

Figure 3-2

6. Strip the remaining parts from the shaft and inspect and replace them, if required.
7. We recommend that you use the latest design withdrawal cam shaft that is applicable to your machine. The end result will be better repeatability and less maintenance.

The new parts needed are:

1	42-17167-2-99	Withdrawal Cam Shaft
1	42-19411-99	Ring
1	42-17172-2-99	Spacer - Thick
1	42-17171-99	Spacer
1	92-2031-19	Washer
1	92-6043-19	Nut
1	92-1000-1224-18	Spring
1	92-2040-40	Washer

8. To reassemble the parts place the withdrawal cam shaft (42-17167) in a vice, threaded end down, with the vice jaws gripping the center section of the shaft between the bearing journals.



9. Assemble the bearing and inner race (424-5) onto the shaft, small end first (should be a sliding fit).
10. Assemble the dust cap (42-17173) and gear (42-17175) to the shaft. **NOTE:** Be sure the "O" on the gear is in line with the "O" on the shaft spline.
11. Assemble the timing lever operating cam (42-17621). **NOTE:** Be sure the "O" on the cam is in line with the "O" on the shaft spline.
12. Position retaining ring 429-1476 in groove on shaft. **NOTE:** One side of the retaining ring has a rounded edge, the other side a sharp edge with a slight burr on it. The *sharp edge* always faces the thrust edge of the groove.
13. Remove the shaft from the vise with all components in position and place in bed of machine.
14. Screw the withdrawal cam shaft retainer nut (42-17172) on the shaft. Using a brass rod in the slots of the nut, tighten the nut enough to cause a slight drag when the shaft is revolved. *This is a must.*
15. Assemble the timing lever (42-17176), retaining ring (429-1496) cam shaft dust cap (42-17173) and cam spacer (42-17171).
16. The withdrawal cam has a safety pin (42-17198) so that the cam will only fit one way on the shaft.
17. Assemble the withdrawal cam retainer (42-17168) and screw (4047).
18. Rotate the assembled shaft and check the clearance between center section of withdrawal cam and 42-17190 lead lever slide plate. No exact dimension is necessary, simply approximate equal clearance. If clearance is not approximately equal, 42-17171 Withdrawal Cam Spacer must be refitted.
19. Set the preload on the cam (page 3-1) and assemble the right bracket.

TYPE II

1. Remove the right bracket (page 7-1) and turret slide springs (page 6-4).
2. Refer to Figure 3-3 and remove the following from the withdrawal cam shaft:
 - (64) Cam Shaft Screw
 - (66) Withdrawal Cam Retainer
 - (67) Withdrawal Cam
 - (69) Withdrawal Cam Spacer



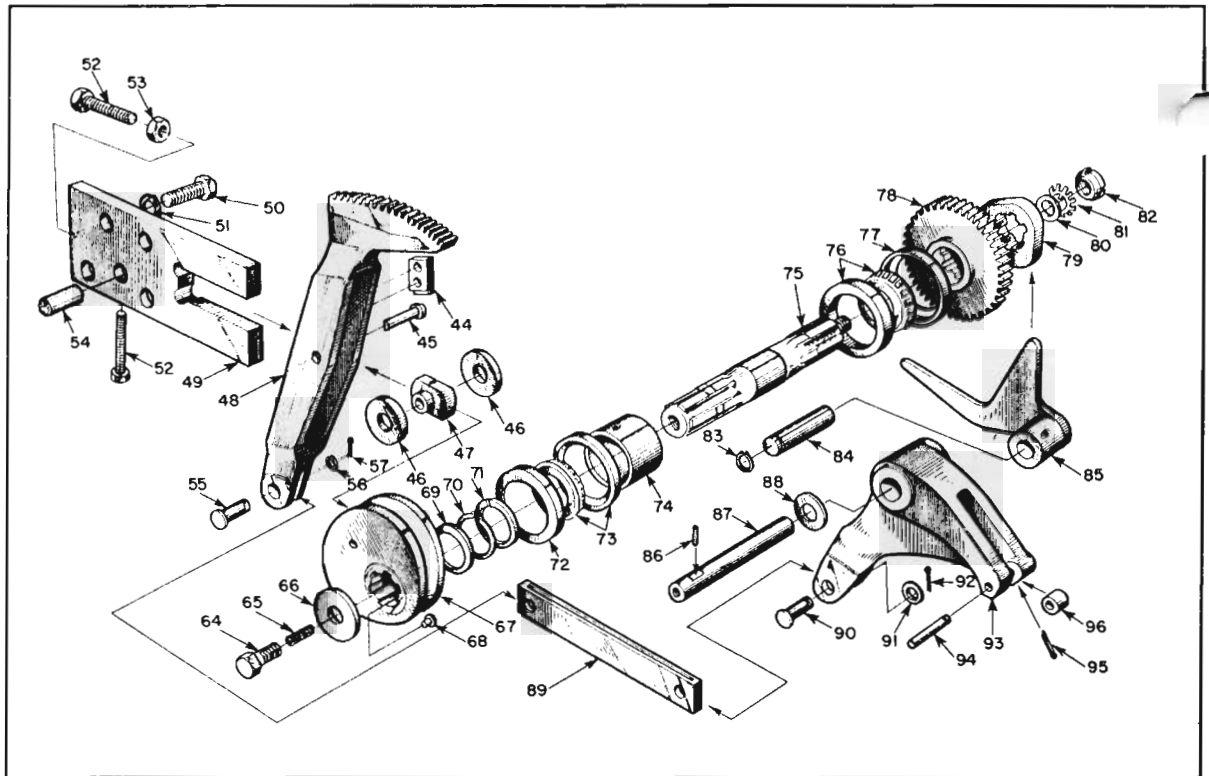


Figure 3-3

3. Straighten the tang on the lock washer (81) and back off the lock nut (82) a couple of turns. *Do not remove.*
4. Using a brass rod and hammer, lightly tap the cam shaft (75) towards the front of the machine to relieve any load on the retaining ring (70). Remove the ring.
5. Remove the bearing spacer (71) and dust cap (72).
6. Assemble the cam shaft screw (64), place a brass rod against the head of the screw and tap with a hammer until the shaft (75) is removed. The outer bearing race (73) will remain in the machine while the inner race is withdrawn with the shaft. The outer bearing race (76) may or may not stay in the machine while the inner race will come out with the shaft.
7. Strip the cam shaft completely, inspect all parts and replace where necessary.
8. We recommend that you use the latest design withdrawal cam shaft that is applicable to your machine. The end result will be better repeatability and less maintenance.

The new parts needed are:

1	42-17167-2-99	Withdrawal Cam Shaft
1	42-19411-99	Ring
1	42-17172-2-99	Spacer - Thick
1	42-17171-99	Spacer
1	92-2031-19	Washer
1	92-6043-19	Nut
1	92-1000-1224-18	Spring
1	92-2040-40	Washer

9. Replace the bearing outer races (73 and 76) in the bed of the machine.
10. To reassemble the parts place the withdrawal cam shaft (75) in a vice, threaded end down, with the vice jaw gripping the center section of the shaft between the bearing journals.
11. Slide the bearing inner race (73) on the shaft along with the bearing spacer (71). Assemble the retaining ring (70). Be careful that the sharp edge of the ring faces the thrust edge of the groove.
12. Remove the shaft from the vise and slide the unit through the front bed of the machine. Assemble the bearing inner race (76) and the dust cap (77) to the shaft.
13. Assemble the cam shaft gear (78) and the trip lever cam (79) on the shaft. **NOTE:** Be sure the "O" on the gear and cam line up with the "O" on the shaft spline.
14. Assemble the washer (80), lockwasher (81) and locknut (82). Using a spanner tighten the nut until a slight drag is felt on the shaft. Bend a tang on the lockwasher into a slot in the locknut. If the washer and nut do not line up, tighten the nut slightly until aligned.
15. Assemble the dust cap (72), spacer (69), withdrawal cam (67), cam retainer (66), and cam shaft screw (64). Tighten the screw.
16. Rotate the assembled shaft to check for clearance between center section of withdrawal cam and 42-17190 lead lever slide. No exact dimension is necessary, simply approximate equal clearance. If clearance is not approximately equal, Item #69 Withdrawal Cam Spacer has to be refitted.
17. Set the preload on the cam (page 3-1) and assemble the right bracket.



TYPE III

1. Remove the right bracket (page 7-1) and the turret slide springs (page 6-4).
2. Disassemble the shaft and parts according to the instructions given for either Type I or Type II designs.
3. Assemble the bearing outer races (73 and 76) (Figure 3-3) into the bed of the machine.
4. Check the ring (42-19411) and spacer (42-17172-2) (Figure 3-4) to see that they fit together. It may be necessary to polish or clean these parts.
5. Partially assemble the bearing inner race (73) onto the cam shaft (42-17167-2).
6. Slide the shaft through the bed of the machine leaving the innermost groove exposed.
7. Place the ring (42-19411) in a vise with the slot on the face close to the vise jaw and parallel to it. Wrap a towel around the ring and tap it with a hammer to break it.
8. After breaking, check the fit of both pieces in the groove in the shaft. They must be a good fit and form a perfect circle.
9. Remove the ring and slide the spacer (42-17172-2) over the shaft so that it bottoms against the inner race of the bearing.

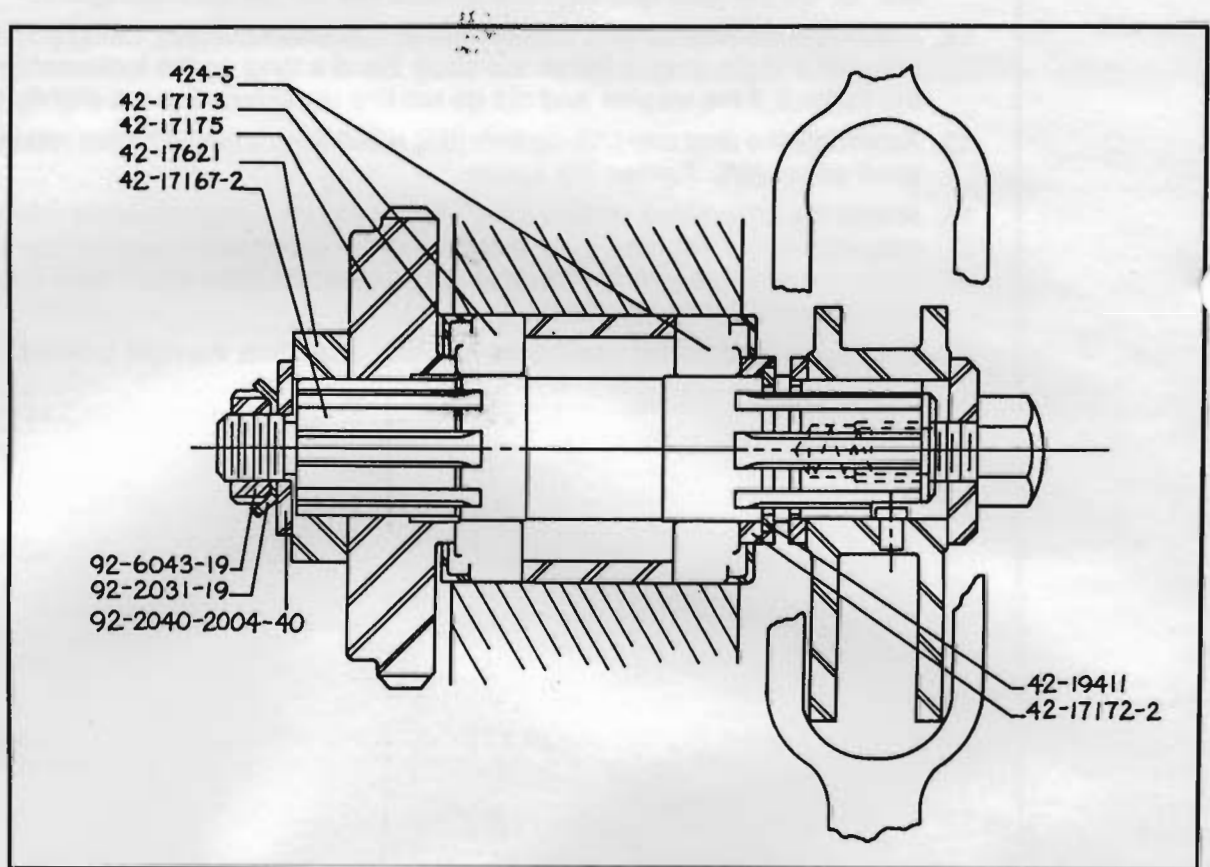


Figure 3-4



10. Assemble the ring (42-19411) into the shaft groove and push the shaft through the bed until the ring bottoms in the spacer.
11. Assemble the dust caps (42-17173) and bearing inner race (424-5) and seat the dust caps in the bed.
12. Assemble the cam shaft gear (78) and the trip lever cam (79) on the shaft. **NOTE:** Be sure the "O" on the gear and cam line up with the "O" on the shaft spline.
13. Assemble the washer (80), lockwasher (81) and locknut (82). Using a spanner, tighten the nut until a slight drag is felt on the shaft. Bend a tang on the lockwasher into a slot in the locknut. If the washer and nut do not line up, tighten the nut slightly until aligned.
14. Assemble the spacer (69), withdrawal cam (67), cam retainer (66), and cam shaft screw (64). Tighten the screw.
15. Rotate the assembled shaft to check for clearance between center section of withdrawal cam and 42-17190 lead lever slide. No exact dimension is necessary, simply approximate equal clearance. If clearance is not approximately equal, Item #69 Withdrawal Cam Spacer has to be refitted.
16. Set the preload on the cam (page 3-1) and assemble the right bracket.

On recent design machines, the withdrawal cam shaft can be preloaded as follows:

 1. Remove the right bracket (page 7-1) and turret slide springs (page 6-4).
 2. Rotate the withdrawal cam shaft gear (42-19743) by hand. The gear should have a slight drag. If it appears loose, the preload must be adjusted.
 3. To set the preload, remove the cam shaft bearing cap (42-19749) and push the outer race of the bearing firmly against the bearing itself. Measure the distance "A" from the finish in the bed counterbore to the face of the bearing outer race (Figure 3-5).
 4. Measure the step on the cap and face the cap to make the depth of the step equal to "A" plus .003".
 5. Reassemble the parts and check for a slight drag on the shaft.

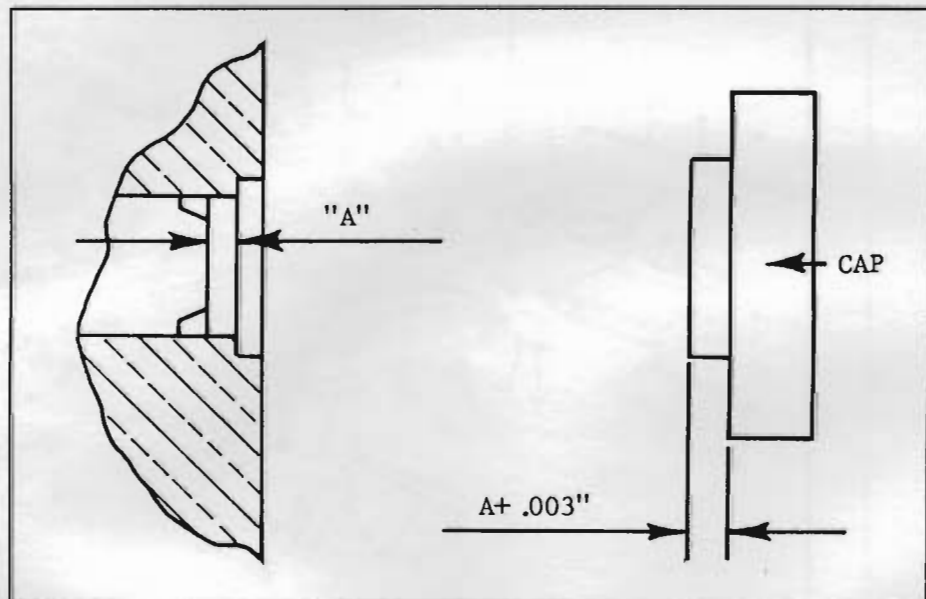


Figure 3-5



10. Assemble the ring (42-19411) into the shaft groove and push the shaft through the bed until the ring bottoms in the spacer.
11. Assemble the dust caps (42-17173) and bearing inner race (424-5) and seat the dust caps in the bed.
12. Assemble the cam shaft gear (78) and the trip lever cam (79) on the shaft. **NOTE:** Be sure the "O" on the gear and cam line up with the "O" on the shaft spline.
13. Assemble the washer (80), lockwasher (81) and locknut (82). Using a spanner, tighten the nut until a slight drag is felt on the shaft. Bend a tang on the lockwasher into a slot in the locknut. If the washer and nut do not line up, tighten the nut slightly until aligned.
14. Assemble the spacer (69), withdrawal cam (67), cam retainer (66), and cam shaft screw (64). Tighten the screw.
15. Rotate the assembled shaft to check for clearance between center section of withdrawal cam and 42-17190 lead lever slide. No exact dimension is necessary, simply approximate equal clearance. If clearance is not approximately equal, Item #69 Withdrawal Cam Spacer has to be refitted.
16. Set the preload on the cam (page 3-1) and assemble the right bracket.

On recent design machines, the withdrawal cam shaft can be preloaded as follows:

 1. Remove the right bracket (page 7-1) and turret slide springs (page 6-4).
 2. Rotate the withdrawal cam shaft gear (42-19743) by hand. The gear should have a slight drag. If it appears loose, the preload must be adjusted.
 3. To set the preload, remove the cam shaft bearing cap (42-19749) and push the outer race of the bearing firmly against the bearing itself. Measure the distance "A" from the finish in the bed counterbore to the face of the bearing outer race (Figure 3-5).
 4. Measure the step on the cap and face the cap to make the depth of the step equal to "A" plus .003".
 5. Reassemble the parts and check for a slight drag on the shaft.

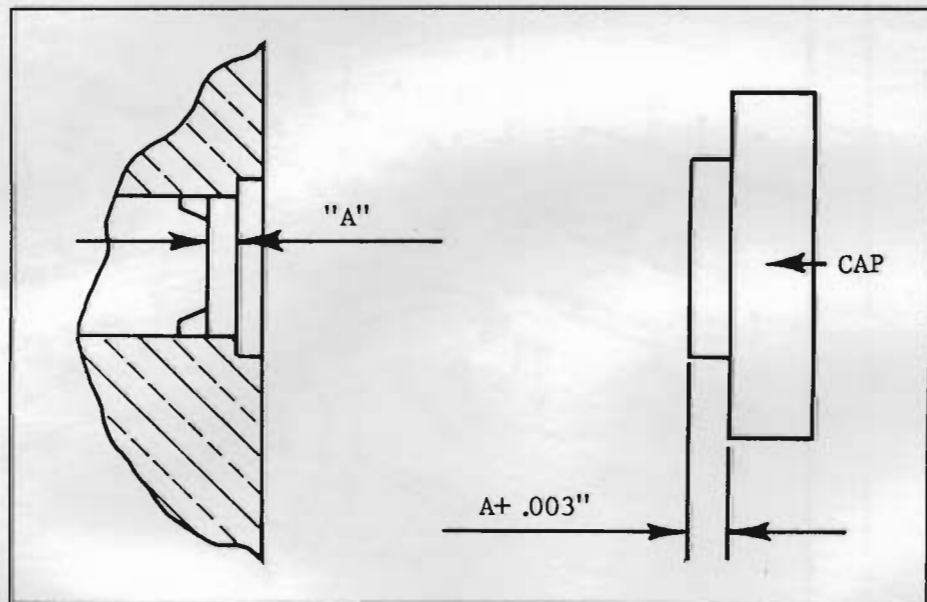


Figure 3-5



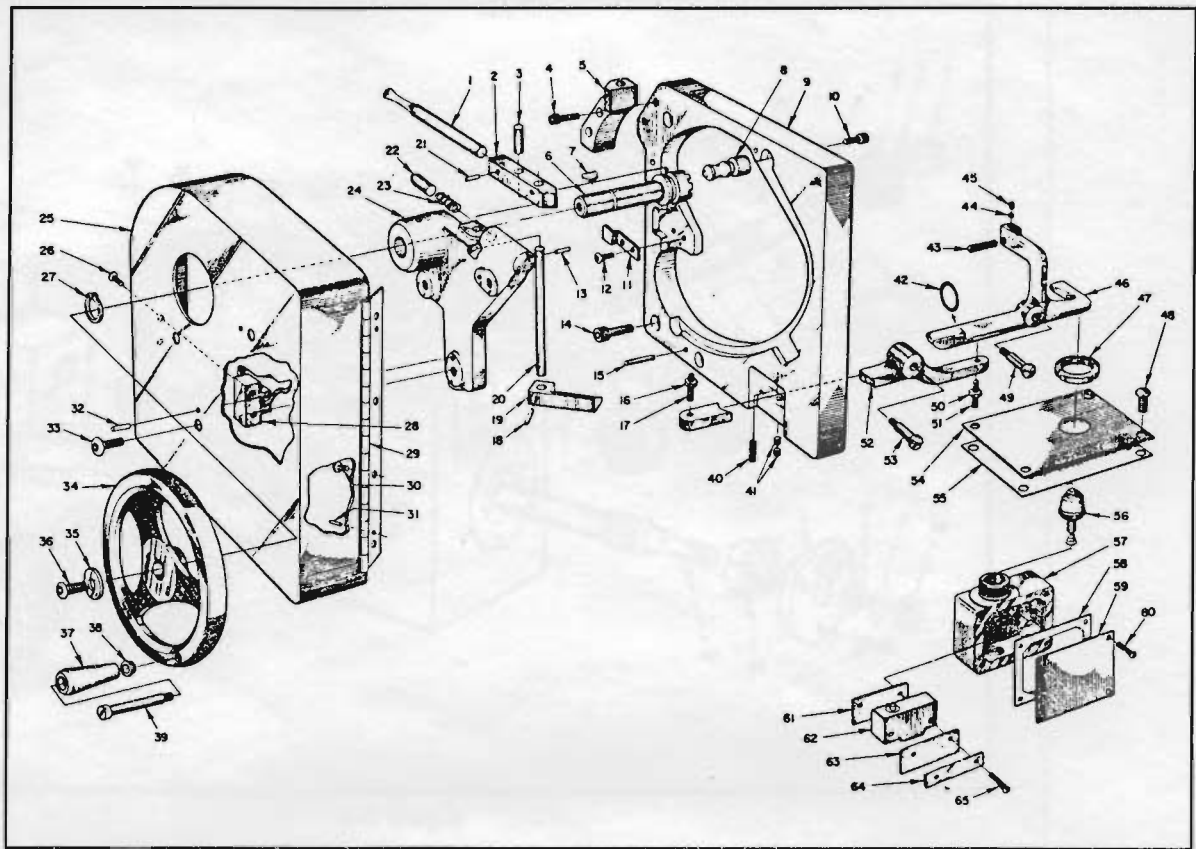


Figure 3-7

7. Use Figure 3-8. Remove (Items #8, #9) and lead cam.
8. Remove rapid pull-out cam and holder if used. It will be located to the right of (Item #41).
9. Remove lead cam shaft nut (Item #41) and washer (Item #40).
10. Remove three (3) button head screws (Item #39) from lead cam shaft bearing retainer (Item #36).
11. The bearing retainer (Item #36) and ball bearing (Item #38) can now be removed from the right bracket casting (Item #35).
12. Slide lead cam shaft bearing spacer (Item #34) out through bearing port.
13. With soft faced hammer, tap lead cam shaft (Item #7) toward front of machine.
14. Remove retaining ring (Item #5) from lead cam shaft and slide lead cam holder (Item #11) off.
15. Remove three (3) cap screws (Item #12) from lead cam shaft bearing retainer (Item #13), being careful not to lose the cork gasket (Item #14) in the bearing retainer.



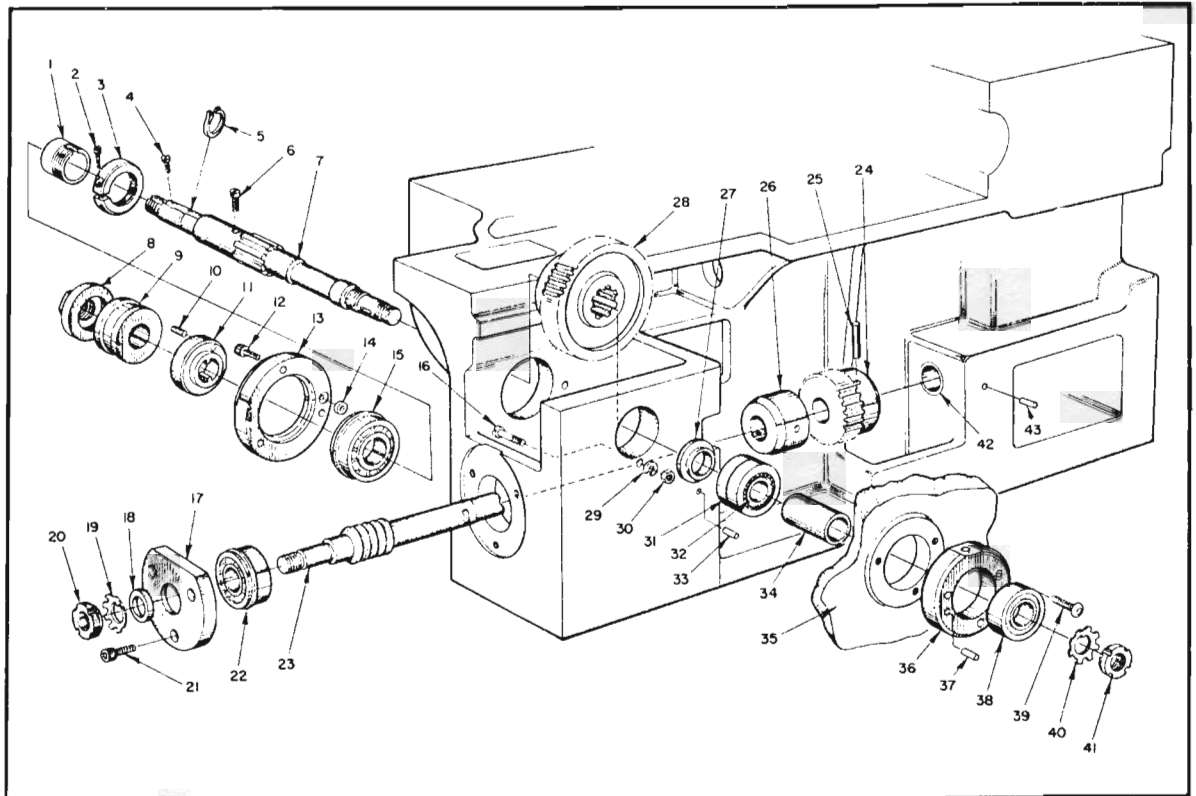


Figure 3-8

16. Hold on to worm wheel (Item #28) with left hand. Tap lead cam shaft out toward front of machine.
17. When removing lead cam shaft, be careful not to lose lead cam shaft spacer (Item #27) or inner bearing race (Item #32).
18. Remove worm wheel (Item #28). Clean the worm wheel reservoir of all oil and dirt. Now replace worm wheel if necessary.
19. If the lead cam shaft is to be replaced, remove the lead cam shaft collar (Item #1) and spacer nut (Item #3) and one screw (Item #4). (Items #1 and #3 should be kept together as one piece.) (Item #6) is a dowel pin ($\frac{3}{16}$ dia. $\frac{5}{16}$ long). One must be installed in a new lead cam shaft. Pin should protrude .080 from shaft.
20. Replace lead cam shaft collar (Item #1), spacer nut (Item #3) and screw (Item #4) onto new shaft (Item #7).
21. Place worm wheel (Item #28) in position on lead worm shaft (Item #23). Start lead cam shaft through from front of machine. When the lead cam shaft is through the worm wheel one inch, slide on lead cam shaft spacer (Item #27) as shown with large diameter against worm wheel.
22. Insert the inner bearing race (Item #32) back into the roller bearing (Item #31). As the lead cam shaft is slid through, make sure that the inner bearing race (Item #32) stays in position.
23. Slide the lead cam shaft through until the splines are in position inside the worm wheel.
24. Install the ball bearing (Item #15) (replace if necessary) over the lead cam shaft. Secure it with the lead cam shaft bearing retainer (Item #13) and three (3) screws (Item #12), making sure not to lose the cork gasket (Item #14). Secure lead cam holder (Item #11) with snap ring (Item #5).

25. If a new lead cam shaft was installed, it may be necessary to fit the lead cam holder (Item #11) to the shaft. Make sure that the key in the lead cam holder is a sliding fit with no side play.
26. Slide the lead cam shaft bearing spacer (Item #34) over the back end of the lead cam shaft until it comes against the inner bearing race (Item #32).
27. Reinstall ball bearing (Item #38) and bearing retainer (Item #36) and fasten with three (3) button head screws (Item #39).
28. Reinstall lead cam shaft washer (Item #40) and nut (Item #41).
29. The worm wheel (Item #28) must now be centralized with the lead worm shaft (Item #23). This is done by painting the teeth in the worm wheel with Prussian Blue. The worm wheel must now be run through the worm on the lead wormshaft (Item #23). As the worm wheel is turned "top coming toward you", torque must be applied in the opposite direction. This torque, or constant pressure, is necessary to get a positive marking on the teeth of the worm wheel so as to determine its location on the lead wormshaft. This marking *MUST BE* in the center on the flat side of the worm gear tooth.

Once the location of the worm wheel is known, it can be aligned with the lead worm shaft. This is done by turning both the cam shaft spacer nut (Item #3) and the lead cam shaft nut (Item #41) in the same direction. Top toward you will move the worm wheel to the back of the machine. Top away will move the worm wheel toward the lead cam or front of the machine. When the worm wheel is centralized, both nuts must be tightened and locked.
30. With a new worm wheel and new lead worm shaft installed, the maximum allowable backlash on the periphery of the worm gear is .006".
31. Retime lead cam shaft with cross slide cam shaft (Refer to instructions for Timing of Cam Shaft).
32. Use Figure 3-7. Remount feed gear box (Item #9) on two (2) dowel pins (Item #15). (Dowel pins will most likely stay in the gear box bracket when the bracket is removed.)
33. Secure feed gear box bracket with three (3) cap screws (Item #14).
34. Replace turret slide lever bracket (Item #5) with two (2) cap screws (Item #4).
35. Reattach "L" shaped oil line support bracket to feed gear box bracket with two (2) button head screws.
36. Reattach operating lever link (Item #52) with lever screw (Item #53). Replace "O" ring (Item #42) around levers (#52 and #46).
37. Readjust safety clutch setting if necessary (see Section 8).
38. Use Figure 3-6. Replace turret slide cover (Item #2) with three (3) cap screws (Item #1).



REPLACING THE WORM WHEEL AND CAM DRIVES ON CNC MACHINES

1. Remove the right cross slide motor guard (42-22387), the left cross slide motor guard (42-22484), the upper connector guard (42-22385) and the lower connector guard (42-22386).
2. Remove the cam shaft drive guard (42-22383).
3. Remove the tool pan-right and its adapter.
4. On the CNC machine there are two separate drives that actuate the cross slide cams (Figure 3-9). The servo motor on the left drives the inner shaft and cams "A" and "D". The servo motor in the rear drives cams "B" and "C" through a worm shaft and worm wheel.
5. (Figure 3-10) Remove the pointer bracket (#26).
6. Remove screw (#23), washer (#24), and spacer (#25), three screws (#22), retainer (#21) and bearing (#20).
7. (Figure 3-11) Loosen locking assembly (#20) and (Figure 3-10) locking assembly (#2) to break cam loose from shaft. Tap the hub of the cam with a hammer and tap cam "A" (Figure 3-9) to the right and cam "D" to the left.
8. (Figure 3-10) Loosen cam shaft coupling screws (#1).
9. (Figure 3-11) Push the inner cam shaft (#2) as far as possible to the left. Cam "A" will slide off the inner shaft. Push the inner shaft to the right and remove from the machine. Cam "D" will slide off as shaft is removed.

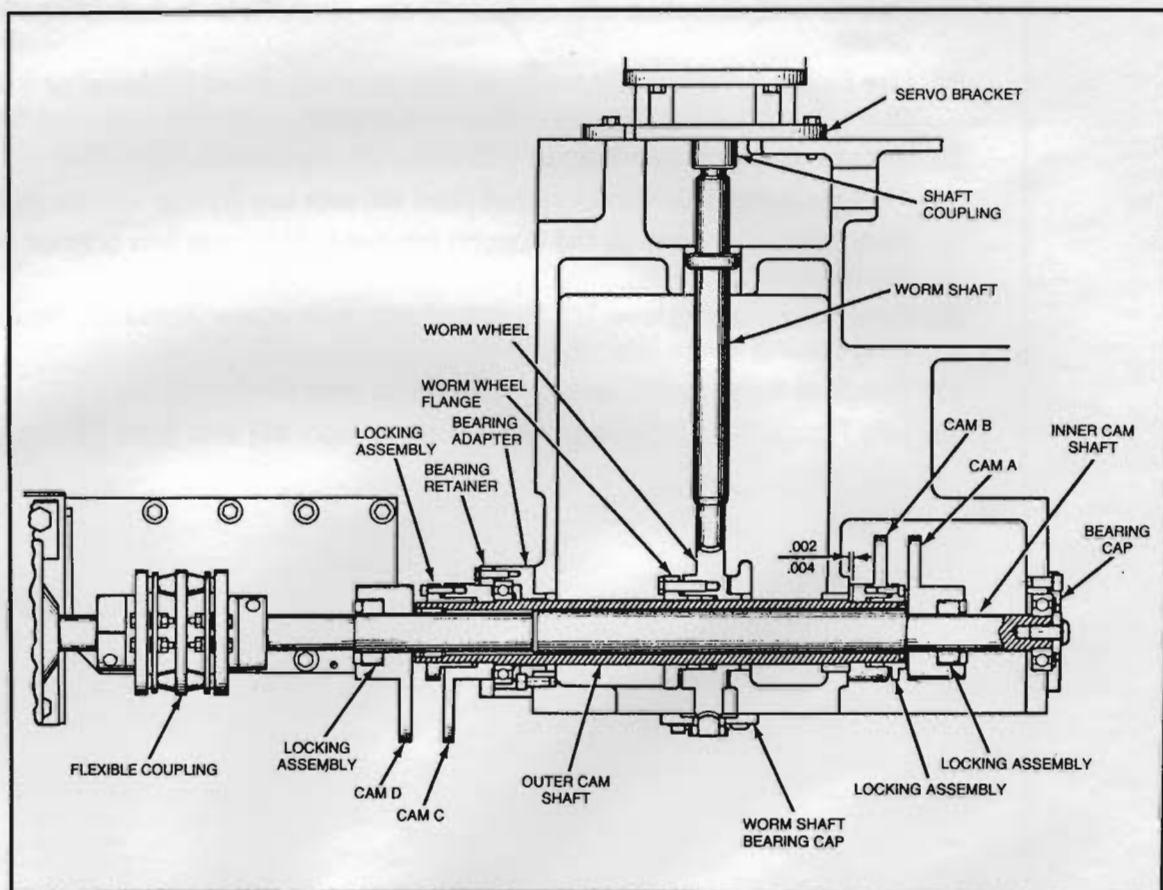


Figure 3-9

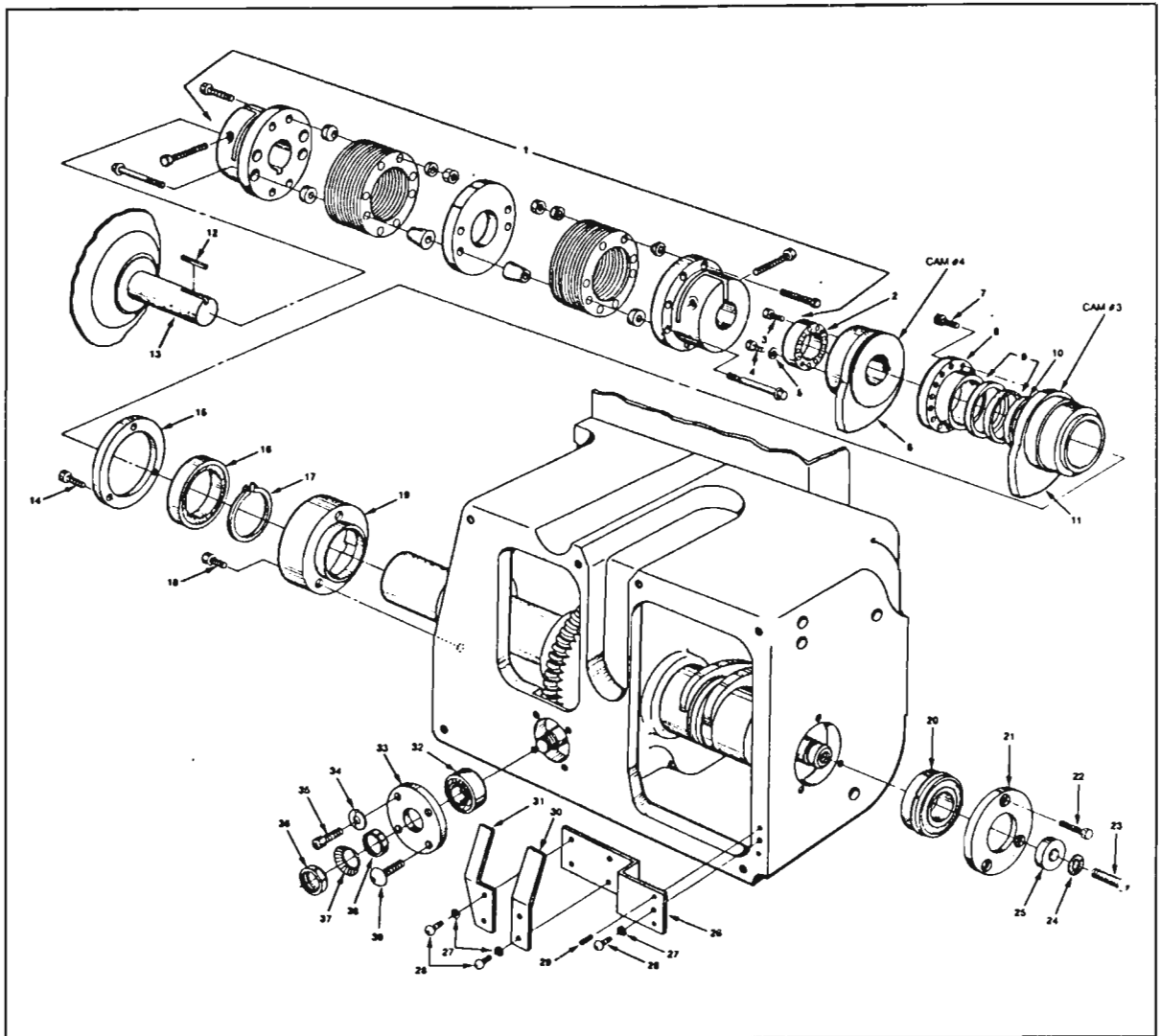


Figure 3-10

10. Mark the coupling and shaft for reassembly and remove the coupling (#1) from the machine as a unit (Figure 3-10).
11. Remove the bed opening cover to expose the worm wheel.
12. (Figure 3-11) Loosen the clamp assembly (#17) and remove cam #2 (#14) from the shaft. This locking assembly is very powerful and may require more than a few taps of the hammer.
13. Loosen the clamp assembly (#5) from the worm wheel (#8). Pry the clamp assembly loose from the worm wheel.
14. (Figure 3-10) Remove the bearing retainer (#15).
15. (Figure 3-11) Tap the worm wheel (#5) to the right with a rubber faced mallet. This will release the locking arrangement.
16. Pull the cam shaft (#2) to the left until the worm wheel slides off.
17. On the bench strip the locking assembly (#4, #5, #6, and #7). Clean all parts and assemble to the new worm wheel.

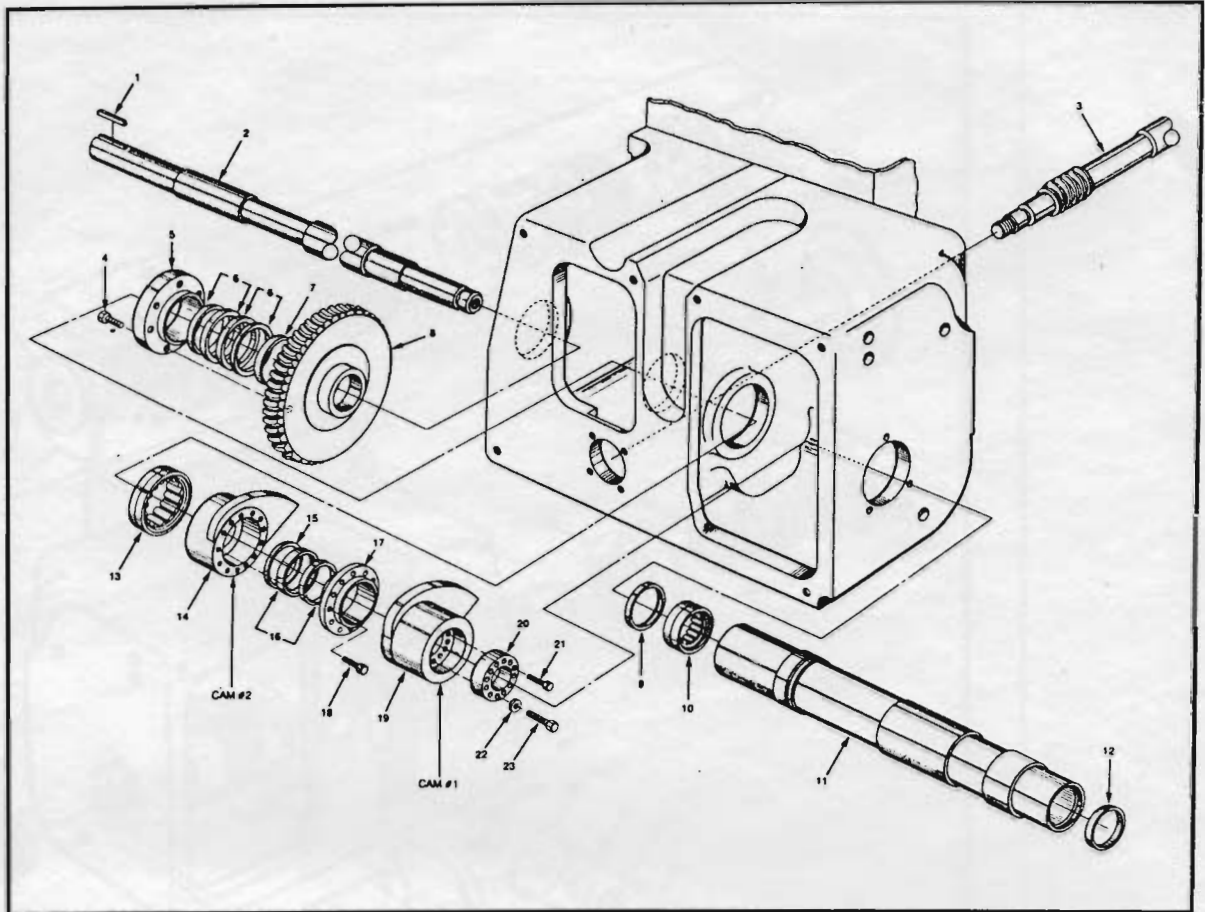


Figure 3-11

18. Assemble the locking assembly and tighten the screws (#4) finger tight. Check the worm shaft and if worn or pitted replace the shaft according to the directions given later.
19. Hold the worm wheel in place on the worm shaft (#3) and slide the outer cam shaft (#11) all the way through.
20. (Figure 3-10) Replace the bearing retainer (#15) and fasten in position.
21. Centralize an indicator against the worm wheel by gently prying the worm in one direction and then the other.
22. When the "O" position is set push the worm wheel to the right so it is .005" off center.
23. (Figure 3-11) Gradually tighten the screws (#4) and with a wrench hold the worm shaft nut (Figure 3-10) (#36) to keep from turning. Tighten all six screws to 30 ft. lbs. torque. The tightening process should bring the indicator back to "O". Slowly turn the worm shaft to make sure there is a slight backlash for all 360° of worm wheel rotation.
24. Time cams "B" and "C" to "O" before assembling the inner shaft.

25. Rotate the worm shaft until the start of the cam rise is against the cam roll. Next rotate the cam (top coming) by rotating the worm shaft $1\frac{3}{4}$ turns counter clockwise. Mark the shaft to keep count of the number of turns. *Hold in this position.*
26. Assemble cam "B" on the outer shaft. Place one .0015" thick feeler on the top and the other on the bottom of the shaft between the hub of the cam and the bed. Rotate the cam until the rise is against the roll. Gradually tighten the clamp screws (#18) (Figure 3-11), alternating screws, until a final tightening of 8 ft. lbs. torque is obtained.
27. (Figure 3-10) Reassemble coupling (#1) on the shaft of the speed reducer.
28. Slide the inner shaft to the right so that cam #4 (#6) can be mounted. Then slide the shaft all the way to the left so that cam #1 (#19) (Figure 3-11) can be assembled.
29. Slide the inner shaft back to the right and assemble the bearing (#20) (Figure 3-10), the retainer (#21), the retainer screws (#22), the spacer (#25), the washer (#24) and the screw (#23). Lock securely.
30. Centralize cam #1 (#19, Figure 3-11) with the cam roll. Gradually tighten the clamp screws (#23) until 10 ft. lbs. torque is obtained.
31. Slide the coupling (#1, Figure 3-10) all the way to the right so that it clears the speed reducer shaft. The inner shaft will not turn freely.
32. Rotate the inner shaft so that cam #1 is in line with cam #2. Use a straight edge across the cams to check their position.
33. Centralize cam #4 with the cam roll and rotate the cam so it is in line with cam #3. Use a straight edge to check alignment. Gradually tighten the clamp screws to obtain 10 ft. lbs. torque.
34. Rotate the worm shaft $\frac{7}{8}$ turn. Turn the inner shaft by hand to align cam #1 with cam #2.
35. Assemble the pointer bracket so that it is halfway between the scribed lines on the hub of the cams.
36. Jog the servo motor on the left end of the machine to align the key and keyway. Check the identifying marks so the coupling can be engaged. Lock the clamp screws on each side of the coupling.
37. Assemble all guards and pans.



REPLACING THE WORM SHAFT ON CNC MACHINES

To replace the worm shaft follow steps 1 thru 18 of instructions for worm wheels.

1. (Figure 3-10) remove the retainer (#33). Be careful that the worm lubrication trough (not shown) does not drop when the two screws (#35) are removed.
2. Remove the worm wheel shield.
3. (Figure 3-12) Loosen the clamp screw (#20).
4. Support the outboard section of the servo motor (#13). Using a ratchet wrench, remove screws (#19) and washers (#18) and slide the servo motor out of the bracket (#17).
5. Loosen the second clamp screw (#20) and remove the coupling (#21) from the worm shaft.

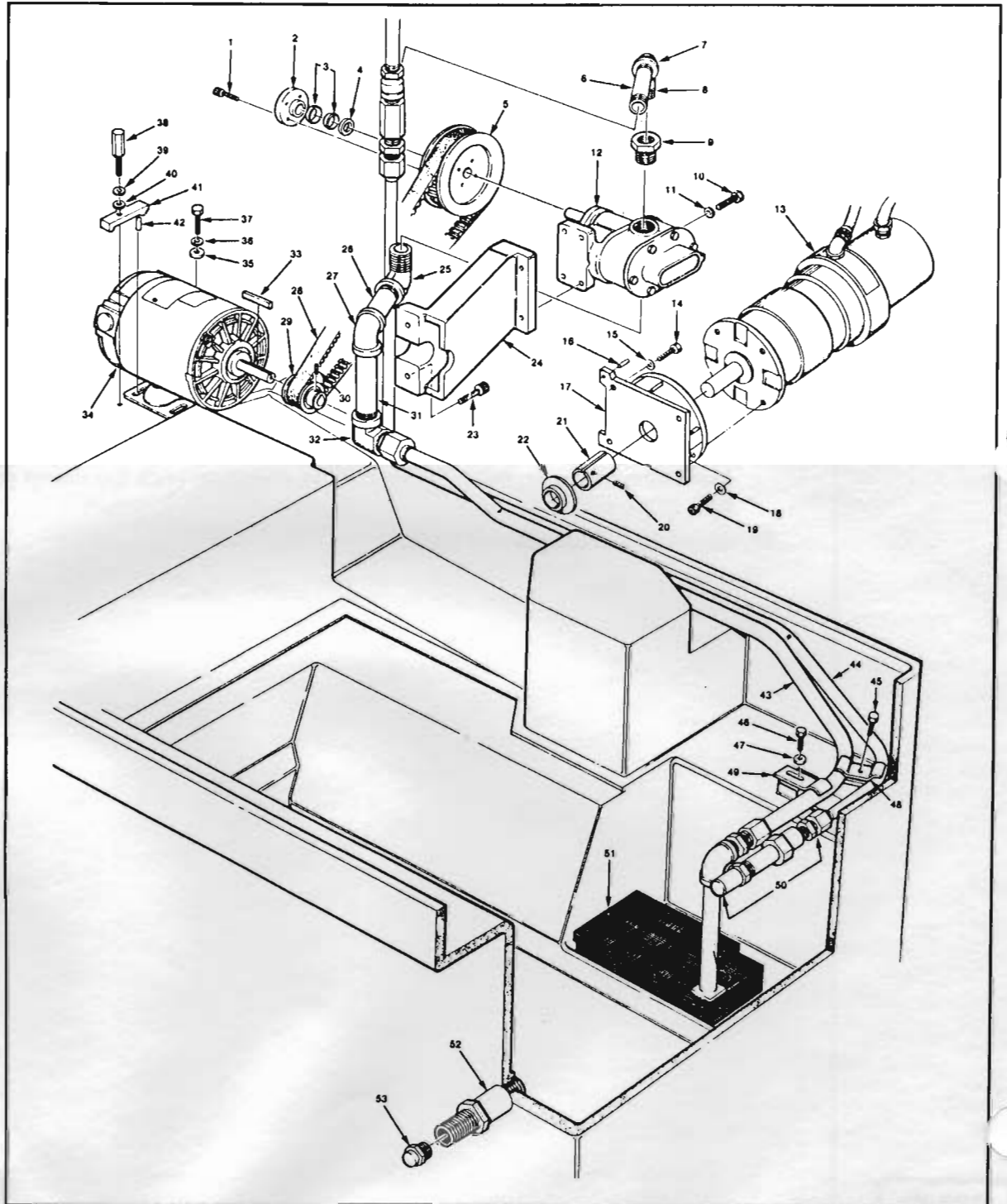


Figure 3-12



6. From the rear of the machine tap the worm shaft until the oil shield (#22) breaks loose. The shield is assembled to the shaft with loctite. Slide the worm shaft out the front of the machine.
7. With the worm shaft in a vise, disassemble locknut (#36), lockwasher (#37), spacer (#38), and bearing (#32) (Figure 3-10).
8. Clamp the new wormshaft in a vise and assemble the bearing, spacer, lockwasher, and nut. Don't forget to bend the lockwasher tang into the nut.
9. Slide the worm shaft in from the front of the machine and fasten the retainer with screws (#35 and #39). Assemble the worm lubrication trough at the same time.
10. (Figure 3-12) Apply 3 or 4 drops of loctite 601 to the worm shaft at the oil shield seat and assemble the oil shield (#22) against the shoulder. The loctite requires 6 to 10 minutes for a partial set and 1 to 6 hours for a full set.
11. Seat the coupling (#21) against the shield and lock with screw (#20).
12. Slide the servo motor (#13) into the coupling and secure with screws (#19) and washer (#20).
13. Fasten the coupling to the motor shaft with screw (#20).
14. With power off worm shaft should turn freely.
15. Continue with instructions for worm wheels at step 19.

CHANGING TO A DOUBLE SHEAR ARRANGEMENT TO REDUCE LEAD CAM PIN BREAKAGE

To change to a double shear arrangement on machines starting serial #542-2-7747 and 542-3-320 refer to Figures 3-13 and 3-14 and proceed as follows:

1. Remove from the lead cam shaft (#10) the following: $\frac{1}{2}$ -20 bolt (#6), washer (#5), cam washer (#4), cam shaft spacer (#3), cam retaining ring (#2) and the lead cam holder (#1).
2. Replace the lead cam holder with a new holder (42-17111-1) or replace the driving pin (#76) with a longer driving pin 42-17759. **NOTE:** If the driving pin has sheared more than once and the hole in the lead cam holder is somewhat oversized or egg shaped, replace the lead cam holder.
3. Carefully remove the driving pin (#76) from the lead cam shaft.



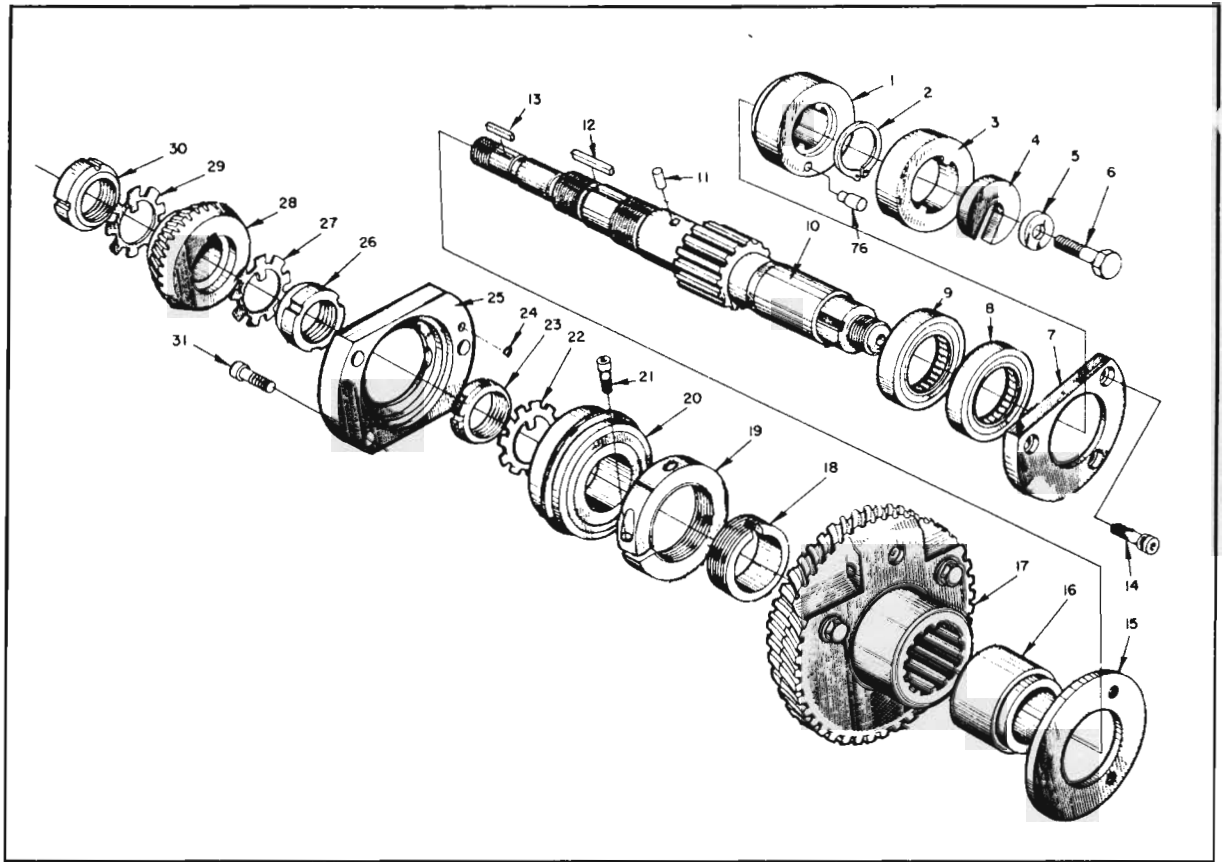


Figure 3-13

4. Assemble the cam shaft spacer (#3) and lead cam holder (#1) backwards on the lead cam shaft (#10). (Figure 3-14).
5. Using lead cam holder as a drill jig, center drill hole with $\frac{5}{16}$ " diameter center drill in cam shaft spacer (Figure 3-14).
6. Remove lead cam holder and cam shaft spacer from shaft.
7. Drill and ream $\frac{5}{16}$ " hole through cam shaft spacer.
8. Press new long driving pin #42-17759-2 into lead cam holder.
9. Reassemble parts with new driving pin. **NOTE:** If retaining ring is hard to install, remove the feed change gear case and unlock the washer (#22) and loosen the locknut (#23) on the lead cam shaft. Tap the lead cam shaft forward to install the ring. Tighten the nut and lock the washer. Reassemble the feed change gear case.

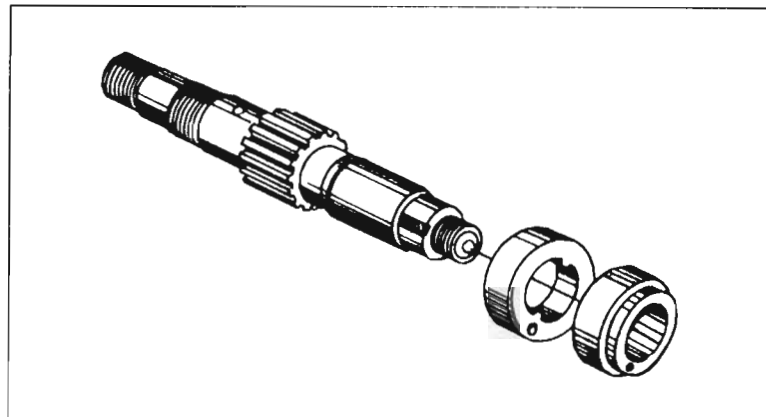


Figure 3-14

10. Prior to machine serial number 542-2-7747 and machine serial number 542-3-320, lead cam shaft (#10) has a threaded portion at end of shaft as shown in Figure 3-13. Remove threaded end with hack saw and file flat.
11. Drill .453" 1.560" deep and tap 1/2-20 UNF 1.180" deep and countersink 60° to 5/8" diameter.
12. Reassemble parts.

TIMING OF CAM SHAFTS

To time the cam shafts starting on the following machines 542-00-3300 and 542-2-3100 a set of timing cams is required (Symbol #42-16789 for #00 and 42-17840 for #2 and #3). The timing is done by a serrated sleeve (Figure 3-15) located under the lubricating pump at the rear of the machine.

1. Remove coolant pump from machine on #00, #2 and #3 machines. Be careful not to lose shims between pump and bracket on #00 machine.
2. Remove plate from machine. (On #00 Machine) right end of plate has slots for easy removal. Just loosen two right side hex head bolts and slide plate to left.
3. Put on front timing cam and rotate camshaft by hand until cross slide roll is in cam pocket.
4. Unlock lockwasher locking nut X on lead worm shaft which locks the shaft gear adjusting sleeve, back off the shaft gear adjusting sleeve nut X. Separate serrations of sleeve from serration on lead worm shaft gear.

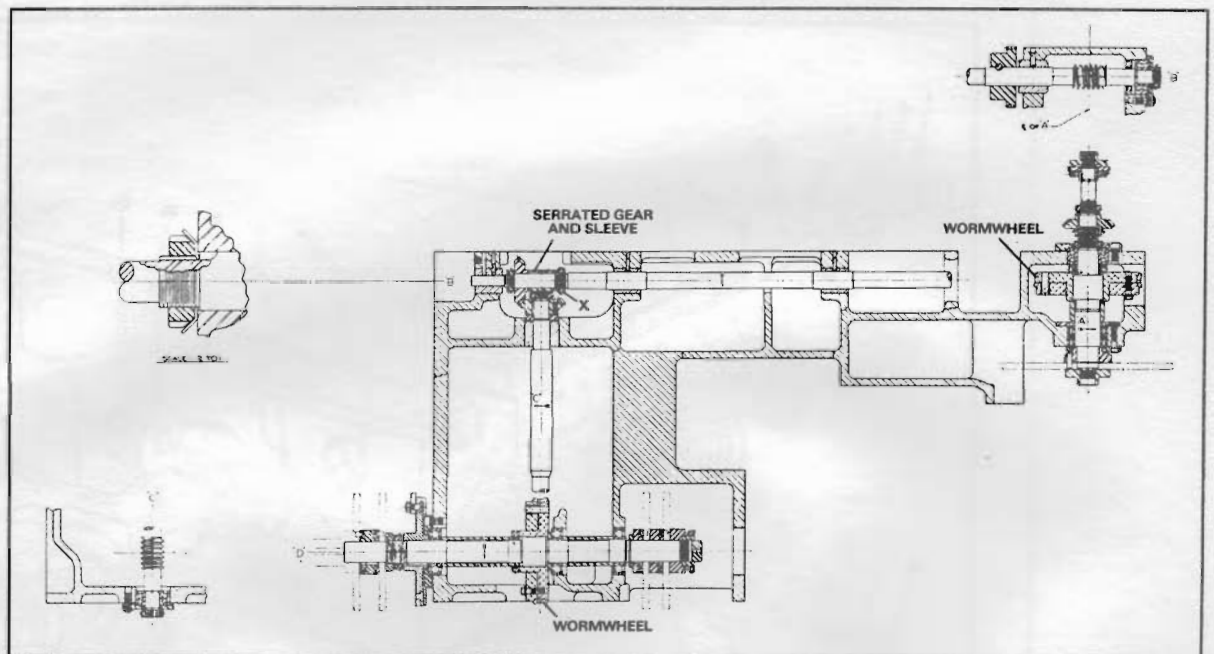


Figure 3-15



5. Rotate hand wheel to rotate lead cam until lead cam roll falls into pocket of lead cam. Cross slide cam should still have the roll in its pocket. Both cams are now at point 0.
6. Tighten nut to draw sleeve and gear serrations together. Lock tight and lock with lockwasher.
7. Put back cover plate and pump.

REPLACING THE LEAD WORM SHAFT

To replace the lead worm shaft on machines starting serial numbers 542-00-3300 and 542-2-3100, refer to Figures 3-16 and 3-17 and proceed as follows:

1. Make sure that *ALL* clutches are disengaged.
2. At this point, disconnect the cam shaft timing mechanism as previously described for Timing of Cam Shafts. It is also necessary to remove the driving shaft bracket, right. Refer to Section 7.
3. Remove the lead cam and rotate the lead worm shaft, (Item #23) (Figure 3-16) until the small end of the drive gear pin, (Item #25) is toward you. With the proper size punch, drive the pin out.
4. Remove three screws, (Item #21) from the bearing bed cap, (Item #17). As the lead worm shaft, (Item #23) is pulled out, it will be necessary to remove (Figure 3-17) two locknuts, (Items #11 and #3), lead worm shaft gear, (Item #5), and shaft adjusting sleeve, (Item #9).
5. Lead worm shaft can now be removed from machine.

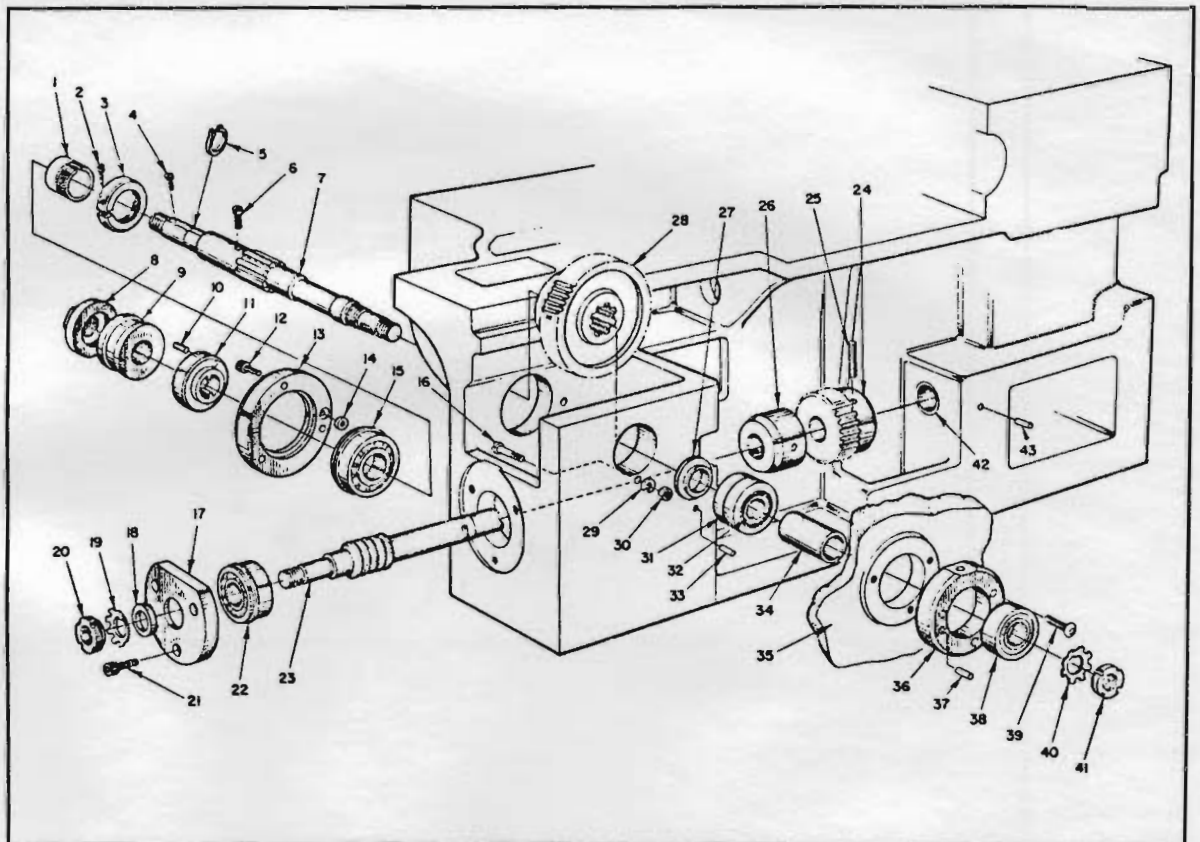


Figure 3-16



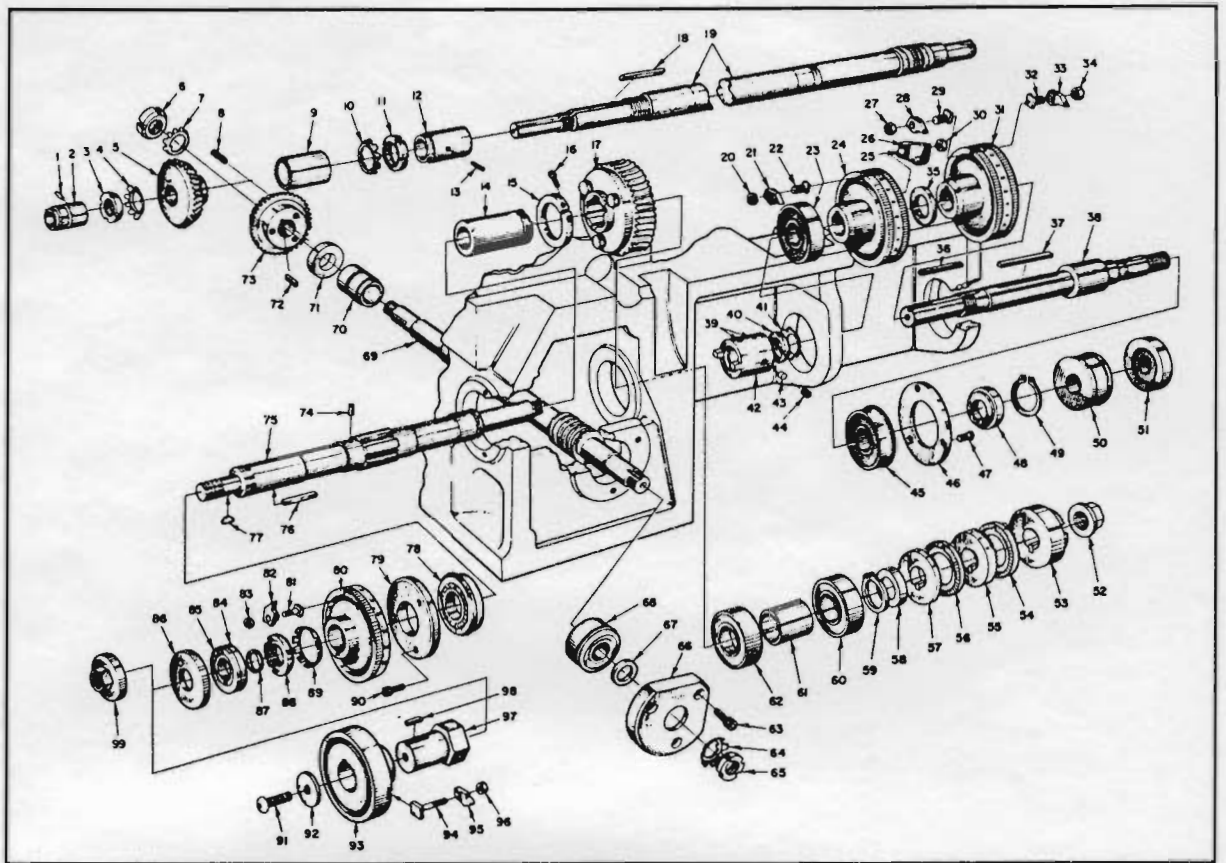


Figure 3-17

6. Remove ball bearing from lead worm shaft. Replace if necessary. Press bearing onto shaft, (Item #22), replace and install (Items #17, #18, #19, #20) (Figure 3-16).
7. Before installing the new shaft, check to see that the drive gear pin, (Item #25) goes all the way into the lead worm shaft gear. If it does not, it will be necessary to take a round file and enlarge the slot in the shaft. If the pin goes through too far, it will be necessary to use an oversize pin. Part #91-90-796.
8. Clean the worm wheel well of all oil and dirt.
9. Try all parts which were removed for proper fit on lead worm shaft before installing in machine.
10. Strip shaft.
11. Start lead worm shaft into bed, slip on (Item #24). (Figure 3-16) Slide shaft through center bearing, then, refer to Figure 3-17 and put onto shaft (Items #11, #10, #9, #5, #4, and #3). Now install the shaft all the way into bed and secure with three #21 screws as shown on Figure 3-16.
12. Match the lead worm shaft gear (Item #5) to the cross slide worm shaft gear (Item #73) and lock in place with locknut and lockwasher (Figure 3-17).
13. Pin (Item #24) to shaft with (Item #25) (Figure 3-16).
14. See previous pages for timing of cam shafts.

