping screws and open the upper casing. Remove the eight plate dam screws. Hold the plate dam against the front hub to prevent the plate dam 'O' rings from slipping out. Adjust the plate dam to the proper setting by rotating the plate dam on the hub as explained in paragraph 2 of 'Operation'.

(ii) The conveyor flights may be sufficiently worn, allowing excessive solids build-up on the bowl. A wetter solids discharge and/or incomplete clarity of the liquid discharge results.

To check the conveyor, the bowl must be disassembled as described in section 6 of 'Maintenance'.

(iii) The feed temperature may be too low.

(iv) The feed rate may be too high.

(v) Method of feeding may result in degradation of solids size or in emulsification. In general, avoid the use of high speed pumps.

(c) Torque Arm Kicks Off Persistently

(i) The feed rate or solids concentration may be too high. Reducing either one will reduce the torque load.

(ii) Foreign material such as tramp iron may be lodged in the bowl. Removal of the conveyor is usually necessary in this case.

(d) Wear on the Conveyor

If the feed to the centrifuge contains abrasives, wear on the conveyor flights will result. Such wear can be reduced by hard surfacing.

Unless it is known from previous experience that the solids are not abrasive, set up a regular inspection schedule prior to initial operation as follows:

(i) After one month of operation, disassemble the bowl and examine the conveyor. If the unit has not been hard surfaced and no wear is seen, schedule for re-examination after three more months. If signs of wear are evident, arrange with Pennwalt India Limited for hard surfacing.

(ii) If the conveyor has been hard surfaced, inspect after one month of operation, re-inspect after three months and estimate from these examinations the rate of wear. Make subsequent examinations at periods

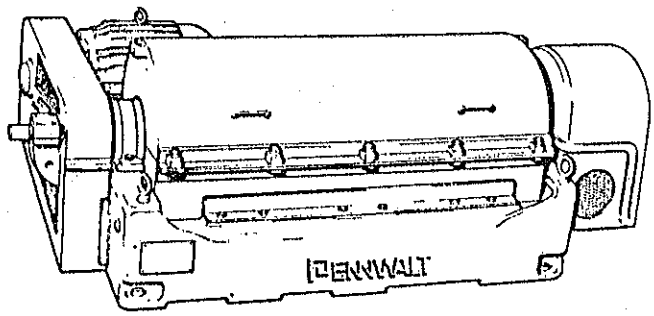
based on these wear rates, arranging with Pennwalt India Limited for re-surfacing before the wear has reached the softer metal. Should abrasion continue until the edges of the flight are considerably worn, repair of the conveyor will be expensive.

To substantially reduce the abrasive action of the slurry, a liquid cyclone can be used to remove some of the abrasive particles before they reach the centrifuge. For further information on liquid cyclones, contact Pennwalt India Limited

PENNWALT SUPER-D-CANTER

Section 4.

MAINTENANCE



PENNWALT

1. Mechanical Construction (figures 32 and 33)

The bowl consists of a shell to which are attached the front and rear hubs. Horizontal extensions of these hubs are mounted on bearings in pillow blocks. The joint between the front hub and the bowl shell is sealed by an 'O' ring against leakage.

Four circumferential grooves are located on the outside of the bowl shell. The grooves house the casing baffles, thus forming a labyrinth which confines the discharged liquid and solid phases to their respective compartments.

Inside the bowl is a conveyor. Ball bearings and seals are pressed into removeable inserts at each end of the conveyor. The conveyor is driven, relative to the bowl, by a gear box mounted on an adaptor attached to the front hub. A shaft from the gear box extends through the front hub and has spline engagement with a bushing in the conveyor.

The conveyor is driven in the same direction as the bowl shell (clockwise as viewed from the pulley end) but at a slower speed, determined by the gear box reduction ratio. Ball bearings, mounted on the bowl hubs, support the conveyor. A duplex bearing is provided in the front insert for thrust and radial loads, while a single row bearing is provided in the rear insert for radial loads only. The conveyor seals exclude centrifuged product from the bearings and also prevent the passage of conveyor grease into the bowl interior.

Grease fittings are provided at each end to permit lubrication of the bearings (see section 9b of 'Operation').

A casing encloses the rotating bowl, forming compartments for the collection of the solids from one end and the liquid from the opposite end, diverting them in separate streams away from the machine.

Attached to each hub, adjacent to the casing, is a flinger which prevents the escape of liquid or solids to the outside of the machine.

For sanitary applications where cleanliness is essential, a retainer tube is provided which excludes feed material from the interior of the conveyor.

2. Removal of the Gear Box (See figures 3 and 4)

(a) Remove the gear box guard.

(b) If the machine is equipped with conveyor differential control, carefully remove the items from the pinion shaft.

On machines equipped with a torque control, back off the jam nut and remove the torque arm screw. Pull off the torque arm.

(c) Support the gear box with a sling attached to a hoist so that the spline shaft will not be damaged when the splined connection is disengaged.

(d) Remove the gear box adaptor screws.

(e) Use 2–M8 x 40mm screws as jack screws in the threaded holes provided in the adaptor to jack the gear box off (figure 3).

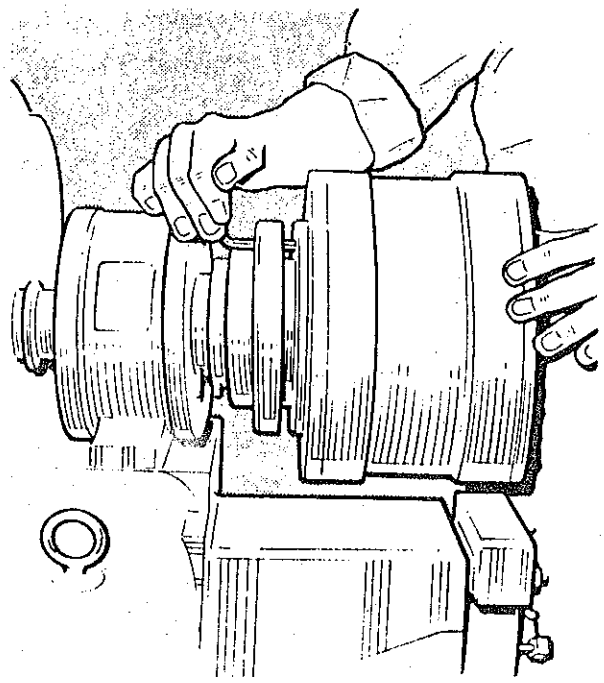


Figure 3. Gearbox removal

(f) Support the gear box weight on the sling and carefully withdraw the gear box from the machine (Figure 4).

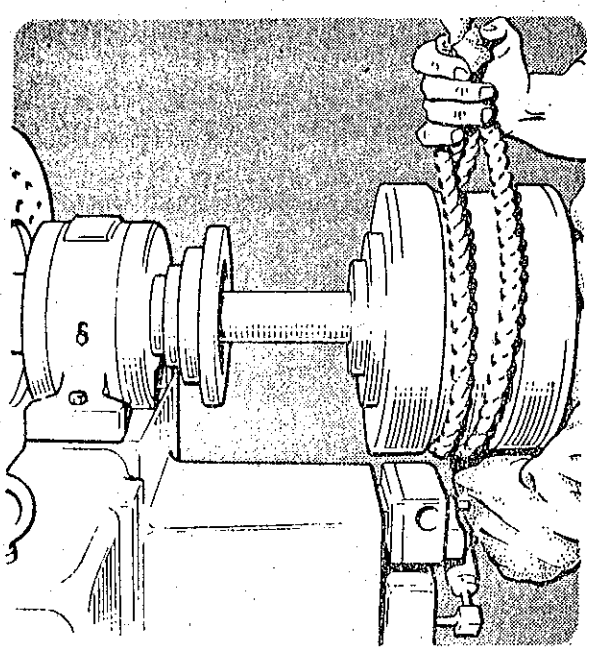


Figure 4. Support and removal of Gearbox

(g) Do not attempt to make any repairs to the P-52 gear box. Do not attempt any repairs to the P-125 and P-126 gear boxes, other than replacements of the pinion shaft, pinion shaft oil seal, gasket and bearing as described in paragraph 4 below. If any other parts are damaged, the entire assembly must be replaced with a rental or new gear box. The damaged gear box must be returned to Pennwalt India Limited for repairs.

3. Installation of the Gear Box

(a) Support the gear box with a sling attached to a hoist. Raise the gear box high enough so that the spline shaft can enter the gear box adaptor and front hub.

(b) Push the gear box spline shaft into the adaptor. Rotate the centrifuge bowl or the gear box pinion while constantly pushing until the spline enters the spline bushing in the conveyor. Leave about ¼" (6mm) opening between the leading edge of the gear box and the bolting face of the adaptor.

(c) On machines equipped with a torque control, slip the torque arm on the pinion shaft. Align the torque arm bolt with the flat on the pinion shaft. Tighten the bolt and secure it with the jam nut.

(d) Turn the pinion shaft until the tapped holes in the gear box are in line with the bolt holes in the adaptor.

(e) Push the gear box into the recess of the adaptor. Install and tighten the gear box adaptor screws.

(f) Rotate the gear box until one of the pipe plugs on the front face is in its topmost position and check the oil level as described in 9a of the 'Operation' section.

(g) Reconnect conveyor differential control if fitted ensuring correct alignment.

On machines equipped with a torque control, reset the torque control assembly by pushing down on the female spring compression link. Install the gear box guard.

4. Removal of the Pinion Shaft Bearing (figures 32 and 33)

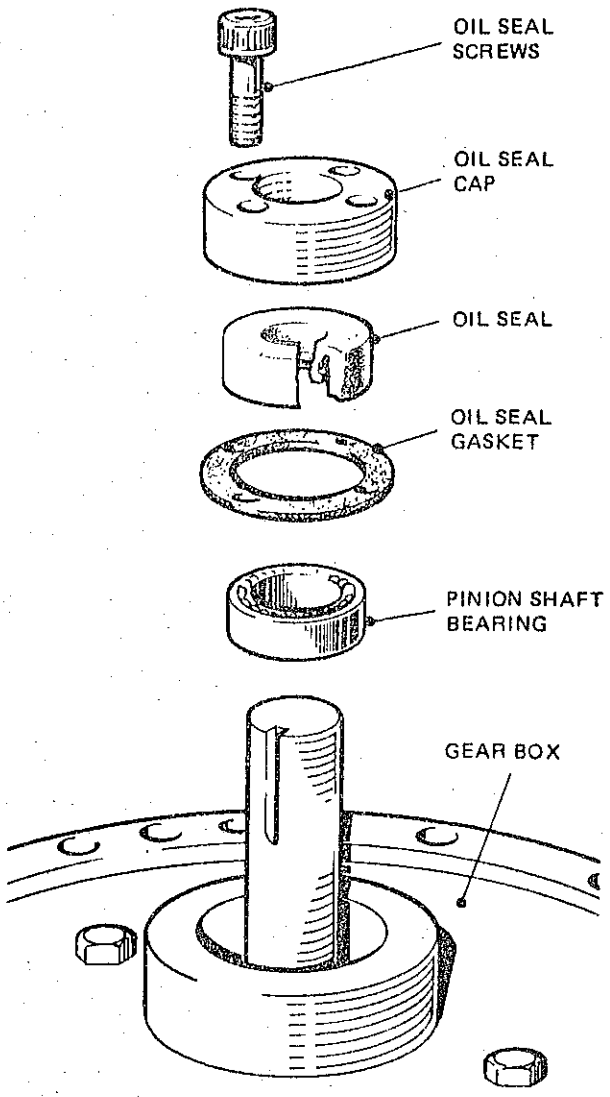


Figure 5. Pinion Shaft Bearing

(a) On the P-125 gear box, the pinion shaft, pinion shaft bearing, pinion shaft oil seal and pinion shaft oil seal gasket can be replaced. This work can be done while the gear box assembly is assembled to or removed from the machine (Figure 5).

(b) On machines equipped with a conveyor differential control, remove the guard, and disconnect. On machines equipped with the torque control, remove the gear box guard and the torque arm.

(c) Unscrew the pinion shaft oil seal cap screws. Remove the pinion shaft oil seal cap and the pinion shaft oil seal gasket. The pinion shaft oil seal is a press fit in the cap and thus will be removed at the same time as the cap.

(d) Pull the pinion shaft and bearing from the gear box.

(e) All parts should be inspected for wear. The gear teeth on the pinion shaft must be free of dents, cracks and flaws of any nature. Check the bearing for damage by spinning it. Any unusual noise indicates damage and necessitates bearing replacement. Mount the pinion shaft and bearing in an arbor press. Press the bearing from the shaft. Press on the inner race of a new bearing with a length of clean tubing to assemble the bearing to the pinion shaft.

5. Assembly of the Pinion Shaft Bearing (figures 32 and 33)

(a) Insert the pinion shaft in its proper location in the gear box. Mesh the pinion shaft gear teeth with the first stage planet gears. The pinion shaft must enter a bearing within the gear box. If the outer pinion bearing (pressed on the pinion) does not enter the recess in the gear box housing completely, work the pinion slightly so that it will enter into the inner bearing. Once inserted, the pinion outer bearing (pressed on the pinion) will enter the recess in the gear box housing completely.

(b) Press a new pinion shaft oil seal in the pinion shaft oil seal cap. Place a new pinion shaft oil seal gasket around the cap.

(c) Grease the seal with Vaseline and assemble these parts to the gear box with the pinion shaft oil seal screws.

(d) Install the gear box if it has been removed. Install the torque arm or conveyor differential control and install the gear box guard.

6. Removal of the Conveyor

(a) Remove the gear box guard.

(b) Remove the casing screws and swing the hinged upper casing back.

(c) Loosen the feed tube bracket screws and withdraw the feed tube.

(d) If your machine is of the sanitary design, remove the pulley seal retainer screws from inside the pulley and pull out the pulley seal retainer, gasket and pulley seal (Figure 6).

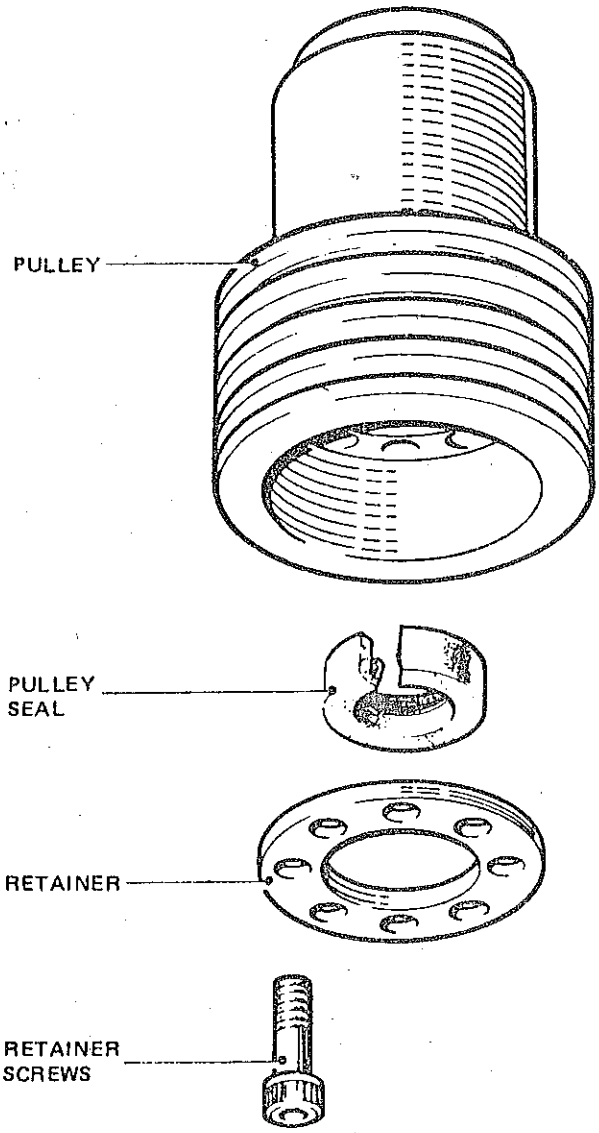


Figure 6. Pulley Seal and Retainer

(e) Remove the gear box as described in paragraph 2 above.

(f) Remove the pillow block dowels with the dowel extractor tool.

(g) Remove the pillow block bolts.

(h) Attach the bowl lifter to the bowl by bolting the chain plates tightly to the front hub and bowl extension joint with the hardened screws supplied as in Figure 7. Make sure these screws are tight.

(i) Lift out the bowl assembly. Figure 7 shows this procedure with the gear box attached.

(j) Carefully set the bowl assembly on a clean surface in a horizontal position.

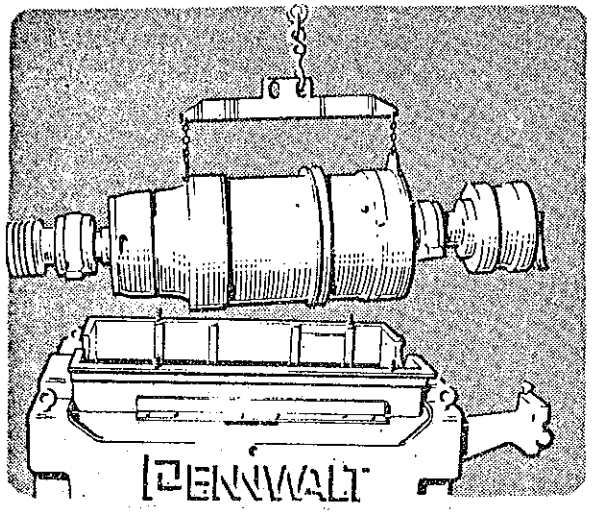


Figure 7. Lifting Bowl

(k) Remove the bowl lifter. With the gear box removed, attach the conveyor lifter to the adaptor as in (Figure 8). With the pulley end secured from sliding, slowly lift the bowl assembly to a vertical position.

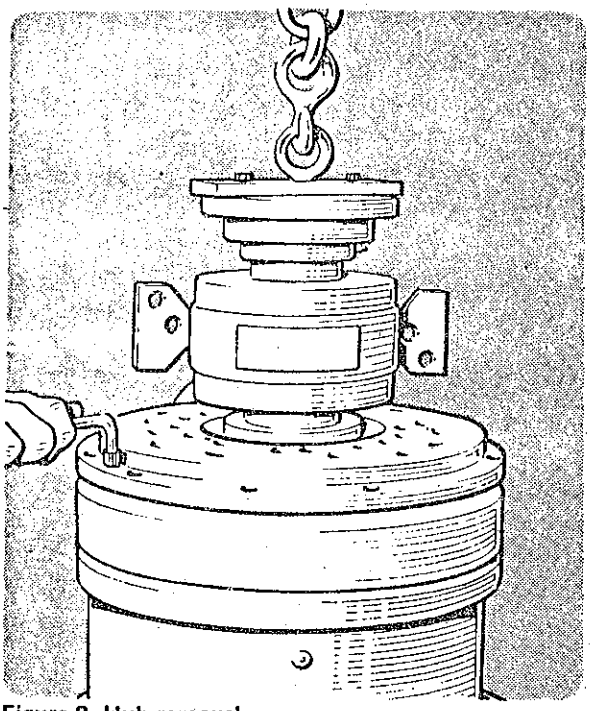


Figure 8. Hub removal

(l) Stand the bowl assembly by placing underneath the rear hub end blocks of such size that the pulley will clear the floor (Figure 9). Do not rest the pulley on the floor and, under no circumstances, attempt to disassemble the bowl in a horizontal position.

(m) Remove the front hub screws.

(n) Back the hub away from the bowl shell by means of the hardened steel jack screws. Be sure the screws have no notches or sharp edges to burr the surface against which they bear.

(o) The assembly of the gear box adpator, pillow block, and front hub can now be lifted off. ENSURE THAT THE CONVEYOR IS NOT REMOVED AT THE SAME TIME. Set this assembly aside in a clean location.

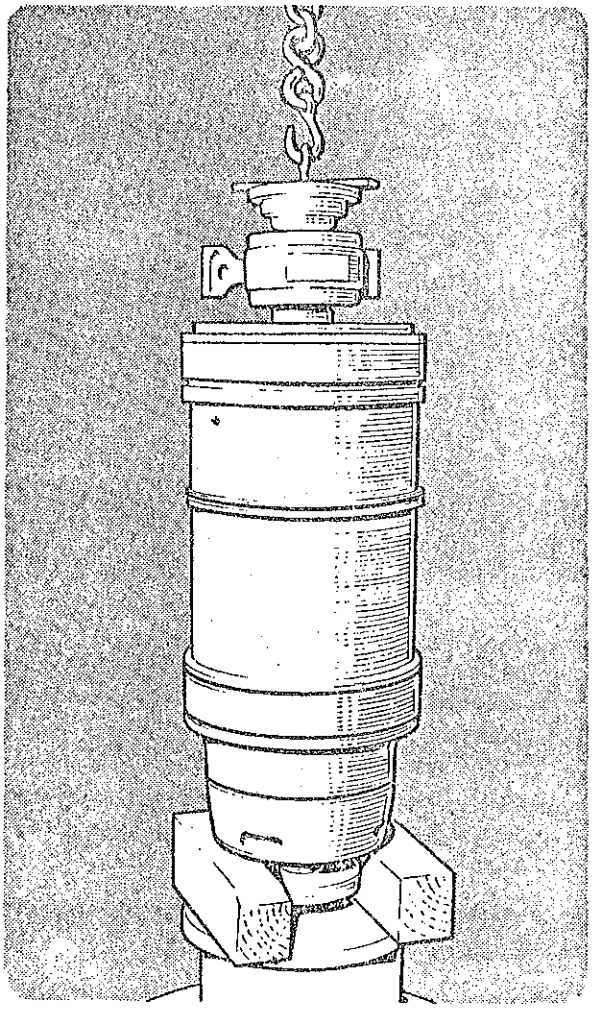


Figure 9, Vertical position for Conveyor removal

(p) Remove the conveyor lifter from the gear box adaptor and bolt it to the front conveyor insert. Carefully lift out the conveyor (Figure 10). When lifting out the conveyor on sanitary

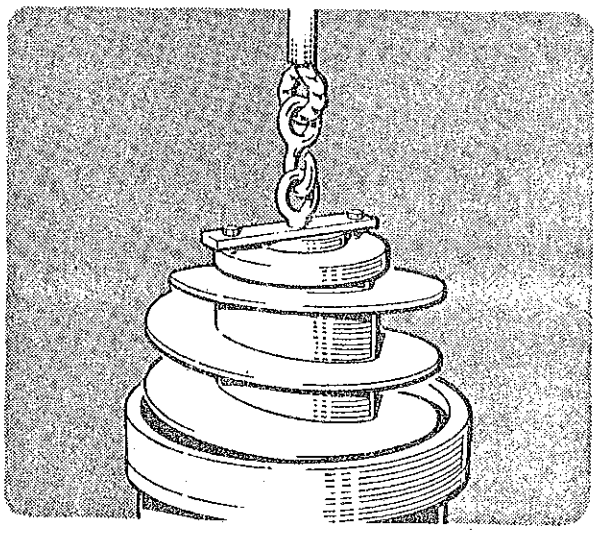


Figure 10. Conveyor removal

machines, take care not to damage the retainer tube. Rubbing against the rear hub is a result of of a bent tube.

(q) Some machines are equipped with bowl liners which cannot be removed for cleaning.

7. Removal and Disassembly of Front Conveyor Insert (Gear Box End) (figure 11)

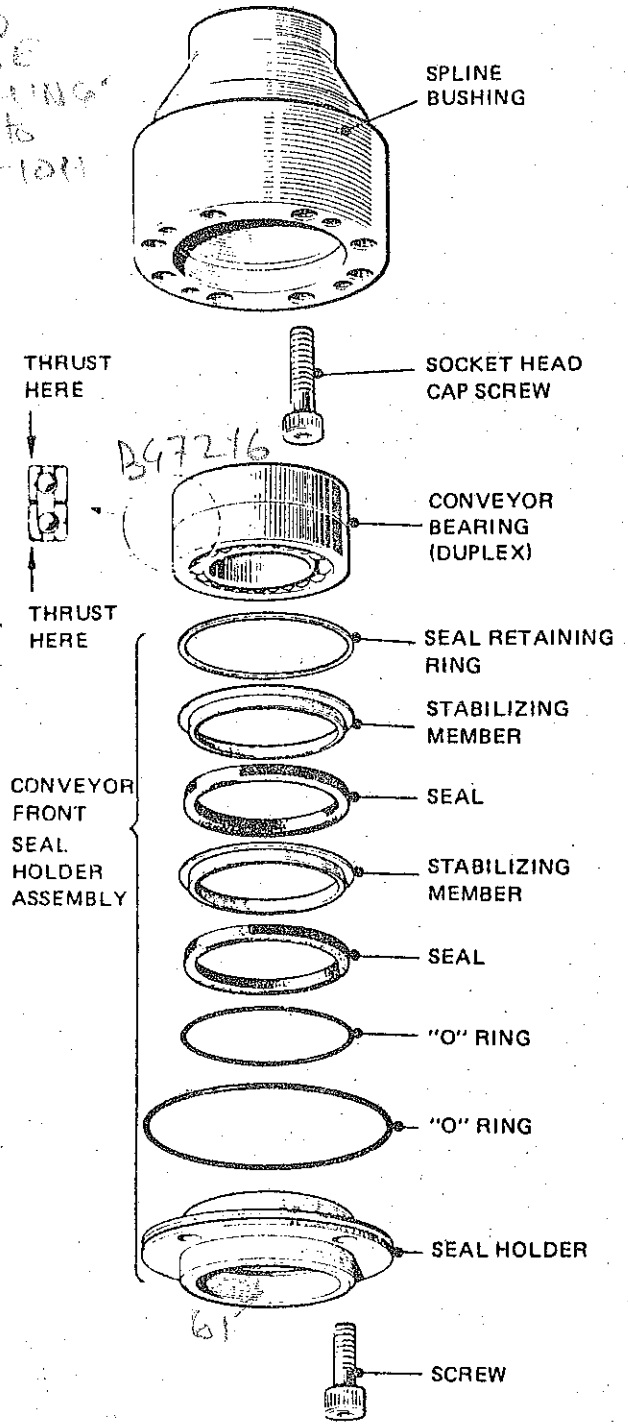


Figure 11. Front Conveyor Insert Assembly

(a) This method explains removal of a damaged bearing. If the bearings are still in good condition and need not be removed from the spline bushing, follow 7b.

(i) Remove the four seal holder screws. Jack off the seal holder with the hardened steel jack screws supplied (Figure 12).

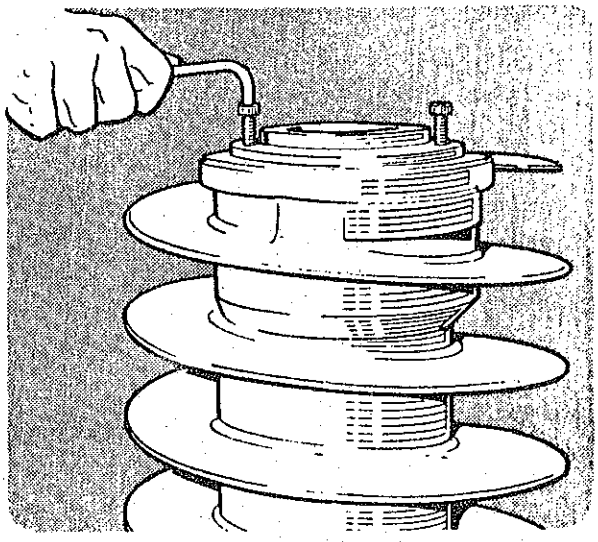


Figure 12. Seal Holder removal

(ii) With the spline bushing still bolted to the conveyor, insert a bearing puller as in Figure 13. Remove the bearing set by using the slide hammer, that is, shock method.

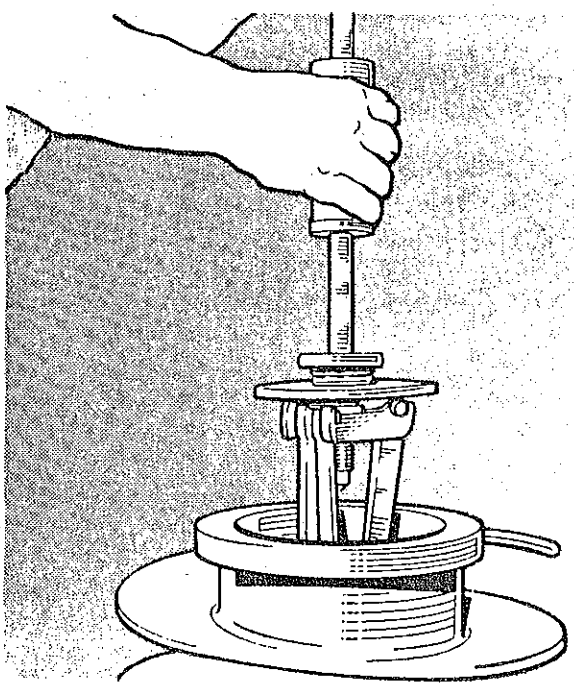


Figure 13. Bearing removal

(b) To obtain access to the inside of the conveyor without damaging the thrust bearings:

(i) Remove the eight (8) spline bushing screws (Figure 14).

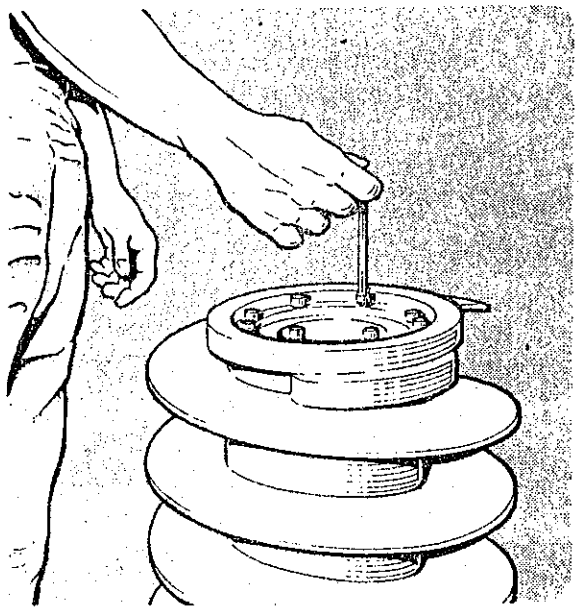


Figure 14. Spline Bushing Screws removal

(ii) Remove the spline bushing by jacking evenly with the hardened steel jack screws supplied.

8. Removal of the Feed Cone and Feed Zone Liner (figures 32 and 33) P2000, P3000

(a) Remove the front conveyor bearing insert as described in section 7b of 'Maintenance'.

(b) Screw a M10 x 75mm machine bolt in the tapped hole of the feed cone.

(c) With an allen wrench, remove the two M10 feed cone set screws by backing them out away from the centre of the conveyor. These set screws are located on the outside of the conveyor hub, just above the feed zone ports (towards the gear box end of the conveyor) 180° apart.

(d) Pull out the feed cone by means of the M10 x 75mm machine bolt. The feed cone 'O' ring will come with it.

(e) If the machine is equipped with a conveyor feed zone liner and conveyor port wear sleeves, these items may now be removed.

(i) Lay a wooden block on the exposed end of the port. Gently tap the block with a rubber hammer until the block contacts the outside diameter of the hub. Reach in the conveyor and remove the wear sleeve and 'O' ring.

(ii) Reach in the conveyor and pull out the feed zone liner with 'O' rings attached.

9. Removal of Feed Cone and Feed Zone Liner P3400

Unscrew the socket head cap screws from the spline bushing adaptor and jack the spline bushing and attached parts from the conveyor (Figure 15). Proceed as 8(b) to 8(e).

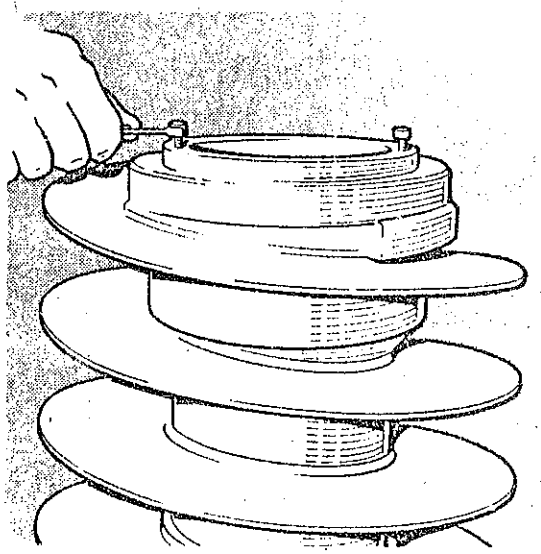


Figure 15. Spline Bushing Adapter Removal (P3400)

10. Removal and Disassembly of Rear Conveyor Bearing Housing (figures 32 and 33)

(a) General

(i) Remove the conveyor as in paragraph 6 (a-m) of 'Maintenance'.

(ii) Set the conveyor on a clean surface in a horizontal position.

(iii) Remove the conveyor lifter from the front (gear box) end of the conveyor.

(iv) Provide an extremely clean location on which to set the front (gear box) end of the conveyor. Carefully raise the conveyor to a vertical position with the front end of the conveyor resting on the clean surface.

(b) Standard, Non-Sanitary Machines

(i) To remove the bearing housing and seal holder:

1. Remove the six mounting screws.

2. Jack the seal holder from Bearing Housing.

3. Jack out Bearing Housing using hardened steel Jack Screws supplied (Figure 16).

(ii) To disassemble:

1. Pull retaining ring from seal holder.

2. Press stabilizing members and seals from seal holder. Slip 'O' ring from groove in seal holder.

3. Remove Bearing from Bearing Housing.

4. Remove Circlip and Press Stabilizing Members and Seals from Bearing Housing.

(c) Sanitary Machines (Figure 17)

(i) To remove Seal Holder, Bearing Housing, and Retainer Tube.

1. Remove the six mounting screws.

2. Jack the Seal Holder from the Bearing Housing. (Figure 16.)

3. Jack out Bearing Housing and Retainer Tube, using Hardened Steel Jack Screws supplied (Figure 16).

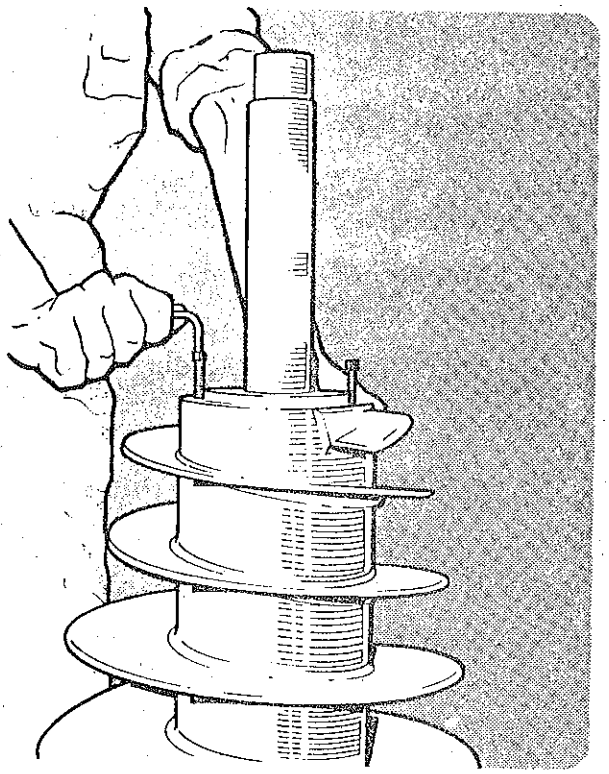


Figure 16. Insert removal

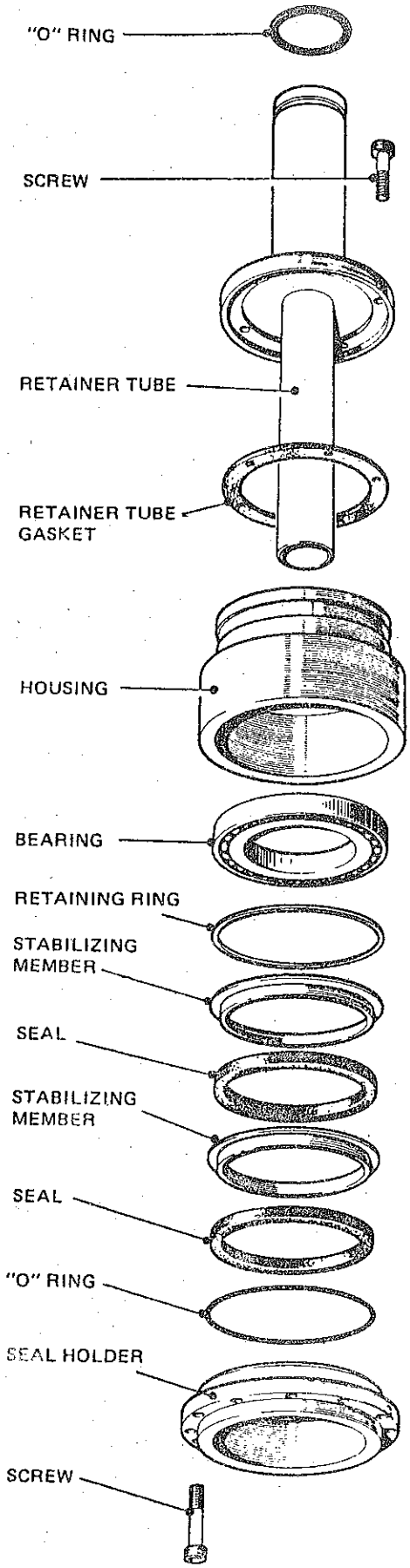


Figure 17. Sanitary Rear Conveyor Insert Assembly

(ii) To disassemble:

1. Pull Retaining Ring from Seal Holder.

2. Press stabilizing Members and Seals from Seal Holder. Slip 'O' ring from groove in Seal Holder.

3. Remove screws and pullout Retainer Tube from Bearing Housing. Lift off gasket and remove 'O' ring.

4. Remove Bearing from Bearing Housing.

11. To Assemble the Conveyor (figures 32 and 33)

(a) The Feed Zone.

(i) Place the 'O' ring on the conveyor feed zone liner (if supplied) and insert the liner in the conveyor. Line up the ports with those of the conveyor.

(ii) Place the 'O' rings on the port wear sleeves (when supplied) and insert them in the ports with a 'snapping' wrist action.

(iii) Insert a M10 x 75mm machine bolt in the tapped hole of the feed cone and place the 'O' ring on the feed cone.

(iv) Lower the feed cone into the conveyor until it rests against the feed zone liner. Secure in place with the two set screws.

(v) Unscrew the M10 x 75mm machine bolt.

(vi) Replace Spline Bushing Adaptor (P3400 only).

(b) Front Conveyor Bearing Insert

(i) Heat the spline bushing to 200°F (93°C) in clean oil. Install the bearings in the heated housing as in Figure 11.

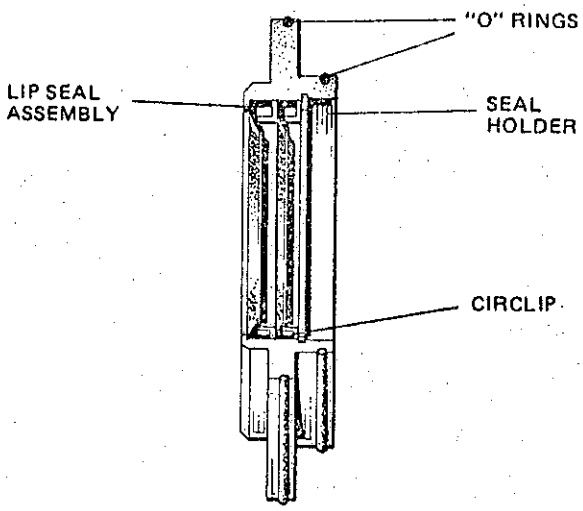


Figure 18. Conveyor front Seal Holder

(ii) Using the hardened steel jack screws as handles, lower the spline bushing in the conveyor. Carefully press the spline bushing in the conveyor by tapping evenly with a hammer on a wood block mounted on the bushing. Bolt the spline bushing to the conveyor.

(iii) Install the two 'O' rings, the front conveyor seals and stabilizing members into the conveyor front seal holder as in Figure 18. Install the seal holder in the conveyor, taking care not to damage the 'O' rings. Bolt the seal holder to the spline bushing.

(c) Rear Conveyor Bearing Insert

(i) Standard Non-Sanitary Machine (Figure 19).

1. Insert the two bearing housing seals, stabilizing members and circlip in the rear bearing housing as shown in Figure 33.

2. Press fit the bearing into the bearing housing by pressing on the outer race of the bearing with a length of clean tubing.

3. Carefully press the bearing housing into the conveyor by tapping evenly with a hammer on a block of wood mounted on the housing.

4. Install the two rear conveyor seals, stabilizing members and retaining ring and the 'O' ring, in their respective places on the seal holder. Figure 33.

5. Install the conveyor rear seal holder in the conveyor, taking care not to damage the 'O' ring. Bolt in place.

(ii) Sanitary Machines

1. Press the bearing into the rear conveyor bearing housing with a length of clean tubing.

2. Bolt the retainer tube and fibre gasket to the forward end of the housing.

3. Place the 'O' ring onto the retainer tube and carefully press the bearing housing into the conveyor by tapping evenly with a hammer on a block of wood mounted on the housing.

4. Insert the rear seals, stabilizing members and retaining ring and the 'O' ring onto the conveyor rear seal holder.

5. Insert the rear holder into the conveyor, taking care not to damage the 'O' ring. Bolt the rear seal holder to the conveyor.

12. Assembly of the Bowl Unit

(a) Place the bowl in a vertical position, blocked under the rear hub.

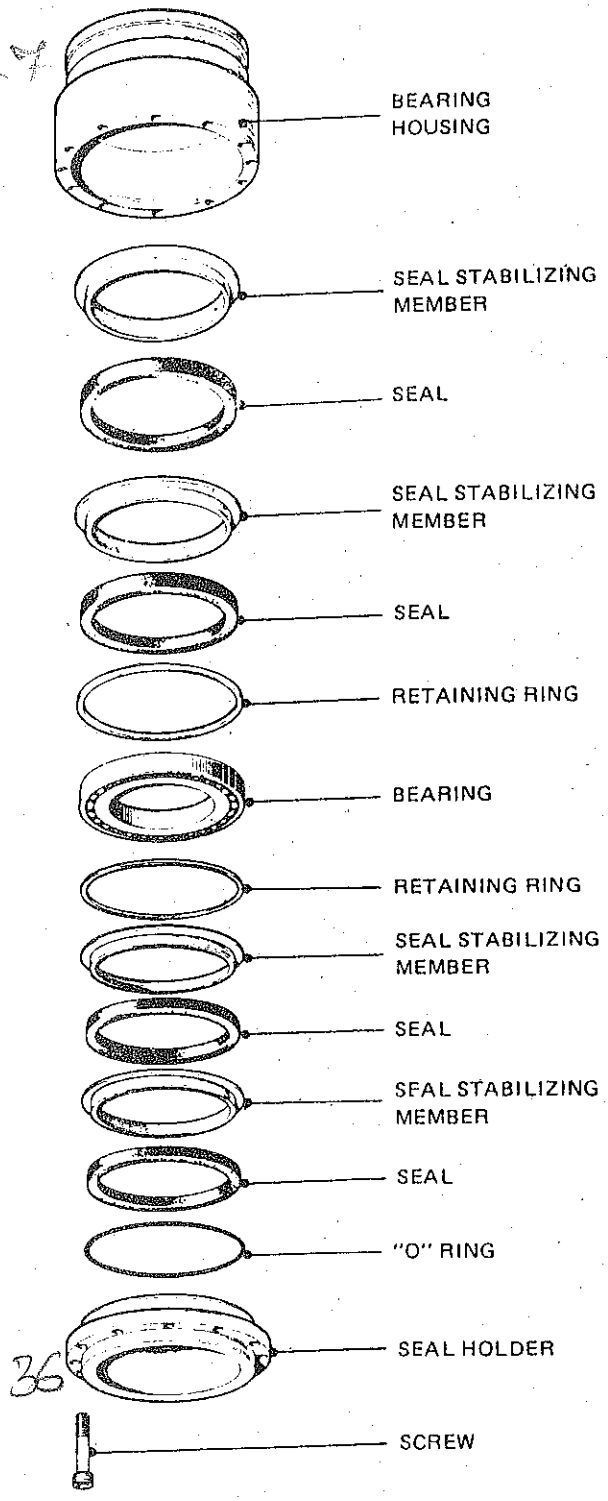


Figure 19. Rear Conveyor Insert Assembly

(b) Attach the conveyor lifter to the front seal holder. Carefully lower the conveyor into the bowl, making certain that it is centered at all times, ensuring fingers are not trapped between conveyor flights and bowl shell.

hub and the mating surface of the bowl shell are clean and free from burrs. Make sure that the bowl 'O' ring is in good condition. If it is not, replace with a new one.

(d) Locate the front hub so that the 'V' balancing marks on the hub and bowl shell are aligned. Failure to line up these marks on assembly will result in an out-of-balance and a rough running bowl.

(e) Pull the front hub into place, using the front hub screws. Draw down evenly all around, not allowing the hub to cock.

(f) After the screws are tightened by hand, check the tightness by tapping the wrench handle with a light hammer.

(g) Check the condition of the frame pillow block pads, the pillow blocks and the dowel pins. All mating surfaces must be clean and free of burrs.

(h) Attach the bowl lifter to the front and rear hubs, using the hardened steel screws supplied. Make sure the screws are tight.

(i) Station a man at each pillow block. Slowly lower the bowl assembly toward the frame. When the pillow blocks are approximately $1/2$" (12mm) from the frame, insert the dowel sleeves through the pillow blocks into the frame. Lower the bowl assembly onto the frame. Insert and tap home the taper portion of the dowel, thus obtaining correct alignment. Bolt the pillow blocks to the frame.

(j) Check to make sure the mating surfaces between the gear box and gear box adaptor are absolutely clean and free of burrs. Alignment of the gear box and smooth running of the machine depend on a proper fit at these surfaces.

(k) Install the gear box as described in paragraph 3 of 'Maintenance'.

(l) Push the feed tube into the bowl until the collar contacts the feed tube bracket. Secure the feed tube by tightening the feed tube bracket screws.

(m) Make sure there is a $1/16$" (1.5mm) clearance between the front and rear hub flingers and the lower casing. Close the upper casing and tighten in place with the clamping screws.

(n) Grease the conveyor bearings and check seals as described in paragraph 9b of 'Operation'.

(o) Assemble the driving belts as described in paragraph 3-k) of 'Installation' Assemble the torque arm assembly, or conveyor differential control, the gear box guard and the drive belt guard.

13. Removal of the Rear Hub (figures 32 and 33)

(a) Remove the conveyor as described in paragraph 6 of 'Maintenance'.

(b) Turn the bowl over on wood blocks so that the adaptor clears the floor. Under no circumstances

should the adaptor be allowed to contact the floor. This part is critical for smooth machine operation; therefore, great care must be exercised to prevent damage to it.

(c) Unscrew the rear hub screws.

(d) Jack the rear hub away from the bowl shell using the jack screws supplied. Lift the rear hub with a hoist, using 12mm eye bolts in the jack screw holes. Lower the hub on a wood block or rubber mat.

14. Assembly of the Rear Hub

(a) Lift the rear hub, the rear bearing assembly and the pulley with a hoist and eye bolts. Lower the rear hub onto the bowl shell, making sure that the 'V' balancing marks are aligned. This is important. Failure to line up these parts on assembly will result in an out-of-balance and rough running.

(b) Tighten the rear hub in place with the rear hub screws. Draw down evenly all around, not allowing the rear hub to cock.

(c) After the screws are tightened by hand, check the tightness by tapping the wrench handle with a light hammer.

(d) Assemble the conveyor, the front hub and other parts as described in paragraphs 12(a-o) above.

15. Removal of the Front Bearing (figure 20)

The bearing adjacent to the pulley (known as the rear bearing) is restrained by the bearing filler ring and locates the bowl longitudinally with respect to the casing and the frame. The bearing adjacent to the gear box (the front bearing) is free to move longitudinally to allow for expansion of the bowl.

(a) Remove the parts as described in paragraphs 6 (a-i) of 'Maintenance.' Set the bowl assembly in a horizontal cradle as in Figure 21 or stand it vertically as explained in 6(l)

(b) Rotate the Pillow Block until one of the Outer Bearing Flinger Cover Screws lines up with one of the large holes in the Adaptor Outer Flange.

(c) Remove this Flinger Cover Screw through the Adaptor Flange and repeat for the other two screws. Remove the Flinger Cover.

(d) Unscrew the bearing flinger set screws in each of the flingers.

(e) Take out the Front Hub Adaptor Screws and pull off the Gearbox Adaptor, using the Adaptor Puller provided, to jack against the Bearing End Plate as shown in Figure 23.

(f) Remove the end plate screws and the front end plate.

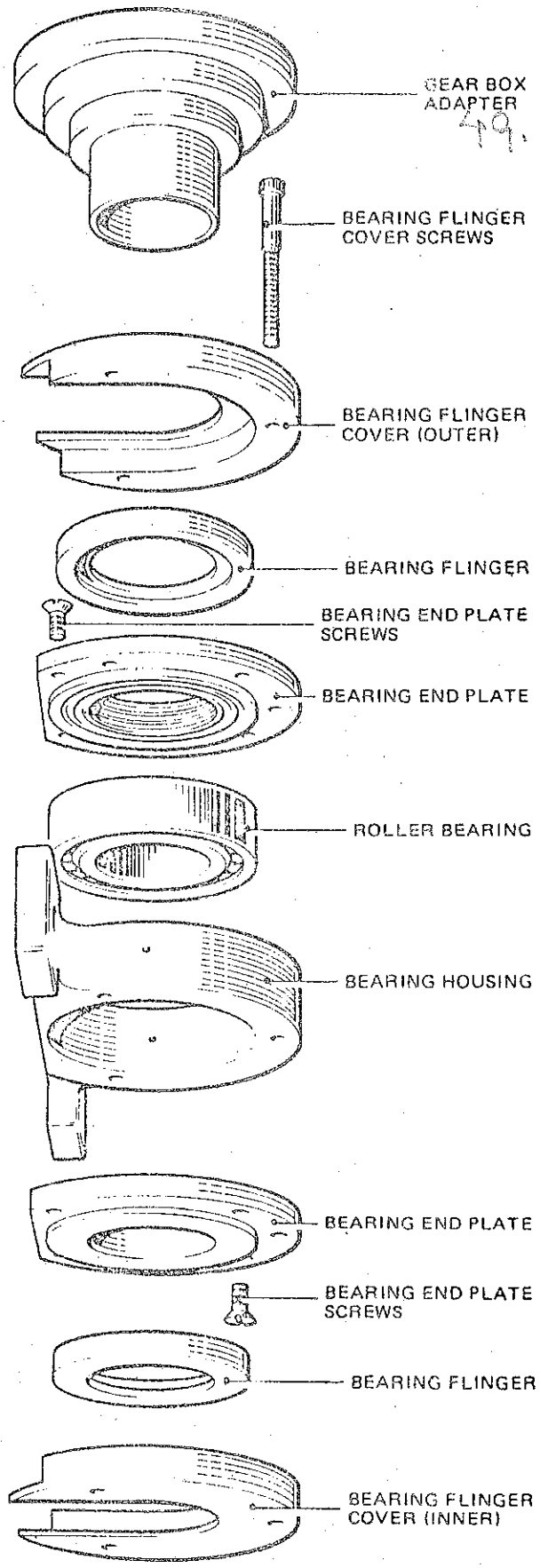


Figure 20. Front Bearing and Pillow Block Assembly

(g) Remove the pillow block frame by sliding it away from the bowl by hand (Figure 21). This will remove the outer race and the roller assembly.

(h) If the Bearing is to be removed and is not damaged.

(i) Fit the two halves of the special bearing remover clamp around the inner race, ensuring that no foreign particles can damage the Race, and clamp together.

(ii) Fit the end of the Bearing remover over the Hub end and tighten the three bolts connecting the clamp and flange as shown in Figure 22.

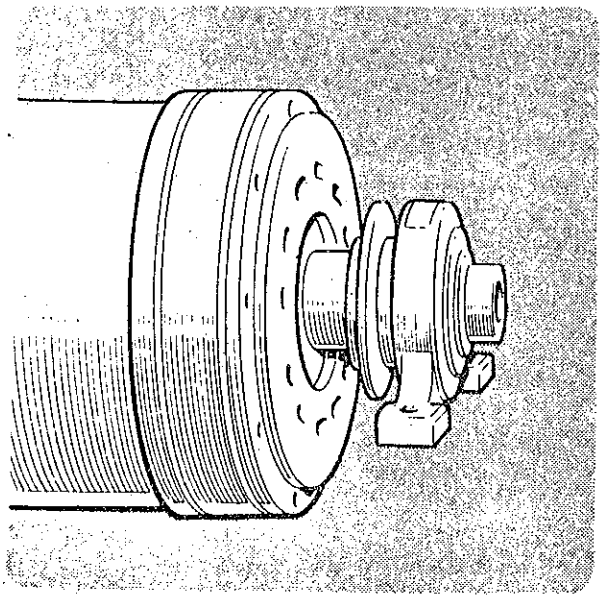


Figure 21. Removal of Pillow Block

(iii) Pull the Bearing off, using the large Jacking Bolt.

16. Assembly of Front Bearing

(a) Slip the inner flinger on the hub.

(b) Heat the inner race in oil at 200°F (93°C). Slip the heated race on the hub.

(c) Assemble both end plates and outer race with rollers, to the Pillow Block Housing, and slide over the inner race.

(d) If the bowl lifter was removed, attach it to the front hub and rear extension joint with the hardened screws supplied.

(e) Check and make sure the frame pads and pillow blocks are clean and free of burrs.

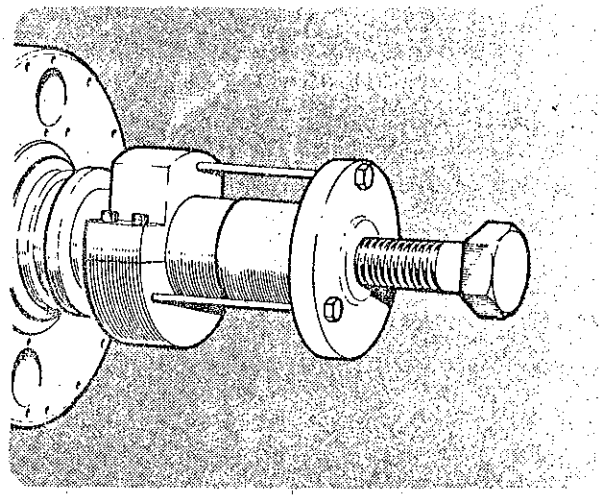


Figure 22. Bearing removal

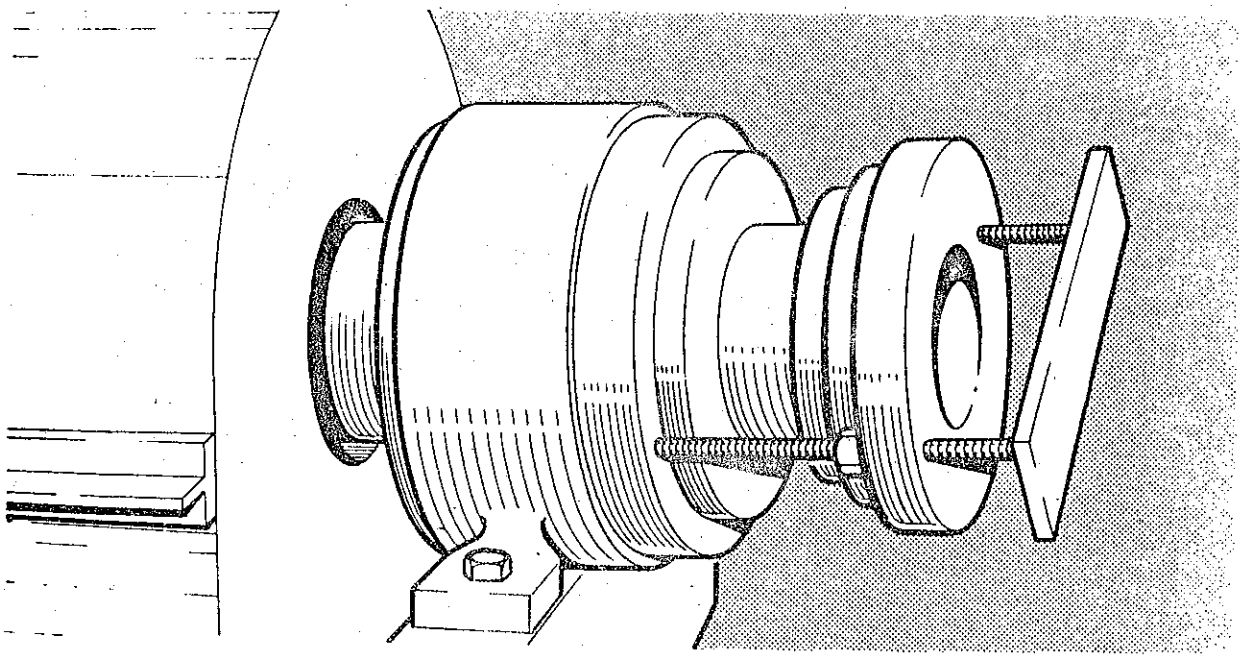


Figure 23. Gearbox Adaptor removal

(f) Lift the bowl assembly and carefully lower it onto the frame.

(g) After replacement of any part of the pillow block bearings, alignment check is necessary. A reliable, accurate dial indicator with stand must be obtained and a bracket for it must be made (Figure 24). Make the bracket to mount on the hub, the mounting screws being 180° apart. Mount the indicator stand on this bracket so that the indicator pointer can ride as close to the full 360° as possible on the face of the bearing housing without obstruction.

Set the indicator at the 12:00 position and adjust the dial to read zero. Insert the dowel pins and tighten the pillow blocks

Rotate the bowl and note the dial readings as closely as possible to every 90° (12:00, 3:00, 6:00 and 9:00). The 3:00 and 9:00 readings should indicate within .001 of zero.

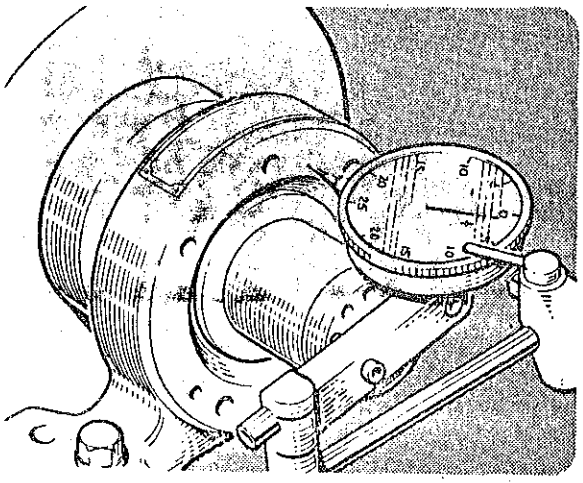


Figure 24. Indicating alignment

If the 6:00 reading is not within .002" of the 12:00 reading, warpage of the pillow block or twisting of the frame is likely. Re-check all mating surfaces for burrs or dirt. Check the frame hold-down bolts.

(h) Fasten both end plates to the pillow block housing with the end plate screws.

(i) Slip on the outer flinger. Press on the gear box adaptor, locating the adaptor with the dowel pin on the front hub extension. Tighten the adaptor to the hub with the steel gear box adaptor screws.

(j) Adjust the flingers to about 1/32" (0.8mm) clearance from the end plates. Tighten the flinger set screws and check this clearance at several points. A uniform clearance is important.

(k) Assemble the inner and outer flinger covers and rotate the gear box adaptor

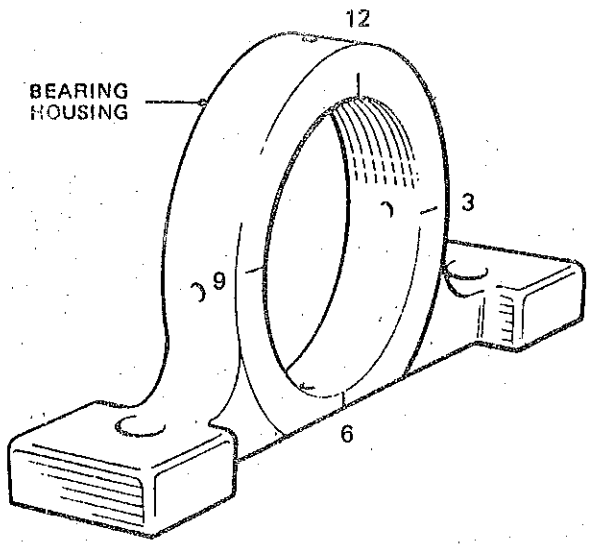


Figure 25. Indicator nomenclature

until the holes in its outer flange line up with the flinger cover screw holes.

(l) Insert the bearing flinger cover screws in the matching holes of the gear box adaptor and the outer flinger cover. Tighten these screws firmly.

(m) Install the balance of parts as described in paragraph 12(j-o).

NOTE: When running the centrifuge for the first time after replacing the bearings, lubricate as described in 9c of 'Operation'.

17. Removal of the Rear Bearing (Figure 26)

(a) Remove the parts as described in paragraphs 6 (a-h) of this section.

(b) Set the bowl assembly on a horizontal cradle as in Figure 21 or stand the bowl assembly on end by placing, underneath the front hub, blocks of such size that the gear box adaptor will clear the floor. Never rest the gear box adaptor on the floor, as severe gear box mis-alignment could result.

(c) Remove the bearing flinger cover screws and remove the bearing flinger covers.

(d) Unscrew the bearing flinger set screws.

(e) Remove the Pulley Retaining Screws and Jack off the Pulley with 2 Hardened Steel Jack Screws.

(f) If the Bearing is to be removed and is not damaged.

(i) Fit the end of the Bearing remover over the Hub end and bolt through the Pillow Block Housing and end plates with the 3 Puller Bolts as shown in Figure 27.

(ii) Pull off the complete Bearing Assembly using the large Jacking Bolt.

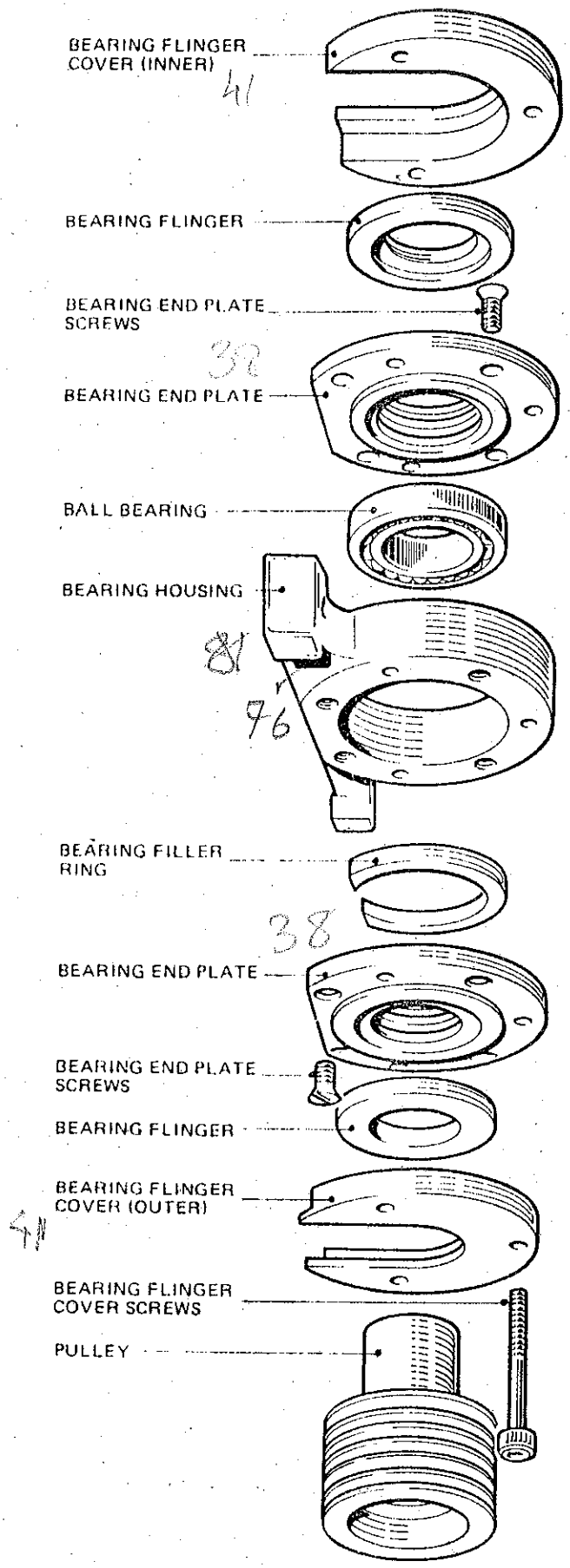


Figure 26. Rear Bearing Assembly

(g) Remove the end plate screws and the end plates from the Pillow Block.

(h) Push out the Bearing and the Filler Ring from the Pillow Block.

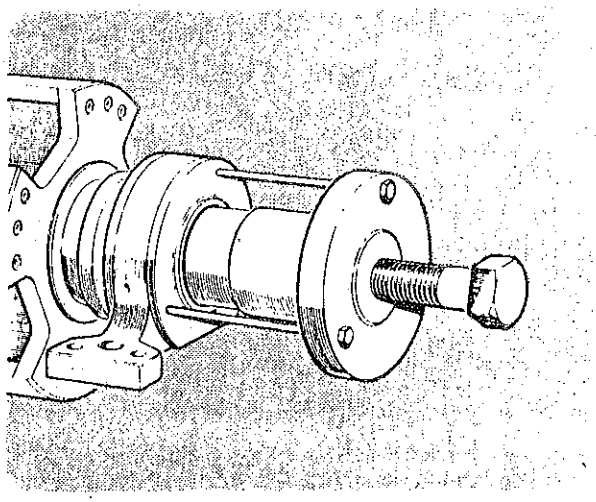


Figure 27. Rear Bearing Removal

18. Assembly of the Rear Bearing (figure 26)

(a) Slip the inner flinger and the inner end plate on the hub.

(b) Heat the ball race in oil at 200°F (93°C). Slip heated bearing onto the hub.

(c) Slip pillow block housing over the bearing

(d) Slip the rear bearing filler ring into the bearing housing.

(e) Fasten both end plates to the housing with the end plate screws.

(f) Slip on the outer flinger and install and tighten the pulley to the rear hub with the pulley screws.

(g) Assemble rotating assembly into frame and check alignment as for front bearing.

(h) Assemble inner and outer flinger covers after first checking the flinger gap is at $^{1}/_{32}$"(0.8mm).

(i) Lubricate bearings as in paragraph 9(c) of 'Operation' section.

19. Spare Parts

(a) If a spare gear box is kept on hand, protect the spline shaft from corrosion. First wash it carefully with methyl alcohol, then apply a suitable slushing compound.

(b) New bearings are properly treated with slushing compound and carefully wrapped and boxed to

preserve this coating. Keep all such spare bearings in their original container without opening.

(c) Spare parts should be replaced as they are used. Order them by the names indicated in the instruction book. The replaceable parts of the gear box are the pinion shaft, pinion shaft bearing, pinion shaft oil seal and pinion shaft oil seal gasket. The gear box, other than the parts mentioned, must be returned to Pennwalt India Limited for repair.

20. General Information

For some applications the type of conveyor and location of the feed zone may be different from that shown in the cross sectional drawings, (Figure. 33) Some machines are provided with double lead conveyors and others have their feed zones located at a different place. When the conveyor feed ports are located in the rear of the conveyor, a shorter feed and retainer tube (when used) is required.

21. Rust Preventatives Used for Machine Storage

(a) In plants where only seasonal operation of the machine is required, much trouble and expense can be eliminated by carefully preparing the machine for a long shutdown. It is suggested that rust preventatives, Cosmoline 1059, Cosmoline 1093, Rust Veto 342 and Rust Veto 377, manufactured by the E.F. Houghton Company, be used.

(b) Cosmoline 1059 is a soft amber-coloured film applied by brush, dip or spray and is used for long-term under cover protection of interior or exterior surfaces of machinery with or without overwrap. Removal is required by solvent wiping before parts are used.

(c) Cosmoline 1093 is a light rust preventative especially used to flush out and protect lubricating systems containing filters, gear boxes and pumps. The preventative must be circulated through the interior of the equipment and then drained. The protective oil film that remains is compatible with the lubricating oil.

(d) Rust Veto 342 is a preventative to be used for outdoor storage. It must be set up with plaster and dried to a transparent film. It can be applied with brush, dip or spray, and requires a petroleum solvent or mild alkaline cleaner to remove.

(e) Rust Veto 377 is a polar-type solvent preventative having water displacing ability. It is used where metal parts will be stored inside and can be sprayed on intricate machine parts. It can be removed by solvent wiping, but since it is light, removal is not necessary in many applications.

(f) Suitable equivalents to the above materials are recommended by the Shell International Petroleum Company as follows:

Cosmoline 1059	--	Shell Ensis Fluid 256
Cosmoline 1093	—	Shell Ensis Oil 152
Rust Veto 342	—	Shell Ensis Fluid 260
Rust Veto 377	--	Shell Ensis Fluid 254

A booklet issued by Shell International Petroleum Company Limited; entitled 'Shell Ensis, Oils, Fluids, Compounds' provides additional information regarding the use of the above alternatives.

PENNWALT SUPER-D-CANTER

RECOMMENDED LUBRICANTS

1) GREASE PACKED MAIN BEARINGS

Main Bearings	—	Grease Shell Alvania R3
Conveyor Bearings	—	Grease Shell Alvania R3
Gear Box	—	Oil Shell Macoma R71

2) OIL MIST LUBRICATED MAIN BEARINGS

Main Bearings	--	Oil Shell Tellus 23ıia R3
Conveyor Bearings	--	Grease Shell Alvania R3
Gear Box	--	OilShell Macoma R71

These lubricants comply with the general specification given in Section 3 Lubrication in comprehensive instruction Book.