

**Summary Report for Individual Task  
551-88L-2043  
Maintain a Purifier  
Status: Approved**

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DISTRIBUTION RESTRICTION: Approved for public release; distribution is unlimited.

DESTRUCTION NOTICE: None

**Condition:** Aboard a vessel, at sea, at anchor or moored alongside a pier, day or night, under all sea and weather conditions, conduct maintenance of an Alfa Laval purifier using the appropriate Alfa Laval special tools and part kits. While wearing appropriate PPE, (i.e. hearing protection, Nitrile gloves, eye protection, etc..) with no injuries and/or damage to equipment.

**Standard:** The Soldier knows the pre-maintenance checks, maintenance safety, effects of wear, and critical components of the purifier, and can correctly conduct the monthly, hourly, and annual maintenance procedures pertaining to the Alfa Laval purifier.

**Special Condition:** None

**Special Standards:** None

**Special Equipment:**

**Safety Level:** High

**MOPP:**

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|------------------------|
| <b>Task Statements</b> |
|------------------------|

**Cue:** None

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|---------------|
| <b>DANGER</b> |
| None          |

|                |
|----------------|
| <b>WARNING</b> |
| None           |

|                |
|----------------|
| <b>CAUTION</b> |
| None           |

**Remarks:** None

**Notes:** None

## Performance Steps

### 1. Perform Pre-Maintenance Checks.

a. Be sure that the centrifuge has come to a complete stop before unscrewing the feed tube handle, loosening cover clamps, or initiating any disassembly or maintenance procedures.

b. Before performing any maintenance activities, make sure that the main electrical disconnect switch at the power supply panel is opened and locked out, or tagged out.

c. Be sure that the maintenance area and/or the area around the centrifuge is clean and free of loose gear, trash, oil spills, and/or grease spots.

d. Be sure that all tools and equipment necessary to the maintenance task are kept readily available near the work area, but not underfoot.

e. Be sure that plant services to the centrifuge such as air and water, have been adequately secured before any maintenance tasks are undertaken.

### 2. Demonstrate basic knowledge of maintenance safety pertaining to the centrifuge.

a. Experience has shown that centrifuges suffer a certain amount of damage and wear during assembly and disassembly. This is practically unavoidable due to the nature of the machine, i.e., close tolerances of many parts, intricacies of construction and assembly, and weight of parts. Because of these factors, it is extremely important that even experienced operating and/or maintenance personnel follow the maintenance procedures given in the machine manual as closely as possible, in order to minimize such damage and wear. In addition, it is also vital to operational safety that the correct tools be used when assembling and disassembling a centrifuge, in order to avoid jamming, cocking, scratching or scoring components. Incorrect assembly of parts, or hidden damage coupled with extremely high kinetic energy developed by the centrifuge during operation can lead to **POTENTIALLY SERIOUS SAFETY HAZARDS**. Following is a list of maintenance safety rules which should be observed when performing service tasks.

(1) Always provide an adequate area in which to work, and to lay out tools and parts. Keep tools and parts away from the immediate work area and from underfoot.

(2) Keep tools clean and properly maintained. Store tools in a clean dry environment to prevent rust and corrosion. Steel tools which are not plated should be painted, or wiped occasionally with an oily rag.

(3) A chain hoist should be available to lift heavy machine parts during removal and replacement. Hand operated chain falls are recommended. Never lift heavy machine parts by hand.

(4) Pay particular attention to components requiring adjustments and to the correct procedures to be used in making the adjustments.

(5) Do not place centrifuge parts on hard or rough surfaces where they can become nicked, scored or dented leading to potential safety hazards. Use mats, plywood or other relatively soft material to lay parts on.

(6) Do not attempt to pry apart bowl components which are locked together. Prying at these components with screwdrivers or other implements may damage them and affect their balance. Use the special tools provided to break pressure/taper locks the correct way.

(7) Do not perform welding operations on the bowl or bowl components or subject any parts to extreme heat.

b. Certain centrifuge models require the use of a disc stack compression tool for proper assembly/disassembly of the bowl. These tools require a certain amount of care in their use and maintenance in order to provide safe and efficient service. Always follow the instructions in the machine manual and the compression tool instruction manual/sheet carefully when using the tool. Be sure to follow the maintenance schedule and instructions in the tool instruction booklet when servicing the tool. **ALWAYS** follow the procedure given in the machine manual when using the disc stack compression tool as a lifting tool. When separate bowl hood and lock ring lifting tools are provided, always use these instead of the compression tool to lift parts.

c. Lifting tools are supplied with many centrifuge models. The purpose of these items is two fold:

(1) First, they provide sure and adequate points at which to grip the part or attach a hoist.

(2) Second, they insure that lifting force is applied evenly and in the correct direction, eliminating, or at least reducing wear on closely fitting parts which could otherwise become cocked, or jammed, causing damage to themselves and other components.

(3) When lifting tools are provided with a centrifuge be sure to use them, and use them correctly.

d. The bowl components of all centrifuges are assembled in a certain relative order and position. Locating marks, pins and lugs are furnished on many centrifuge parts to ensure proper seating and alignment during assembly. These must be legible, and/or intact to ensure proper positioning and assembly, (refer to Figure 551-88L-2043\_01).

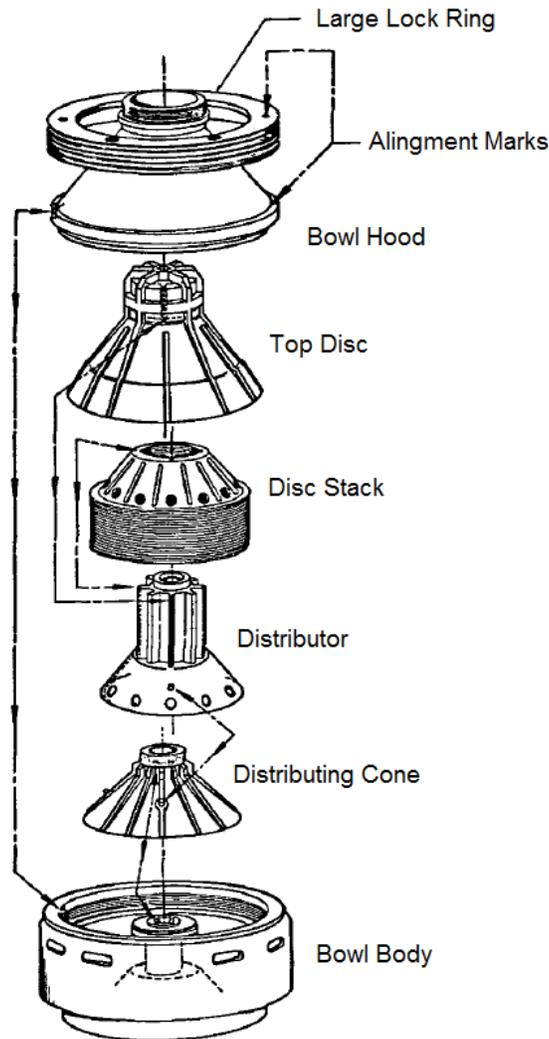


Figure 551-88L-2043  
Locating guides

## WARNING

A centrifuge must not be operated when locating pins and lugs are worn away, or damaged so as to prevent proper assembly, or indicating marks are illegible.

e. Proper disc stack compression is a factor vital to safe centrifuge operation. In addition, obtaining the proper disc stack pressure by using the correct procedure is equally important. Proper disc stack pressure or bowl closure must not be obtained by leaving out bowl components such as discs. If bowl closure cannot be obtained without removing discs, then the bowl has been assembled improperly and must be disassembled, and reassembled correctly. After correct bowl assembly, disc stack pressure is obtained by using the compression tool to compress the disc stack, while seating the bowl hood onto the bowl body, and threading down the lock ring until the proper tightness and alignment is obtained. Always follow the exact procedures give in the applicable machine manual when applying or releasing disc stack pressure.

f. A maintenance and repair log should be kept for each centrifuge. In this way, any parts, components or adjustments, etc. which exhibit a high failure rate, or require constant attention can be flagged. Underlying or hidden problems, failures, etc. can be detected and rectified avoiding potentially dangerous situations. An on-going record of machine operation and performance characteristics can also help to detect operating or performance irregularities which might otherwise go unnoticed and lead to unsafe conditions. The rate of corrosion and erosion should also be recorded as an important part of this record, so that a schedule of parts replacement can be instituted, helping to eliminate the risk of mechanical failure during operation.

3. Demonstrate basic knowledge of the effects of wear on the centrifuge.

a. Due to the ever increasing development of new methods, and processes in industry, greater and greater performance demands are being made on the centrifuge. Because of the high corrosive and/or erosive potentials of many of these processes, materials for use in the manufacture of centrifuges and centrifuge components must be as resistant as possible. Corrosion and erosion must be continuously monitored and evaluated in order to prevent hazardous conditions from developing. Unchecked, corrosion and/or erosion of centrifuge components can result in mechanical failure and disintegration of the centrifuge bowl at high speed. **THE RESULTS COULD BE SEVERE PERSONAL INJURY AND PROPERTY DAMAGE.** Complete elimination of corrosive and/or erosive attack, even through the use of high resistance materials is extremely difficult, if not impossible, due to the stresses and velocities associated with centrifuge machinery when potentially corrosive or erosive conditions exist in a system.

b. Do not be misled by the belief that you have a so-called "non-corrosive", or "non-erosive" operation. Corrosion and erosion may occur in any system regardless of metallurgy, or no matter how "non-corrosive" or "nonerosive" the process or the cleaning agents employed.

c. Centrifuge owners, operators and maintenance personnel should be continually alert to corrosion and erosion and aware of its potential effects. Below is a list of suggested ways of dealing with corrosion and erosion:

(1) Make an effort to become familiar with corrosion and erosion, its causes and effects, and to learn as much as possible about the extent, and rate, of these problems as they apply to the specific application.

(2) Determine the necessary frequency of parts replacement, and establish a planned program of same in order to avoid costly and potentially hazardous breakdowns and/or failures.

(3) Always clean the centrifuge bowl immediately after shutdown and never leave accumulated solids, process liquid, or cleaning fluids in the centrifuge.

(4) Be alert to pitting. Pits might appear to be only minor surface blemishes, but could be an outward sign of stress corrosion, in which the metal below has become extremely porous resulting in severe weakening of structural members.

(5) Be alert to pitting which displays a pattern such as a straight or curved line.

(6) Contact an Alfa-Laval service center if you think you have a pitting/corrosion/erosion or related problem, or would like more information about same.

(7) Be aware that certain components of the centrifuge are more critically susceptible to corrosion and erosion and their effects, and that these parts contribute most significantly to the stability of the centrifuge. These parts should be watched most closely and carefully and their condition closely monitored. They are:

- (a) the bowl lock ring (coupling ring)
- (b) the bowl body (bowl shell)
- (c) the bowl hood (bowl top)
- (d) the bowl spindle
- (e) all threaded areas within the bowl assembly

d. Normal operating wear is actually a form of erosion caused by the friction generated by and between moving parts. When the speed and subsequently the energy developed by moving parts is normally low, then the friction induced wear of parts occurs at a lower rate. However, when the speed and energy developed by moving parts is extremely high, as in the case of a centrifuge, then the friction induced "wear" rate of subjected components can be surprisingly high. When a process liquid is introduced, containing even small percentages of residual solids which have to be removed, the situation becomes aggravated, and the potential exists for "normal" machine wear to develop into serious erosion.

#### 4. Demonstrate basic knowledge of the critical components pertaining to the centrifuge.

a. There are a number of components in a centrifuge whose condition can critically affect the continued safe operation of the machine. Deterioration, or improper installation of these components can create increasingly greater risk of failure and/or breakdown. Under some circumstances, the failure of any one of these components can lead to extremely hazardous conditions. The critical components are:

- (1) Bowl lock ring (coupling ring)
- (2) Bowl body (bowl shell)
- (3) Bowl hood (bowl top)
- (4) Spindle
- (5) Drive train (belt drive and gear drive)
- (6) Bearings

b. Bowl Lock Ring. The bowl lock ring holds the entire bowl assembly together by securing the bowl hood to the bowl body. The entire bowl body contains the forces produced by the rotation of the bowl. These forces consist of the self-stress of the rotating bowl combined with the hydraulic forces produced by the rotating liquid within the bowl. As a result, an upward force of considerable magnitude exists on the bowl hood. The brunt of this force is exerted on the lock ring and its threads, and the corresponding threads of the bowl body. The condition of these threads, after being in a state of high stress for long periods is obviously extremely important.

(1) The lock ring and bowl body and their corresponding threads must be kept in good condition, and constantly monitored. Particularly close attention must be given to the condition of the threads. Failure to recognize damage, wear, corrosion or erosion on these critical parts, or to rectify same can result in conditions which would render the centrifuge unsafe to operate and hazardous to personnel, plant, and equipment.

(2) Alfa-Laval centrifuges utilize two types of lock rings; an internal type in which the ring screws down inside the bowl body against the bowl hood, (refer to Figure 551-88L-2043\_02), and an external type in which the ring screws down on the outside of the bowl body and compresses the bowl hood against the body.

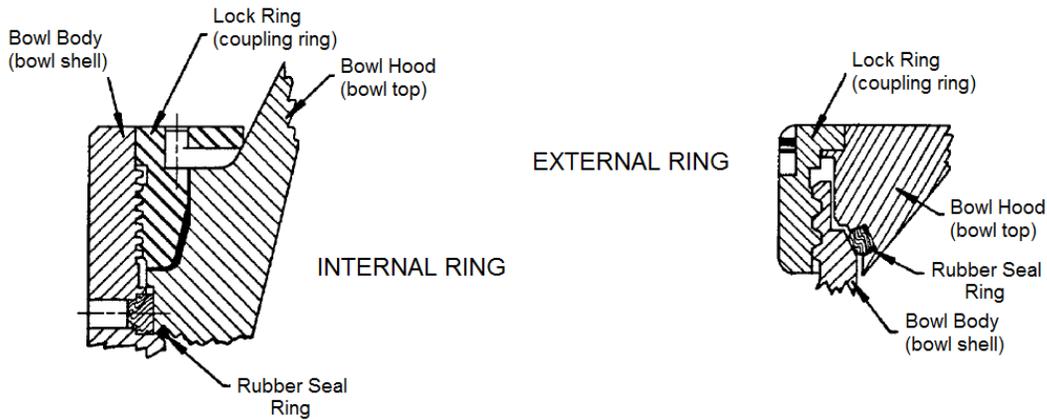


Figure 551-88L-2043\_02  
Locking ring types

(3) In addition to monitoring the physical condition of the lock ring, care must be exercised to ensure that it is reinstalled correctly each time the bowl is reassembled. This includes a procedure applied during assembly which is designed to indicate thread wear limit.

(4) A basic description of this procedure follows here. However, when performing the actual procedure on a centrifuge, you **MUST** follow the exact procedure given in the machine operating and maintenance manual, since details of this procedure can vary from one type of centrifuge to another.

(a) Make sure that all locating and alignment marks are visible (figure 6). If they are not, **DO NOT OPERATE THE CENTRIFUGE**. Locating marks should appear on the lock ring, and on the bowl hood, or bowl body depending upon the type of centrifuge.

(b) If the marks are not visible, contact an Alfa-Laval service center before proceeding further. They can inspect the centrifuge, assess the condition of the bowl, re-establish the alignment marks, and recommend necessary service action.

(c) Reassemble the bowl, leaving out the disc stack and bowl hood O-ring.

(d) Lubricate the lock ring and thread it down on the bowl hood and bowl body.

(e) Turn the lock ring down until metal to metal contact is felt. If the alignment marks on the lock ring and the bowl are in alignment, then the threads are not worn. If the alignment mark on the lock ring goes past the mark on the bowl body or top, then thread wear has taken place.

## WARNING

If the alignment mark on the lock ring passes the stationary alignment mark by more than 25° (or 25mm) **DO NOT OPERATE THE CENTRIFUGE**. Thread wear has exceeded the limits of safety. Contact an Alfa-Laval service center to arrange to have the centrifuge bowl reconditioned.

(5) If the alignment mark on the lock ring passes the stationary mark by less than 25° (or 25mm), a new stationary mark must be struck on the bowl hood, following the instructions given in the individual machine manual. **DO NOT REMOVE THE OLD ALIGNMENT MARK.**

c. Bowl Body. The bowl body provides a housing for the bowl components. With the bowl hood, it forms an enclosed containment for the centrifuge process. The bowl body and bowl hood contain the forces produced by bowl rotation. The bowl body is continually exposed to conditions which cause wear; corrosion, erosion and stress. It must be periodically inspected for signs of pitting and cracking around the inside perimeter. The threads of the bowl body, like those of the lock ring, must be frequently inspected for signs of wear; pitting, cracking and galling.

d. Bowl Hood. The bowl hood seats on the bowl body and forms the upper portion of the bowl enclosure. As is the case with the bowl body, the bowl hood must be frequently inspected for signs of pitting and cracking, around the inside. In addition, the seal ring in the lower rim, which forms a liquid tight seal between the bowl hood and the bowl body, must be frequently inspected and periodically replaced in order to avoid the occurrence of high-flow, high pressure leakage between the bowl hood and bowl body, which can be hazardous.

e. Major bowl components cannot be replaced in the field, because the entire bowl assembly must be rebalanced. This can only be accomplished at an Alfa-Laval facility. To be certain of maximum compliance with safety requirements, PURCHASE REPLACEMENT PARTS ONLY FROM AUTHORIZED ALFA-LAVAL SOURCES. Alfa-Laval warranties will be voided if parts from unauthorized sources are used. Alfa-Laval maintains a rental bowl inventory in each of its two service centers. A bowl can be rented to you while your bowl is undergoing repair and/or rebalancing. If you have more than one centrifuge of the same or similar model, DO NOT INTERCHANGE BOWL PARTS in order to effect repair. Bowl parts from the same centrifuge are stamped with the machine serial number, or the last three digits of that number. Keep them in the same bowl. Bowls are balanced after assembly as a single unit. Using bowl parts interchangeably will seriously affect the balance of the bowl assembly.

f. Spindle. It is not necessary to disassemble the entire centrifuge periodically in order to inspect the spindle. However, whenever the bowl assembly is removed or disassembled, it is advisable to check the exposed upper end of the spindle for signs of wear and/or fatigue. Particular attention should be given to the spindle cap nut threads since they are subjected to forces and conditions similar to those affecting the lock ring and bowl shell threads. Extra attention should be given to the spindle if the process utilization is in any way considered to be unusually corrosive or erosive. As with other internal parts, the spindle upper end should also be checked for signs of pitting and cracking. Spindle wobble, or runout should be checked periodically using a dial indicator as covered in the machine manual. This check should be performed during reassembly, particularly if excessive vibration has been present. Vibration could be due to a bent spindle.

g. Drive Components. The drive components or drive train transfers the rotational motion and torque of the motor to the spindle and bowl assembly. This is done through one of two systems of power transmission; pulley and belt drive, or direct coupled gear drive. Both of these drive types require regular inspection and maintenance in order to ensure continued proper and safe operation. Belts must be checked for wear and stretching, factors which must be detected and arrested before they can lead to belt failure. This can result in broken belts becoming entangled in moving parts, or being thrown from the centrifuge. Both situations can be unsafe. The pulleys used in conjunction with belt drives must be periodically inspected for wear and evidence of failure, particularly the split taper bushings, when these are used. Bushings may develop cracks opposite the split which could lead to hazardous conditions if the pulleys and belts should fly apart during operation. Gears, gear boxes, and gear trains require regular inspection and maintenance in order to detect irregular and/or unusual wear on gears and teeth such as spalling, cracking or pitting, or other signs of fatigue indicating possible imminent failure. Guards should be inspected regularly to ensure that they are properly mounted and in good condition. Always be sure that guards are properly secured when operating a centrifuge. In addition, gear lubricants must be regularly inspected and proper lubrication ensured in order to maintain the drive gears in good condition. Lubricants must be changed regularly in order to prevent overheating of gears or excess friction and wear caused by the breakdown of old, or overworked lubricants, and to prevent dangerous build ups of contaminants contained in old oil.

(1) On units with direct gear drive, the proper alignment between the motor and the horizontal drive shaft is extremely important. Alignment must be checked every time the motor is remounted, or the horizontal shaft is reassembled and/or reinstalled.

(2) Proper alignment procedures are given in the machine manual. Follow them. Improper alignment can lead to motor overload, speed reduction, vibration, bearing failure and accelerated wear.

(3) Proper care and maintenance procedures for individual centrifuge drive components are contained within the applicable machine manuals. These must be followed in order to ensure proper and safe centrifuge operation.

h. Bearings. The centrifuge spindle, and in machines with gear drives, the horizontal gear shaft, are mounted in the frame of the centrifuge in ball bearings. These bearings must be continually bathed with lubricating oil during centrifuge operation in order to prevent overheating and bearing failure/seizure. For this reason lubricants should be changed regularly, and all lubrication holes, channels, passages etc. should be kept clear of debris and sediment by flushing out the centrifuge lubricant spaces and channels each time the lubricant is changed.

(1) Bearing failure caused by defects, or overheating can cause severe operational malfunctions resulting in equipment damage and personnel safety hazard, especially if complete seizure occurs while the centrifuge bowl is rotating at high speed.

(2) Before seizure occurs, there are usually a number of detectable symptoms indicative of imminent bearing failure. They are:

- (a) Change or increase in noise level, intensity or pitch.
- (b) Increase in vibration.
- (c) Increase in motor amperage.
- (d) Decrease in throughput rate (as affected by increased motor amperage).
- (e) Scorched or burnt lubricating oil (observable only with centrifuge stopped).
- (f) Burnt or scorched odor in vicinity of centrifuge.
- (g) Reduction in centrifuge speed.

(3) Centrifuge operators and maintenance personnel must be constantly aware of and ready to detect any and all of the foregoing conditions.

(4) A number of important precautions must be borne in mind whenever bearings are handled, serviced and installed, in order to ensure proper and safe operation.

- (a) Never spin an ungreased bearing.
- (b) Never blow an ungreased bearing with compressed air.

(c) Never force a bearing on a shaft by striking the outer race, (refer to Figure 551-88L-2043\_03), nor into a housing, or seat by striking the inner race, (refer to Figure 551-88L-2043\_04).

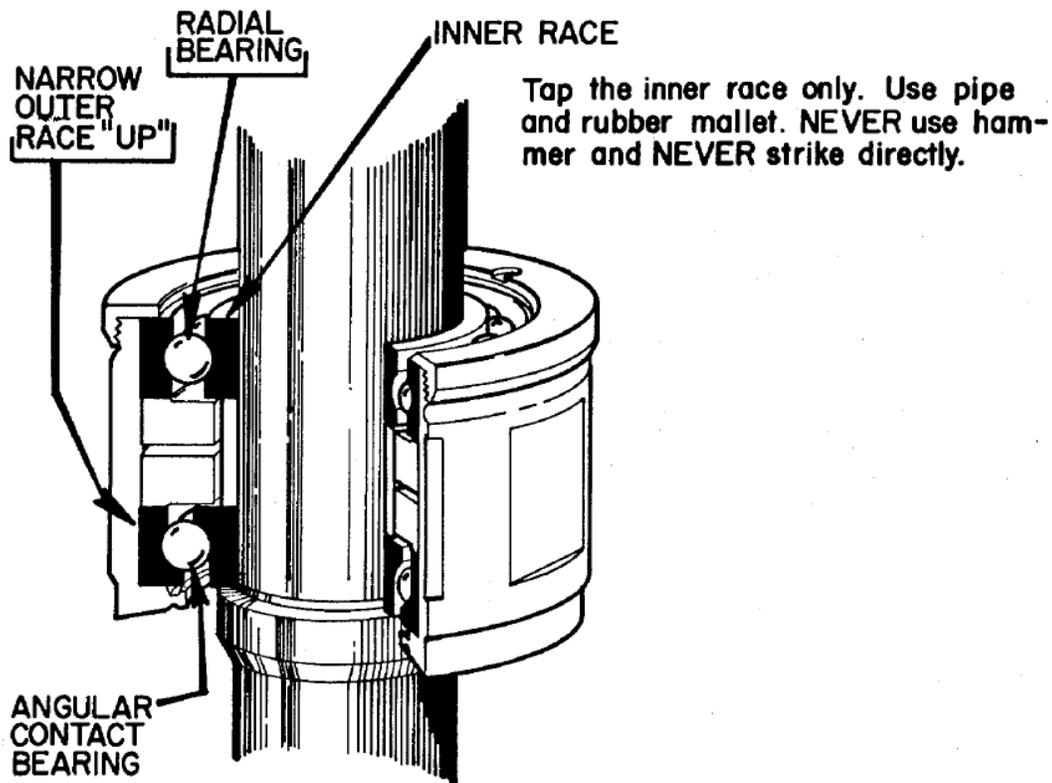


Figure 551-88L-2043\_03  
Bearing on a shaft

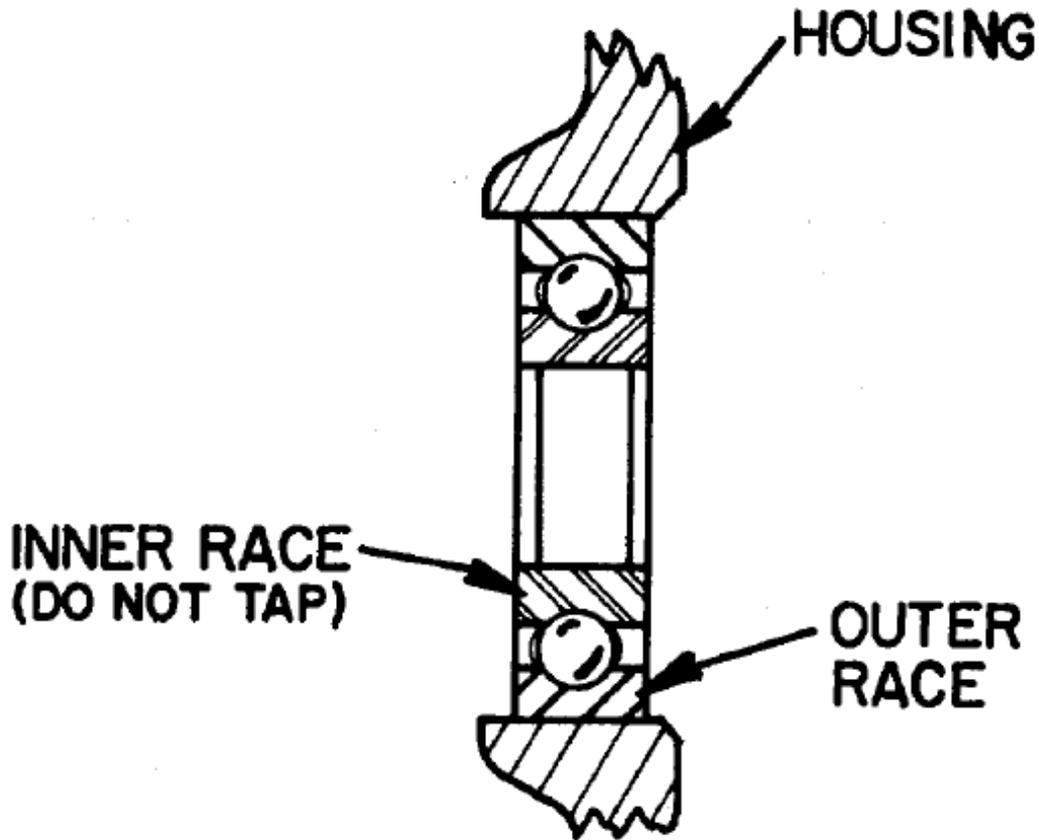


Figure 551-88L-2043\_04  
Bearing in a housing

(d) Always follow ALL machine procedures concerning bearings.

(5) With the aid of a comprehensive preventive maintenance system, it should be no problem to detect a worn out or defective bearing and replace it before failure occurs. When handling, removing and installing bearings, always follow the procedures given in the machine maintenance manual. Be sure that all recommended warnings, cautions, notes, etc. are carefully observed.

5. Perform monthly maintenance on a centrifuge.

a. Switch off and lock out the power supply to the motor controller.

b. Disassemble, clean, and reassemble the separator bowl assembly.

(1) Switch off and lock out the power supply to the motor controller.

(2) While cleaning the purifier, the parts must be handled carefully. Don't place parts directly on the deck, but on a clean rubber mat or rag-covered deck.

(3) Disassemble the purifier:

(a) Loosen the clamp bolts and open the collecting cover.

\_1\_ Locate the locking mechanism at the collection cover pivot point.

\_2\_ Engage the locking mechanism to keep the collection cover open.

(b) Tighten the two bowl locking screws (refer to Figure 551-88L-2043\_05).

\_1\_ Locate the two indentations on the side of the bowl.

\_2\_ Align the indentations with the locking screws.

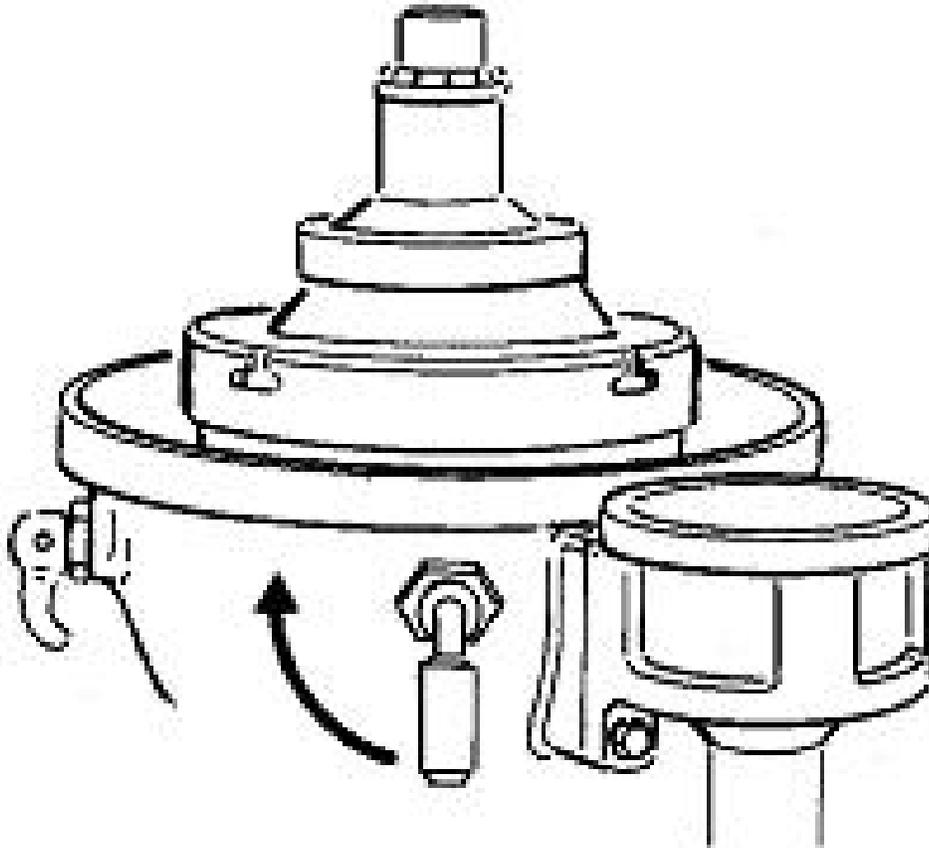


Figure 551-88L-2043\_05

Locking screws

(c) Using the smaller Alfa Laval spanner, remove the gravity disk-locking ring turning clockwise to remove (refer to Figure 551-88L-2043\_06).

\_1\_ Hand power should be enough force to free the locking ring.

\_2\_ A dead blow hammer is NOT recommended for this step.

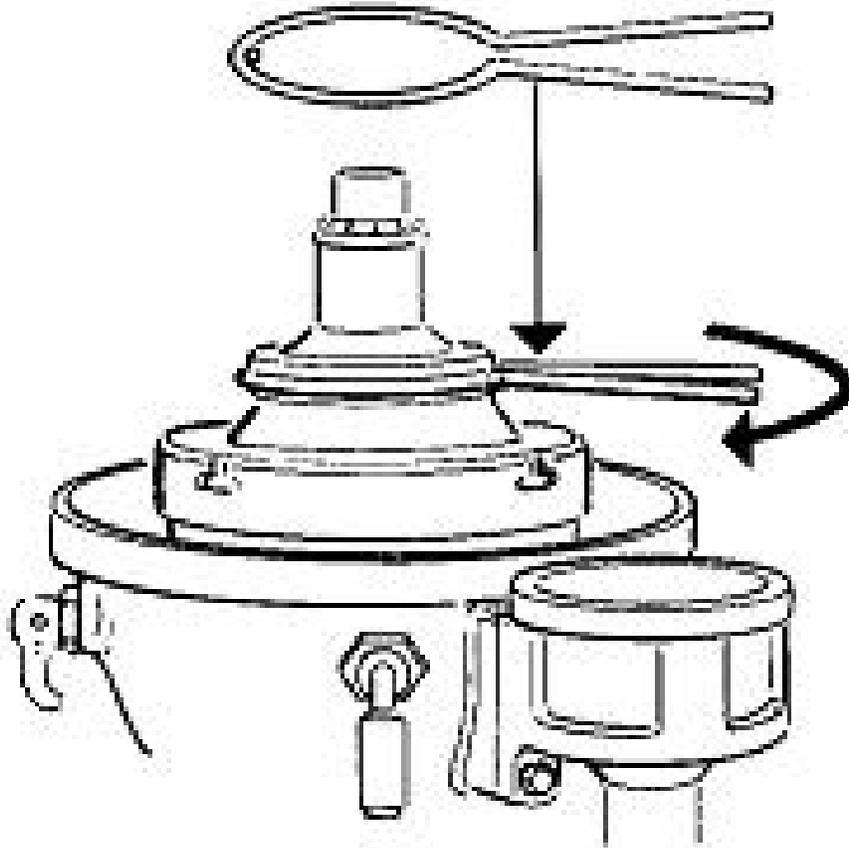


Figure 551-88L-2043\_06  
Removing the locking ring

(d) Remove the gravity disc and o-ring.

(e) Using the larger Alfa Laval spanner, remove the bowl's lock ring.

\_1\_ Use a lead (dead blow) hammer (refer to Figure 551-88L-2043\_07).

\_2\_ Tap the handle of the tool in a clockwise direction.

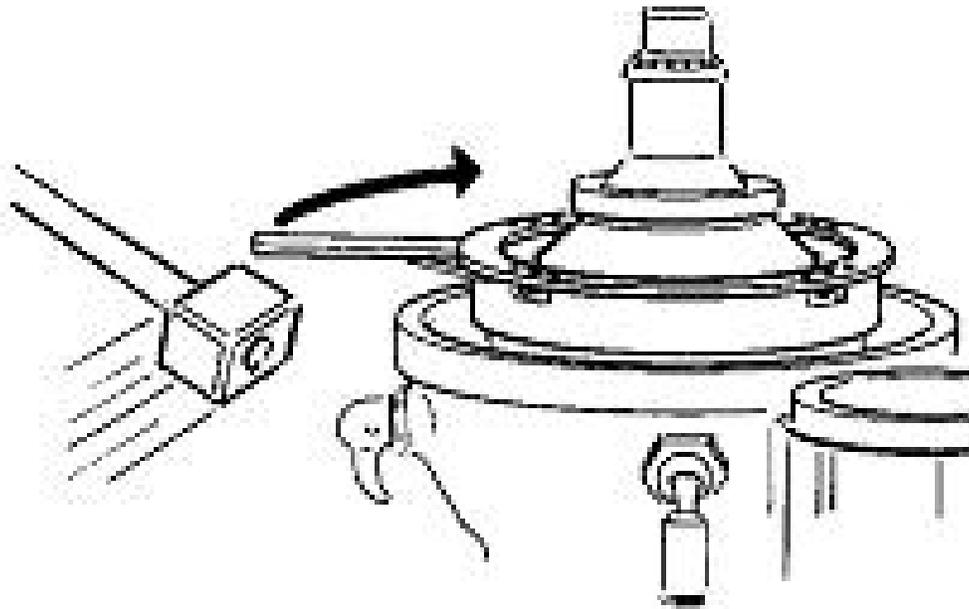


Figure 551-88L-2043\_07  
Removing bowl locking ring

(f) Remove the bowl hood taking care not to damage the two o-rings around the bowl hood.

(g) Remove the top disc.

(h) Lift the disc stack straight up and place it into a bucket of clean diesel fuel to aid in cleaning (refer to Figure 551-88L-2043\_08).

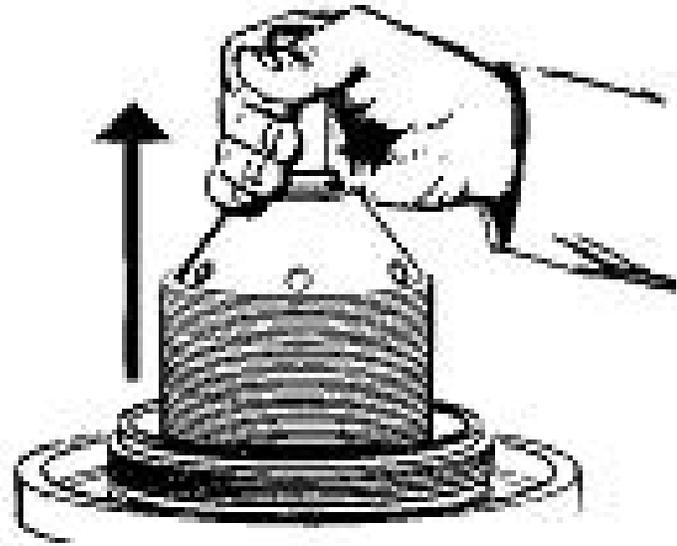
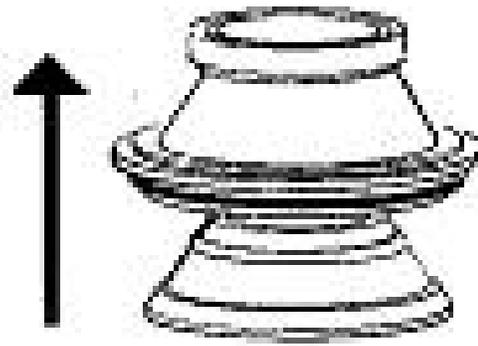


Figure 551-88L-2043\_08  
Removing disc stack

- (i) Empty the bowl of oily water using a small suction pump or cup.
- (j) Remove the spindle lock nut (refer to Figure 551-88L-2043\_09 # 1).
- (k) Release the bowl locking screws (refer to Figure 551-88L-2043\_09 # 2).
- (l) Lift the bowl from the purifier (refer to Figure 551-88L-2043\_09 # 3).

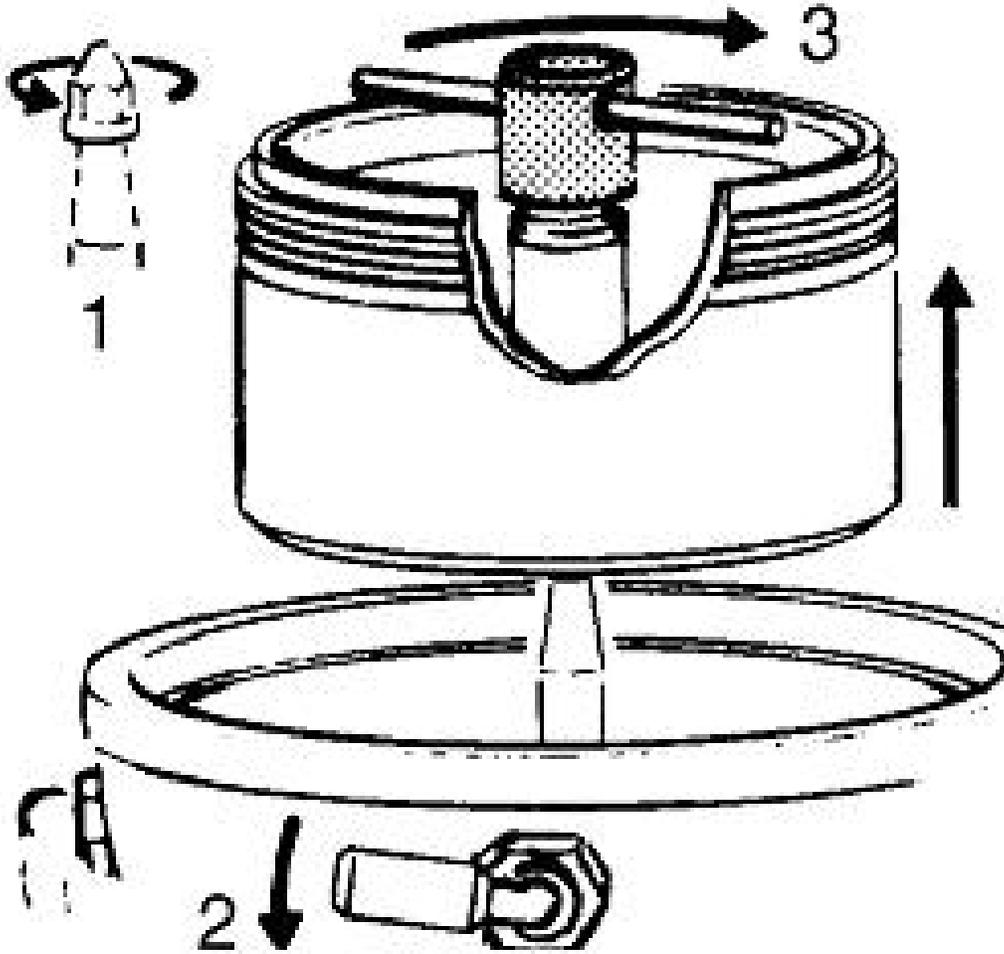


Figure 551-88L-2043\_09  
Removing purifier bowl

(m) Carefully remove the lid's o-ring and the two sight glass o-rings.

(4) Clean the purifier components.

(a) Handle bowl discs carefully to avoid damage to the surface during cleaning.

(b) Remove discs one at a time from the distributor.

(c) Clean discs with a soft brush.

\_1\_ Once disc is cleaned place it upside down on the rubber mat or rag-covered deck to dry.

\_2\_ Clean all discs, stacking one disc inside the previous.

(d) Clean the distributor with a soft brush and wipe dry with a clean rag.

(e) Place the distributor on the rubber mat or rag-covered deck.

(f) Place discs on clean distributor one at a time.

\_1\_ Start with top disc turn it over and place on the distributor.

\_2\_ Continue placing each disc on the distributor.

(g) Clean the gravity disc, hood, top disc and locking rings with a plastic brush.

(h) Clean the purifier bowl.

(i) Carefully clean and inspect the lid's o-ring and the two sight glass o-rings.

(5) Assemble the purifier:

(a) Wipe off the spindle top (refer to Figure 551-88L-2043\_10 # 1).

\_1\_ Apply a few drops of oil onto the taper.

\_2\_ Smear it over the surface.

\_3\_ Wipe it off with a clean cloth.

(b) Place the purifier bowl on the spindle in the purifier (refer to Figure 551-88L-2043\_10 # 2).

(c) Reset the bowl locking screws.

(d) Replace the spindle lock nut and tighten till snug (refer to Figure 551-88L-2043\_10 # 3).

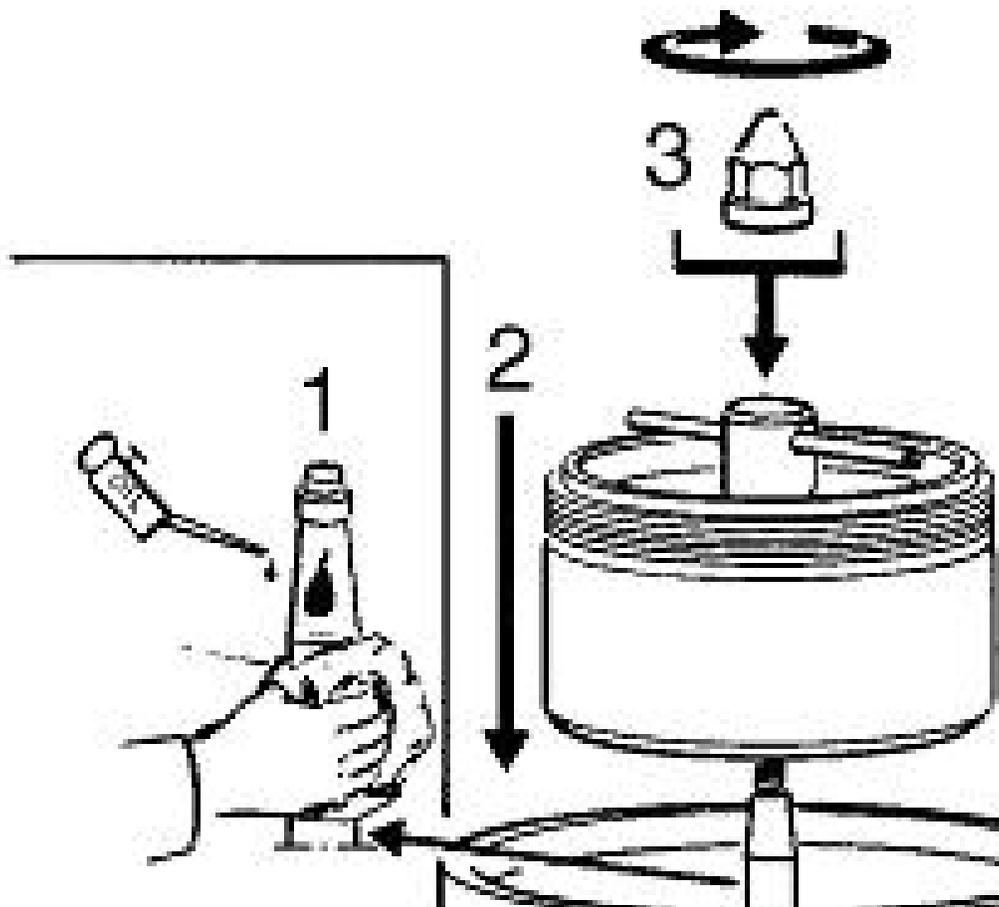


Figure 551-88L-2043\_10  
Replace purifier bowl

(e) Place the disc stack in the bowl and rotate the disc stack until it falls into place (refer to Figure 551-88L-2043\_11).



Figure 551-88L-2043\_11  
Replace disc stack

(f) Place the top disc on the disc stack and rotate the disc stack until it falls into place (refer to Figure 551-88L-2043\_12).

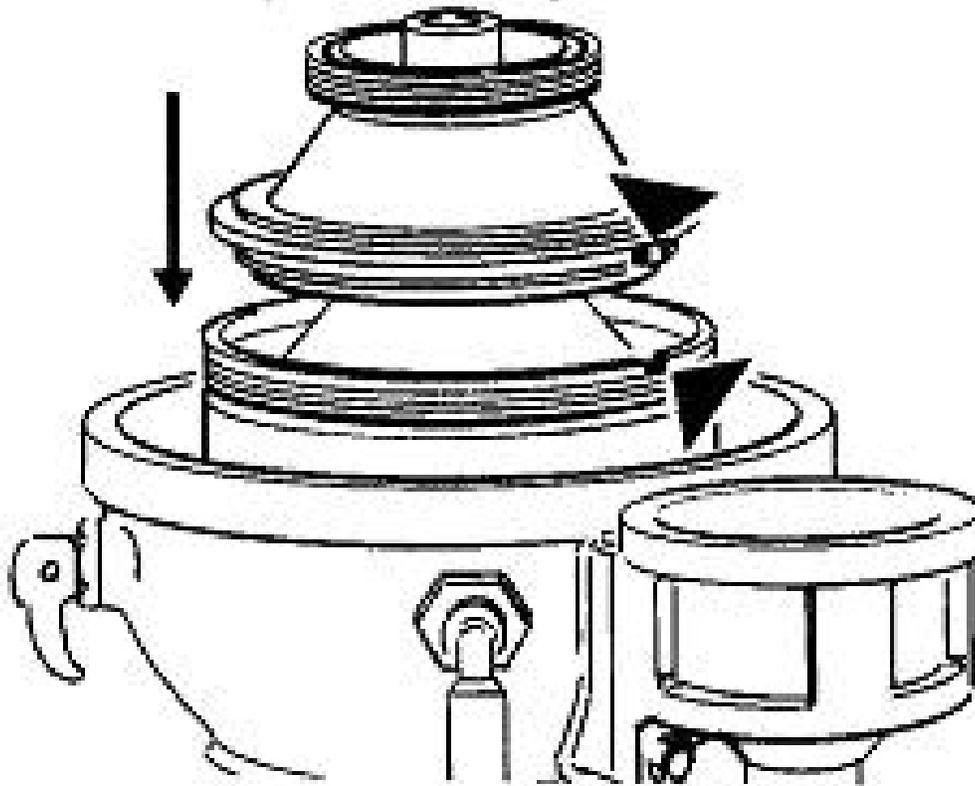


Figure 551-88L-2043\_12  
Replace top disc

(g) Clean and lubricate the large o-ring with silicon and set it in the groove of the hood.

(h) Place the hood in the bowl, aligning the tab on the hood with the notch in the bowl.

(i) Lightly lubricate the large locking ring with Molykote and install.

(j) Compress the disc stack by tightening the lock ring.

(k) Correct pressure is obtained when it is possible to tighten the lock ring by hand until the -mark on the lock ring is positioned 60° - 90° before the mark on the bowl hood.

(l) Using the dead blow hammer, the large spanner and medium force, drive the lock ring counter clockwise until (refer to Figure 551-88L-2043\_13) The marks on the ring match up to the , marks on the hood (refer to Figure 551-88L-2043\_14).

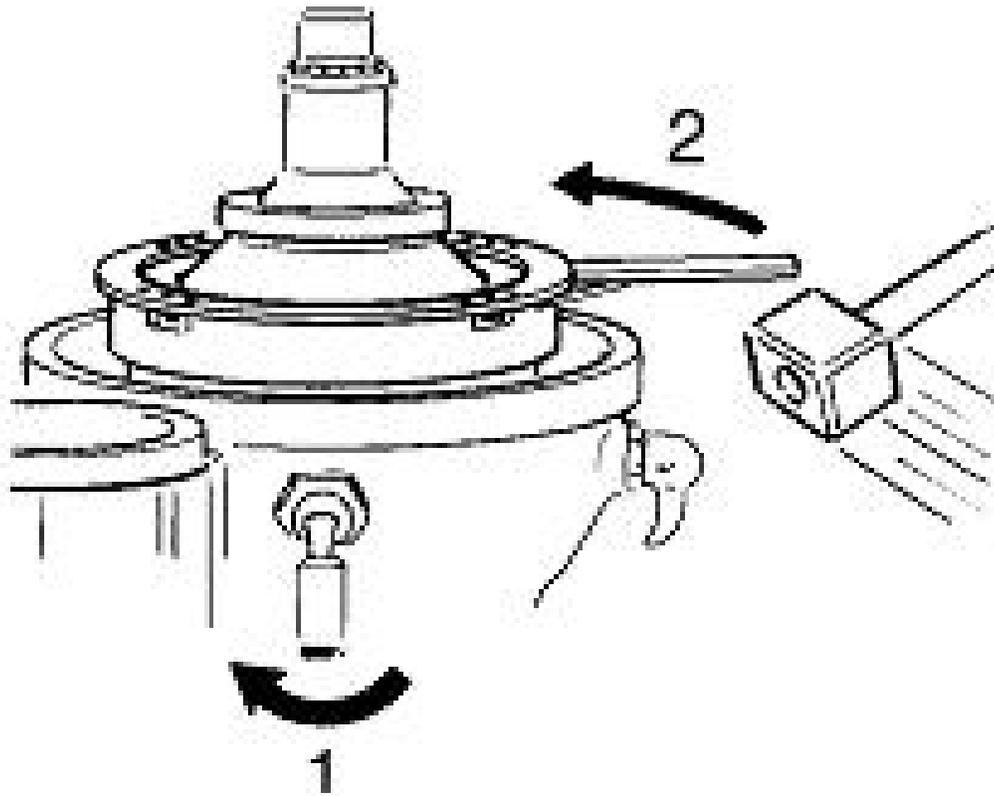


Figure 551-88L-2043\_13  
Replace bowl locking ring

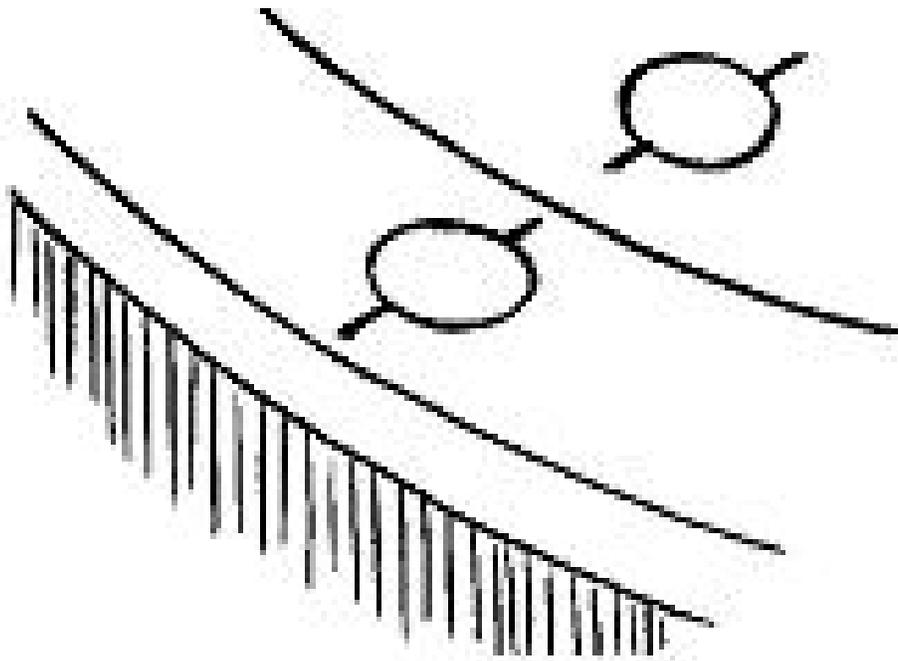


Figure 551-88L-2043\_14  
Alignment marks

(m) Clean and lubricate the small o-ring with silicon and insert it in the hood's top groove.

(n) Replace the gravity disc.

- (o) Lightly lubricate the threads of the small locking ring with Molykote and install.
  - (p) Using the small spanner moderately tighten the locking ring.
  - (q) Release the locking screws.
  - (r) Rotate the bowl assembly by hand to check for grinding, roughness or other trouble.
- (6) Close the collecting cover.
- (7) Tighten the cover clamp bolts.
- c. Remove the lockout on the power supply to the motor controller.
6. Perform hourly maintenance on a purifier.
- a. Switch off and lock out the power supply to the motor controller.
  - b. Every 800 Operating Hours. Change worm gear housing oil (refer to Figure 551-88L-2043\_15).
    - (1) Drain the oil from the worm gear housing.
      - (a) Place a collecting tray under the drain hole.
      - (b) Remove the drain plug and drain off the oil.
    - (2) Fill worm gear housing with new oil.
      - (a) The oil level should be slightly above the middle of the sight glass.
      - (b) For quality and quantity see Lubrication Schedule in Operator's Manual.
    - (3) In new installations, change the oil the first time after 300 hours of operation.
    - (4) In seasonal operation change the oil before every period of operation.

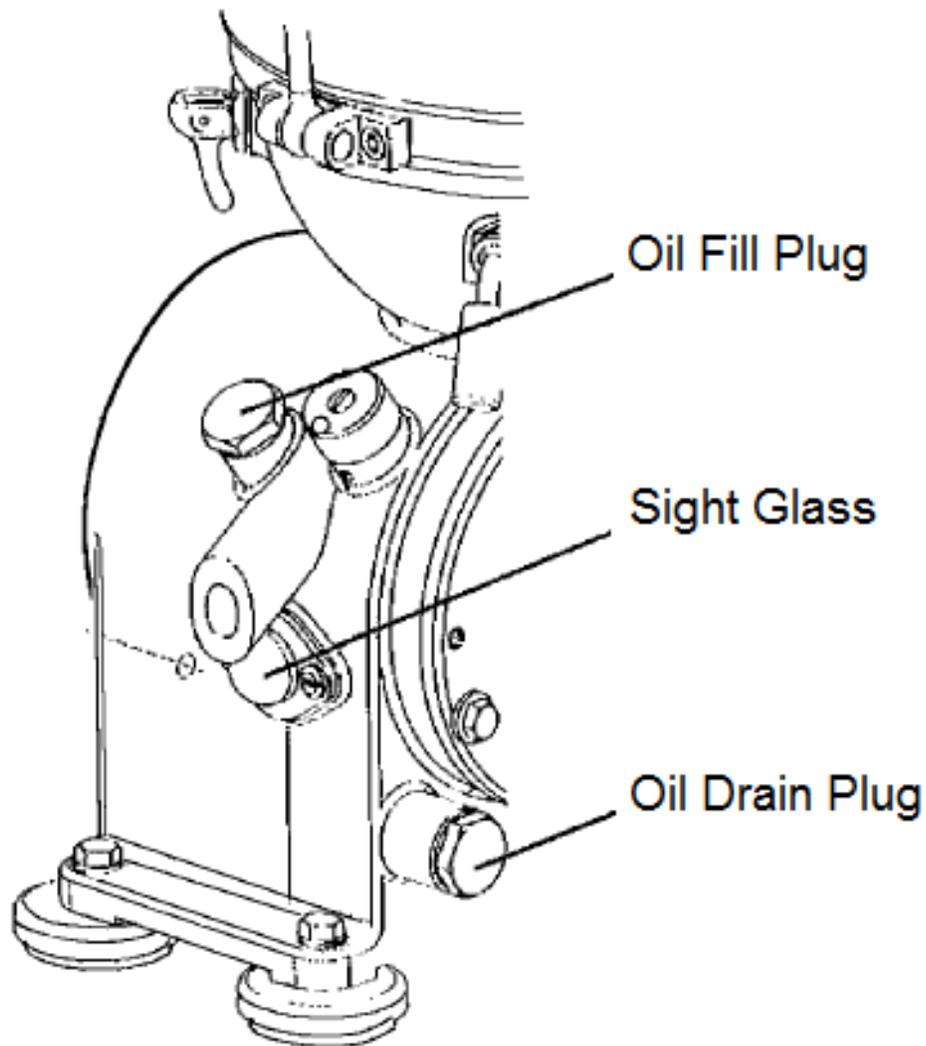


Figure 551-88L-2043\_15  
Oil fill, drain and sight glass

- c. Remove the lockout on the power supply to the motor controller.
7. Perform annual maintenance on a purifier.
- a. Switch off and lock out the power supply to the motor controller.
  - b. Disassemble and conduct a complete machine overhaul.
    - (1) Remove and clean the separator bowl assembly in accordance with the monthly maintenance.
    - (2) Check for signs of:
      - (a) Corrosion
      - (b) Erosion
      - (c) Cracks
    - (3) Check threads of large lock ring and bowl body. Refer to paragraph 4.b, Bowl Lock Ring.

(4) Check disc set pressure. Insufficient pressure in the disc set may affect the bowl balance, which in turn will cause abnormal machine vibration.

(a) The lock ring (refer to Figure 551-88L-2043\_16 #1) should press the bowl hood (refer to Figure 551-88L-2043\_16 #2) firmly against the bowl body (refer to Figure 551-88L-2043\_16 #3), the hood in turn should exert a pressure on the disc set (refer to Figure 551-88L-2043\_16 #4) clamping the latter in place.

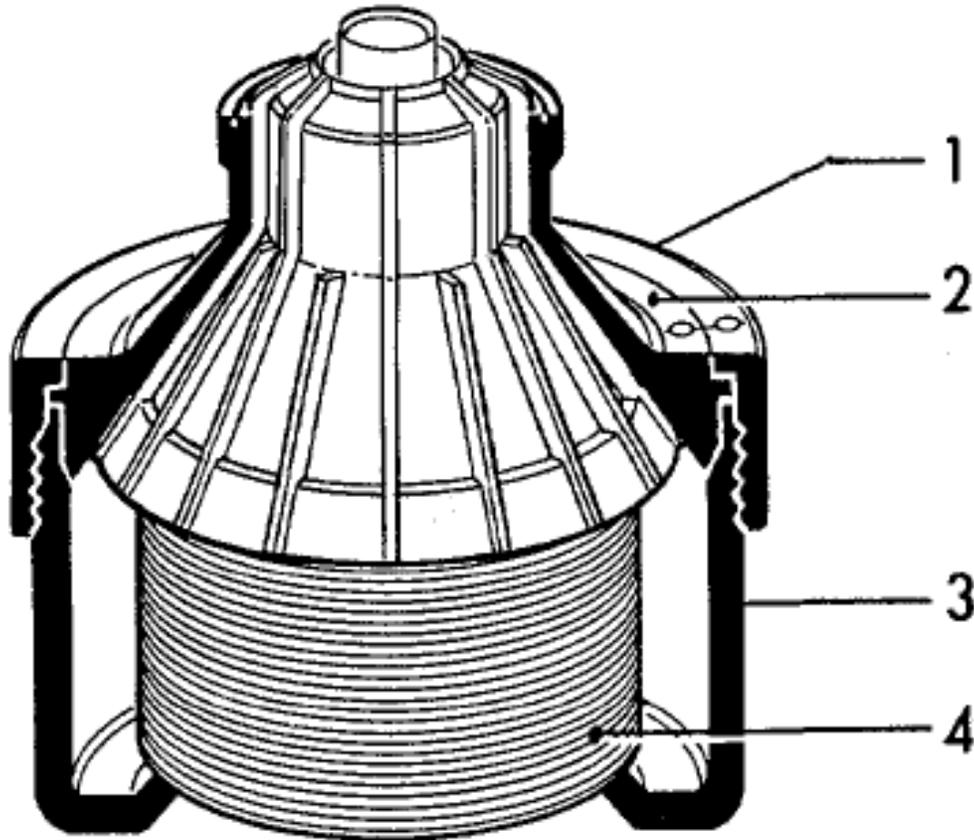


Figure 551-88L-2043\_16  
Checking disc stack pressure

(b) If the Bowl Lock Ring thread check is satisfactory, and if the lock ring can be tightened without resistance until the bowl hood lies tightly against the bowl body, increase the pressure by adding one or more discs to the top of bowl disc set beneath the top disc, (refer to Figure 551-88L-2043\_17).

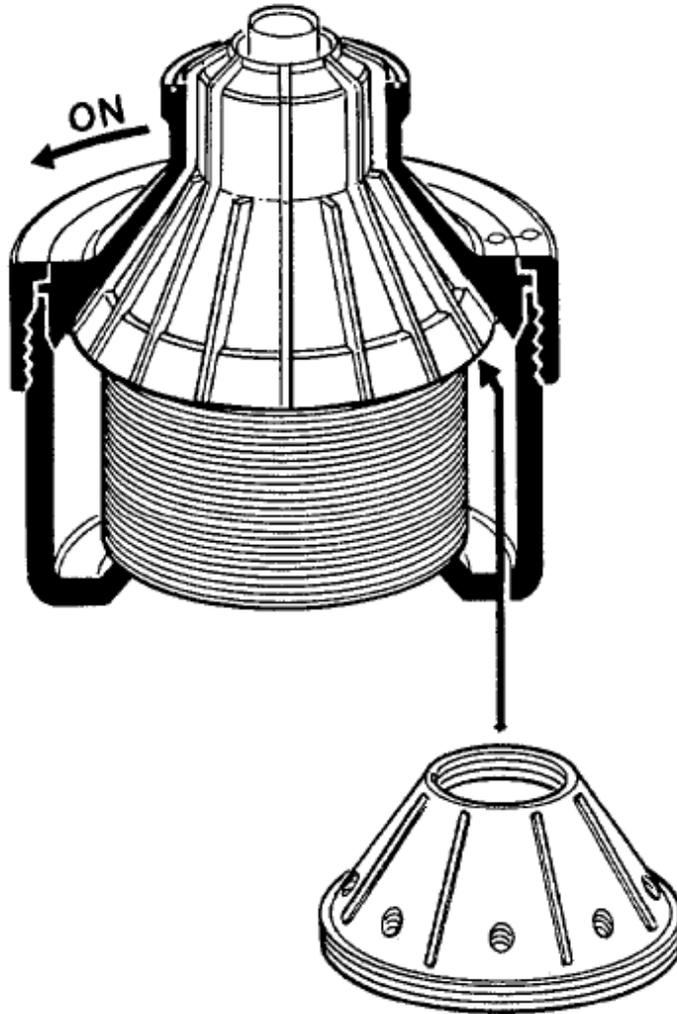


Figure 551-88L-2043\_17  
Increasing disc pressure

(5) Remove the pipe connections of the pump.

(6) Screw off the lock ring of the sight glass. Remove the upper gasket and the sight glass. (refer to Figure 551-88L-2043\_18).

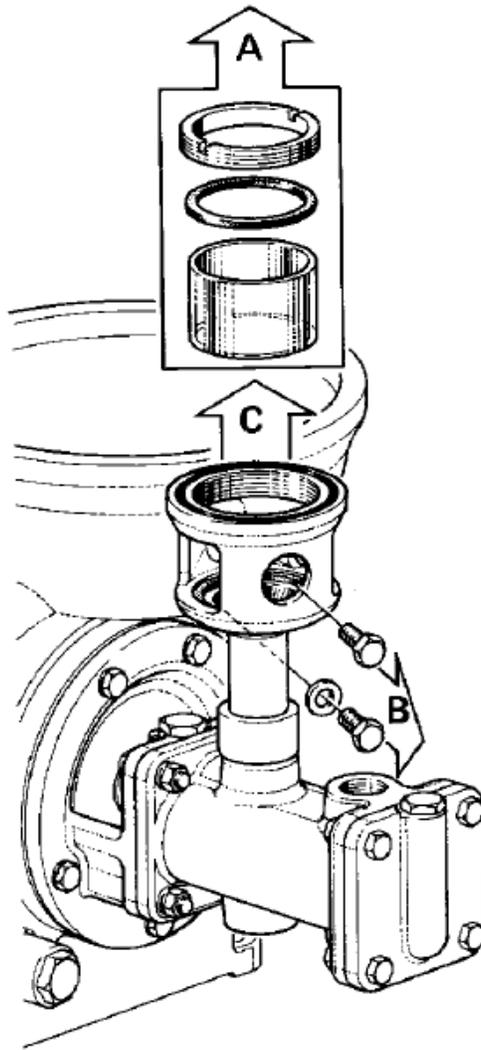


Figure 551-88L-2043\_18  
Removing outlet parts

(7) Check radial wobble of bowl spindle. Excessive spindle wobble is indicated by rough bowl run (vibration).

(a) Measure the wobble at the top of the spindle tapered end. Highest permissible radial wobble: 0.15 mm, (refer to Figure 551-88L-2043\_19).

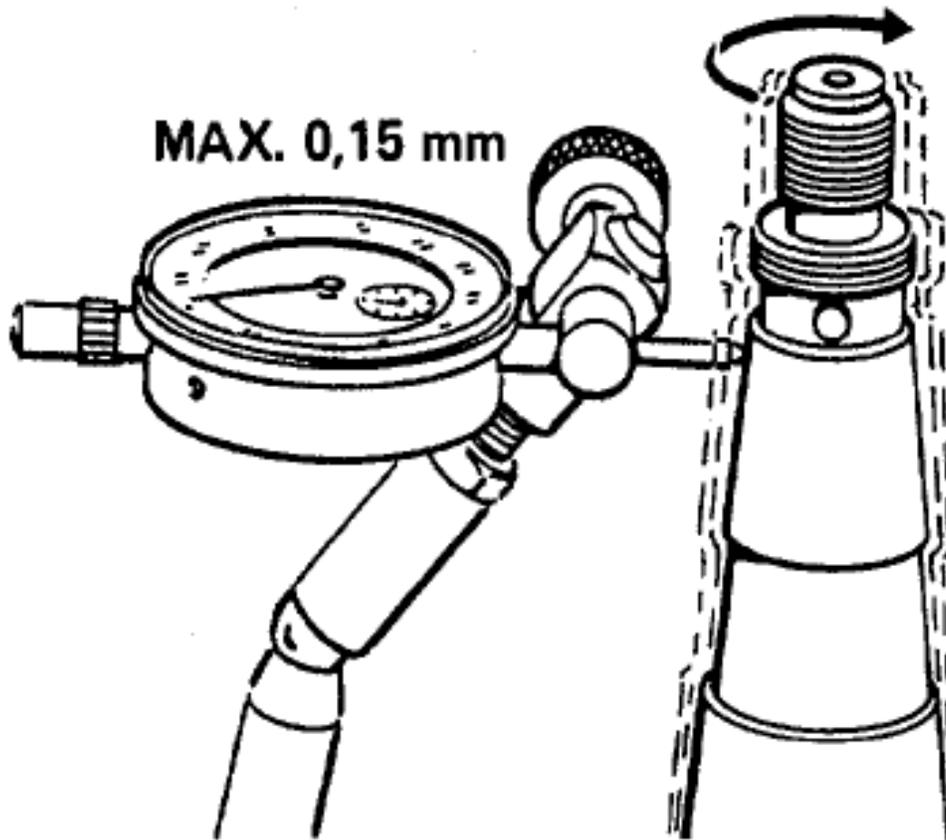


Figure 551-88L-2043\_19  
Checking spindle wobble

(b) First check the wobble before stripping the spindle. If wobble is too large: replace ball bearings in top and bottom bearings.

(c) Repeat measuring procedure after assembly. If wobble is still too large, the spindle is probably damaged and must be replaced.

(d) During indication the spindle must be revolved by means of the worm wheel shaft. Before measuring make sure the buffer plugs are properly tightened, refer to Top bearing springs, paragraph 5.c.v.

\_1\_ Remove the motor to get access to the coupling drum.

\_2\_ Use the coupling drum to revolve the spindle manually.

(8) Drain the oil.

(9) Remove the feed / discharge pump assembly.

(a) Drive out the tubular pin (refer to Figure 551-88L-2043\_20 #1) of the sheer pin coupling, using special tool (refer to 551-88L-2043\_20 #2).

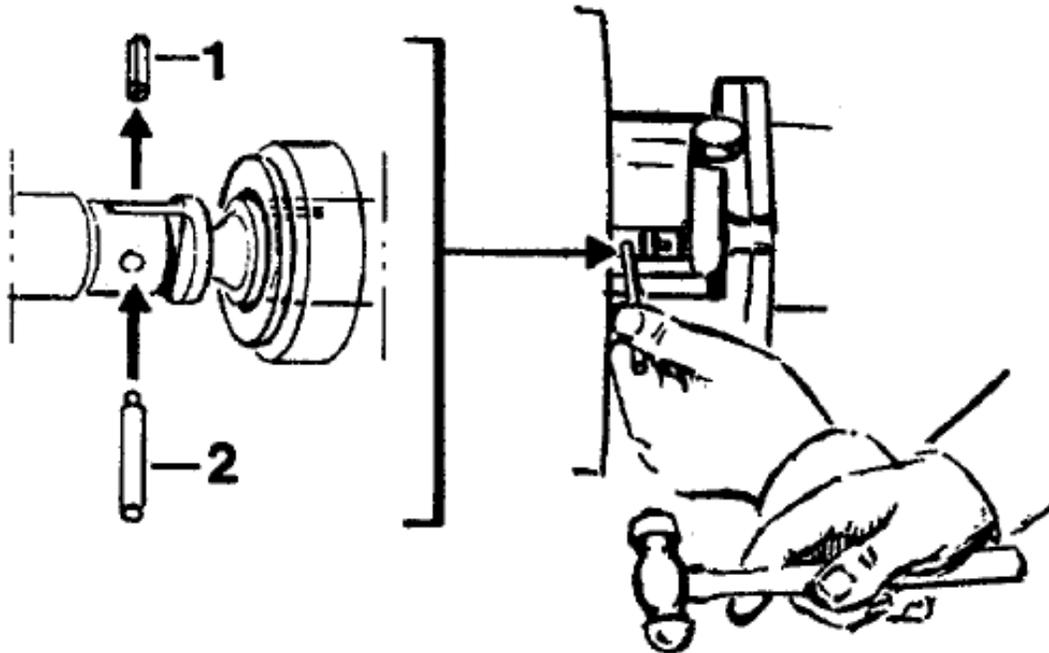


Figure 551-88L-2043\_20  
Shear pin removal

- (b) Remove the sleeve enclosing the pump shaft.
  - (c) Make sure the impeller shaft can be revolved by hand.
  - (d) Remove the bolts holding the pump to the purifier housing.
- (10) Examine the feed / discharge pump assembly.
- (a) Examine the valve cone and valve seat, (refer to Figure 551-88L-2043\_21).

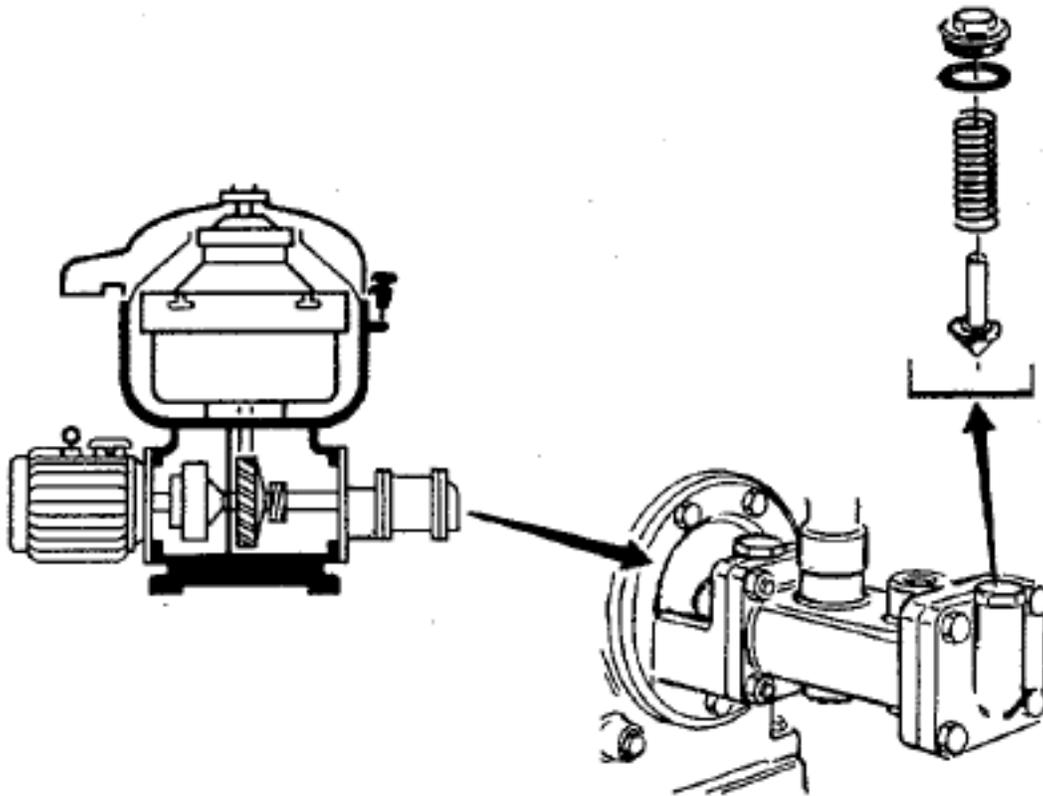


Figure 551-88L-2043\_21  
Valve cone and Valve seat

(b) Bushings. Exchange the bushings if they are scratched or there is a play between the shaft and bushings, (refer to Figure 551-88L-2043\_22 #1).

(c) Wearing seals. Replace the seals if the surface is rough, cracked, or dented by the impeller, (refer to Figure 551-88L-2043\_22 #2).

(d) Lipseal rings. Replace the rings at the annual overhaul, ensuring the rings are turned the right way, (refer to Figure 551-88L-2043\_22 #3).

(e) Shear pin coupling. Replace the shear pin coupling upon reassembly, (refer to Figure 551-88L-2043\_22 #4).

(f) Impeller shaft. Check the groove in the impeller shaft, (refer to Figure 551-88L-2043\_22 #5).

(g) Disengagement. The feed pump can be disengaged by turning the impeller (refer to Figure 551-88L-2043\_22 #6) thereby placing the diving blade of the impeller in the recess of the shield.

(h) Axial Play. The total axial play must be 0.1 – 0.3 mm. If the play is too large even though the wearing seals have been renewed, it can be compensated by adding a brass leaf liner, (refer to Figure 551-88L-2043\_22 #7).

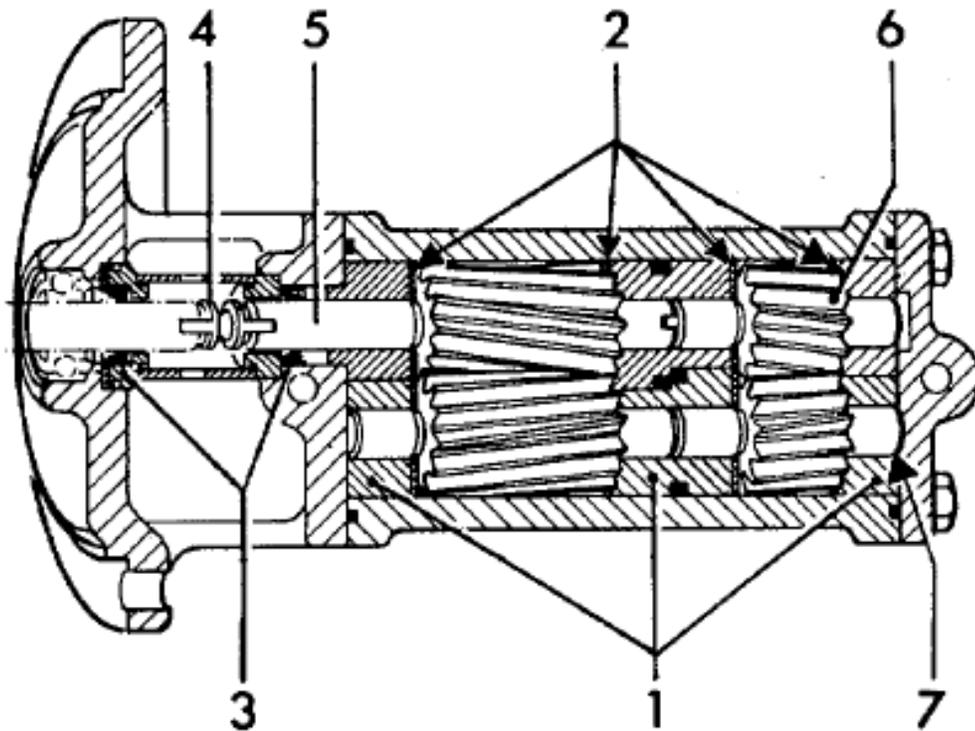


Figure 551-88L-2043\_22  
Feed / Discharge pump

(11) Loosen the screw for the revolution counter and pull out the revolution counter, (refer to Figure 551-88L-2043\_23).

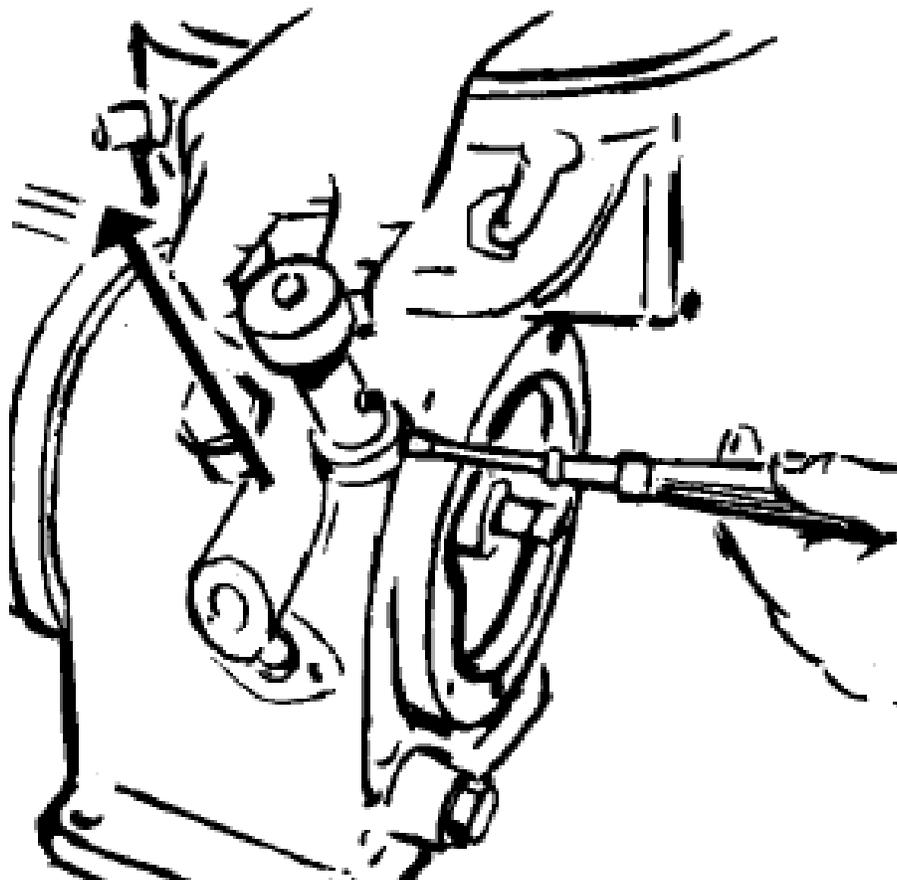


Figure 551-88L-2043\_23  
Removing revolution counter

(12) Force out the conical pin, using a tin hammer as a holder-on for the worm wheel shaft, (refer to Figure 551-88L-2043\_24).

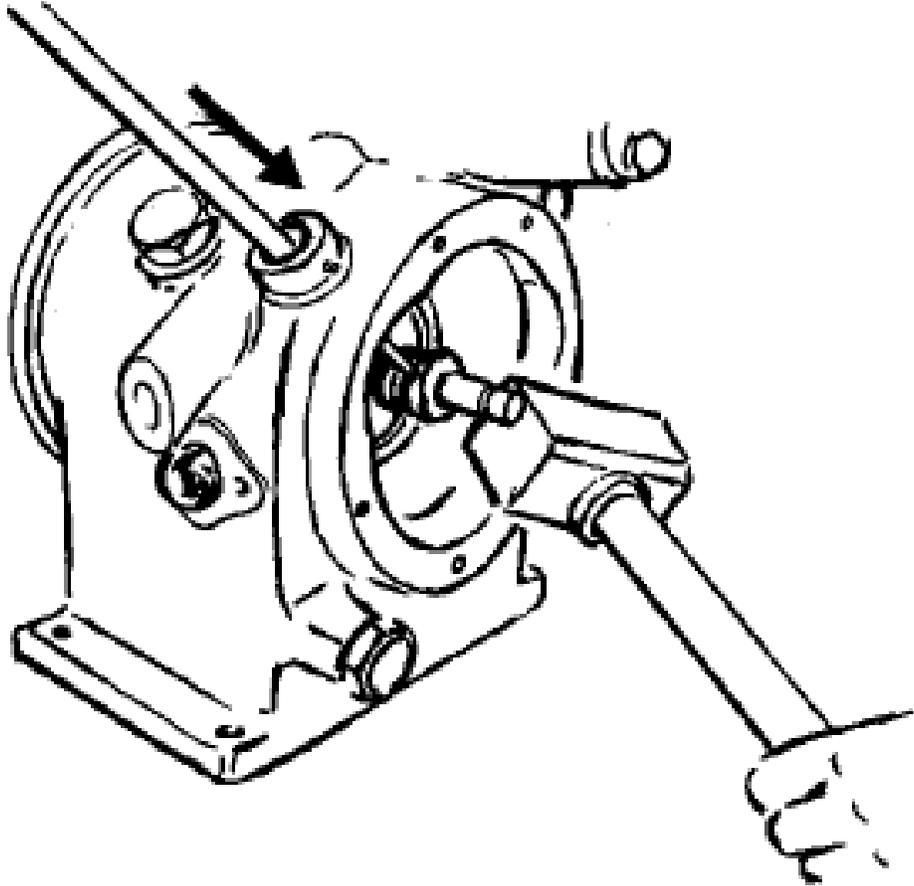


Figure 551-88L-2043\_24  
Remove conical pin

(13) Use the puller-tool to first pull off the bearing and then the worm wheel, (refer to Figure 551-88L-2043\_25).

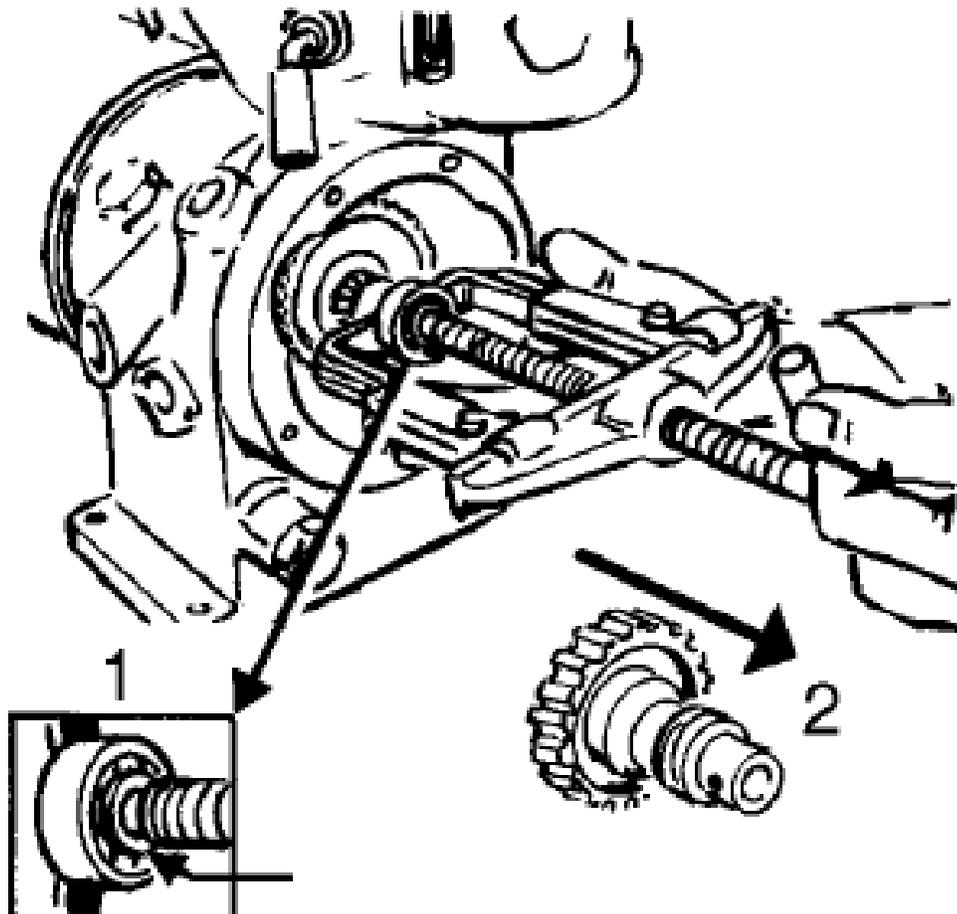


Figure 551-88L-2043\_25  
Removing worm wheel

(14) Loosen the top bearing holder, (refer to Figure 551-88L-2043\_26).

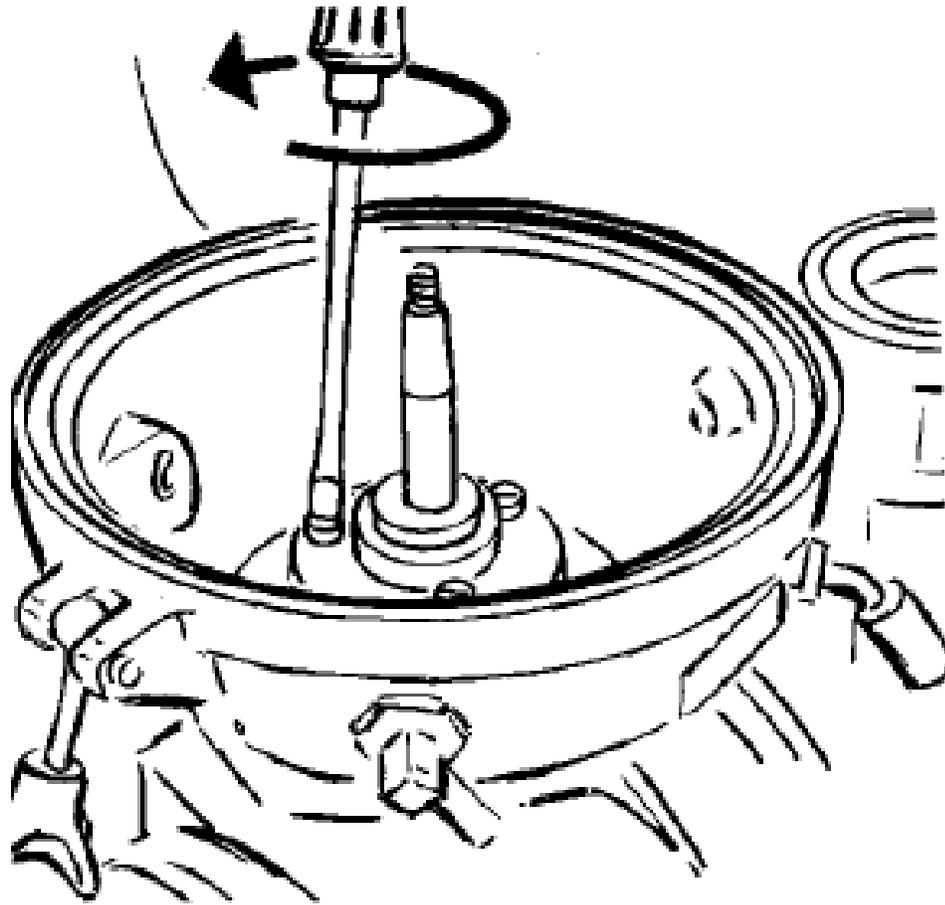


Figure 551-88L-2043\_26  
Loosen bearing holder

(15) Fit the cap nut to the spindle top and lift the spindle, (refer to Figure 551-88L-2043\_27).

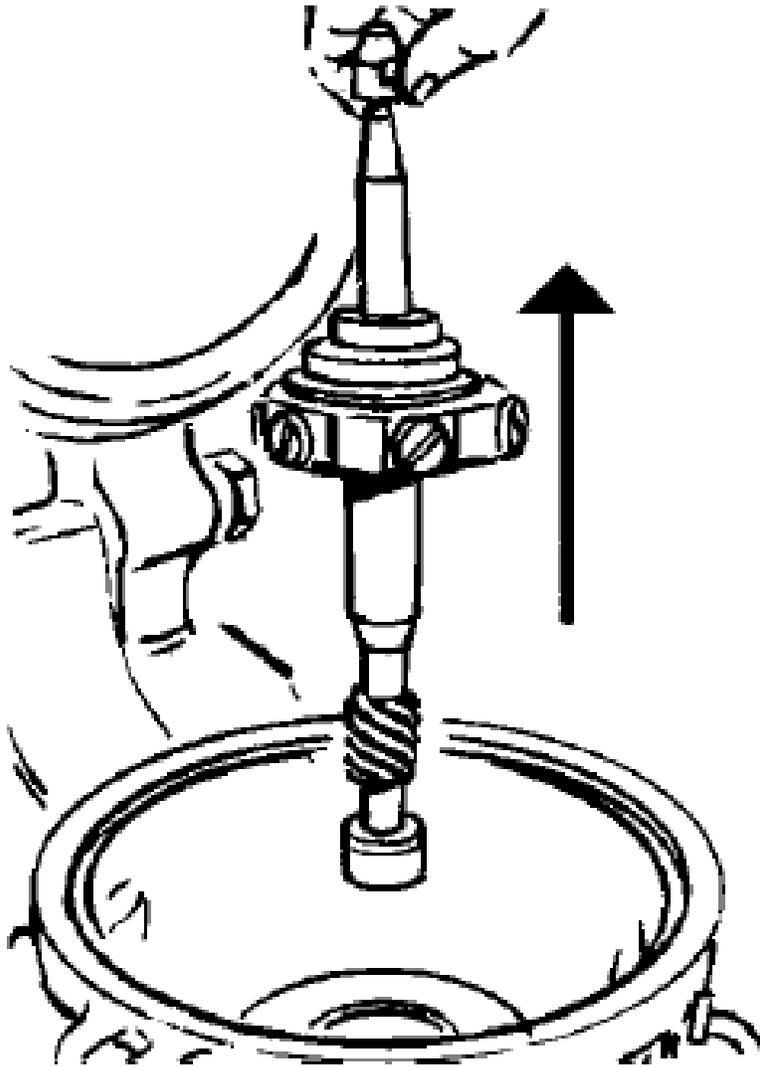


Figure 551-88L-2043\_27  
Lifting the spindle

(16) Use the puller-tool to remove the bottom bearing from the spindle, (refer to Figure 551-88L-2043\_28).

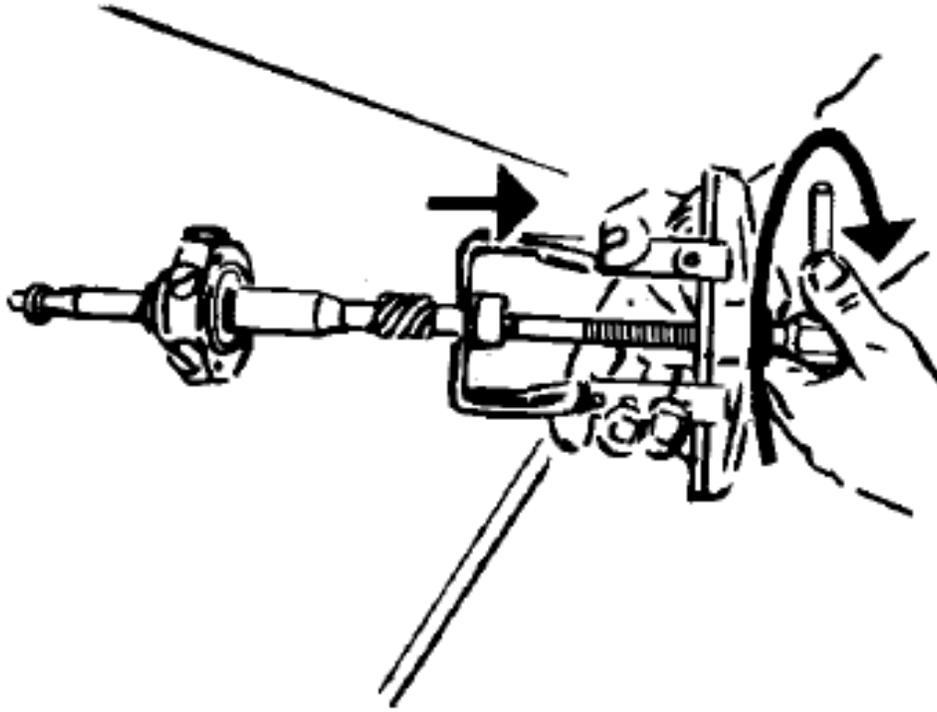


Figure 551-88L-2043\_28  
Removing spindle bearing

(17) Loosen and check top bearing springs and ball bearing housing.

(a) Weakened or broken buffer springs as well as defective contact surfaces for the buffers on the ball bearing housing may give rise to machine vibration (rough bowl running).

(b) Springs. The condition (stiffness) of a spring can hardly be determined without using special testing equipment. So, an estimation of the spring condition must be based on the knowledge of the machine run before the overhaul. It is recommended, however, to replace all the springs at the annual overhaul. In case of a sudden spring fracture, the complete set should be replaced even when only one spring has broken.

(c) Ball Bearing Housing. Examine the contact surface for the buffers on the ball bearing housing. In case of defects (indentations deeper than 0.1 mm) replace the buffers (refer to Figure 551-88L-2043\_29 #1), springs (refer to Figure 551-88L-2043\_29 #2), and housing (refer to Figure 551-88L-2043\_29 #3).

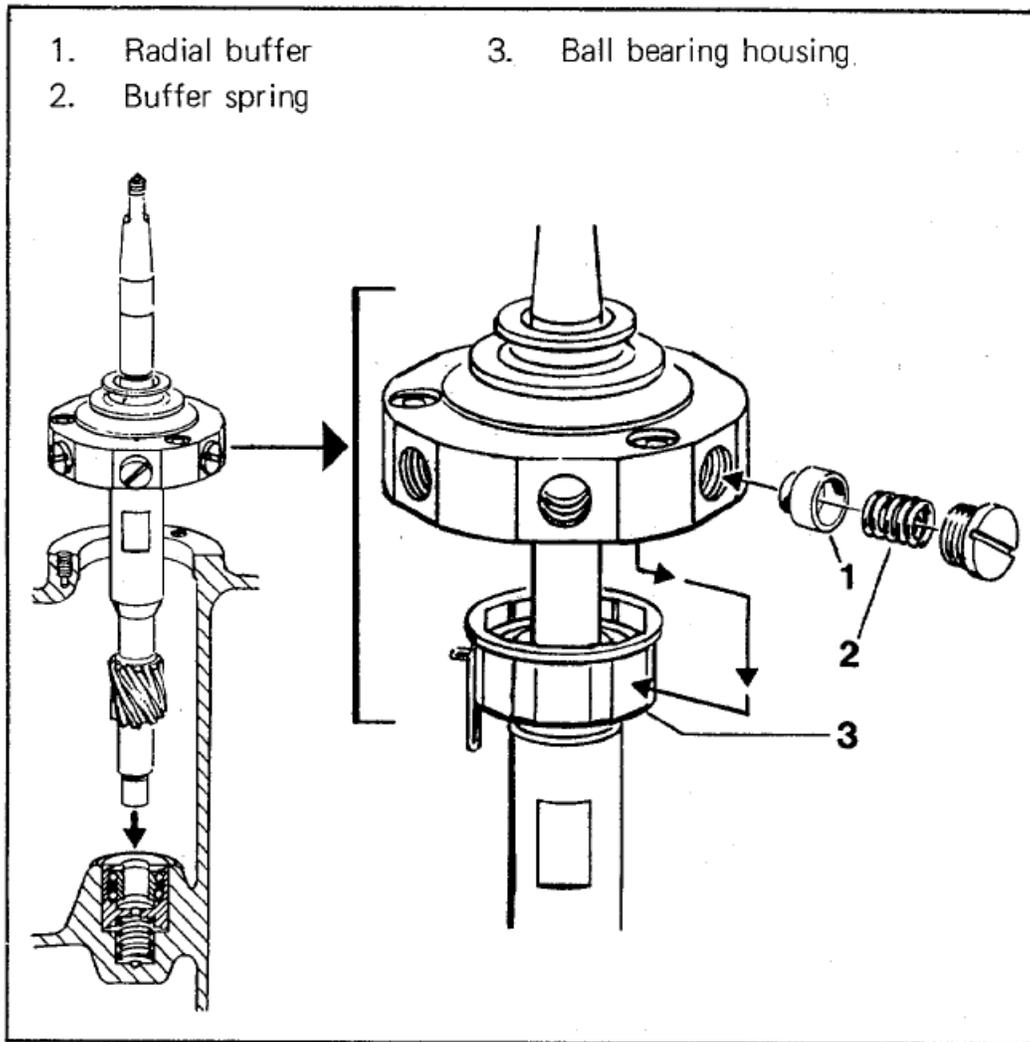


Figure 551-88L-2043\_29  
Top bearing springs and housing

(18) Pull off the upper ball bearing (together with sleeve), (refer to Figure 551-88L-2043\_30).  
Note: Always discard a used bearing after removal.

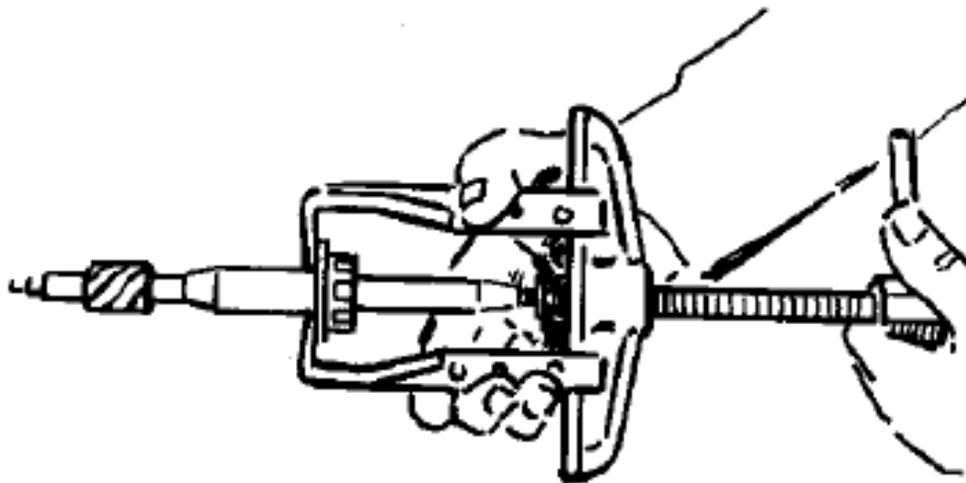


Figure 551-88L-2043\_30  
Remove upper bearing

(19) Check the teeth of worm wheel and worm for wear.

- (a) Examine the contact surfaces and compare the tooth profiles.
- (b) The gear may work satisfactorily even when worn to some degree.
- (c) Presence of metal chips in the oil bath is an indication that the worm wheel is subjected to abnormal wear.
- (d) Replace worm wheel and worm at the same time, even when only one of the parts is considerably worn.
- (e) Examples of various tooth appearances after operation:

1 Satisfactory teeth. Uniform wear of contact surfaces. Surfaces are smooth. Good contact surfaces will form on the teeth when the gearing is subjected only to moderate load during a running-in period, (refer to Figure 551-88L-2043\_31).

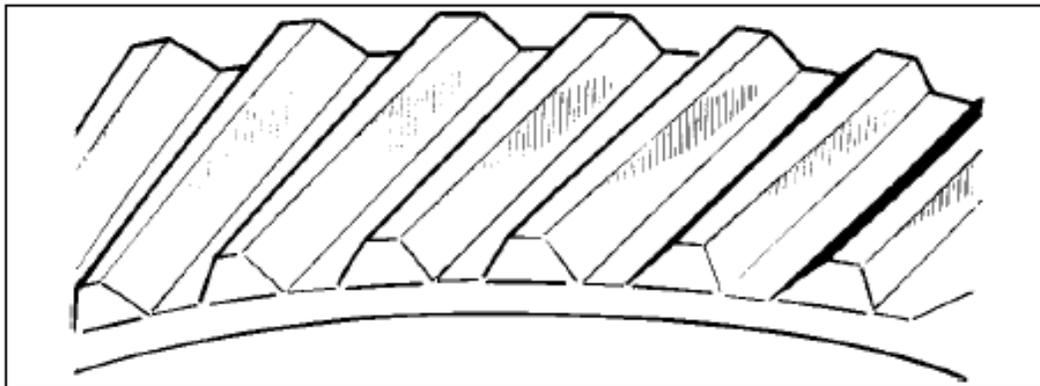


Figure 551-88L-2043\_31  
Satisfactory teeth

2 Worn teeth. Tooth wear, sometimes occurring only on some of the teeth. If the wear has advanced as far as shown in the illustration, replace worm wheel and worm, (refer to Figure 551-88L-2043\_32).

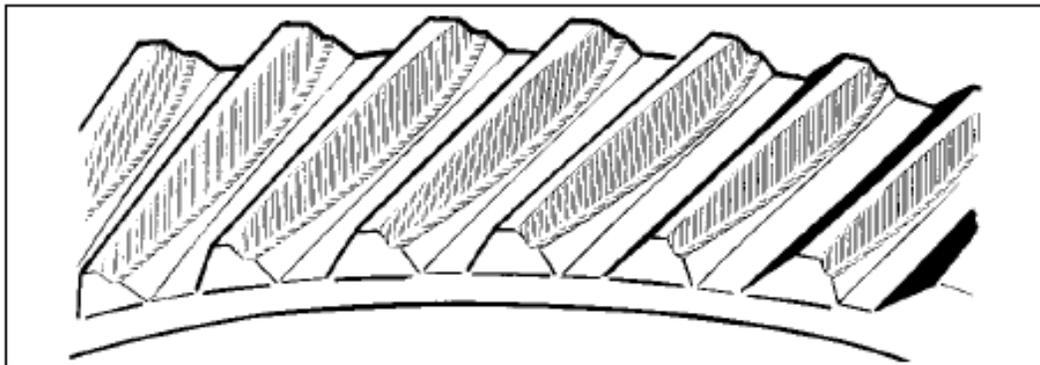


Figure 551-88L-2043\_32  
Worn teeth

3 Spalling. Small bits of the teeth have split off, so-called spalling. Generally due to excessive load or improper lubrication. Damage of this type need not necessitate immediate replacement, but carefully checking at short intervals is imperative, (refer to Figure 551-88L-2043\_33).

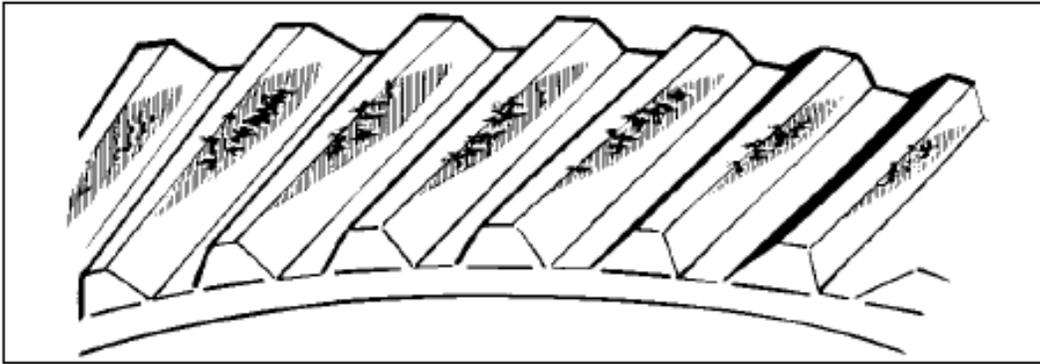


Figure 551-88L-2043\_33  
Spalling

4 Pitting. Small cavities in the teeth, so-called pitting. Can occur through excessive load or improper lubrication. Damage of this type need not necessitate immediate replacement, but careful checking at short intervals is imperative, (refer to Figure 551-88L-2043\_34).

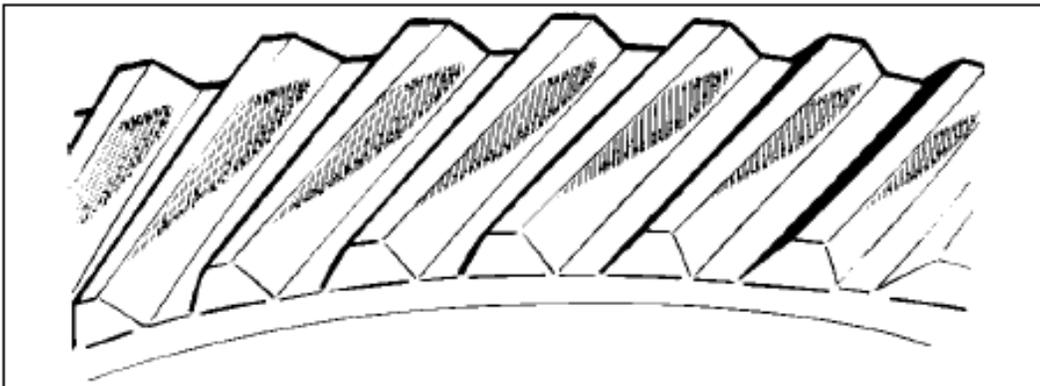


Figure 551-88L-2043\_34  
Pitting

(20) Remove the motor.

(21) Renew the pads on the friction blocks.

(a) If the friction elements are only greasy: clean the friction elements and the inside of the coupling drum with a degreasing agent.

(b) When refitting the blocks make sure the arrow on each block points in the same direction as the arrow on the frame, that is in the direction of rotation, (refer to Figure 551-88L-2043\_35).

(c) Secure the blocks with washer and split pins.

(d) Replace all friction pads even if only one is worn.

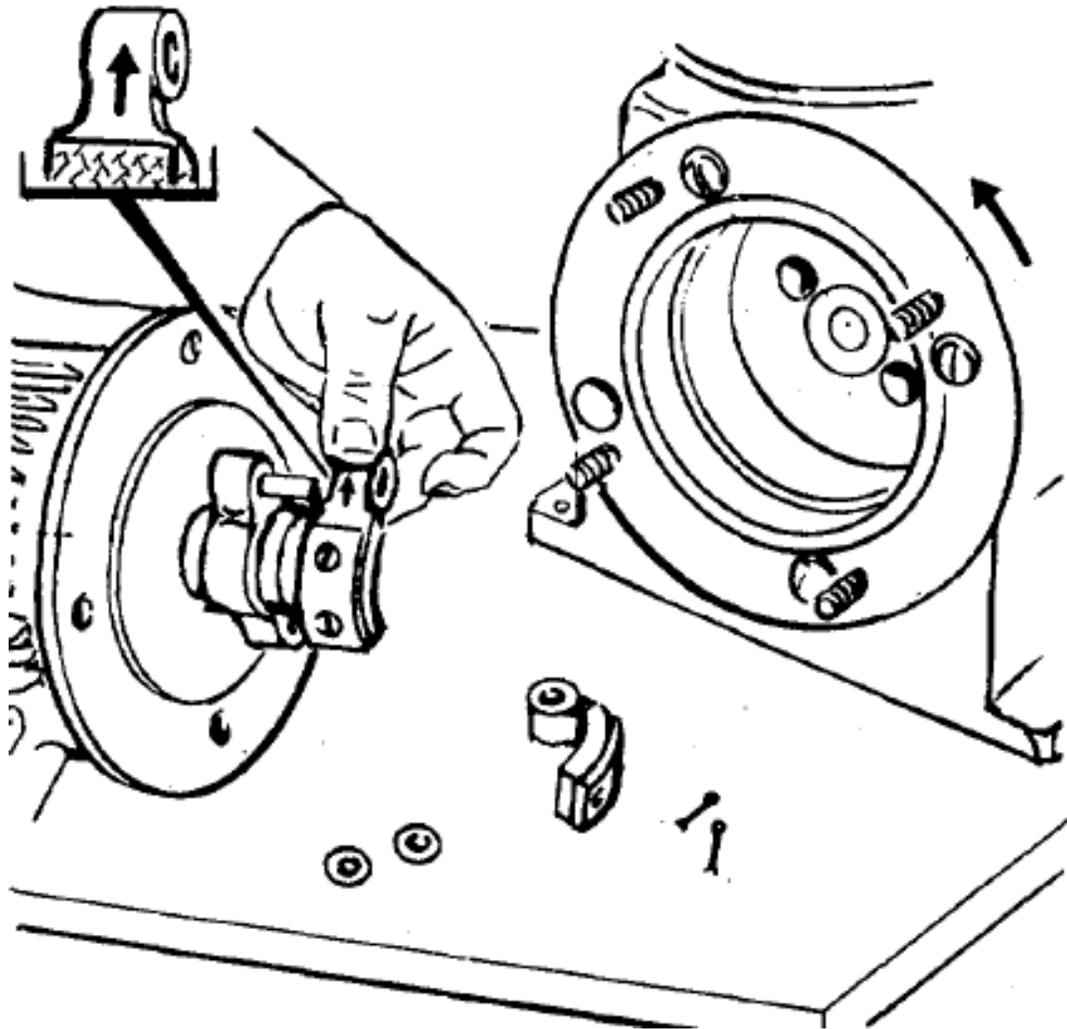


Figure 551-88L-2043\_35  
Friction pads

(22) Loosen the three screws holding the sealing washer. Use a hexagon key, (refer to Figure 551-88L-2043\_36).

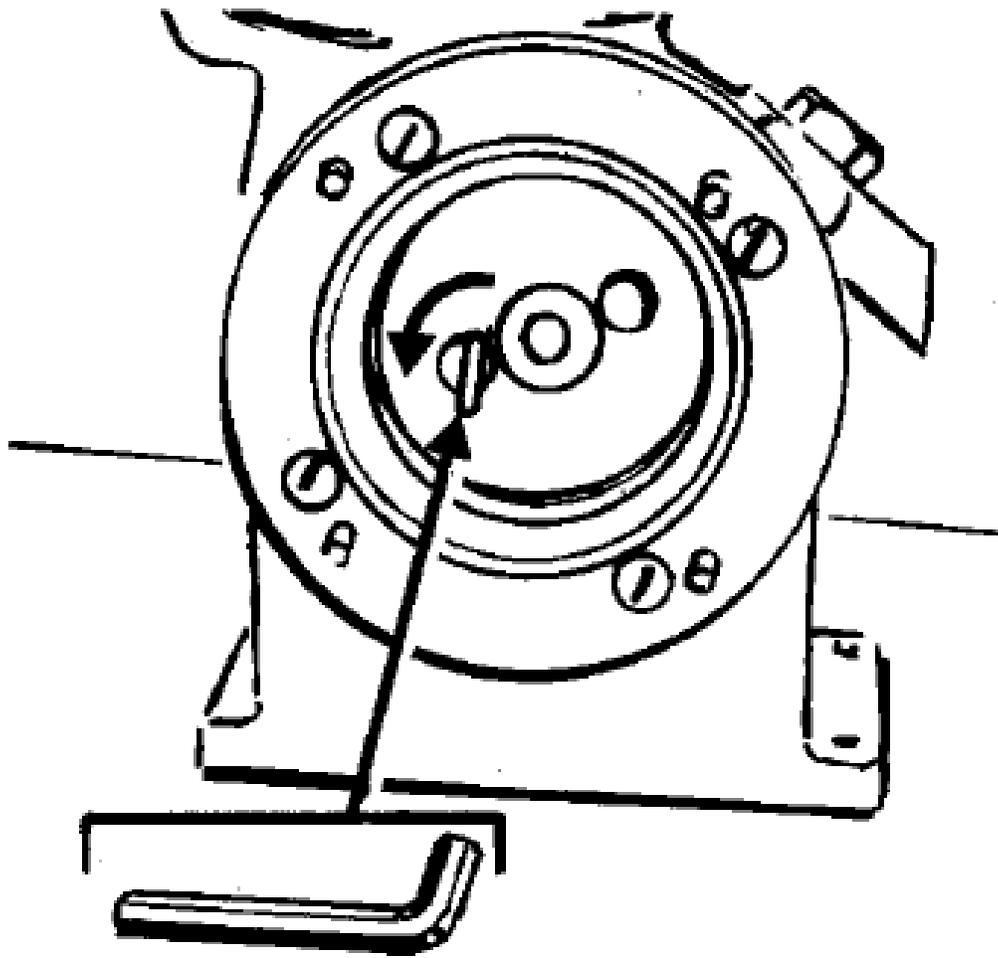


Figure 551-88L-2043\_36  
Removing sealing washer

(23) Remove the worm wheel shaft, (refer to Figure 551-88L-2043\_37).

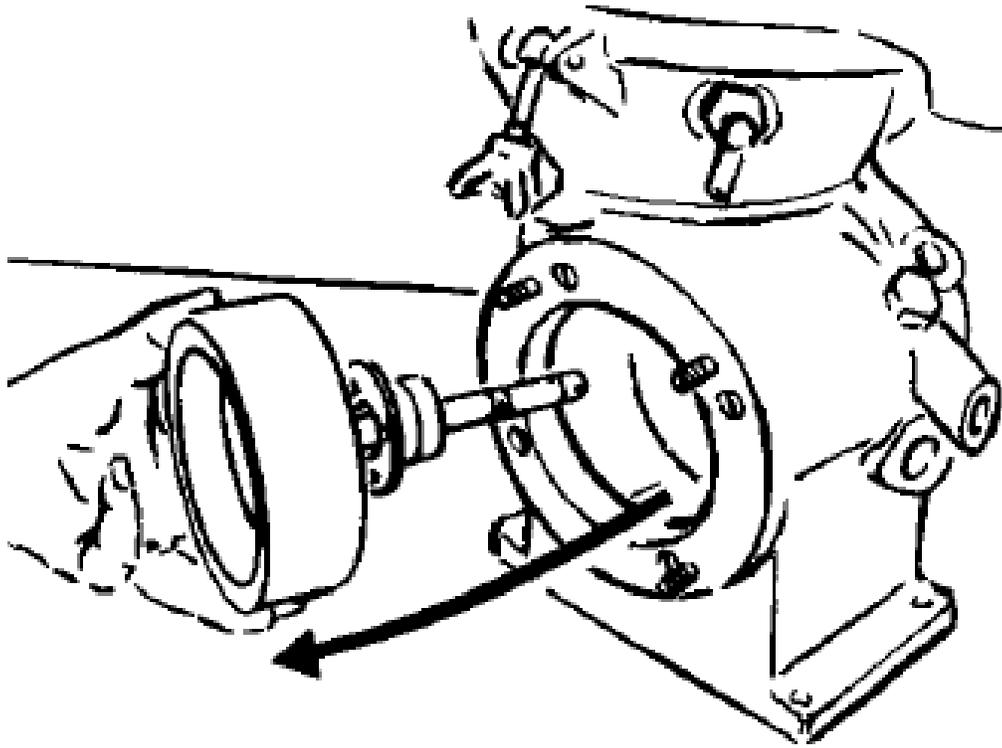


Figure 551-88L-2043\_37  
Removing worm wheel

(24) Use the puller tool to pull off the sealing washer. Protect end of worm wheel shaft with a washer, (refer to Figure 551-88L-2043\_38).

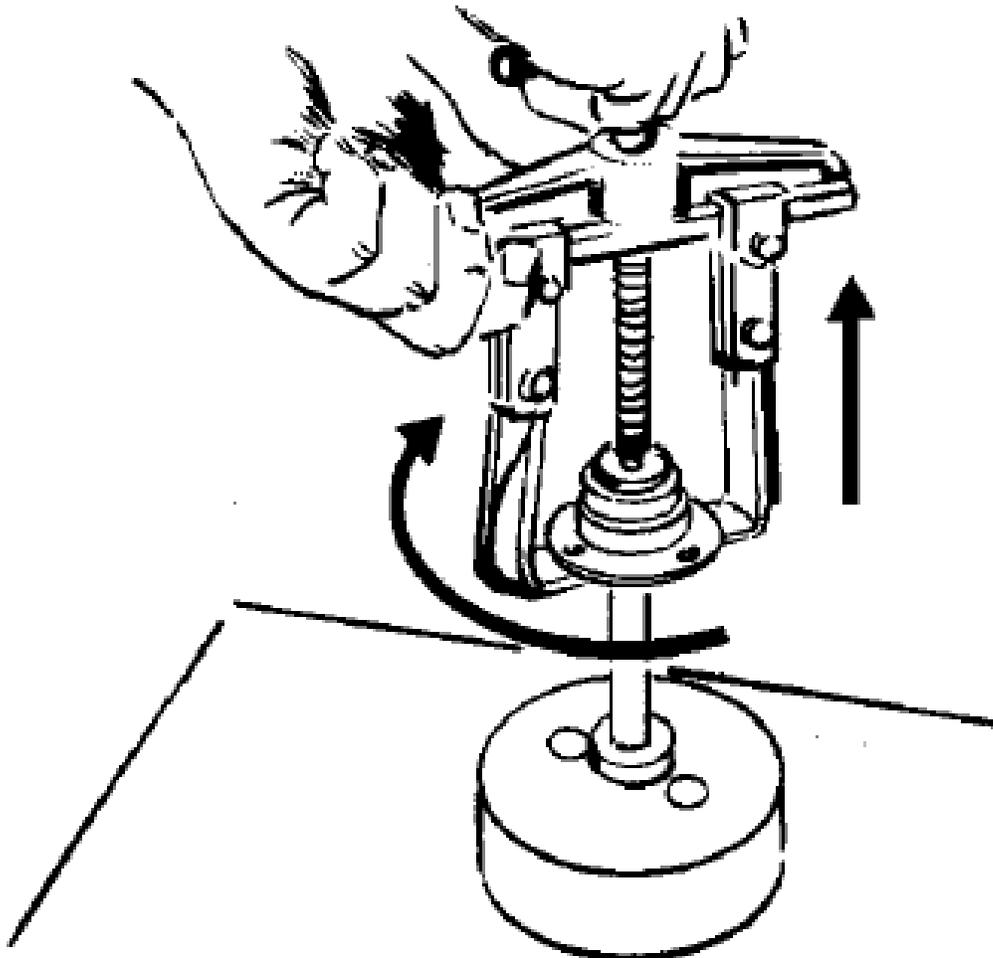


Figure 551-88L-2043\_38  
Removing seal

(25) To replace coupling drum or worm wheel shaft force out the spring pin and gently knock out the shaft, (refer to Figure 551-88L-2043\_39).

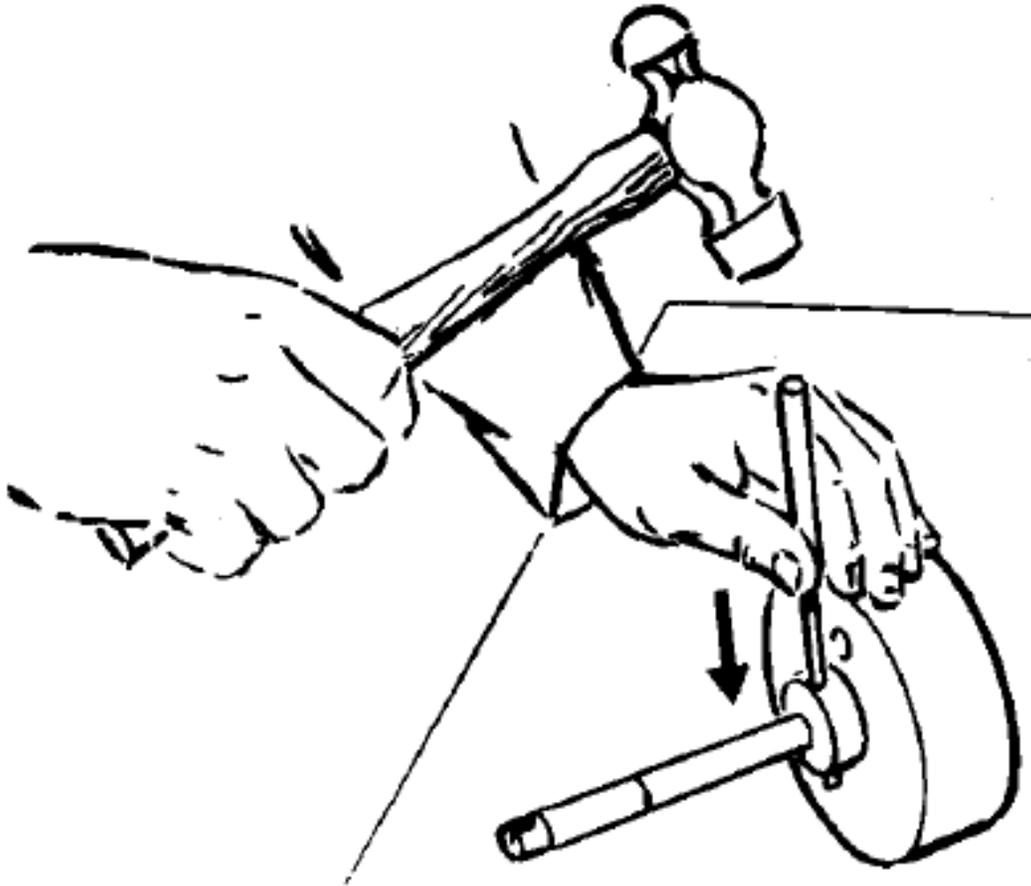


Figure 551-88L-2043\_39  
Replace coupling drum

(26) Knock out the horizontal spindle, (refer to Figure 551-88L-2043\_40).

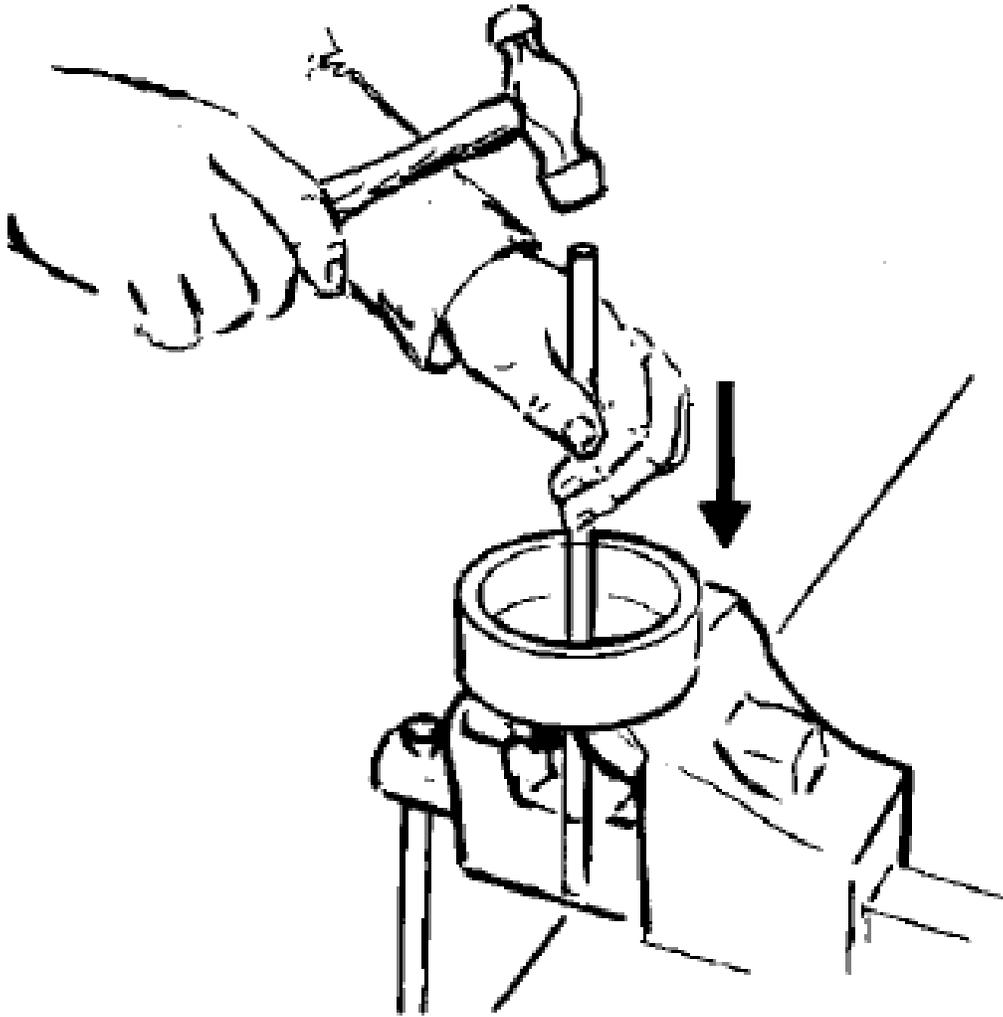


Figure 551-88L-2043\_40  
Knockout spindle

(27) Check the brake plug.

(a) A worn brake plug will cause a long braking period.

(b) Replace the plug when the friction material has worn down to 0.5 mm (refer to Figure 551-88L-2043\_41).

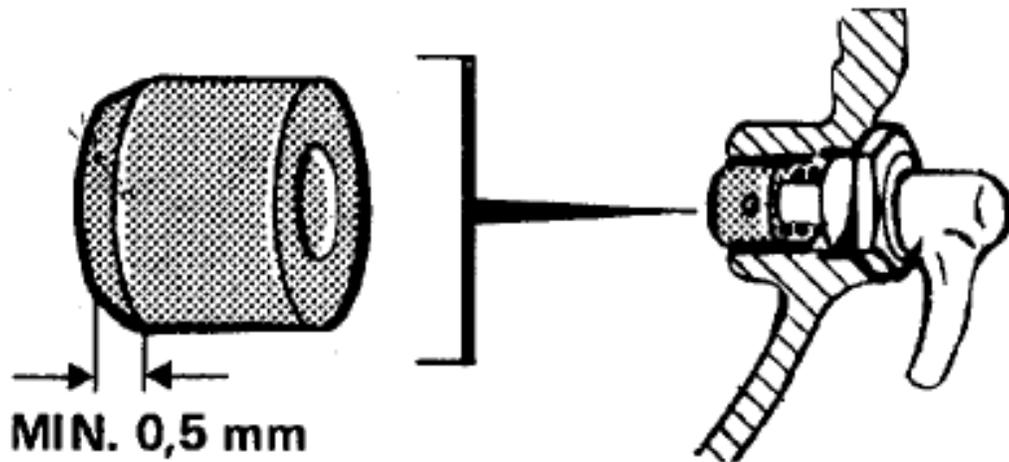


Figure 551-88L-2043\_41  
Brake Plug

c. Reassemble the purifier.

- (1) Clean all parts in a degreasing agent and replace parts supplied in the Spare parts kits.
- (2) Before assembling the bowl spindle, make sure the relevant checks have been carried out.
- (3) Wipe off and oil the bearing seat before fitting the ball bearing.
- (4) Inspect the tapered end of the bowl spindle and assemble ball bearings.
- (5) Heat the new ball bearings in oil to maximum 125 °C.

## CAUTION

Use protective gloves when handling the heated bearings.

- (6) Fit the bearing onto the shaft, (refer to Figure 551-88L-2043\_42).

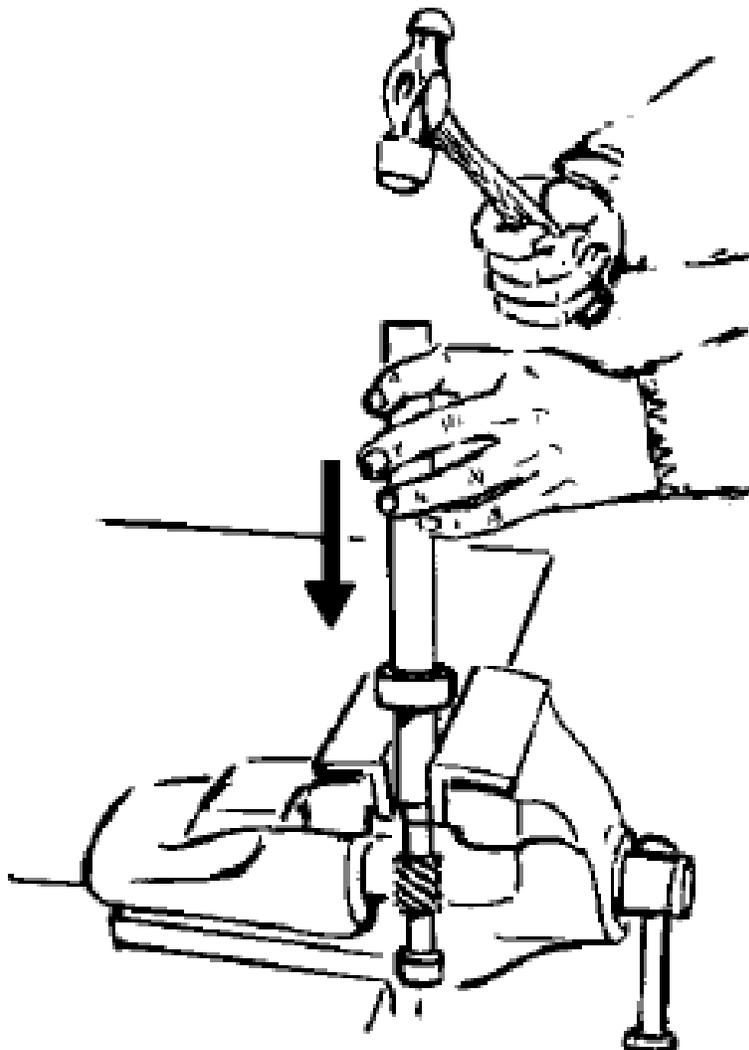


Figure 551-88L-2043\_42  
Fitting the bearing

(7) Reassemble the bearing springs and bearing housing.

(8) Lower the spindle into position. Apply Loctite 242 onto the threads of the screws. Check for impact marks on the spindle cone and in the bowl body nave, (refer to Figure 551-88L-2043\_43).

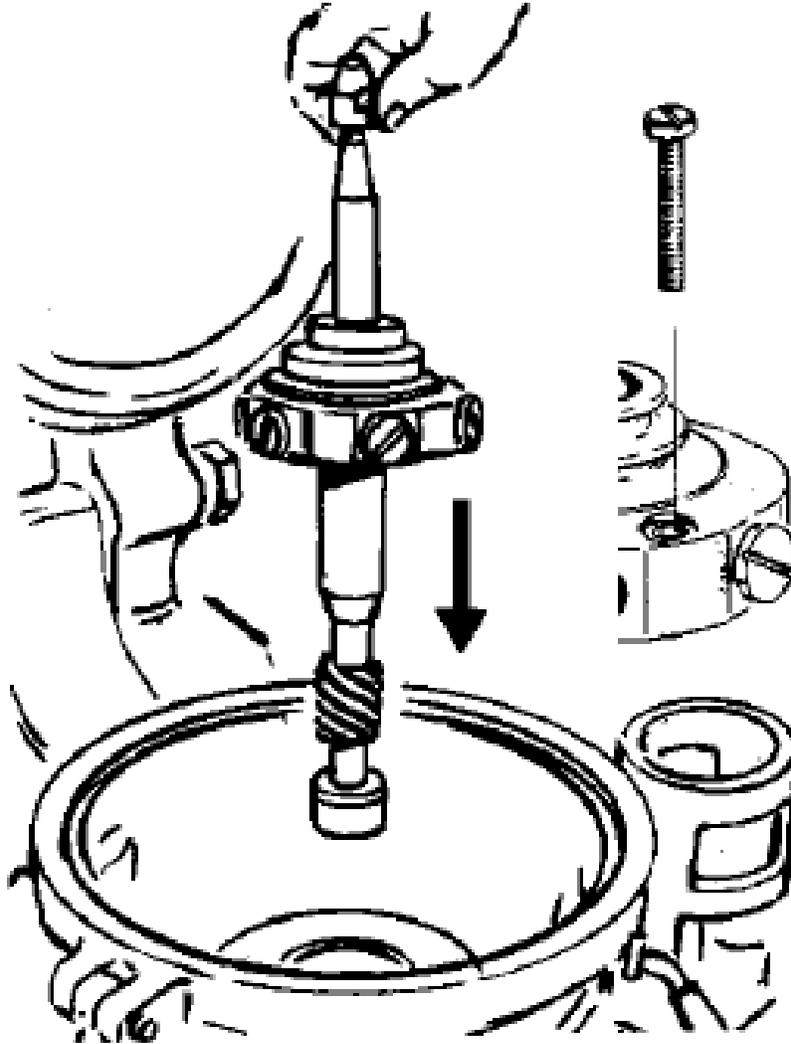


Figure 551-88L-2043\_43  
Lowering the spindle

(9) Clean the worm wheel shaft and the inner surface of the worm wheel nave thoroughly. Make sure seal ring in sealing washer is turned in the right direction, (refer to Figure 551-88L-2043\_44).

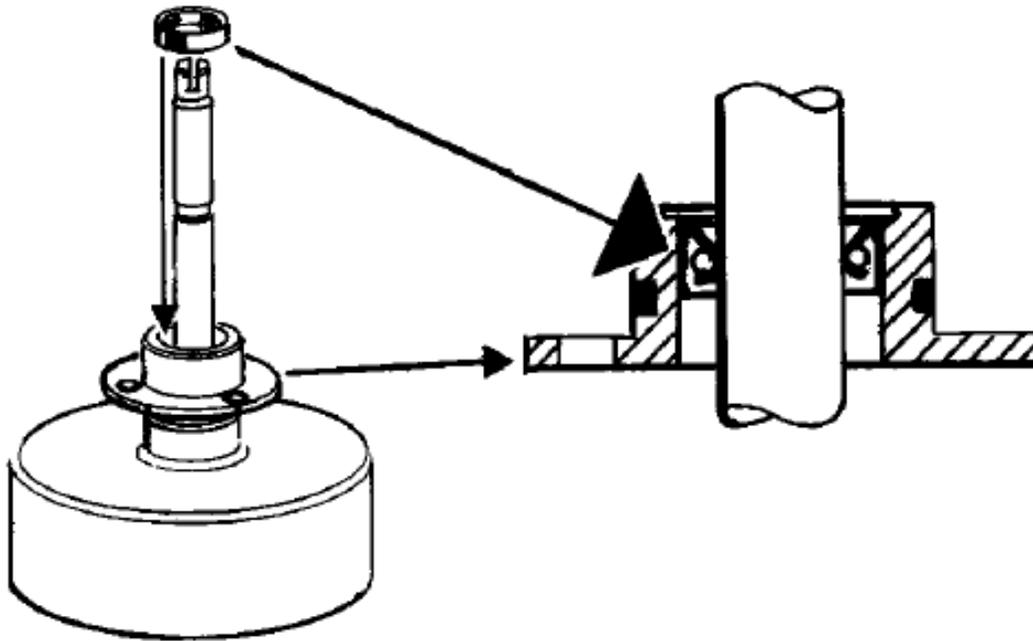


Figure 551-88L-2043\_44  
Seal ring direction

(10) Force bearing onto shaft, but stop when sealing washer is approx. 10 mm from bottom position, (refer to Figure 551-88L-2043\_45).

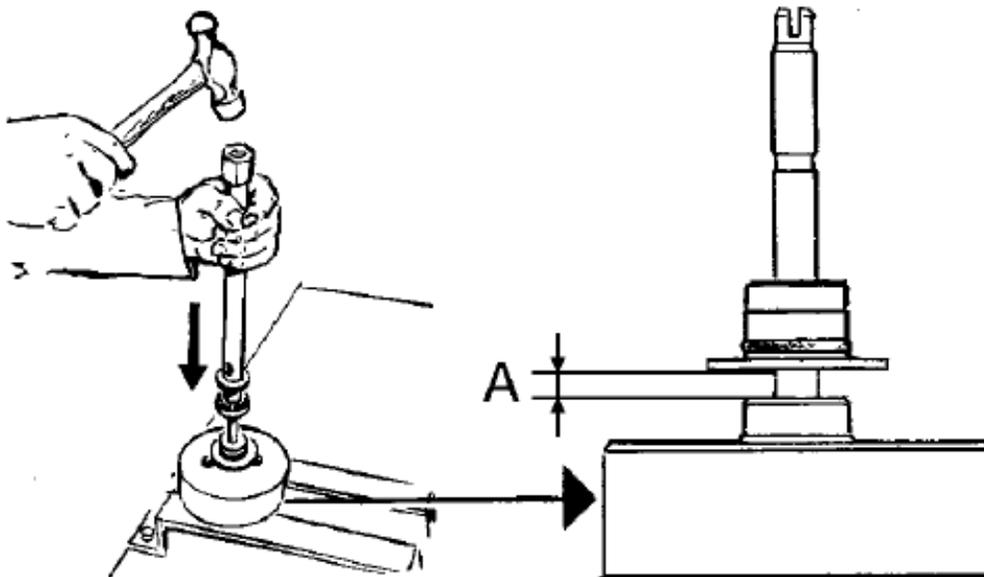


Figure 551-88L-2043\_45  
Forcing the bearing

## DANGER

Disintegration hazard. When replacing the gear, always make sure that the new worm wheel and worm have the same number of teeth as the old ones.

(11) Push the worm wheel into its position on the shaft on top of the bearing. Knock with a brass sleeve on end of wheel, (refer to Figure 551-88L-2043\_46).

(a) Observe holes for spring pin.

(b) Count the number of teeth!

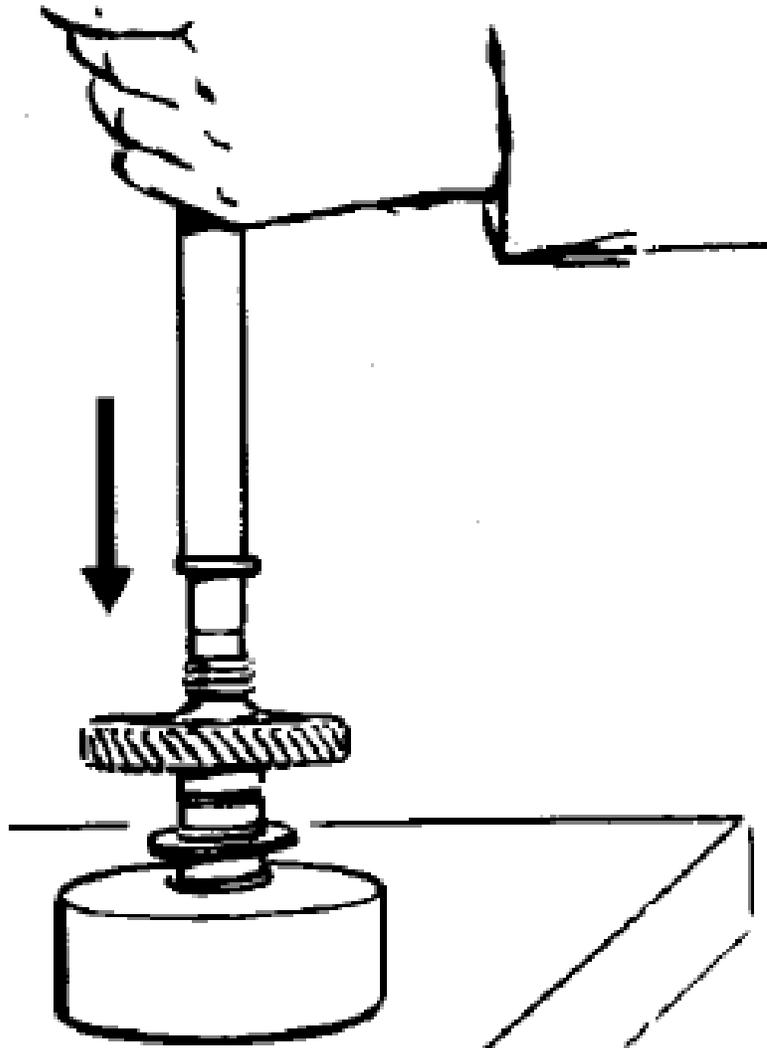


Figure 551-88L-2043\_46  
Installing worm wheel

(12) Check with the conical pin to get the larger side of holes in same direction, when holes coincide, mark the parts to facilitate the fitting. Remove worm wheel from shaft, (refer to Figure 551-88L-2043\_47).

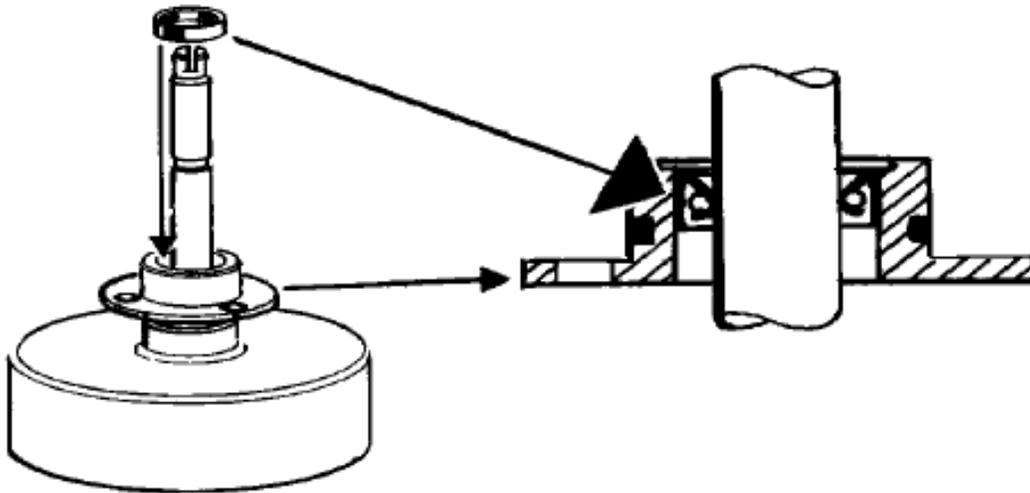


Figure 551-88L-2043\_47  
Checking conical pin

(13) Clean the ball bearing housing in the frame and oil the outer race of the ball bearing. Force the worm wheel shaft into its position in the frame, so that the ball bearing enters correctly into its seat, (refer to Figure 551-88L-2043\_48).

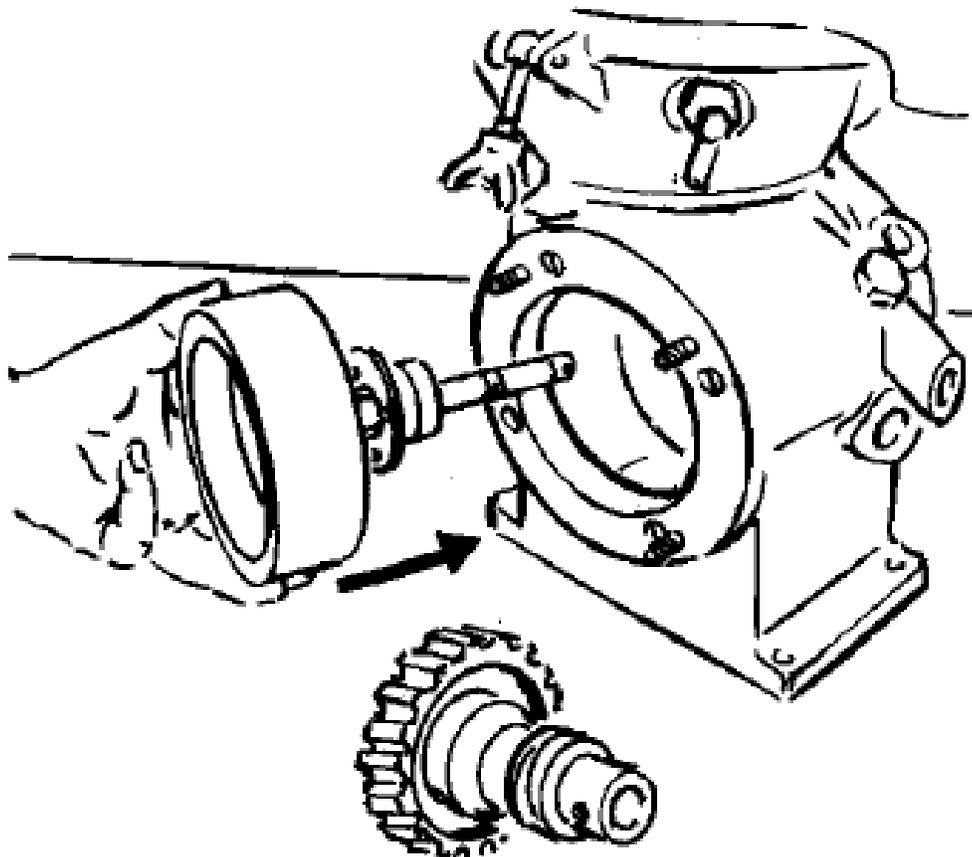


Figure 551-88L-2043\_48  
Replacing worm wheel shaft

(14) Tighten screws of sealing washer, (refer to Figure 551-88L-2043\_49).

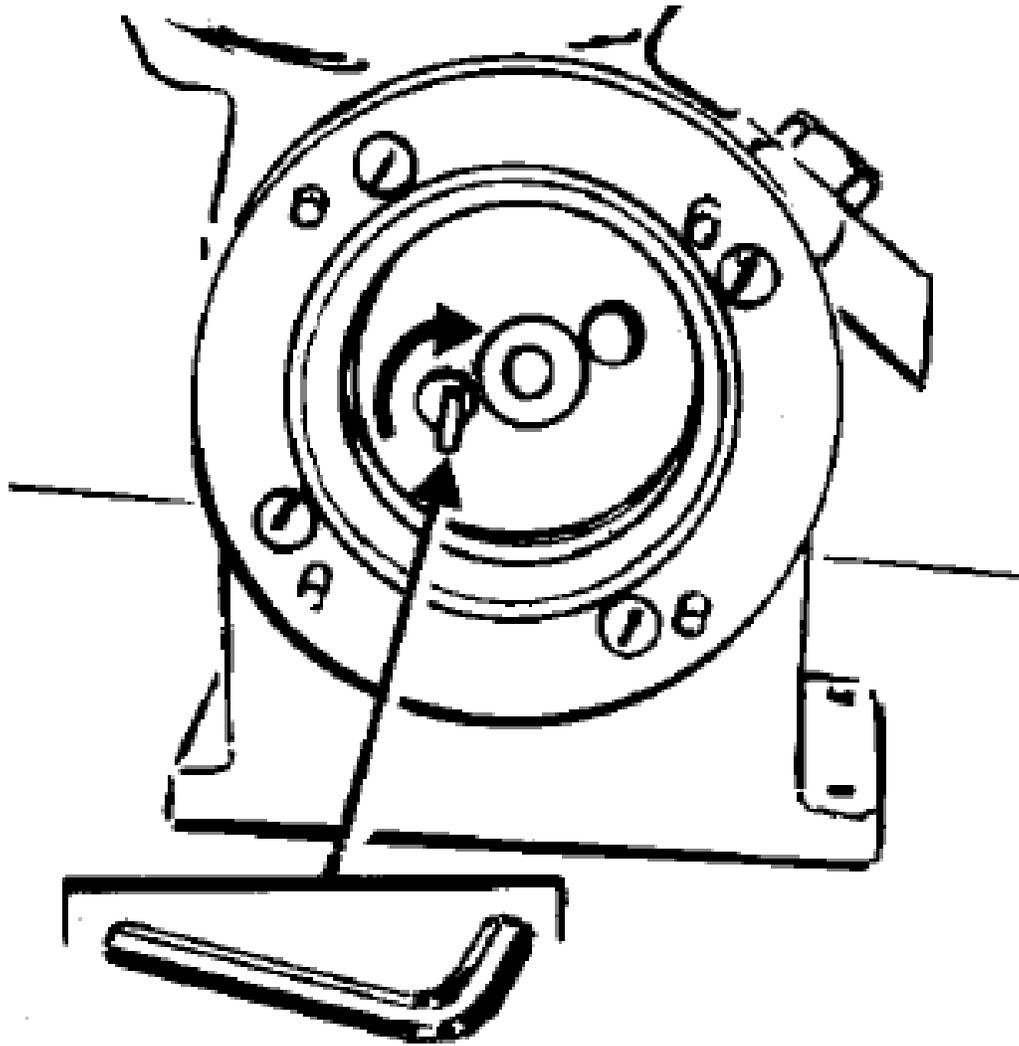


Figure 551-88L-2043\_49  
Tighten sealing washer screws

(15) Fit the worm wheel and knock conical pin into holes, (refer to Figure 551-88L-2043\_50).

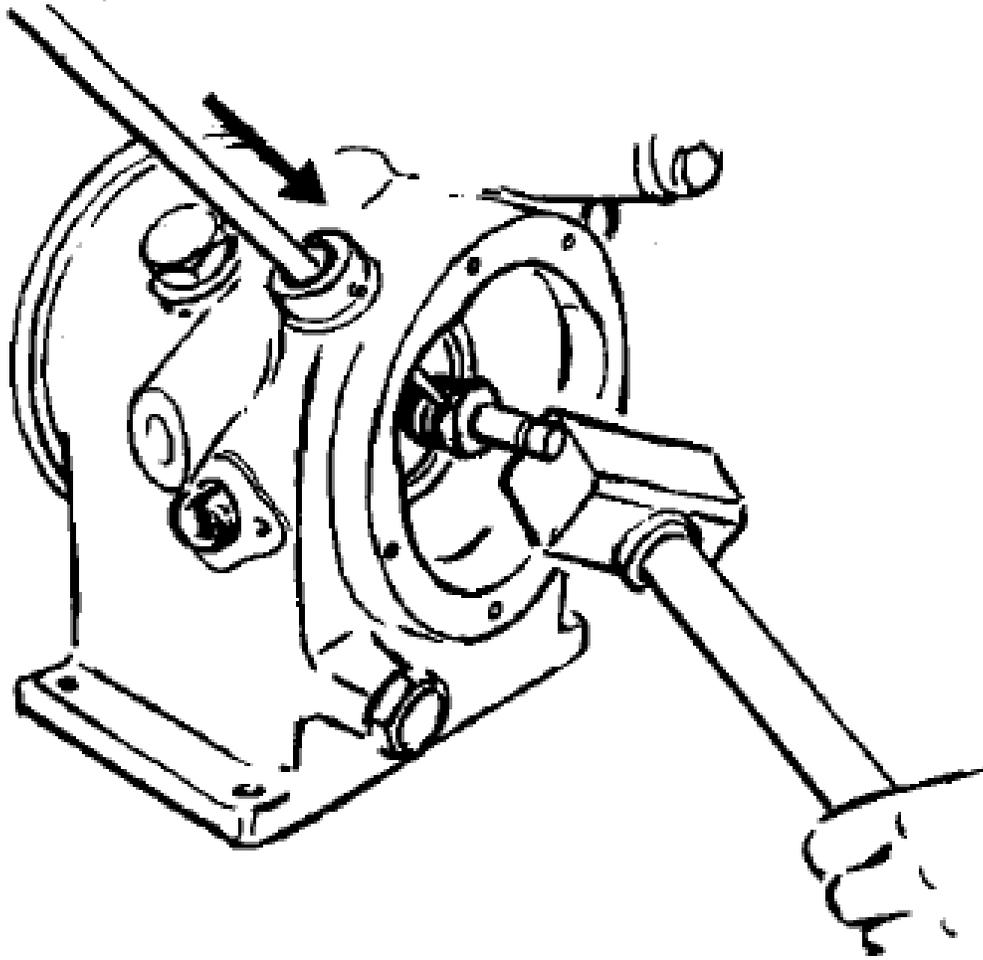


Figure 551-88L-2043\_50  
Fitting conical pin

(16) Knock the bearing into position with the mounting tool and a hammer, (refer to Figure 551-88L-2043\_51).

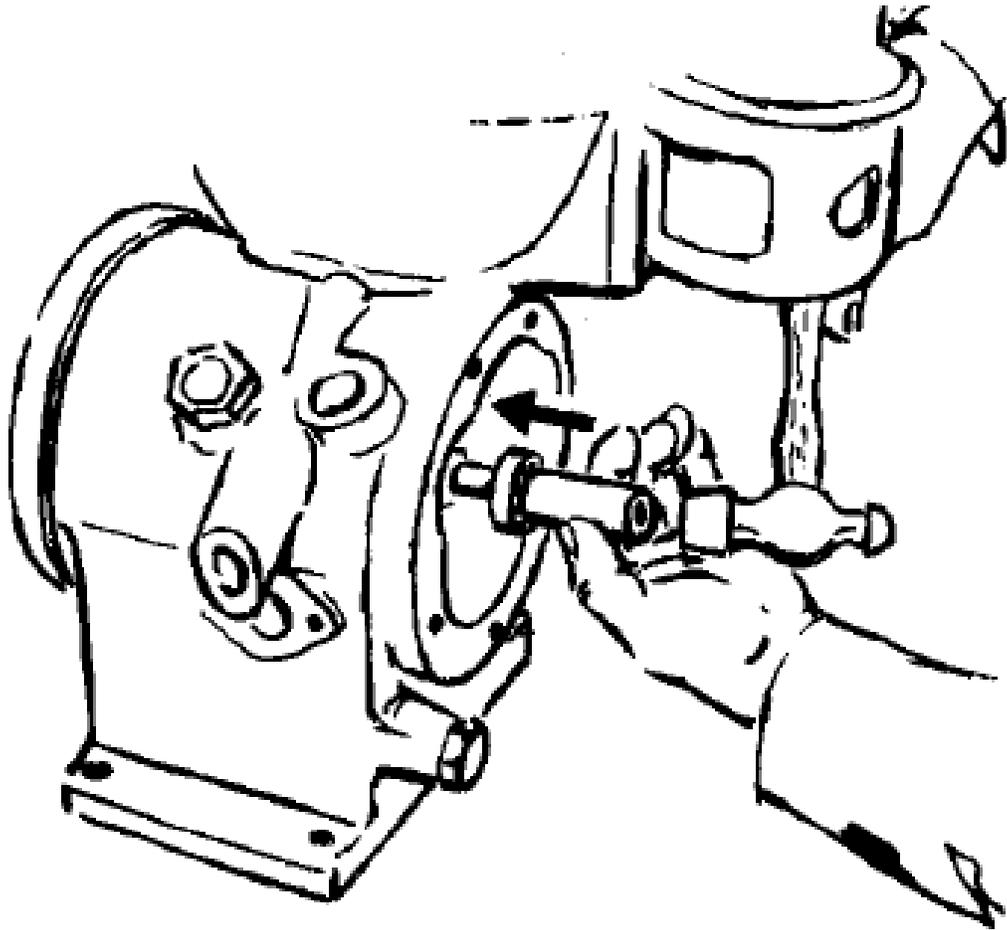


Figure 551-88L-2043\_51  
Positioning the bearing

(17) Fit the revolution counter. Lock it with the lock screw, (refer to Figure 551-88L-2043\_52).

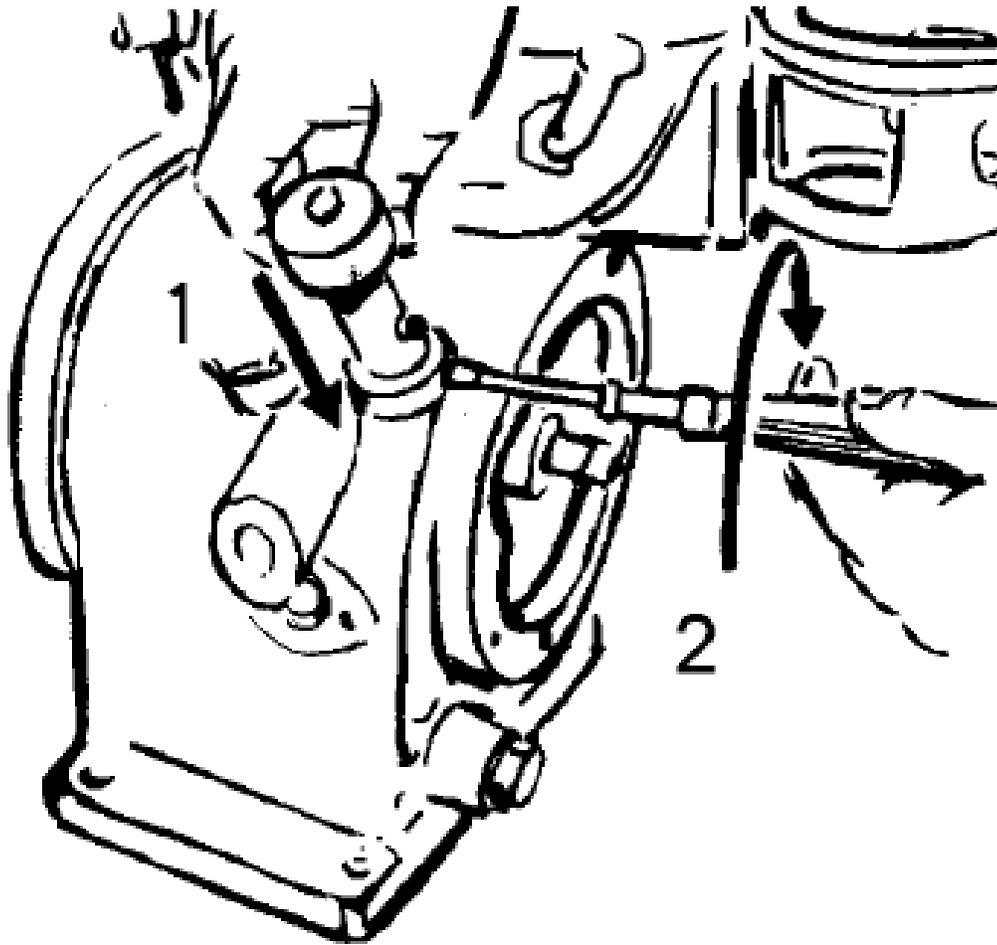


Figure 551-88L-2043\_52  
Replacing the revolution counter

(18) Fit pump and shear pin coupling, (refer to Figure 551-88L-2043\_53).

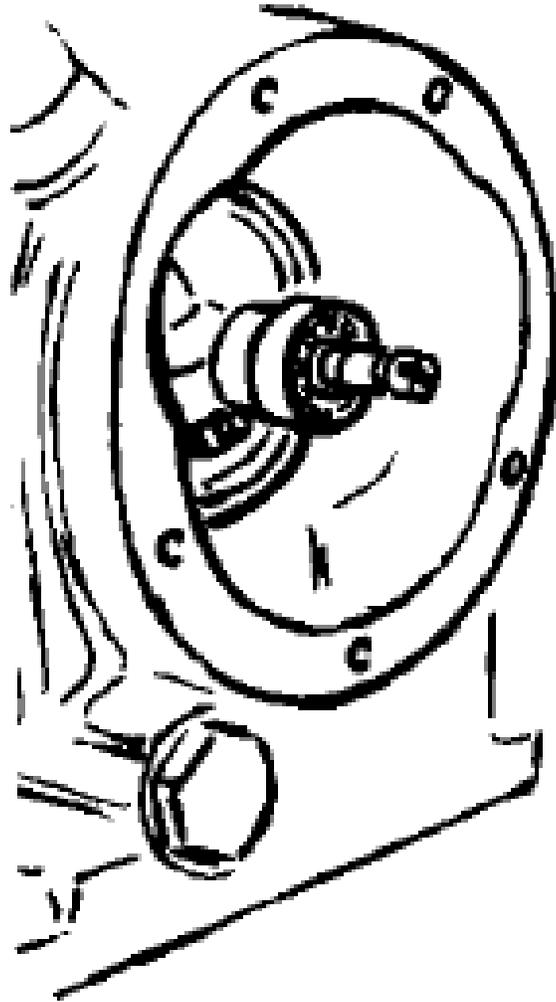


Figure 551-88L-2043\_53  
Fit shear pin coupling

(19) Fit the pump housing with parts. Be careful not to damage the lipseal ring. Fit the sleeve halves over the shear pin coupling.

(20) Fit the sight glass and the upper gasket. Screw on the lock ring. Fasten the pipe connections of the pump, (refer to Figure 551-88L-2043\_54).

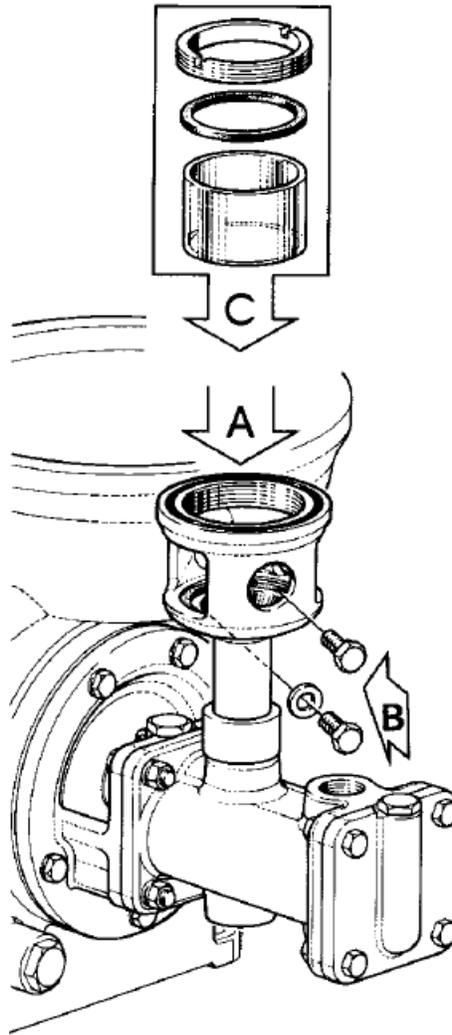


Figure 551-88L-2043\_54  
Fit sight glass

(21) Check the coupling disc of the motor.

(a) The position of the coupling disc on the motor shaft is establishing the location of the friction pads inside the coupling. If the coupling disc is loosened without first marking its position on the motor shaft, the correct position must be determined again.

(b) Measure the distance on the frame (refer to Figure 551-88L-2043\_55).

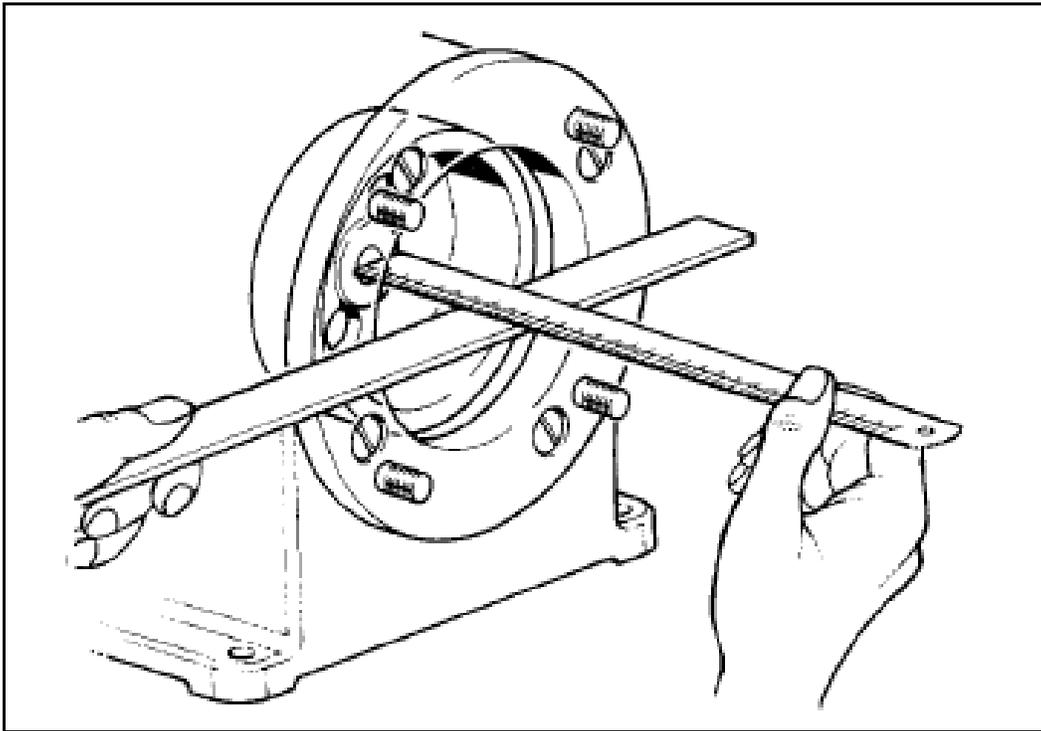


Figure 551-88L-2043\_55  
Frame measurement

(c) Measure the distance on the motor (refer to Figure 551-88L-2043\_56)

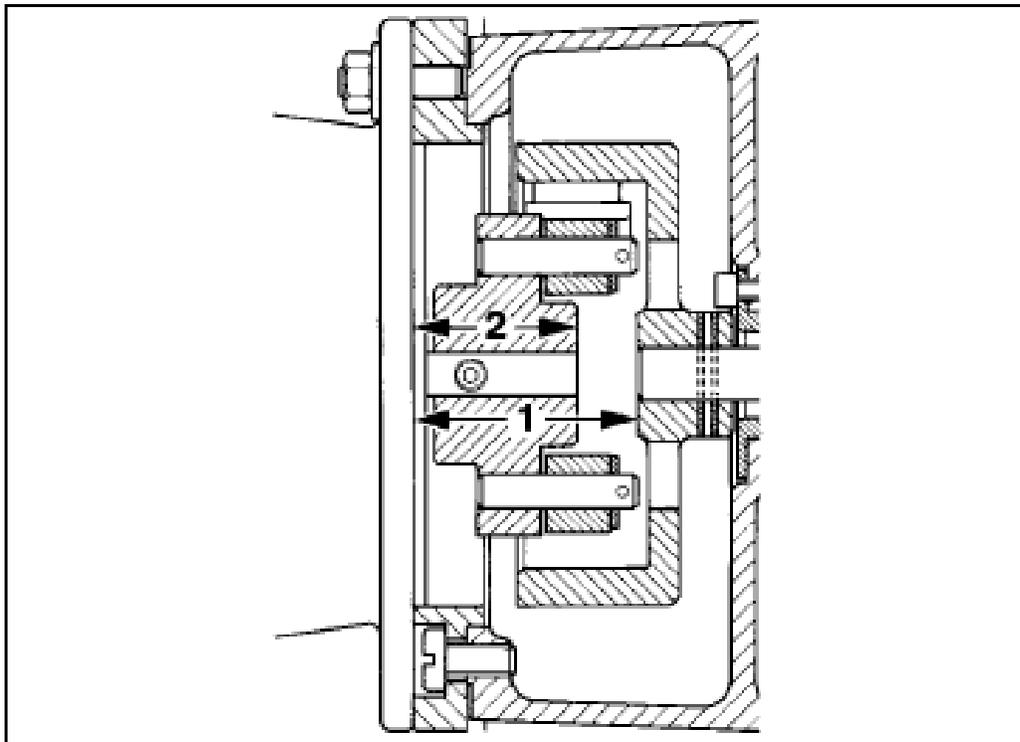


Figure 551-88L-2043\_56  
Motor measurement

(d) The coupling disc is in the correct position when the frame distance (1) is 8 mm larger than the motor distance (2) (refer to Figure 551-88L-2043\_57).

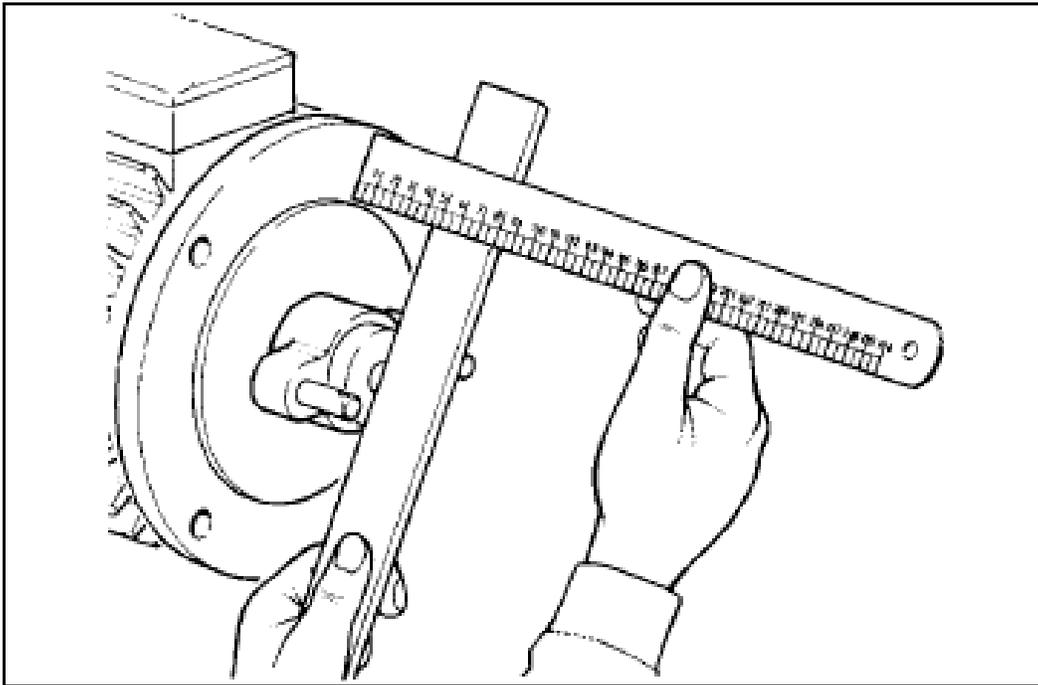


Figure 551-88L-2043\_57  
Coupling disc distance

## DANGER

Disintegration hazards. When power cables have been connected, always check direction of rotation. If incorrect, vital rotating parts could unscrew causing disintegration of the machine

(22) Fit the motor.

(23) Reinstall the separator bowl assembly, (refer to monthly maintenance).

(24) Fill new oil in the worm gear housing. The oil level should be slightly above middle of the sight glass.

d. Remove the lockout on the power supply to the motor controller.

e. Perform a post overhaul test of the purifier.

(Asterisks indicates a leader performance step.)

**Evaluation Preparation:** None

| PERFORMANCE MEASURES  | GO | NO-GO | N/A |
|---|----|-------|-----|
| 1. Performed Pre-Maintenance Checks.  |    |       |     |
| a. Ensured the centrifuge is stopped.   |    |       |     |
| b. Ensured equipment power supply was open and locked or tagged out.                |    |       |     |
| c. Ensured all tools and equipment was readily available.                           |    |       |     |
| d. Ensured plant services had been secured.   |    |       |     |
| 2. Demonstrated basic knowledge of maintenance safety pertaining to the centrifuge. |    |       |     |
| a. Provided an adequate work area.  |    |       |     |
| b. Kept tools clean and properly maintained.  |    |       |     |
| c. Used a chain hoist for lifting heavy parts.                                      |    |       |     |
| d. Ensured correct adjustment procedures were being used.                           |    |       |     |
| e. Did not pry on bowl components.  |    |       |     |
| f. Did not perform any welding operations on the purifier.                          |    |       |     |
| g. Utilized supplied lifting tools.   |    |       |     |
| h. Ensured proper seating and alignment of parts via locating pins.                 |    |       |     |
| i. Ensured proper disc stack compression was achieved.                              |    |       |     |
| j. Made appropriate entries in a maintenance and repair log.                        |    |       |     |
| 3. Demonstrated basic knowledge of the effects of wear on the centrifuge.           |    |       |     |
| a. Monitored corrosion and erosion.   |    |       |     |
| b. Knew the suggested ways of dealing with corrosion and erosion.                   |    |       |     |
| c. Knew which components were more susceptible to corrosion and erosion.            |    |       |     |
| (1) Bowl lock ring  |    |       |     |
| (2) Bowl body   |    |       |     |
| (3) Bowl hood   |    |       |     |
| (4) Bowl spindle  |    |       |     |
| (5) All threaded areas within the bowl assembly                                     |    |       |     |
| 4. Demonstrated basic knowledge of the critical components of the centrifuge.       |    |       |     |
| a. Bowl lock ring   |    |       |     |
| b. Bowl body  |    |       |     |
| c. Bowl hood  |    |       |     |
| d. Spindle  |    |       |     |
| e. Drive train  |    |       |     |
| f. Bearings   |    |       |     |
| 5. Performed monthly maintenance on a centrifuge.                                   |    |       |     |
| a. Disassembled the separator bowl assembly.  |    |       |     |
| b. Cleaned and reassembled the separator bowl assembly.                             |    |       |     |
| 6. Performed hourly maintenance on a purifier.                                      |    |       |     |
| a. Switched off and locked out the power supply to the motor controller.            |    |       |     |
| b. Changed the worm gear housing oil.   |    |       |     |
| c. Removed the lockout on the power supply to the motor controller.                 |    |       |     |
| 7. Performed annual maintenance on a purifier.                                      |    |       |     |
| a. Disassembled the purifier.   |    |       |     |
| b. Cleaned and inspected parts.   |    |       |     |
| c. Changed out parts from the parts kit.  |    |       |     |
| d. Reassembled the purifier.  |    |       |     |

**Supporting Reference(s):**

| Step Number | Reference ID        | Reference Name   | Required | Primary |
|-------------|---------------------|--|----------|---------|
|             | TM 55-1915-224-24&P | UNIT, INTERMEDIATE DIRECT SUPPORT AND INTERMEDIATE GENERAL SUPPORT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST) FOR LUBE OIL/FUEL OIL PURIFIER MODEL NUMBER MAB103B-24, P/N MAB 103B-2 | No       | No      |

**Environment:** None

**Safety:** In a training environment, leaders must perform a risk assessment in accordance with FM 5-19, Composite Risk Management. Leaders will complete a DA Form 7566 COMPOSITE RISK MANAGEMENT WORKSHEET during the planning and completion of each task and sub-task by assessing mission, enemy, terrain and weather, troops and support available-time available and civil considerations, (METT-TC). Note: During MOPP training, leaders must ensure personnel are monitored for potential heat injury. Local policies and procedures must be followed during times of increased heat category in order to avoid heat related injury. Consider the MOPP work/rest cycles and water replacement guidelines IAW FM 3-11.4, NBC Protection, FM 3-11.5, CBRN Decontamination.

**Prerequisite Individual Tasks :** None

**Supporting Individual Tasks :**

| Task Number  | Title                   | Proponent                         | Status   |
|--------------|-------------------------|-----------------------------------|----------|
| 551-88L-3048 | Troubleshoot a Purifier | 551 - Transportation (Individual) | Approved |

**Supported Individual Tasks :**

| Task Number  | Title                   | Proponent                         | Status   |
|--------------|-------------------------|-----------------------------------|----------|
| 551-88L-3048 | Troubleshoot a Purifier | 551 - Transportation (Individual) | Approved |

**Supported Collective Tasks :**

| Task Number | Title | Proponent    | Status   |
|-------------|-------|--------------|----------|
| N/A         | N/A   | Not Selected | Obsolete |