GAMAJET® IV "GT"

OWNER'S MANUAL

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v. 2/99a

TABLE OF CONTENTS

1. INTRODUCTION

1.1 DESCRIPTION

The Gamajet IV GT is a turbine-driven 360° rotary nozzle machine designed for cleaning the interior surfaces of a wide variety of process, transport, and storage tanks. It is powered entirely by the cleaning solution and requires no electricity or compressed air for operation.

To handle the broadest possible range of applications, the Gamajet is available in stainless steel or silicon bronze construction -- with dual or triple nozzles- oil or cleaning-solution (Flo-Thru) lubricated gearbox; and with either 180° or 360° spherical washing coverage. For additional flexibility, an extensive selection of optional nozzle sizes, turbines, and gear ratios can adapt the Gamajet to clean tanks ranging in size from a few hundred gallons up to several million. The performance capabilities of these options are detailed in Appendix E.

1.2 INSTALLATION OF NEW MACHINES

1.2.1. ASSEMBLY

Every Gamajet is operationally tested at the specified pressure and flow before shipment and is ready to run after unpacking. No assembly is required prior to use except for clean-in-place (CIP) models equipped with the external self-rinse nozzle #7.

Reference numbers (such as #7) appearing below may be used to identify parts in the exploded view in Appendix F

To install the self-rinse nozzle:

a. Screw the locknut onto the nozzle tube threads until it stops.
b. Screw assembled nozzle #7 into nozzle carrier #10 hand tight.
c. Unscrew the nozzle just far enough (less than one turn) so that the nozzle tip is pointing directly toward the body of the Gamajet. The correct position is shown in the drawings in Appendix B.
d. Hold the nozzle in position and tighten the locknut against the nozzle carrier with a 9/16" wrench.

1.2.2. INLET CONNECTIONS

All Gamajets are supplied with a 2" NPT female inlet correction. Additionally, they will have either a 2-1/2" male quick-disconnect coupling (MIL-C-27487) or a 2-1/2" NST male hose thread (same as 2-1/2" NH).

If the NPT thread is to be used, the mating male thread is usually wrapped with PTFE pipe joint tape prior to assembly. This will minimize any chance of leakage and will make subsequent removal much easier.

1.2.3. MOUNTING

The full-coverage 360° Dual Nozzle Gamajet is hydraulically balanced and may be mounted on rigid piping, hung from a hose, or used with a tripod or cart. The Triple Nozzle and Directional 180° machine develops an unbalanced reaction force when operating and therefore must be rigidly mounted.

Most applications will mount the Gamajet in an "upright" position (inlet connection pointing up), but the Gamajet will function equally well inverted (as on a tripod), or even horizontally, if required.

1.2.4. LOCATION IN TANK

Generally, a single Gamajet should be mounted at the approximate center of the tank in order to equalize the cleaning radius in all directions. Some tanks may have specific cleaning problems such as heating coils or heavy deposits at the liquid level line. In these applications the Gamajet may need to be positioned for best effect on the more difficult areas.

Tanks with internal mechanisms or structures such as agitators or baffles may require careful positioning to minimize "shadows" on areas which do not receive direct jet impact. Sometimes, more than one machine or more than one placement of a single machine may be necessary to completely avoid shadow problems.

When choosing a mounting position, it is essential to allow sufficient clearance around the Gamajet so that its rotating parts do not strike any obstructions. The operating clearances required are shown in Appendix D.

1.2.5. ENTRY OPENINGS

When Gamajet are used in portable service, the tanks being cleaned must be provided with entry openings large enough to avoid interference during insertion and removal. The minimum opening size required will range from 6.7 to 12.7 inches in diameter, depending on the Gamajet configuration. These are illustrated in Appendix C. An optional nozzle carrier can be used to reduce the minimum opening size to 6" if required.

1.2.6. DRAINAGE

If it is necessary to clean the floor of a tank, standing liquid will diminish the effectiveness of the jet. Wherever possible, the tank floor should be pitched toward the drain and the discharge opening should be large enough to keep the liquid depth to a minimum. If gravity alone is insufficient, a scavenge or stripper pump should be connected to the drain. In extreme cases, it may be necessary to run smaller nozzles on the Gamajet, or even to operate it intermittently to allow time for draining.

1.2.7. FILTERS

All tank cleaning systems should be equipped with a strainer that will trap solids 1/16 inch or larger, as these will not pass through the Gamajet. These large particles will not harm the machine, but they can get caught in the turbine or nozzles and cause it to stop. It will then be necessary to disassemble the Gamajet and remove the blockage.

In recirculation cleaning or any application where the cleaning solution may carry abrasive solids in suspension, adequate filtration is a must. These particles can be extremely destructive to the Gamajet, as well as pumps, valves, and other system components. Filters properly installed and maintained will more than pay for themselves with lower overall operating costs in these applications.

1.3. SAFETY

When Gamajets are operating, the covers for the tank entry openings should be sealed well enough to withstand the full force of the jet striking the cover plate. If the cleaning solution is hot, corrosive, or toxic, a leak could present a serious hazard to any personnel in the immediate vicinity.

Any tank cleaning machine can develop a static electricity charge while in operation. If the tank being cleaned contains combustible liquid or vapor there is considerable risk of ignition or explosion. It is therefor imperative to insure that the Gamajet is properly grounded whenever there is any likelihood of combustible material being present.

2. PREVENTATIVE MAINTENANCE

NOTE. A rigorously implemented maintenance program can significantly reduce repair costs over the life of the Gamajet. The foundation of any such program is regularly scheduled inspection to discover and replace worn or damaged parts before they can cause the failure of other, more costly, components. The inspection intervals required will depend on the severity of the application, but 100 hours is recommended initially.

Two different gearbox designs are available: sealed, which is filled with oil; and Flo-Thru, which is lubricated by the cleaning solution. For some maintenance procedures it will be necessary to determine which type is used on the machine being serviced. The Flo-Thru gearbox will have one or more holes visible on the bottom of gearbox cover #64, while the sealed gearbox will have none.

Reference numbers (such as #64) appearing below may be used to identify parts in the exploded view in Appendix F.

2.1. SEALED GEARBOX

2.1.1. Remove screws #1, nameplate #3, and nozzle carrier #10.

2.1.2. Inspect bearings #4, seals #5, and cups #6. If any of these are worn or damaged, refer to section 4.4.2. of this manual and disassemble the Gamajet for inspection of tee housing bearings #22, seals #23, and cups #24. Otherwise, proceed to step 3.

2.1.3. Remove screws #51 and gearbox cover #64.

HINT: When gearbox cover #64 is removed for inspection of the gearbox on sealed machines, suction may cause idler shaft #43 to be withdrawn with the cover, leaving the idler shaft gears free to disengage. Prevent this by slowly lifting the cover and, at the same time, rocking it back and forth to separate the cover from the shaft. In the event the idler shaft gears do get disengaged, it will be necessary to drain the oil and remove rotor shaft #41 so that the gears can be reassembled.

2.1.4. Inspect the gearbox lubricant level and condition. If cleaning solution is present, refer to section 4.4.6. and disassemble the Gamajet for replacement of seals #36 and other parts as required. If the lubricant is free of contamination, proceed to step 5.

2.1.5. If the lubricant level is low, refill the gearbox to the correct level (see section 4.5.14.).

2.1.6. Reinstall gearbox cover #64, nozzle carrier #10 and nameplate #3.

2.1.7. Return the machine to service.

2.2. FLO-THRU GEARBOX

2.2.1. Remove screws #l, nameplate #3 and nozzle carrier #10.

2.2.2. Inspect bearings #4, seals #5, and cups #6. If any of these are worn or damaged, refer to section 4.4.2. of this manual and disassemble the Gamajet for inspection of tee housing bearings #22, seals #23, and cups #24.
Otherwise, proceed to step 3.

2.2.3. Remove screws #51 and gearbox cover #64.

2.2.4. Carefully inspect bushings #42, #61, and #62 for looseness on their shafts, and wear or damage on their flanges. If any of these are unserviceable, refer to section 4.4.6. and disassemble the Gamajet for inspection of bushings #45, #48, and #55 and replacement of parts as required. If the bushings are satisfactory, proceed to step 5.

2.2.5. Inspect gears #47, #59 and #60. If the teeth on any of these are worn more than .005", refer to section 4.4.6. and disassemble the Gamajet for inspection of gears #44, A6, #57, and #58 and replacement as required. If the gears are still serviceable, proceed to step 6.

2.2.6. Reinstall gearbox cover #64, nozzle carrier #10 and nameplate #3.

2.2.7. Return the machine to service.

3. TROUBLESHOOTING GUIDE

Reference numbers appearing below may be used to identify parts on the exploded view in Appendix F.

3.1. TEE HOUSING DOES NOT ROTATE

3.1.1. INSUFFICIENT FLOW

Look for restrictions in the fluid supply such as a clogged filter, kinked hose, or deposits in the piping. Inspect also for partially plugged nozzles, as these will have the same effect.

3.1.2. TIGHT CLEARANCES

In low-flow applications (below 50 gpm), a newly-overhauled Gamajet may fail to operate when first returned to service. If the machine seems otherwise all right, try running it with the nozzles removed. The additional flow will often be enough to overcome the extra resistance of new bearings and seals. A few minutes of operation should loosen tight clearances enough for the machine to run normally.

3.1.3. DEBRIS IN TURBINE

Remove retaining ring #15, and lift out stator #16. Look for and remove any debris caught between the stator and rotor vanes. Remove any material wound around the rotor shaft.

3.1.4. ROTOR SHAFT BINDING

Try to spin rotor #18 by hand. The rotor shaft should turn very easily with one finger and should be approximately centered in the stem bore. If the rotor is difficult to turn or is visibly off-center, look for a bent gearbox #32, cover #64, or stem #19. This kind of damage is particularly likely if the Gamajet has been struck hard or dropped.

If the shaft will turn freely in one direction, but not the reverse, check inside the gearbox.

3.1.5. GEAR TRAIN DAMAGE

If the rotor shaft turns freely (in section 3.1.4.) continue turning it to see if tee housing #25 rotates also. Failure to rotate may indicate worn or damaged gearbox internal parts. Another check on the gear train can be made by trying to rotate the tee housing directly by hand. It should have a small amount of free play, but it should not turn in a full circle.

3.1.6. DAMAGED TEE HOUSING KEY

If tee housing #25 rotates freely (in section 3.1.5.), look for damage to the key that engages ring gear #27. Also inspect the ring gear for damage where it contacts the tee housing key.

3.2. NOZZLE CARRIER ROTATES SLOWLY OR NOT AT ALL

3.2.1. BEARINGS BINDING

Grasp one of the nozzle tips and try to rotate nozzle carrier #10 in both directions. It should have a few degrees of free play before it stops (pin-drive) or becomes more difficult to turn (clutch-drive). If there is no free play, remove the carrier and check the fit of bearings #4 in cups #6. If the bearings do not spin freely in their cups, look for deposit build-up or damaged parts and correct as required.

Binding can also be caused by incorrect installation of bearings #4. On the Gamajet IV these bearings are located by pins in nameplate #3 and tee housing #25. These pins must enter their mating holes in the bearing flanges, or the nozzle carrier will be locked when the nameplate screws are tightened. Bearings that are incorrectly installed will show indentations or cracks in their flanges where they contact the pins.

3.2.2. DRIVE PIN OR CLUTCH DAMAGE

If the nozzle carrier rotates freely in a full circle (in section 3.2.1.), remove the carrier and disassemble retaining ring #14 and bevel gear #13. Look for a damaged drive pin #11 or O-ring #12. Examine the bevel gear and carrier for wear caused by slippage where they contact each other.

Clutch O-ring #12 should be flush with the surface of the carrier or slightly protruding. If it is deeply sunken into its groove, it may be frozen in place and unable to engage the bevel gear. Remove the O-ring, taking care not to scratch the groove walls. The O-ring should be replaced with a new one if it is hard or deformed. Install the O-ring so that it protrudes slightly and will be compressed when the gear and retaining ring are reinstalled.

3.2.3. WORN HOUSING BEARINGS

Look for excessive wear of nozzle and tee housing bearings #4 and #22. Excessive clearance (over 0.015") between the bearings and cups #6 and #24 can allow the bevel gears to disengage under load. Replace worn parts as required.

3.2.4. WORN BEVEL GEARS

Examine bevel gears #26 and #13 for worn or damaged teeth, and replace as required.

3.2.5. DAMAGED GEARBOX KEY

Remove nozzle carrier #10. Using a screwdriver, try to rotate gear #26 where it is exposed near the bottom of the tee housing. If the gear can be turned more than a few degrees, look for a worn or broken key on gearbox #32. Inspect gear #26 for damage to its slot that engages the key.

3.3. CLEANING SOLUTION LEAKAGE

NOTE. All Gamajets can be expected to show some apparent leakage at the gap between tee housing #25 and gearbox #32. This comes from an internal bypass system that cools and lubricates the waterside bearings and seals and also keeps the ring and bevel gears flushed free of debris. CIP models incorporate additional internal passages and drain holes, so these machines will also show some leakage around the nozzle carrier. Flo-Thru machines have a vent near the top of the gearbox, and the discharge from this will emerge at the bottom of the tee housing. On any of these units, this apparent leakage is entirely normal and does not impair the operating efficiency or cleaning performance of the Gamajet.

3.3.1. WORN OR INPROPERLY INSTALLED SEALS

Excessive leakage from the tee housing or nozzle carrier usually indicates worn housing seals #23 and #5. Inspect the seals for worn or damaged lips or loss of spring tension, and replace as required.

If the seals were recently replaced, verify that they are installed in the correct direction. These seals are designed to seal in one direction only and, therefore, must be installed with their sealing lips facing toward the pressure. They are installed correctly when the side of the seal with the exposed spring faces away from the adjacent bearing.

3.3.2. WORN BEARING CUPS

Inspect bearing cups #6 and #24 for excessive wear, particularly near the inside flange where they contact seals #5 and #23. Replace any that show distinct grooves.

3.3.3. WORN BEARINGS

Inspect bearings #4 and #22 and replace any that are excessively worn. Bearing clearances greater than 0.015 " can prevent the seals from functioning properly.

3.3.4. WORN OR ERODED CASTINGS

Inspect the seal contact surfaces of inlet stem #19 and tee housing #25. If these are worn or grooved, new seals will be ineffective. Replace the damaged parts as required.

3.3.5. CLUTCH O-RING DAMAGE

On clutch-drive machines, severe leakage at the nozzle carrier may indicate a damaged clutch O-ring #12. Remove nozzle carrier retaining ring #14, and lift off bevel gear #13 to inspect the O-ring.

3.4. POOR CLEANING PERFORMANCE

3.4.1. INADEQUATE FLOW OR PRESSURE

Check the pressure at the Gamajet inlet under actual operating conditions. The supply piping and hoses must be large enough to handle the flow rate required for the nozzle size being used to ensure adequate pressure. Insufficient pressure may also result from line losses when the machine is far from the pump, so the line size must be increased accordingly for long runs. Although the Gamajet will rotate at flow rates as low as 30 gpm to 40 gpm, effective cleaning may require considerably more flow.

3.4.2. CHEMICAL CONCENTRATION AND TEMPERATURE

Verify that the cleaning solution is the correct compound and concentration for the deposit being cleaned. If heating is necessary, also check that the solution is at the proper temperature.

3.4.3. PLUGGED NOZZLES

Unscrew the nozzles #8 to see if there is any debris caught in stream straighteners #9. If removal is required for cleaning, the straighteners may be driven out with a rod through the nozzle bore. These straighteners are an essential part of the nozzle design and must be reinstalled in the nozzles to ensure proper jet impact.

3.4.4. SLOW OR NO ROTATION OF NOZZLE CARRIER

This will result in partial or erratic washing coverage. Refer to section 3.2.

3.4.5. GAMAJET CONFIGURATION

Determine if the deposit being cleaned requires greater jet impact or longer jet dwell time (slower rotation) for more thorough scrubbing. Confirm that the Gamajet nozzle size, turbine, and gearing are correct for the specific application. Gamajet performance tables are available that show flow rate, cycle time, and jet impact force for various combinations of pressure, nozzle size, turbine, and gear ratio. Contact a Gamajet representative if assistance is required.

4. DISASSEMBLY, REPAIR, AND REASSEMBLY

4.1. TOOLS REQUIRED

Pliers
Screwdriver
3/8" hex deep socket wrench
7/16" hex deep socket wrench
6" socket extension
Socket drive handle
9/16" open-end wrench
Soft-faced hammer
1-1/2 pound hammer
1-1/4" open-end or 12" adjustable wrench
5/16" brass or soft steel rod
1/2" brass or soft steel rod
5/16"- 1 8 (or M8 x 1.25) machine screw tap
3/8"-16 (or M10 x 1.5) machine screw tap
1/4" pipe tap
Tap handle
Knife
Vise
Arbor press, 3 tons or larger

4.2. GENERAL DISASSEMBLY

FLO-THRU NOTE. Two types of gearbox are used: sealed, which contains oil, and Flo-Thru, which is lubricated by the cleaning solution. The Flo-Thru will have one or more holes visible on the bottom gearbox cover #64, while the sealed will have none. Most of the service procedures are the same for both types. Whenever the two differ, the sealed procedure will be given first, followed by a "FLO-THRU NOTE:" detailing any differences.

The reference numbers appearing below may be used to identify parts in the exploded view in Appendix F.

4.2.1 Remove two screws #1 with a 7/16" socket and pull nozzle carrier #10 off of tee housing #25. If tight bearings prevent removal, pry carefully between the nozzle carrier and tee housing #25.

4.2.2 Remove retaining ring #15 with pliers and lift out stator #16.

4.2.3 Insert a screwdriver between the vanes of rotor #18 and unscrew nut #17 with a 7/16" deep socket and 6" extension. Lift out the rotor with pliers or invert the machine and shake it out.

4.2.4 Invert the Gamajet and remove two screws #51 with a 7/16" socket. Remove gearbox cover #64 by prying with a thin-bladed screwdriver between the cover and gearbox #32. Pry near the screw holes and lift each side a little at a time or use two screwdrivers on opposite sides.

4.2.5 Remove two thrust washers #49 to prevent their loss and drain the oil into a suitable container for reuse if it is clean. Contaminated oil should be disposed of properly.

FLO-THRU NOTE: There will be no oil in the gearbox.

4.2.6 Pull out rotor shaft #41 and spacer #40. If the shaft is tight, tap the rotor end with a soft hammer until it is free. Pull out idler shaft #43 and remove gears #44, #46, and #47.

4.2.7 Remove three gearbox screws #34 with a 3/8" deep socket and 6" extension. Separate the gearbox from stem #19 by prying between gearbox #32 and tee housing #25.

4.2.8 Lift tee housing #25 off of stem #19. If the tee housing cannot be removed easily, pry carefully between the stem and tee housing.

4.3. DIFFICULT DISASSEMBLY - HINTS

NOTE. Most disassembly problems are caused by deposit build-up on the relevant parts, usually from lack of maintenance. Prevent future occurrences by adhering to a regular schedule of inspection, disassembly, and removal of deposits before they can cause difficulties. In applications particularly prone to scale accumulation, build-up can be minimized by periodically circulating a descaling compound through the Gamajet.

If parts resist disassembly avoid using excessive force except as a last resort First, try soaking the machine in a 5% to 10% citric acid solution for water scale or carbonate deposits, or an appropriate solvent for other types. Often, this is all that is needed

4.3.1. STATOR #16

Invert the Gamajet and remove gearbox cover #64 (section 4.2.4.). Place the machine in a press with the inlet end resting on the press table. Protect the end of rotor shaft #41 with a small piece of brass or aluminum and press the shaft until its end is nearly flush with the carbide thrust washer on pinion #60. Do not press against the washer itself, as it may crack. At this point, pinion #60 will have been separated from rotor shaft #41. If the stator is not yet loose, lift out pinion #60 and spacer #40 and continue pressing the shaft until the stator is free. If additional clearance is needed for the press ram, pull out idler shaft #43 and remove the three idler shaft gears #44, #46, and #47 from the gearbox.

4.3.2. ROTOR #18

Invert the Gamajet and remove gearbox cover #64 (section 4.2.4.). Support gearbox #32 to allow clearance for rotor shaft #41 and tap the rotor end of the shaft with a soft hammer until the shaft end is flush with the top of the rotor. The rotor will now be free.

4.3.3. GEARBOX COVER #64

Drive a knife blade into the joint between the cover and gearbox #32. Repeat at several points around the cover until there is enough clearance to insert a screwdriver and pry the cover off.

4.3.4. GEARBOX #32

If the gearbox will not separate from stem #19, clamp the stem in a vise, making sure the gearbox is free to move. Use a hammer and brass rod against the exposed end of bearing #29

visible inside the inlet stem. Hammer carefully against the bearing and pry between the gearbox and tee housing #25 until the gearbox separates from the stem.

4.4. INSPECTION AND SERVICE OF COMPONENTS

NOTE. Wherever lubrication of parts is called for, gearbox lubricant is satisfactory. On Flo-Thru machines, use any lubricant compatible with the application.

4.4.1. NOZZLE CARRIER #10

4.4.1.1. Nozzles #8

Unscrew the nozzles with a 1-1/4" open-end wrench and inspect for debris plugging stream straighteners #9. Remove the straighteners for cleaning by pressing them out with a 5/16" rod inserted through the nozzle tip. Nozzle sizes smaller than 5/16" will require a rod small enough to be inserted at an angle so that it can bear against one of the fins on the straightener.

Nozzle bores must be smooth, round, and free of damage for maximum jet impact. Replace worn or oversized nozzles if the original flow rate is required. Stream straighteners #9 must be reinstalled in the nozzles if they were removed for cleaning.

4.4.1.2. Self-Rinse Nozzle #7

If the machine is equipped with a self-rinse nozzle, remove it by loosening the locknut with a 9/16" open-end wrench and unscrewing the nozzle by hand. Blow through the nozzle to check for blockage and, if necessary, use a stiff wire or paper clip to clear the orifice in the tip.

4.4.1.3 Bevel Gear #13

Remove retaining ring #14 with a screwdriver and lift off bevel gear #13. Inspect the bevel gear for worn or broken teeth and for wear caused by slippage on the carrier. Removal of the bevel gear will reveal whether the carrier is the pin-type or clutch-type. The pin type requires no further attention if the pin is undamaged.

4.4.1.4 Clutch O-Ring #12

If the carrier is the clutch-type, inspect O-ring #12 and replace it if necessary. Inspect also for wear caused by slippage between the bevel gear and the nozzle carrier. Slippage can result from incorrectly installed nozzle carrier bearings, deposit build-up, or anything else that could make the carrier difficult to turn.

If desired, the clutch-type carrier can be converted to pin-type by installing a drive pin #11 in the hole just inboard of the O-ring, but the O-ring must remain in place to avoid leakage.

4.4.1.5. Nozzle Carrier Bearings #4

Inspect the bearings and discard any that are broken, cracked, or deeply scored. Clean any deposits from the bearings and check their fit in nozzle carrier cups #6. The bearings should turn freely in their cups, but the clearance should be less than 0.015" to avoid shortening the life of the seals or bevel gears.

4.4.1.6. Nozzle Carrier Seals #5

Examine the seals for loss of spring tension or excessive wear of the sealing lips and replace as required.

4.4.1.7. Nozzle Carrier Cups #6

Clean any deposits from the cups and examine for excessive wear. Light scoring is acceptable, but the cups should be replaced if they are grooved in the seal contact area or if the clearance with a new bearing is more than 0.015".

If a lot of cups need to be replaced, it will be worthwhile to make or obtain press tools to fit the cups. If the tools are not available, support the housing and drive the cups out with a hammer and brass rod against their inner flange, using care to avoid damage to the bores in carrier #10.

If the cups are extremely tight and resist removal cut them nearly through with a fine-tooth hacksaw blade. Work very slowly and carefully to avoid cutting into the carrier. The cup will collapse at the cut, relieving the press-fit and allowing easy removal.

Before installing new cups, clean the carrier bores and remove any burrs resulting from cup removal. Lubricate the outside of the new cups and press them in until their flanges are fully seated against the carrier.

4.4.1.8. Reassembly

If clutch O-ring #12 was removed, lubricate the new one and use thumb pressure to install it evenly all the way around its groove. Place bevel gear #13 on the carrier, making sure that pin #11 (if present) fully enters its slot in the gear. Install retaining ring #14 and verify that it is fully seated in its groove all the way around.

Screw in nozzles #8 and tighten with a 1-1/4" open-end wrench. If the machine is equipped with self-rinse nozzle #7 it should not be installed until after the nozzle carrier is assembled onto the Gamajet.

4.4.2. TEE HOUSING #25

4.4.2.1. Disassembly

Remove retaining ring #28 with a screwdriver and lift out ring gear #27. If the gear is tight in the tee housing, strike the bottom of the tee housing sharply against a block of wood until the gear is free. Next, lift out bevel gear #26, bearing #22, and seal #23. If inner nozzle carrier

bearing #4 needs replacement and is too tight to remove by hand, pry under the flange using two screwdrivers on opposite sides.

4.4.2.2. Inspection

Inspect the tee housing for wear or damage, particularly on the areas that contact bearings #4 and seals #5. Inspect also for damage to the tee housing key that engages ring gear #27. If the ring gear was difficult to remove, check if the tee housing is out-of-round where the gear seats.

4.4.2.3. Bevel Gear #26

Inspect gear #26 for worn or damaged teeth and for damage to the slot that engages the key on gearbox #32.

4.4.2.4. Ring Gear #27

Inspect gear #27 for worn or damaged teeth and for damage to the slot that engages the key in tee housing #25. If the gear was difficult to remove from the tee housing, check if it is out-of-round.

4.4.2.5. Tee Housing Bearings #22

Inspect the bearings and discard any that are broken, cracked, or deeply scored. Clean any deposits from the bearings and check their fit in tee housing cups #24. The bearings should turn freely in their cups, but the clearance should be less than 0.015″ to avoid shortening the life of the seals or bevel gears.

4.4.2.6. Tee Housing Seals #23

Examine the seals for loss of spring tension or excessive wear of the sealing lips and replace as required.

4.4.2.7. Tee Housing Cups #24

Clean any deposits from the cups and examine for excessive wear. Light scoring is acceptable, but the cups should be replaced if they are grooved in the seal contact area or if the clearance with a new bearing is more than 0.015". If the bearing cups require replacement, follow the procedure given for nozzle carrier cups #6 in section 4.4.1.7. Replacement cups must be fully seated in order for the tee housing to turn freely when the machine is reassembled.

4.4.2.8. Reassembly

Install seal #23 in the lower bearing cup with its spring side facing into the cup. Next, install bearing #22 and, then, bevel gear #26, malting sure that the lug on the bearing engages the recess in the gear. Locate the key slot on ring gear #27 and install the gear so the slot engages the key on the tee housing. Finally, install retaining ring #28.

If inner nozzle carrier bearing #4 was removed, push it fully against its seat and check that the locating pin enters the hole in the bearing flange. Slide inner nozzle carrier seal #5 up against the bearing, malting sure that the side with the exposed spring faces away from the bearing.

4.4.3. INLET STEM #19

4.4.3.1. Disassembly

Remove three O-rings #20 from their seats around the screw holes in the bottom of the stem and discard them. These should be replaced with new ones when the machine is reassembled. If upper tee housing bearing #22 or seal #23 requires replacement, first clean any deposits from the stem before attempting removal. If the bearing is tight, use two screwdrivers on opposite sides of the flange to pry it free.

4.4.3.2. Inspection

Inspect the stem for wear or damage, particularly on the areas that contact bearings #22 and seals #23.

FLO-THRU NOTE: *Check that restrictor #21 is in place and that its orifice is clear by pushing a stiff wire or paper clip all the way through. If the orifice is blocked and cannot be cleared, push the restrictor out with apiece of heavy wire (like a coat hanger) and replace it. The Gamajet must not be operated with a plugged restrictor or with no restrictor in place.*

4.4.3.3 Reassembly

Slide bearing #22 all the way onto the stem, making sure that the locating lug on the bearing enters the recess in the seat. Slide seal #23 onto the stem until it is up against the bearing, making sure that the side with the exposed spring faces away from the bearing.

4.4.4. GEARBOX COVER #64

4.4.4.1. Inspection

Inspect bushings #42, #61, and #62 for cracks or other damage and look for noticeable wear of the flange faces. Insert an unworn shaft in the bushings and rock it from side to side to check for looseness. Any bushing having more than 0.003" clearance should be replaced. Pay particular attention to bushing #61; because if its flange wears through, the end of the rotor shaft can seriously damage the gearbox cover.

Make sure that dowel pin #50 is in place and undamaged. Inspect gearbox cover O-ring #63 for deterioration or damage and replace if necessary.

FLO-THRU NOTE. *The plastic bushings used in these machines may have up to 0.005" clearance on their shafts.*

4.4.4.2. Bushing Removal

To remove bushing #61, screw in a 5/16"-l8 (or M8 x 1.25) tap until it hits bottom. Continue turning the tap, and the bushing will be pulled out of the gearbox cover. Bushings #42 and #62 are removed in the same way but will require a 3/8"-16 (or M10 x 1.5) tap instead.

4.4.4.3. Bushing Installation

Thoroughly clean any chips or other debris from the bore in the gearbox cover. Position the new bushing in the bore, making sure that it is started straight, and press the bushing in until fully seated. The bushings are quite soft, so use care to avoid damaging the flange faces when pressing them in.

4.4.5. GEARBOX #32

4.4.5.1. Disassembly

Remove final shaft assembly #56 from the gearbox by prying between the #56 pinion and the housing lip immediately above it. Gears #58 and #59 will slide off the shaft after it is out of the gearbox. Remove upper bearing #29 by gripping the flange with pliers and pulling out with a twisting motion.

To remove center bearing #39 or seal housing #38, first remove bearing #29 (for GT Oil machines, also remove seal #68 and washer #67) as described above. Then insert a length of 1/2" diameter soft steel rod through the gearbox from the top until it rests on spacer #35. Place the gearbox in a press and push against the rod to remove the spacer, seal housing #38, and bearing #39 together in one operation.
FLO-THRU NOTE: *Parts #35 and #38 are not used. When the 1/2" rod is inserted it will bear directly against bearing #39.*

4.4.5.2. Inspection

Examine the gearbox carefully for any signs of being bent. This is particularly likely if the Gamajet has been dropped or struck hard. A rough check can be made with a square; but, to eliminate any doubt, the gearbox should be mounted on a lathe and checked with a dial indicator. Inspect for damage to the key that engages bevel gear #26. Inspect O-ring #31 near the top of the gearbox and replace if necessary.

If bearing #39 is removed, check its bore in gearbox #32 for any deep scores that could cause oil leaks past O-rings #37 or interfere with proper seating of the bearing when it is reinstalled.

NOTE: *Field repair of damaged gearbox keys is not recommended A factory repair service is available for this part. Contact Gamajet for details.*

4.4.6. GEARBOX INTERNAL PARTS

4.4.6.1. Upper Idler Shaft Bushing #42

Insert idler shaft #43 in the bushing and rock it to check for looseness. If the bushing needs replacement, follow the procedure given for the gearbox cover bushings (section 4.4.4.2).

4.4.6.2. Idler Shaft #43

Examine the shaft for damage or wear and replace if worn more than 0.002".

4.4.6.3. Final Shaft #56

Disassemble the shaft by supporting gear #57 and pressing against the small end of the shaft. After gear #57 is removed, retainer #53 will slide off the shaft. Examine the shaft for worn or damaged gear teeth and for scoring or excessive wear on the areas that contact bushing #55 and idler gears #58 and #59. Replace if worn more than 0.002".

4.4.6.4. Final Shaft Gear #57

Inspect gear #57 for worn or damaged teeth. Inspect also for excessive wear on the face that contacts the flange of bushing #55 and replace if worn deeper than 0.005". The gear must be replaced if it will not maintain a press fit on shaft #56.

4.4.6.5. Final Shaft Retainer #53

Check for excessive wear of bushing #55 by inserting shaft #56 and trying to rock retainer #53 from side to side. Inspect O-ring #52 and replace if necessary.

If bushing #55 requires replacement, screw a 1/4" pipe tap into the bushing from the flange side. Place the assembly in a press so that retainer #53 is supported by its flange while leaving the flange of bushing #55 free to move. Use a short length of 1/2" rod against the end of the tap to press the tap and bushing out together. Remove seal #54, as this must be replaced whenever the bushing is serviced. Clean any deposits from the retainer bore.

4.4.6.6. Final Shaft Reassembly

Lubricate seal #54 and insert it into retainer #53 so that its spring side will face bushing #55. Press bushing #55 into the retainer until its flange is fully seated. Slide the assembled retainer onto shaft #56 with its flange facing away from the pinion. Place gear #57 on the shaft and carefully align the square hole in the gear with the flats on the shaft. Press the gear on until it is seated against the shoulder on the shaft.

FLO-THRU NOTE: *Seal #54 is not used. All other components are serviced the same as for the sealed gearbox.*

4.4.6.7. Idler Gears #44, #46, #47, #58, and #59

Inspect the gears for worn or broken teeth or worn bushing flanges. Check for loose bushings by inserting an unworn shaft and rocking the gear from side to side. If the clearance is more

than 0.003", replace the bushing. On lower gears #47 and #59, check if thrust washer #49 is damaged or missing and replace if necessary.

FLO-THRU NOTE: *The plastic bushings in these machines may have up to 0.005" clearance on their shafts.*

4.4.6.8. Rotor Shaft #41

Clean the shaft thoroughly and examine the gray ceramic coating for wear or other damage. Replace the shaft if there is damage to the areas that come in contact with bearings #29, #39, and #61 or seals #36. Damage in other areas is less critical and may be ignored as long as it does not interfere with installation or removal of the shaft.

4.4.6.9. Rotor Shaft Pinion #60

Inspect pinion #60 for worn teeth or damage to the thrust washer. If the pinion requires replacement, remove it by supporting the pinion and pressing against the end of shaft #41.

Before pressing the new pinion in place, lubricate the rotor shaft and the pinion bore. Carefully check the alignment of the pinion with the shaft and apply only enough pressure to seat the pinion against its shoulder on the shaft. The carbide thrust washer is quite brittle, and care must be used to avoid damage during installation.

4.4.6.10. Rotor Shaft Spacer #40

Excessive wear of spacer #40 can allow the rotor shaft pinion to strike the bottom gear #59 on final shaft #56. Measure the overall length of the spacer and replace if it is less than 2.230".

4.4.6.11. Rotor Shaft Upper Bearing #29

Check for looseness by inserting the rotor shaft and rocking it from side to side. If the clearance exceeds 0.003" or the bearing is cracked, it should be replaced. Inspect O-ring #30 and replace if required.

4.4.6.12. Rotor Shaft Center Bearing #39

Insert the rotor shaft and check for looseness by rocking it from side to side. Bearing #39 should be replaced if the clearance exceeds 0.003".

4.4.6.13. Seal Housing #38

If seals #36 need replacement, carefully pry the old ones out of housing #38. Pry from the inside diameter of the seals to avoid putting scratches in the housing bores. Clean any deposits from the housing bores that might interfere with the seals. Lubricate the new seals and push them into the housing with their spring sides facing out. Inspect O-rings #37 and replace if required.

4.4.7. GEARBOX REASSEMBLY

Drop spacer #35 into its bore and make sure that it is lying flat against the shoulder at the bottom. Lubricate O-rings #37 on housing #38 and push the housing all the way into the bore by hand. Start bearing #39 in the bore and position it so the flat on its flange is next to the bore for retainer #53. Press bearing #39 in until its flange is fully seated. Lubricate O-ring #30 on bearing #29 and push the bearing into the top of the gearbox by hand.

Final shaft #56 should not be installed until after the gearbox is assembled to stem #19.

Flo-Thru Note: *Parts #35, #37, and #38 are not used*

4.5. REASSEMBLY

NOTE: *All parts must be cleaned thoroughly before reassembly. Any deposits remaining on the parts can cause difficult disassembly the next time the Gamajet needs servicing.*

"Wherever lubrication of parts is required for assembly, gearbox lubricant is satisfactory On Flo-Thru units, use any assembly lubricant compatible with the machine application.

4.5.1. Slide assembled tee housing #25 (section 4.4.2.8) onto inlet stem #19.

4.5.2. Place three <u>new</u> O-rings #20 in the recesses around the screw holes in stem #19.

4.5.3. Lubricate O-ring #31 on gearbox #32 and insert the gearbox into the inlet stem <u>making sure that the key on the gearbox engages its slot in gear #26</u>. Rotate the gearbox to align the screw holes.

4.5.4. Install three screws #34 with lockwashers #33 and tighten to 20-25 lb. ft. with a 3/8" deep socket and 6" extension.

4.5.5. Check to see that the tee housing will rotate freely. Binding could indicate that the gearbox key is not properly engaged with bevel gear #26.

4.5.6. Install idler gear #58 on final shaft #56, followed by gear #59 without its thrust washer.

FLO-THRU NOTE. The two bottom idler gears #47 and #59 are <u>not</u> interchangeable. Gear #4 7 is identified with the letter "N " and must be installed on idler shaft #43. Gear #59 is identified with the letter "T" and must be installed on final shaft #56

4.5.7. Lubricate O-ring #52 on bearing retainer #53 and insert the final shaft assembly into its bore in the gearbox. It may be necessary to use a spacer or sleeve to apply pressure to lower gear #59 until retainer #53 is seated against its flange.

4.5.8. Install gears #44 and #46 on idler shaft #43 followed by gear #47 without its thrust washer.

4.5.9. Position the idler shaft assembly in the gearbox and insert the end of the shaft in bushing #42.

4.5.10. Install thrust washers #49 on shafts #43 & #56.

4.5.11. Slide spacer #40 onto rotor shaft assembly #41. Slip plastic installation sleeve RS-1 over the threaded end of the shaft to protect the oil seals from damage.

4.5.12. Lubricate the shaft and insert it into center bearing #39 with a twisting motion. Push the shaft in until the gears are engaged and spacer #40 is seated. Check to see that the shaft turns freely.

FLO-THRU NOTE. *It is not necessary to use the installation sleeve or to lubricate the shaft.*

4.5.13. Remove installation sleeve RS- 1.

4.5.14. Fill the gearbox with lubricant to one inch (25 mm) below the cover seating face of the gearbox. This will require approximately 11 fluid ounces (325 ml). SAE 90 - 140 straight mineral gear oil is recommended, but food-grade lubricant of equivalent viscosity may be used if desired. Hypoid gear oil or other lubricants containing extreme-pressure additives should be avoided.

FLO-THRU NOTE *Omit this step. Lubricant* is *not required*

4.5.15. Lubricate O-ring #63 on gearbox cover #64.

4.5.16. Install gearbox cover #64 by positioning it so that the ends of the shafts enter the bushings. Align the locating dowel with its hole in the gearbox and tap the cover with a soft hammer until seated.

4.5.17. Install two screws #51 with lockwashers #2 and tighten with a 7/16" socket.

4.5.18. Stand the machine upright. Place rotor #18 onto shaft #41 followed by lockwasher #2 and nut #17. Use a screwdriver to hold the rotor from turning and tighten the nut with a 7/16" deep socket and 6" extension.

4.5.19. Test for proper assembly by turning the rotor with a pencil. The shaft should turn very easily and the rotor vanes must not strike the stein wall. Continue turning and check to see that the tee housing turns also.

4.5.20. Install stator #16 and secure -it- with retaining ring #15.

4.5.21. Place assembled nozzle carrier #10 (section 4.4.1.8) onto the tee housing. If the Gamajet is equipped with self-rinse nozzle #7 the hole for the nozzle should point toward the inlet end of the machine. Rotate the carrier slightly to mesh the bevel gears.

4.5.22. Install outer seal #5 onto the tee housing with its spring side facing into bearing cup #6.

4.5.23. Insert bearing #4 into nameplate #3, taking care that the locating pin enters the hole in the bearing flange. While keeping the nameplate and bearing engaged, push them all the way onto the tee housing.

4.5.24. Rotate the nameplate to align the screw holes, making sure that the locating pin does not disengage from the bearing. Install two screws #1 with lockwashers #2 and tighten with a 7/16" socket.

4.5.25. Try to rotate the nozzle carrier in both directions. It should have a few degrees of free play before it stops (pin-drive) or becomes more difficult to turn (clutch-drive). If this free play cannot be felt, remove the nozzle carrier and check that both bearings #4 are fully seated and engaged with their locating pins.

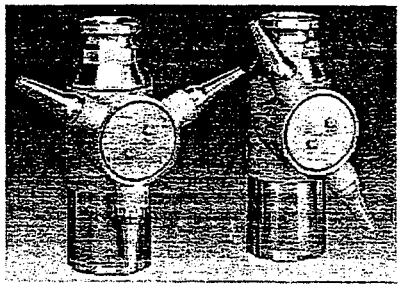
4.5.26. If the machine is equipped with self-rinse nozzle #7, screw it into nozzle carrier #10 hand tight. Unscrew the nozzle just far enough (less than one turn) so that the nozzle tip is pointing directly toward the body of the Gamajet. The correct position is shown in the drawing in Appendix B. Hold the nozzle in this position and tighten the locknut against the nozzle carrier with a 9/16" open-end wrench.

This completes assembly.

APPENDIX A

TECHNICAL SPECIFICATIONS

GAMAJET IV SS
TANK CLEANING MACHINES



DESCRIPTION:	Developed and upgraded from the proven Gamajet III. Hydraulically driven rotary tank cleaning machine revolves 360° in both horizontal and vertical planes with synchronized solid jets providing a tight and thorough scouring pattern covering all interior tank surfaces in one complete cycle. A choice of twelve nozzle sizes and hydraulic turbines, including two gear systems, offer a wide operating range of flow rates, nozzle rotation speeds, and wash cycles. Capable of high concentration chemical recirculation cleaning or high pressure-low volume water blasting in fixed CIP automated systems.
OPERATING RANGE:	
Pressure:	40 to 500 psig (2.8 to 34.5 bar) for standard model 40 to 700+ psig (48.3 bar) for high pressure model
Temperature:	-60° to 250°F. (-29° to 121°C.)
Flow Rate:	30 to 220 gpm (7 to 50 tons/hr) for standard model
Wash Cycle Time: Nozzle	6 to 30 minutes
Rotation Speed:	2 to 10 rpm
OVERALL DIMENSIONS:	
Height:	12.2 in. (31.0 cm.)
Diameter:	4.2 in. (1 0.7 cm.)
Width:	6.0 in. (15.2 cm.) including nozzle housing
MINIMUM ENTRY OPENING:	
Pin Drive:	Dual: 12.6 in. (32.0 cm.) Triple: 11.4 in. (29.0 cm.)
Optional Clutch Drive:	Dual: 6.6 in. (1 6.8 cm.) Triple: 9.6 in. (24.4 cm.)
WEIGHT:	Dual: 26 lb. (1 1.8 kg.) Triple: 27 lb. (12.3 kg.)
DUAL INLET CONNECTION:	
Standard	2 in. NPT female and 2 in. quick disconnect male
Optional:	2 in NPT female and 2 in. NST (NH) hose thread male
CONSTRUCTION/DESIGN:	

New Features:	Streamlined turbine and internal flow passages, including a patented porting design that significantly improves efficiency.
Castings:	Investment cast parts of type 316 stainless steel insure consistent strength and quality for higher pressure ratings.
Shafts:	Rotor shaft and gearbox shafts are made of hardened stainless steel. For increased wear resistance in specific applications, the rotor shaft is supplied with a plasma-sprayed ceramic or other protective coating. The rotor shaft is also fitted with a polished carbide thrust washer for added durability.
Bearings, Shaft:	Rotor shaft bearings are tungsten carbide. Gearbox shaft bearings in Flo-thru (oilless) gearboxes are PTFE or other nonmetallic materials. Standard bearings in oil-lubricated gearboxes are Oilite bronze with nonmetallic bearings available as an option.
Bearings, Waterside:	Tee and nozzle housing bearings are made of carbon fiber reinforced polyphenylene sulfide with PTFE added as a lubricant. Nozzle housing bearings are now pin-located for positive indexing and ease of assembly.
Bearing Cups:	Main body castings are protected against wear by replaceable stainless steel cups installed at all bearing locations.
Seals, Dynamic:	Rotary shaft and housing seals are spring-loaded reinforced PTFE for extra long wear and protection against leakage, abrasion damage, and deposit build-up.
Seals, Static:	O-ring materials are selected for each application. Available materials include Viton®, EPDM, PTFE, and Karez®. Others can be supplied on order.
Drive Gears:	A new gear system of improved design and construction is incorporated in Gamajet IV models for increased wear life. All gears are manufactured entirely of selected stainless steel alloys and the two bottom gears are fitted with long-life tungsten carbide thrust washers. Gear bushings compounded of PTFE or ETFE are standard in Flo-thru oilless gearboxes and are optional in sealed lubricated gearboxes where Oilite bronze is standard.
Lubrication, Gearbox:	
Sealed:	Oil-lubricated machines have a sealed gearbox filled with FDA approved oil. Any heavy duty gear oil, high or low temperature lubricant or grease may be used.
Flo-thru:	The Flo-thru gearbox is lubricated by the cleaning solution. With this option maintenance of gearbox seals is eliminated.
Lubrication, Waterside:	A controlled amount of the cleaning solution is permitted to

flow through the tee and nozzle housing bearings for lubrication and cooling. This flow also aids in removing solid particles from between the bearings and cups to minimize abrasion damage to these parts.

Self-Cleaning Provisions:

In. all Gamajet models, a low-pressure bypass system keeps the bevel gears and other internal parts flushed free of debris that could interfere with proper functioning:

Self-cleaning CIP models are additionally equipped with the following:

1. A small auxiliary nozzle which washes the exterior of the machine.
2. Internal passages to provide direct high-pressure rinsing of any areas where build-up of deposits could allow bacterial growth.
3. Holes to allow complete drainage of any cleaning solution remaining in the machine at title end of the cleaning cycle that could cause product contamination. The gearbox of the Flo-thru model also drains completely when the machine is not in use.

Nozzles:

Redesigned dual and triple nozzle housings with centerline nozzle mounting on the Gamajet IV eliminate unbalanced reaction forces. Interchangeable nozzles are now available in twelve sizes from 5/8" (15.9 mm) down to 0.177" (4.5 mm). Nozzle sizes of 1/4" and smaller are offered with new tungsten carbide inserts for improved jet performance at high pressures.

OPERATING & MAINTENANCE:

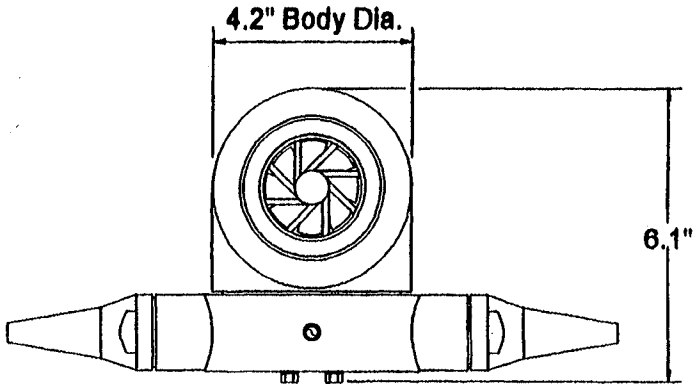
Complete operating and maintenance procedures are covered in a detailed instruction manual furnished with all machines. Ready availability of spare parts or kits and ease of maintenance on-site minimizes or eliminates the need for factory repairs. Prompt factory overhaul or repair service is always available from the factory. Replacement parts are always stocked.

WARRANTY:

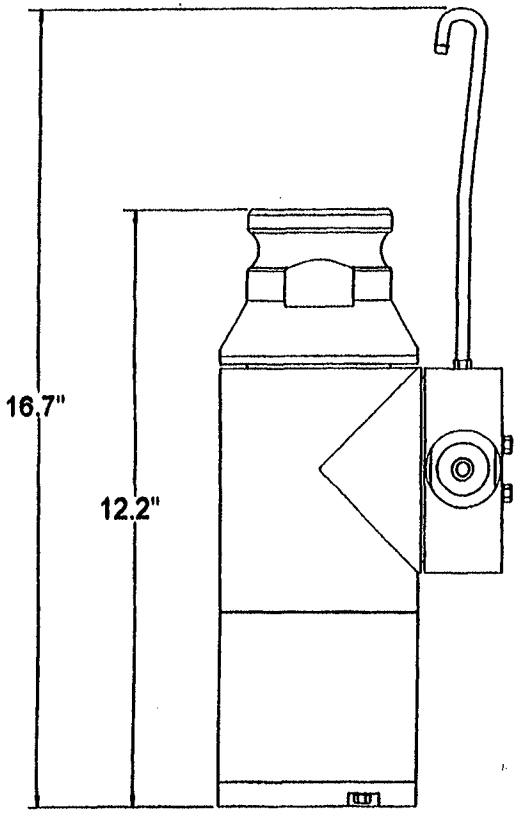
Stainless steel Gamajets are warranted for 18 months from date of shipment or 12 months from date of installation, whichever occurs first, against any defects in workmanship or materials. Normal maintenance parts such as O-rings, bearings, seals, etc. are not included under this warranty, nor is damage caused by dropping, use of destructively corrosive fluids, or other abuse. This warranty shall not apply to any malfunction resulting from use of non-Gamajet replacement parts purchased from any source other than Gamajet Cleaning Systems, Inc. or an authorized Gamajet distributor.

APPENDIX B

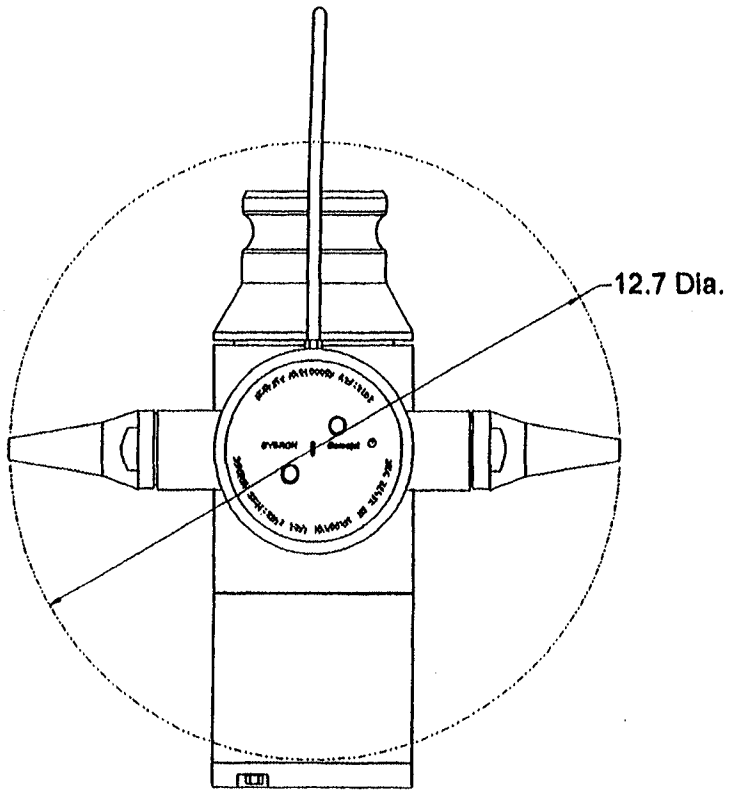
DIMENSIONAL DATA



TOP VIEW



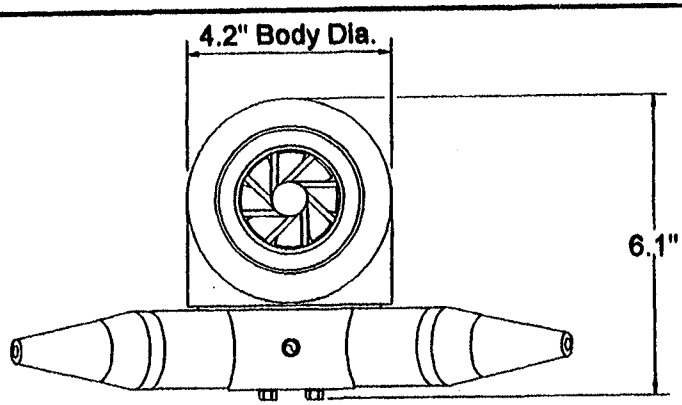
SIDE VIEW



FRONT VIEW

Gamajet Equipment Division
Gamajet IV Dimensional Data
Dual Nozzle

92111



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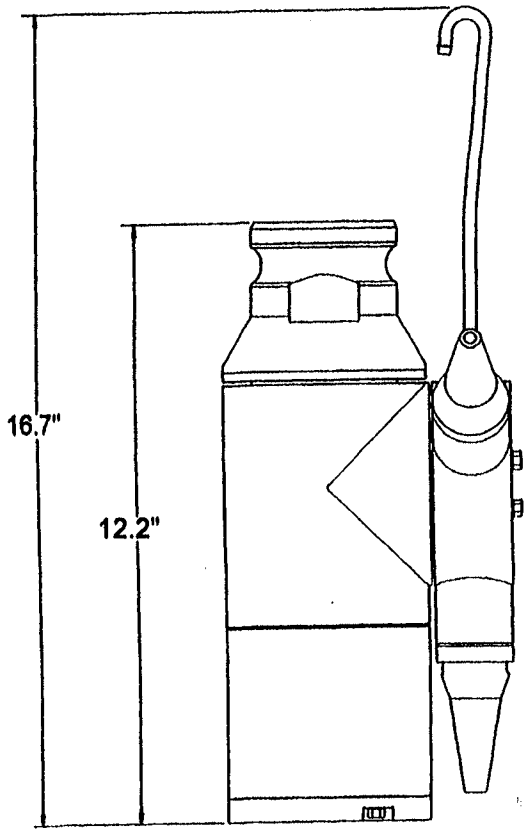

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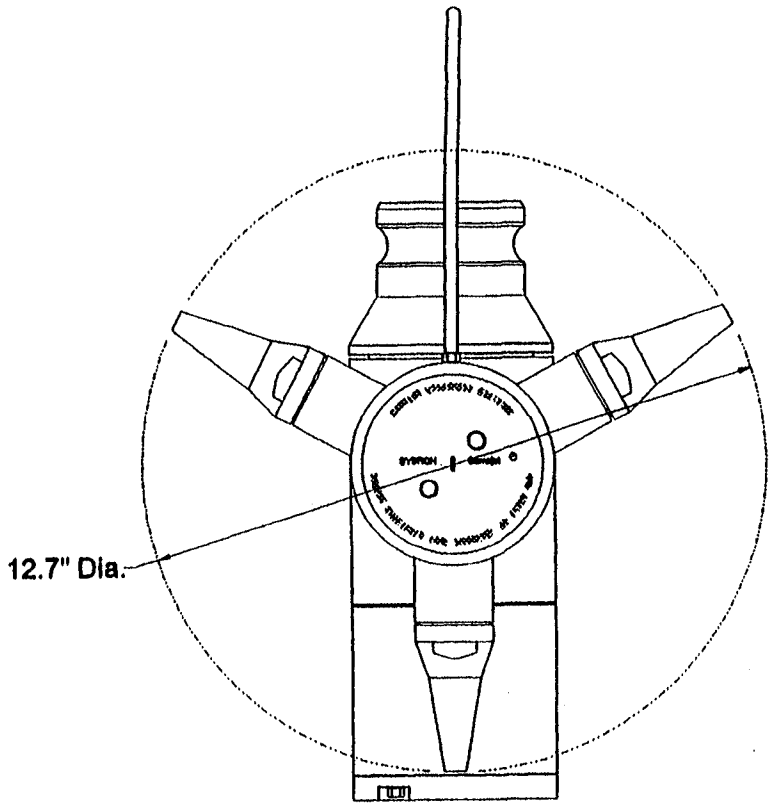


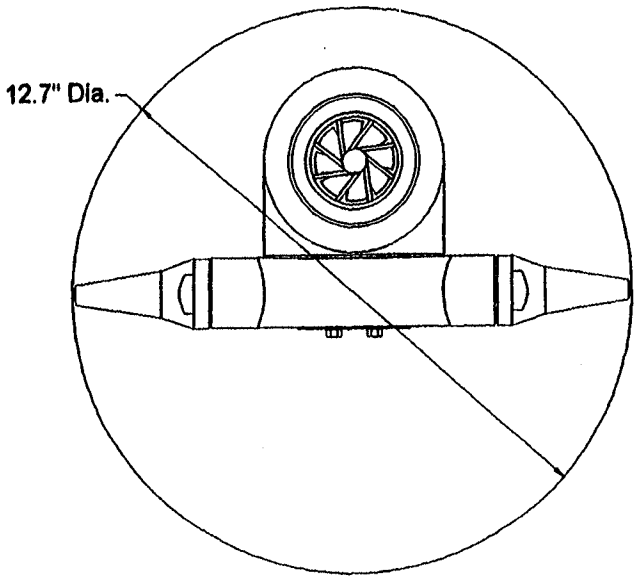
FRONT VIEW

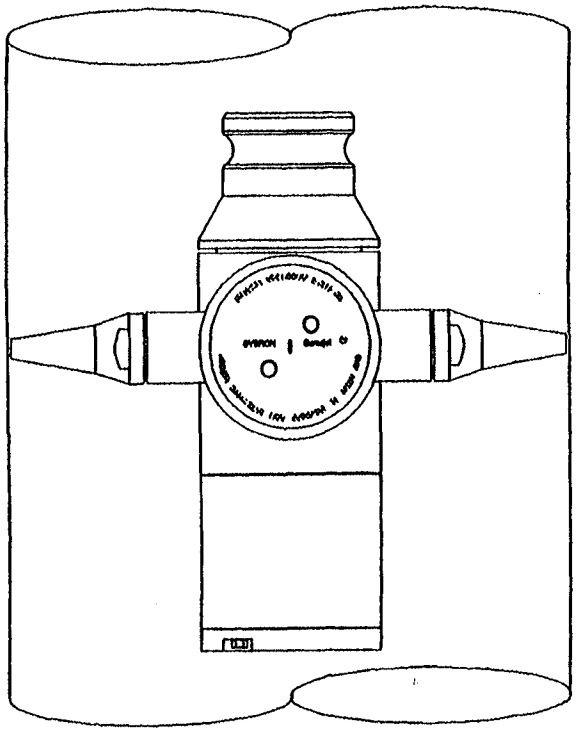
Gamajet Equipment Division
Gamajet IV Dimensional Data
Triple Nozzle

92121

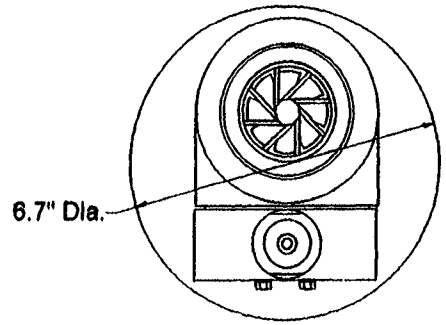
APPENDIX C

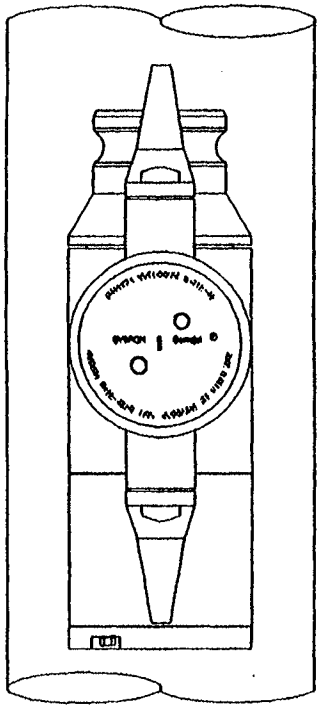
ENTRY OPENINGS





DUAL NOZZLE
Worst Case Max.

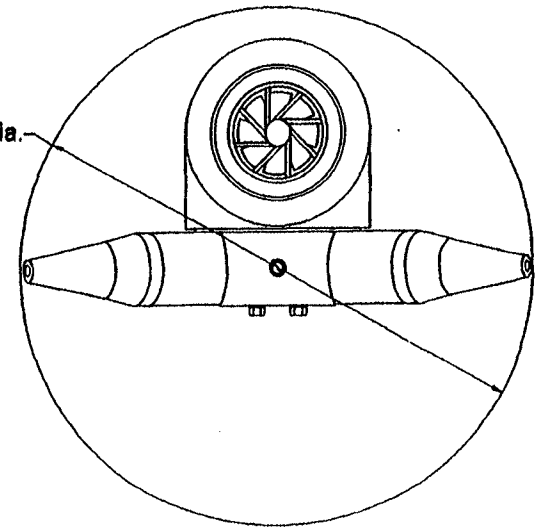


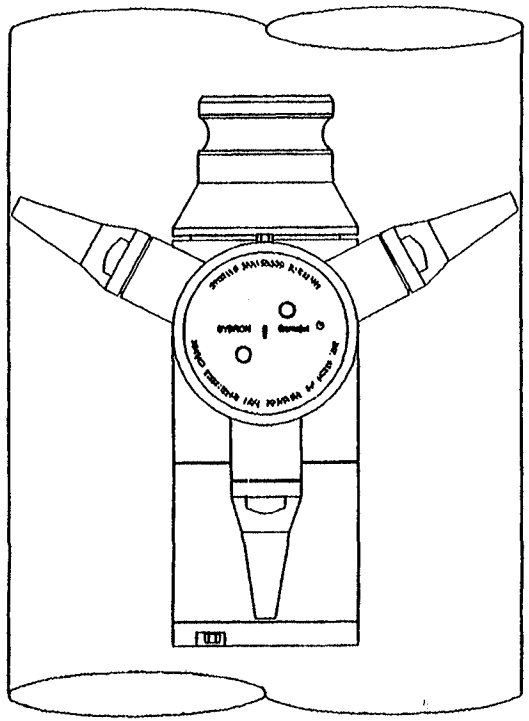


DUAL NOZZLE
Best Case Min.

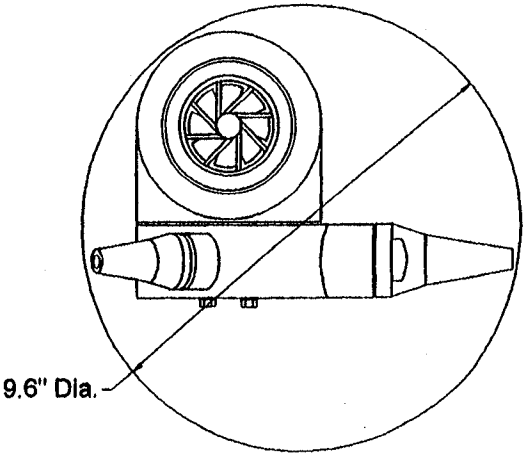
Gamajet IV Entry Openings
Gamajet Equipment Division

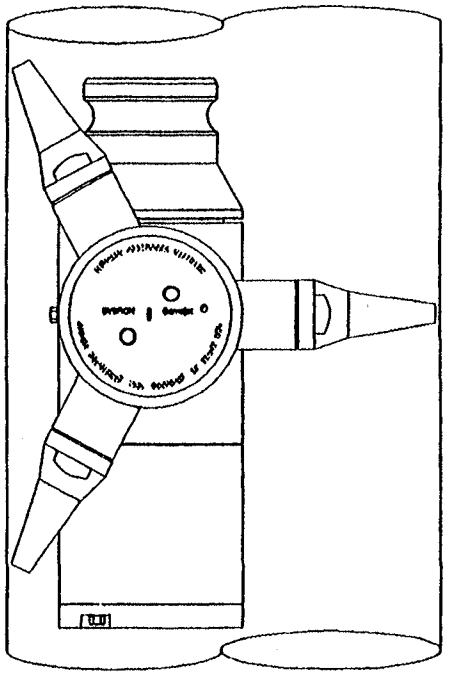
92131





TRIIPLE NOZZLE
Worst Case Max.





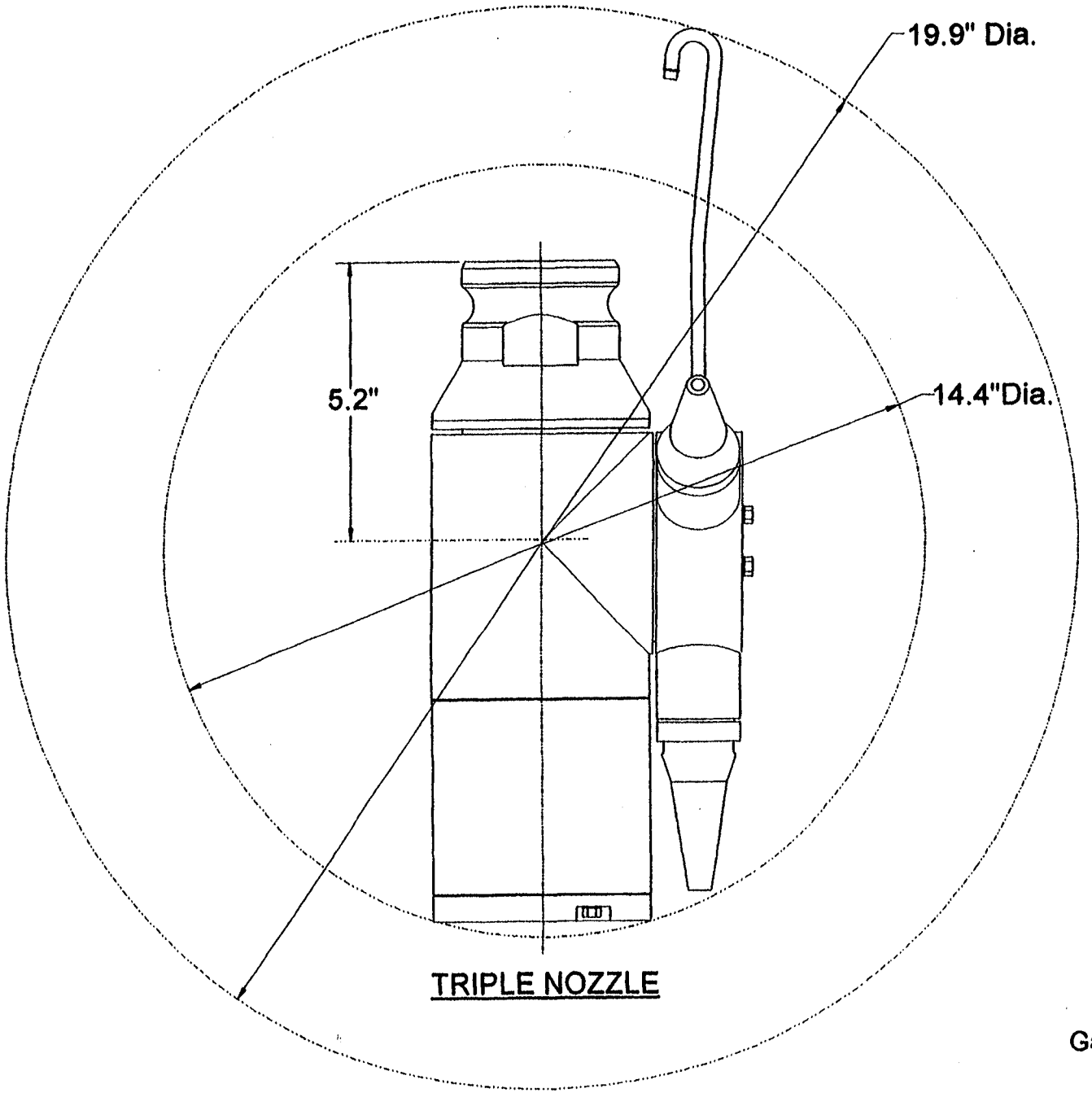
TRIPLE NOZZLE
Best Case Min.

Gamajet Equipment Division
Gamajet IV Entry Openings

92141

APPENDIX D

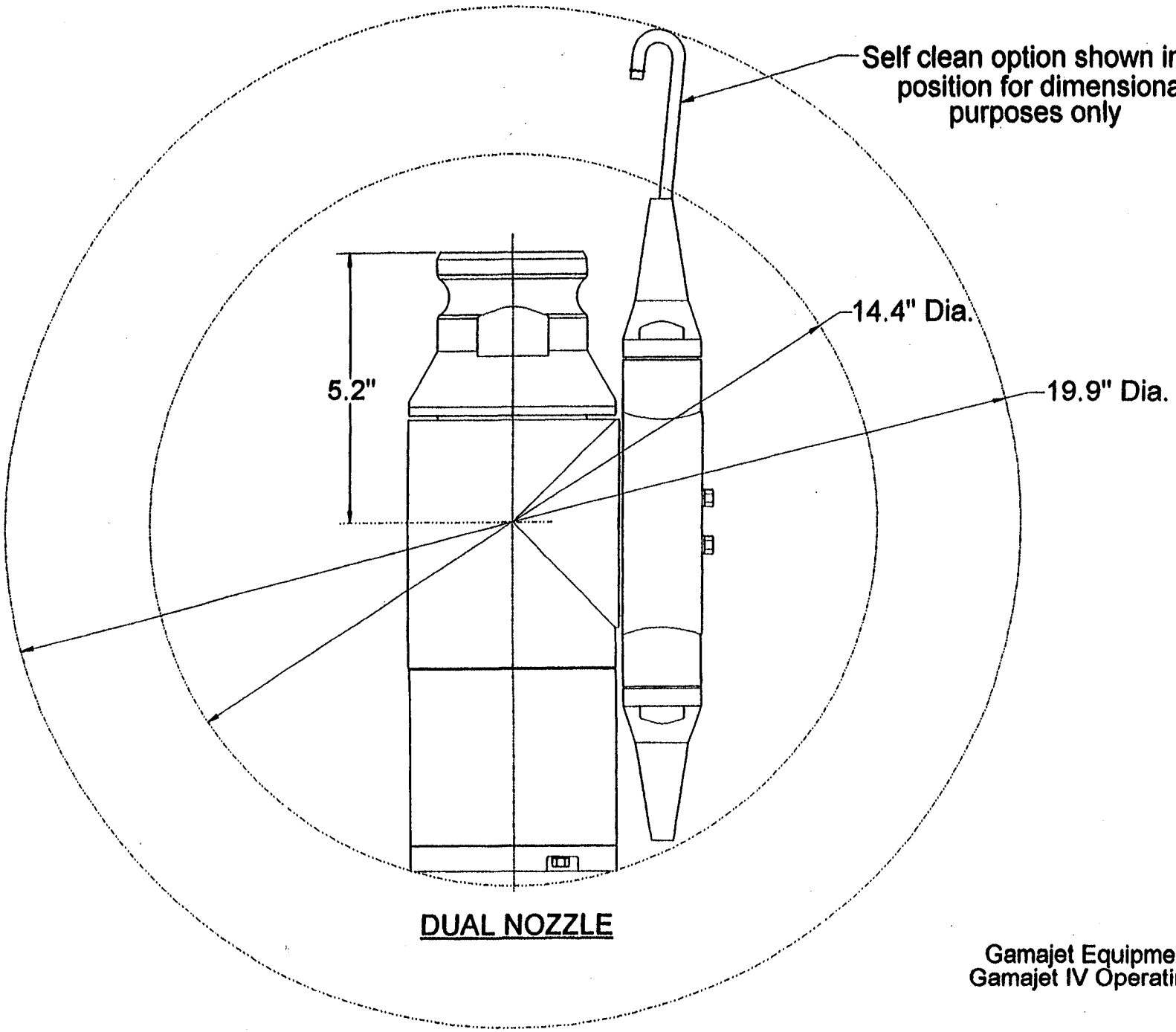
OPERATING CLEARANCES



TRIPLE NOZZLE

Gamajet Equipment Division
Gamajet IV Operating Clearance

91161



DUAL NOZZLE

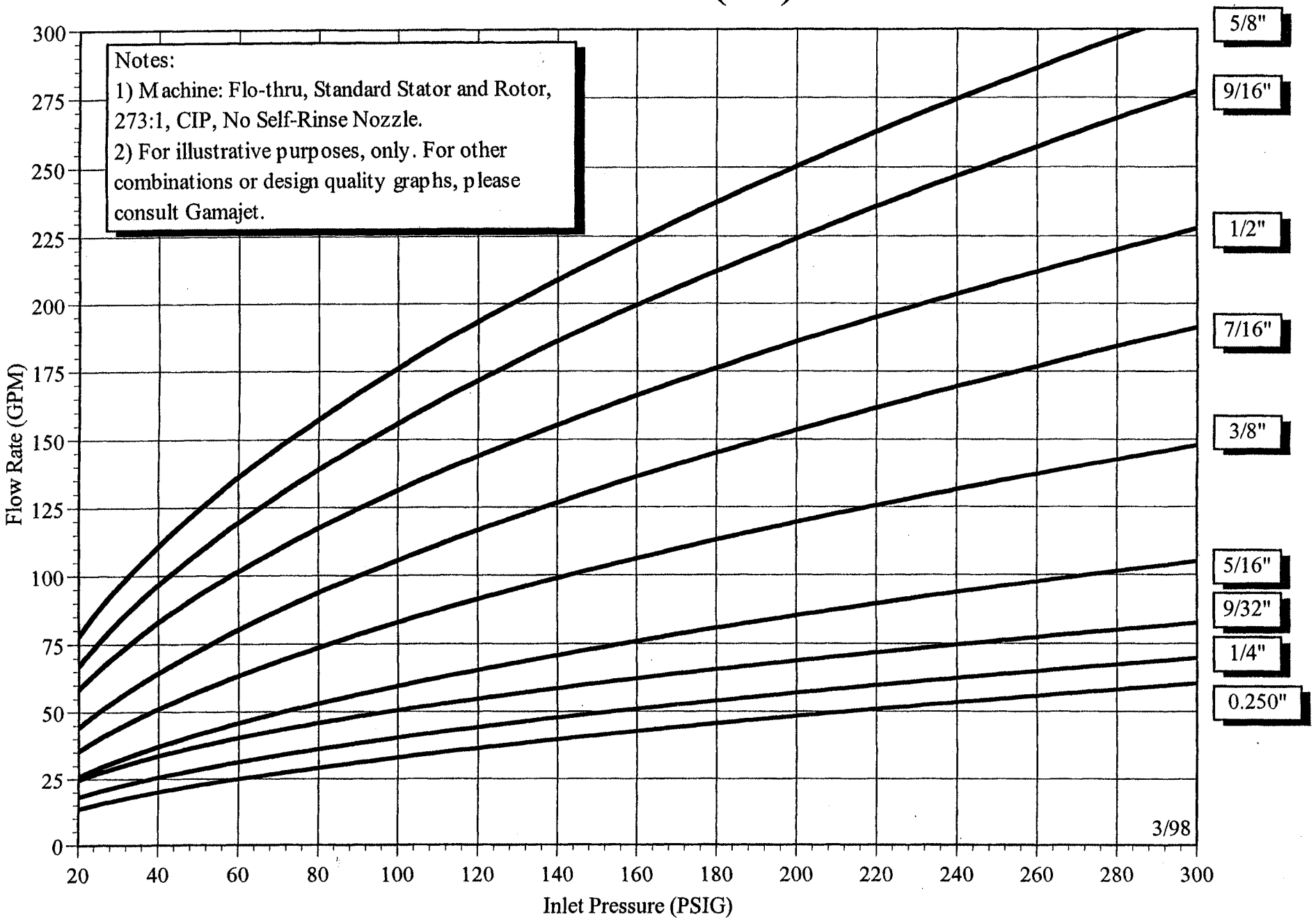
Gamajet Equipment Division
Gamajet IV Operating Clearance

92151

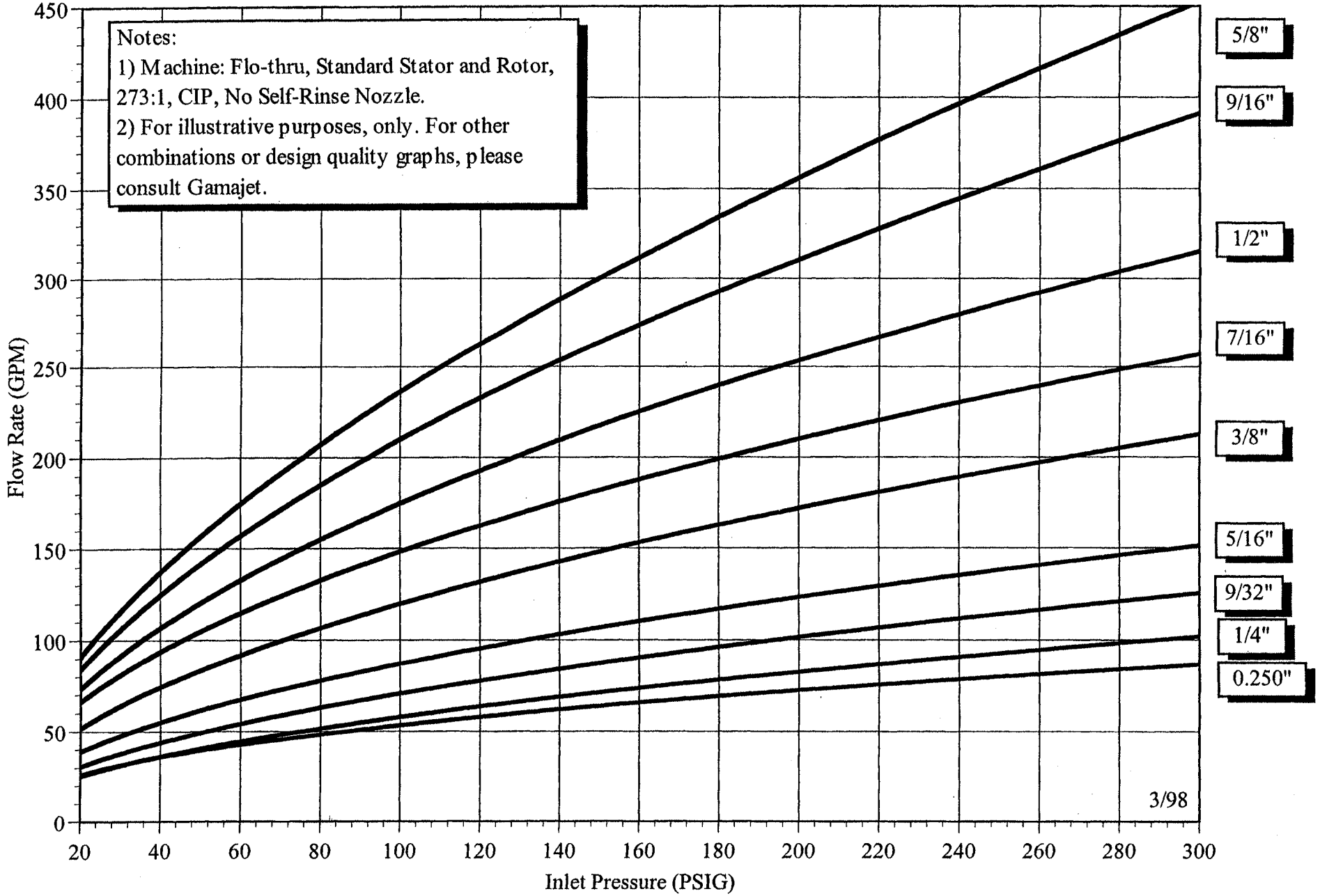
APPENDIX E

PERFORMANCE DATA

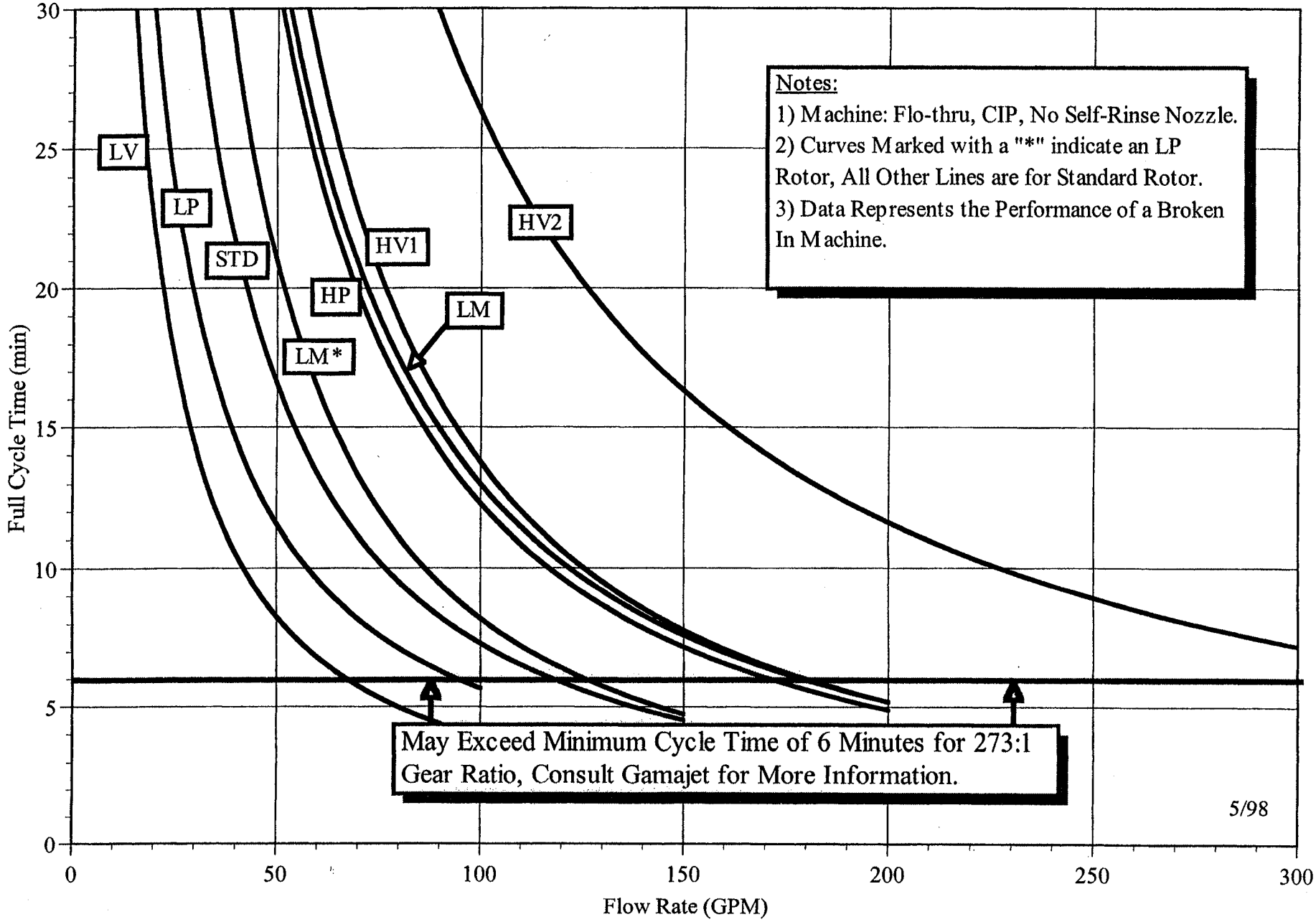
Gamajet IV - Pressure vs. Flow Rate
Dual Nozzle (2N)



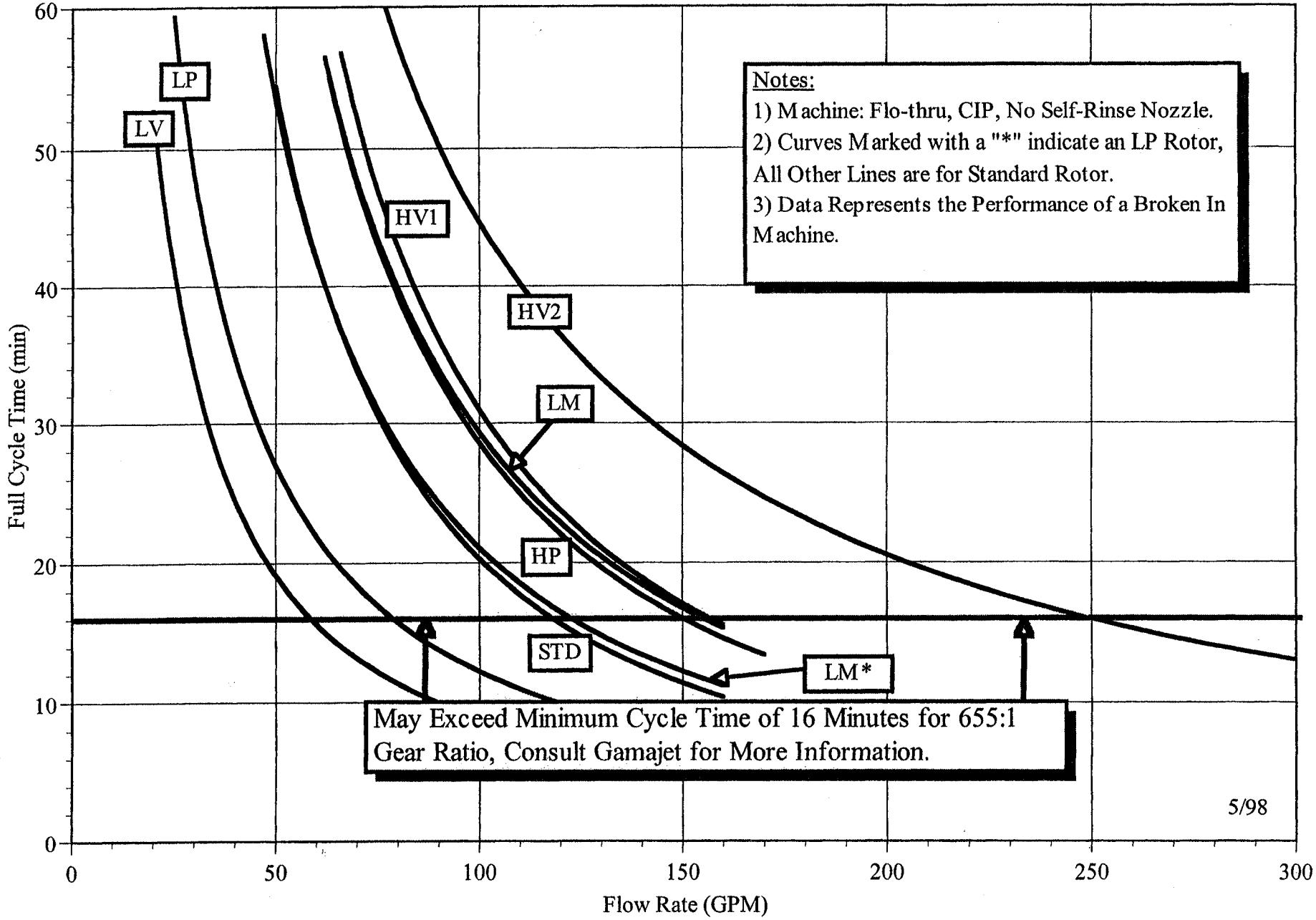
Gamajet IV - Pressure vs. Flow Rate
Triple Nozzle (3N)



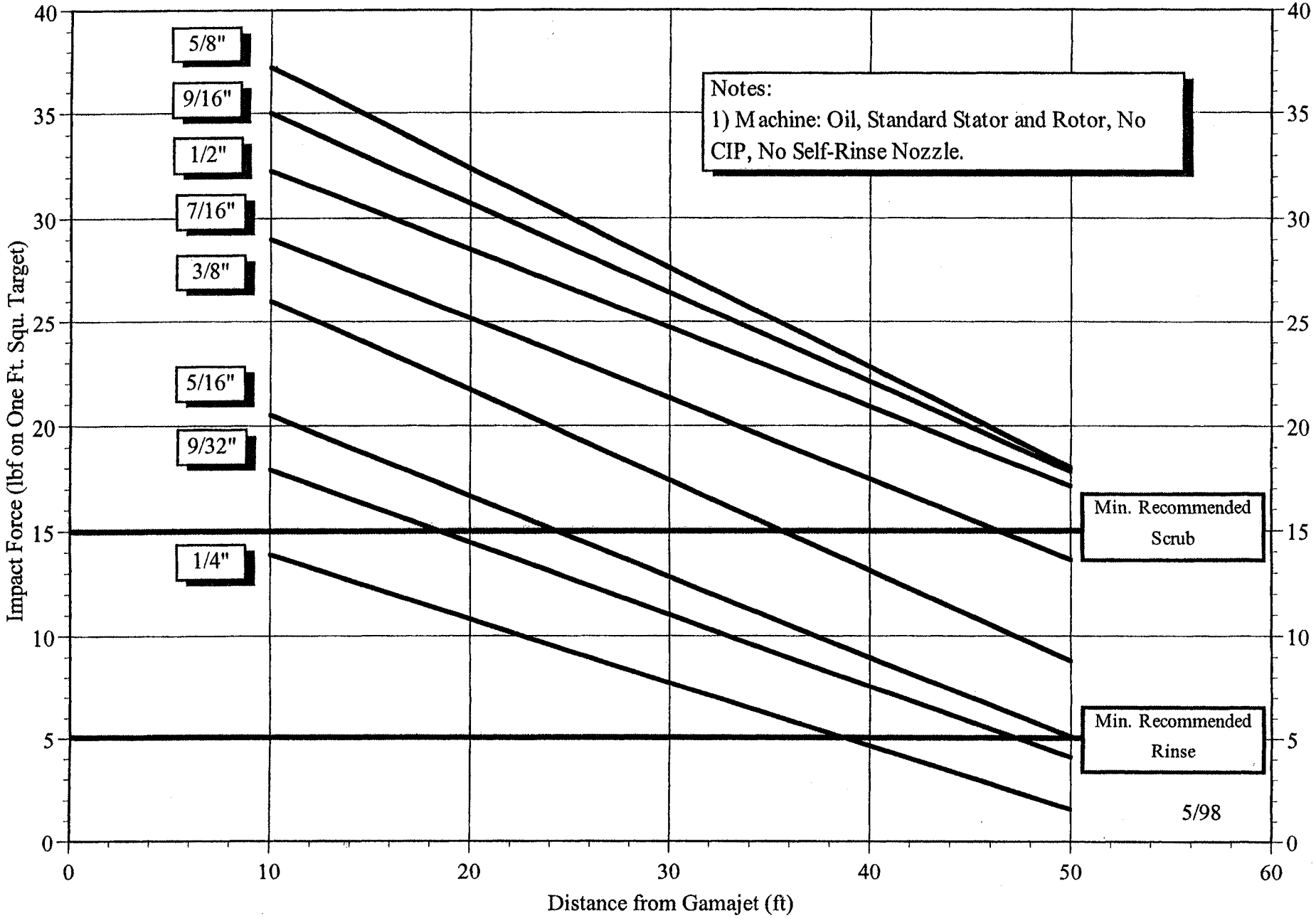
Gamajet IV - Flow Rate vs. Typical Full Cycle Time
273:1Gear Ratio



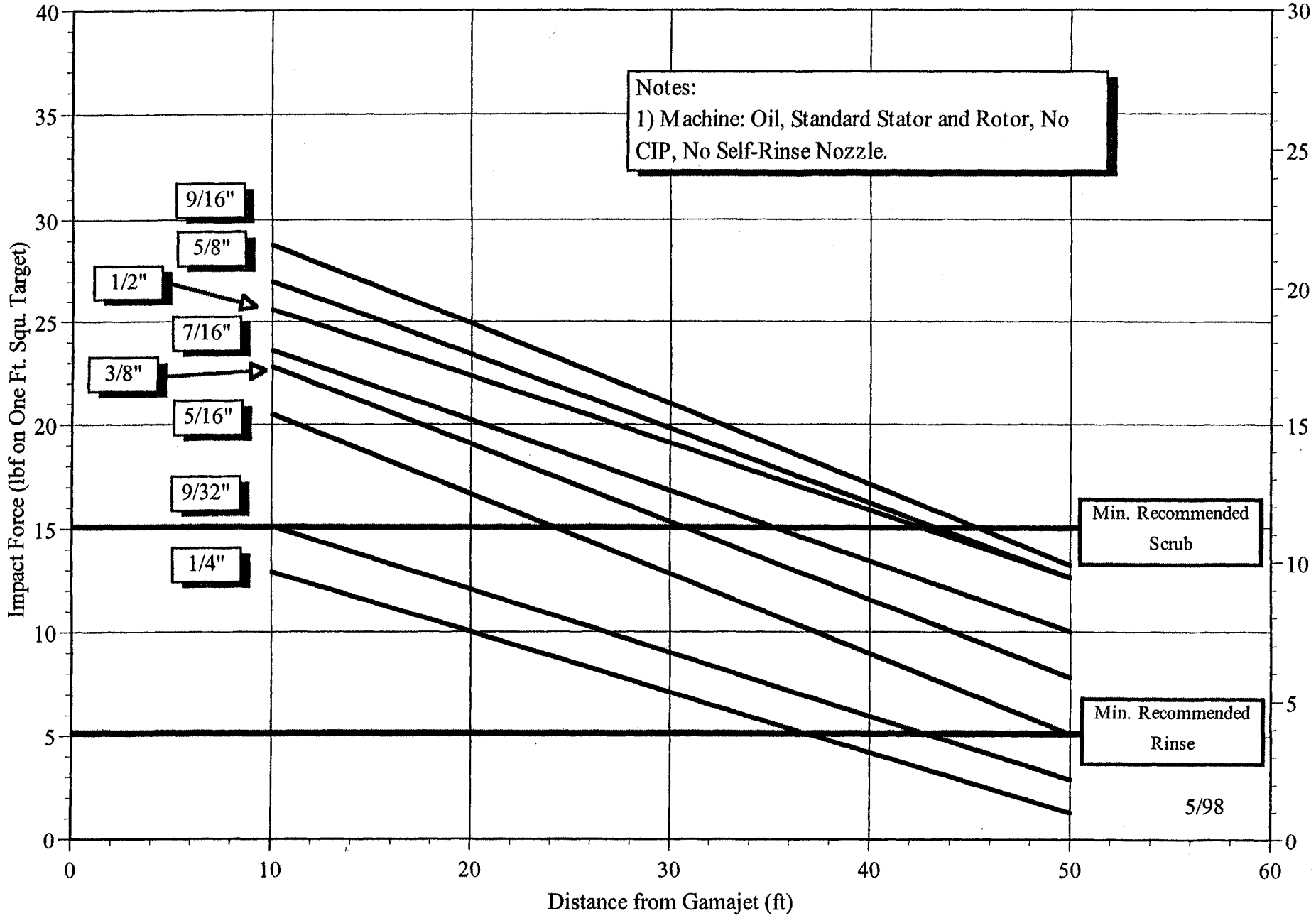
Gamajet IV - Flow Rate vs. Typical Full Cycle Time
655:1Gear Ratio



Gamajet IV - Distance vs. Impact Force @ 100PSI
Two Nozzles



Gamajet IV - Distance vs. Impact Force @ 100PSI
Three Nozzles



APPENDIX F

PARTS LIST AND EXPLODED VIEW

GAMAJET IV GT EXPLODED VIEW DESCRIPTION

Index No.	PRODUCT NUMBER GT Flo-thru	PRODUCT NUMBER GT Sealed	Quantity Per Machine	DESCRIPTION
1	483120	483120	2	Nameplate Screw
2	471120	471120	5	Lockwasher
3			1	Nameplate
	064120	064120		360°
	063220	063220		180° (Directional)
4	331150	331150	2	Nozzle Housing Bearing
5	361230	361230	2	Nozzle Housing Seal
6	341220	341220	2	Nozzle Housing Bearing Cup
7	072120	072120	1	Self-rinse Nozzle Assembly (CIP Model only)
NI	681120	681120	1	Nozzle Housing Plug
8			2 or 3	Nozzle Assembly (included Index No. 9)
	074120	074120		0.210"
	074220	074220		1/4"
	074320	074320		9/32"
	074420	074420		5/16"
	074520	074520		3/8"
	074620	074620		7/16"
	074720	074720		1/2"
	074820	074820		9/16"
	074920	074920		5/8"
9	081120	081120	2 or 3	Stream Straightener
10			1	Nozzle Housing Assembly
	054120	054120		Dual, Clutch Drive (incl. Index No. 6 &12)
	054220	054220		Dual, Pin Drive (incl. Index No. 6, 11 & 12)
	054320	054320		Triple, Clutch Drive (incl. Index No. 6 & 12)
	054420	054420		Triple, Pin Drive (incl. Index No. 6, 11 & 12)
	651120	651120		180° Directional, Pin Drive (incl. Index No. 6 &11)
11	582120	582120	1	Nozzle Housing Drive Pin
12	373170	373170	1	Clutch O-ring
13			1	Nozzle Housing Bevel Gear
	181120	181120		360°
	661120	661120		180° Directional
14	191120	191120	1	Bevel Gear Retaining Ring
15	451120	451120	1	Stator Retaining Ring
16			1	Stator
	094220	094220		LV
	094320	094320		LP
	094420	094420		STD
	094520	094520		HP
	094620	094620		LM
	094720	094720		HV1
	094820	094820		HV2
17	541120	0541120	1	Rotor Retaining Nut
18			1	Rotor
	104320	104320		LP
	104420	104420		STD
19			1	Inlet Stem
	034120	034120		Dual Threaded
	034220	034220		Camlock (Quick Disconnect)
20	411160	411160	3	Gearbox Screw O-ring
21	671120	NU	1	Flow Restrictor
22	311150	311150	2	Tee Housing Bearing
23	351230	351230	2	Tee Housing Seal

GAMAJET IV GT EXPLODED VIEW DESCRIPTION

Index No.	PRODUCT NUMBER GT Flo-thru	PRODUCT NUMBER GT Sealed	Quantity Per Machine	DESCRIPTION
24	321220	321220	2	Tee Housing Bearing Cup
25			1	Tee Housing Assembly (incl. Index No. 24)
	044120	044120		360°
	641120	641120		180° (Directional)
26	171120	171120	1	Tee Housing Bevel Gear
27	201120	201120	1	Ring Gear
28	211120	211120	1	Ring Gear Retaining Ring
29	602190	602190	1	Rotor Shaft Upper Bearing Assy. (incl. Index No. 30)
30	431160	431160	1	Cartridge O-ring
31	422160	422160	1	Gearbox-Stem O-ring
32	014230	014130	1	Gearbox Assembly (incl. Index No. 42)
33	523120	523120	3	Gearbox Bolt Lockwasher
34	503120	503120	3	Gearbox Bolt
35	NU	592120	1	Seal Housing Spacer
36	NU	412130	2	Rotor Shaft Seal
37	NU	391160	2	Seal Housing O-ring
38	NU	113120	1	Rotor Shaft Seal Housing Assy.(incl. Index No.36 & 37)
39	603290	603290	1	Rotor Shaft Center Bearing
40	551140	551140	1	Rotor Shaft Spacer
41	224120	224120	1	Rotor Shaft Assembly (incl. Index No. 60)
42	283230	283230	2 (1 for GT)	Idler Shaft Bushing (Lower Bushing for GT Machine)
	281250	281250	1 for GT	Idler Shaft Upper Bushing (for GT Machine only)
43	151140	151140	1	Idler Shaft
44			1	Idler Gear # 5 (incl. Index No. 45)
	231240	231240		For 655:1 Gear Ratio, 24/10 Teeth
	234240	234240		For 273:1 Gear Ratio, 17/10 Teeth
45	633140	633140	3	Idler Gear Bushing (for Gear # 3, 4, & 5)
46	231240	231240	1	Idler Gear # 3 (incl. Index No. 45)
47	236140	236140	1	Idler Gear # 1 (incl. Index No. 48 & 49)
48	633130	633130	2	Idler Gear Bushing (for Gear # 1 & 2)
49	621190	621190	2	Idler Gear Thrust Washer
50	581120	581120	1	Gearbox Cover Dowel
51	462120	462120	2	Gearbox Cover Screw
52	401160	401160	1	Final Shaft Retainer O-ring
53	131230	131320	1	Final Shaft Retainer Assy. (incl. Index No. 52, 54 & 55)
54	NU	432230	1	Final Shaft Seal
55	293130	293130	1	Final Shaft Upper Bushing
56	161120	161120	1	Final Shaft & Pinion
57	241140	241140	1	Final Shaft Drive Gear
58			1	Idler Gear # 4 (incl. Index No. 45)
	231240	231240	1	For 655:1 Gear Ratio, 24/10 Teeth
	233240	233240	1	For 273:1 Gear Ratio, 24/17 Teeth
59	235140	235140	1	Idler Gear # 2 (incl. Index No. 48 & 49)
60	144120	144120	1	Rotor Shaft Pinion Assembly (incl. Index No. 65)
61	264130	264130	1	Rotor Shaft Thrust Bushing
62	303130	303130	1	Final Shaft Lower Bushing
63	441160	441160	1	Gearbox Cover O-ring
64	024230	024130	1	Gearbox Cover Assy. (incl. Index No. 42, 50, 61 & 62)
65	142193	142193	1	Rotor Shaft Pinion Carbide Thrust Washer
66	601190	601190	2	Rotor Shaft Carbide Bushing
67	NU	691120	1	Rotor Shaft Upper Seal Thrust Washer
68	NU	603120	1	Rotor Shaft Upper Seal

CIP = Cleaning In Place NU = Not Use NI = Not Illustrated

GAMAJET IV STANDARD EXPLODED VIEW

STAINLESS STEEL and SILICON BRONZE

Index No.	PRODUCT NUMBER STAINLESS Flo-thru	STAINLESS Sealed	SILICON BRONZE	Qty Per Machine	DESCRIPTION
1	483120	483120	483110	2	Nameplate Screw
2	471120	471120	471110	5	Lockwasher
3				1	Nameplate
	064120	064120	064110		360°
	063220	063220	NU		180° (Directional)
4	331150	331150	331150	2	Nozzle Housing Bearing
5	361230	361230	361230	2	Nozzle Housing Seal
6	341220	341220	341220	2	Nozzle Housing Bearing Cup
7	072120	072120	NU	1	Self-rinse Nozzle Assembly (CIP Model only)
NI	681120	081120	NU	1	Nozzle Housing Plug
8				2 or 3	Nozzle Assembly (included Index No. 9)
	074120	074120	074110		0.210"
	074220	074220	074210		1/4"
	074320	074320	074310		9/32"
	074420	074420	074410		5/16"
	074520	074520	074510		3/8"
	074620	074620	074610		7/16"
	074720	074720	074710		1/2"
	074820	074820	074810		9/16"
	074920	074920	074910		5/8"
9	081120	081120	081120	2 or 3	Stream Straightener
10				1	Nozzle Housing Assembly
	054120	054120	054110		Dual, Clutch Drive (incl. Index No. 6 &12)
	054220	054220	054210		Dual, Pin Drive (incl. Index No. 6, 11 & 12)
	054320	054320	054310		Triple, Clutch Drive (incl. Index No. 6 & 12)
	054420	054420	054410		Triple, Pin Drive (incl. Index No. 6, 11 & 12)
	651120	651120	NU		180° Directional, Pin Drive (incl. Index No. 6 &11)
11	582120	582120	582120	1	Nozzle Housing Drive Pin
12	373170	373170	373170	1	Clutch O-ring
13				1	Nozzle Housing Bevel Gear
	181120	181120	181110		360°
	661120	661120	NU		180° Directional
14	191120	191120	191120	1	Bevel Gear Retaining Ring
15	451120	451120	451120	1	Stator Retaining Ring
16				1	Stator
	094220	094220	094210		LV
	094320	094320	094310		LP
	094420	094420	094410		STD
	094520	094520	094510		HP
	094620	094620	094610		LM
	094720	094720	094710		HV1
	094820	094820	094810		HV2
17	541120	541120	541110	1	Rotor Retaining Nut
18				1	Rotor
	104320	104320	104310		LP
	104420	104420	104410		STD
19				1	Inlet Stem
	034120	034120	034110		Dual Threaded
	034220	034220	NU		Camlock (Quick Disconnect)
20	411160	411160	411160	3	Gearbox Screw O-ring
21	671120	NU	NU	1	Flow Restrictor
22	311150	311150	311150	2	Tee Housing Bearing
23	351230	351230	351230	2	Tee Housing Seal

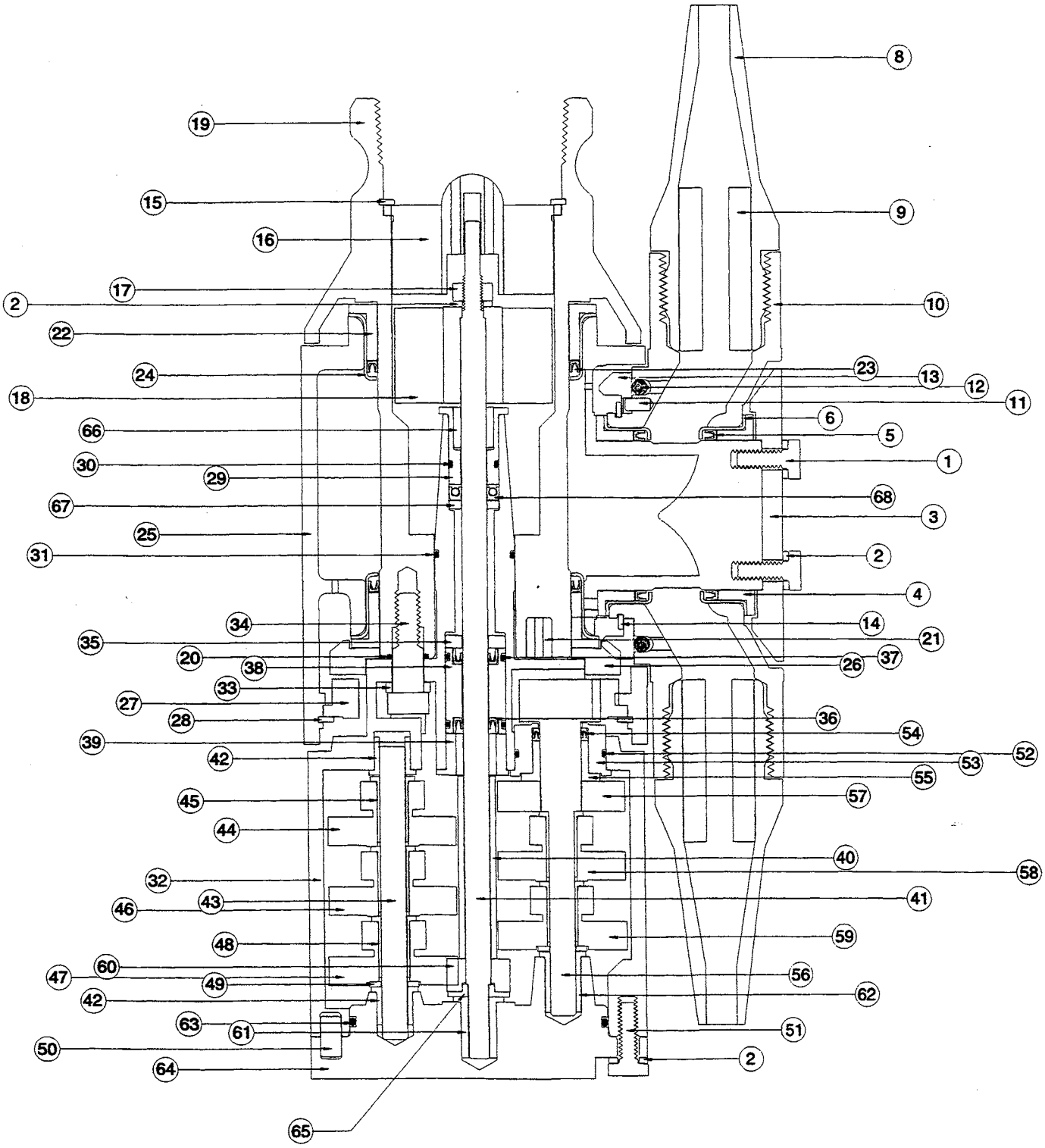
GAMAJET IV STANDARD EXPLODED VIEW

STAINLESS STEEL and SILICON BRONZE

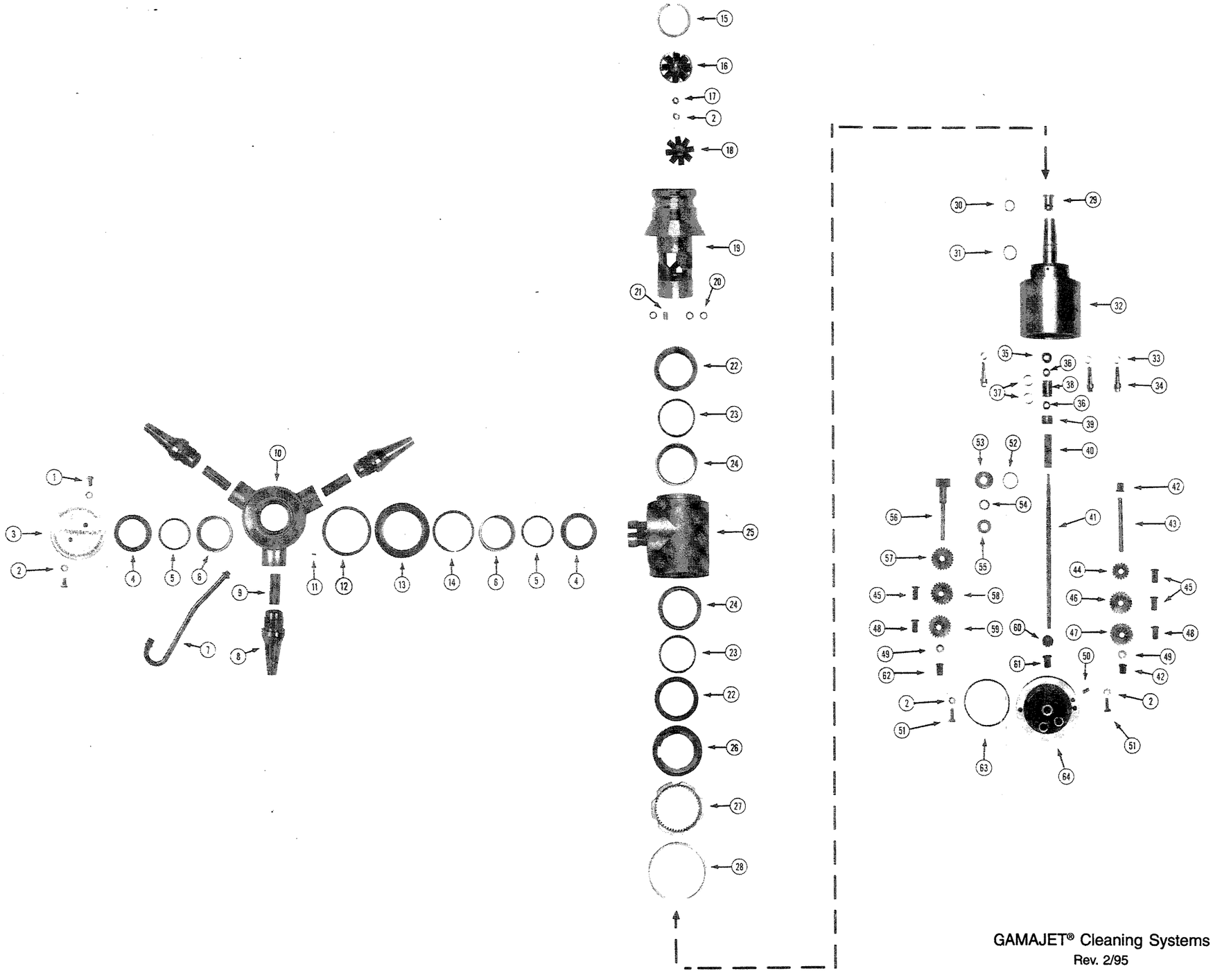
Index No.	PRODUCT NUMBER STAINLESS Flo-thru	STAINLESS Sealed	SILICON BRONZE	Qty Per Machine	DESCRIPTION
24	321220	321220	321220	2	Tee Housing Bearing Cup
25				1	Tee Housing Assembly (incl. Index No. 24)
	044120	044120	044110		360°
	641120	641120	NU		180° (Directional)
26	171120	171120	171110	1	Tee Housing Bevel Gear
27	201120	201120	201110	1	Ring Gear
28	211120	211120	211120	1	Ring Gear Retaining Ring
29	602190	602190	602190	1	Rotor Shaft Upper Bearing Assy. (incl. Index No. 30)
30	431160	431160	431160	1	Cartridge O-ring
31	422160	422160	422160	1	Gearbox-Stem O-ring
32	014220	014120	014110	1	Gearbox Assembly (incl. Index No. 42)
33	523120	523120	523120	3	Gearbox Bolt Lockwasher
34	503120	503120	503120	3	Gearbox Bolt
35	NU	592120	592120	1	Seal Housing Spacer
36	NU	412130	412130	2	Rotor Shaft Seal
37	NU	391160	391160	2	Seal Housing O-ring
38	NU	113120	113120	1	Rotor Shaft Seal Housing Assy.(incl. Index No.36 & 37)
39	603290	603290	603290	1	Rotor Shaft Center Bearing
40	551120	551120	551120	1	Rotor Shaft Spacer
41	223120	222120	222120	1	Rotor Shaft Assembly (incl. Index No. 60)
42	283230	281210	281210	2 (1 for GT)	Idler Shaft Bushing (Lower Bushing for GT Machine)
	NU	NU	NU	1 for GT	Idler Shaft Upper Bushing (for GT Machine only)
43	151120	151120	151120	1	Idler Shaft
44				1	Idler Gear # 5 (incl. Index No. 45)
	231230	231120	231120		For 655:1 Gear Ratio, 24/10 Teeth
	234230	234120	234120		For 273:1 Gear Ratio, 17/10 Teeth
45	633140	631110	631110	3	Idler Gear Bushing (for Gear # 3, 4, & 5)
46	231230	231120	231120	1	Idler Gear # 3 (incl. Index No. 45)
47	236130	232120	232120	1	Idler Gear # 1 (incl. Index No. 48 & 49)
48	633130	632110	632110	2	Idler Gear Bushing (for Gear # 1 & 2)
49	621190	621190	921190	2	Idler Gear Thrust Washer
50	581120	581120	581120	1	Gearbox Cover Dowel
51	462120	462120	462110	2	Gearbox Cover Screw
52	401160	401160	401160	1	Final Shaft Retainer O-ring
53	131230	131120	131120	1	Final Shaft Retainer Assy. (incl. Index No. 52, 54 & 55)
54	NU	432230	432230	1	Final Shaft Seal
55	293130	292110	292110	1	Final Shaft Upper Bushing
56	161120	161120	161120	1	Final Shaft & Pinion
57	241120	241120	241120	1	Final Shaft Drive Gear
58				1	Idler Gear # 4 (incl. Index No. 45)
	231230	231120	231120	1	For 655:1 Gear Ratio, 24/10 Teeth
	233230	233120	233120	1	For 273:1 Gear Ratio, 24/17 Teeth
59	235130	232120	232120	1	Idler Gear # 2 (incl. Index No. 48 & 49)
60	143120	142120	142120	1	Rotor Shaft Pinion Assembly (incl. Index No. 65)
61	263130	262110	262110	1	Rotor Shaft Thrust Bushing
62	303130	301110	301110	1	Final Shaft Lower Bushing
63	441160	441160	441160	1	Gearbox Cover O-ring
64	024220	024120	024110	1	Gearbox Cover Assy. (incl. Index No. 42, 50, 61 & 62)
65	142193	142193	142193	1	Rotor Shaft Pinion Carbide Thrust Washer
66	601190	601190	601190	2	Rotor Shaft Carbide Bushing
67	NU	691120	691120	1	Rotor Shaft Upper Seal Thrust Washer
68	NU	603120	603120	1	Rotor Shaft Upper Seal

CIP = Cleaning In Place NU = Not Use NI = Not Illustrated

GAMAJET® IV ASSEMBLY VIEW



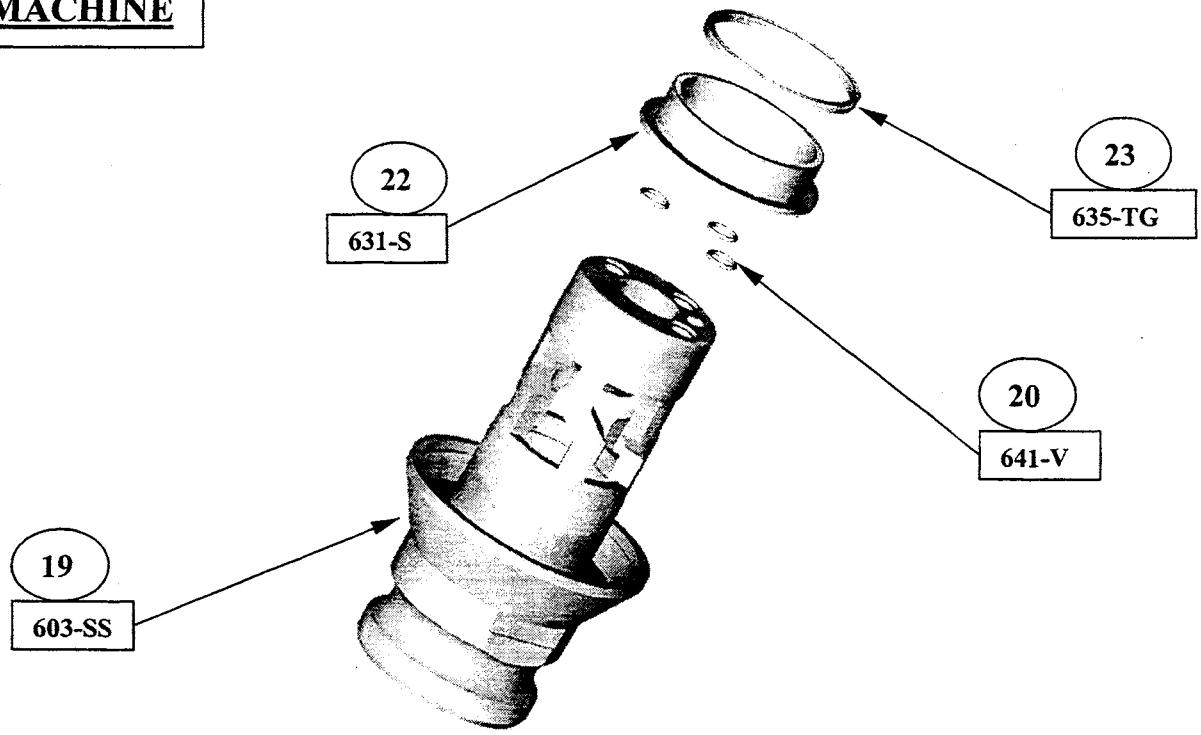
GAMAJET® IV EXPLODED VIEW



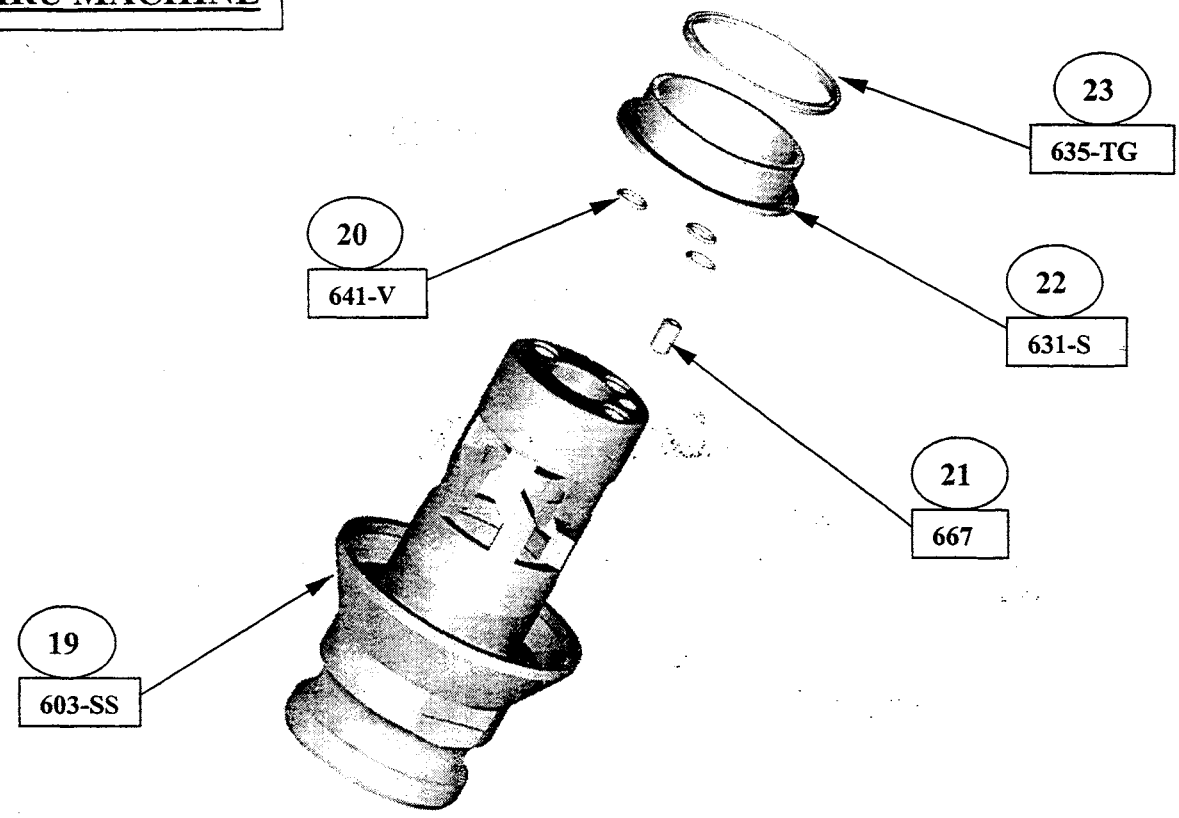
GAMAJET® Cleaning Systems
Rev. 2/95

STEP 1: INLET STEM ASSEMBLY

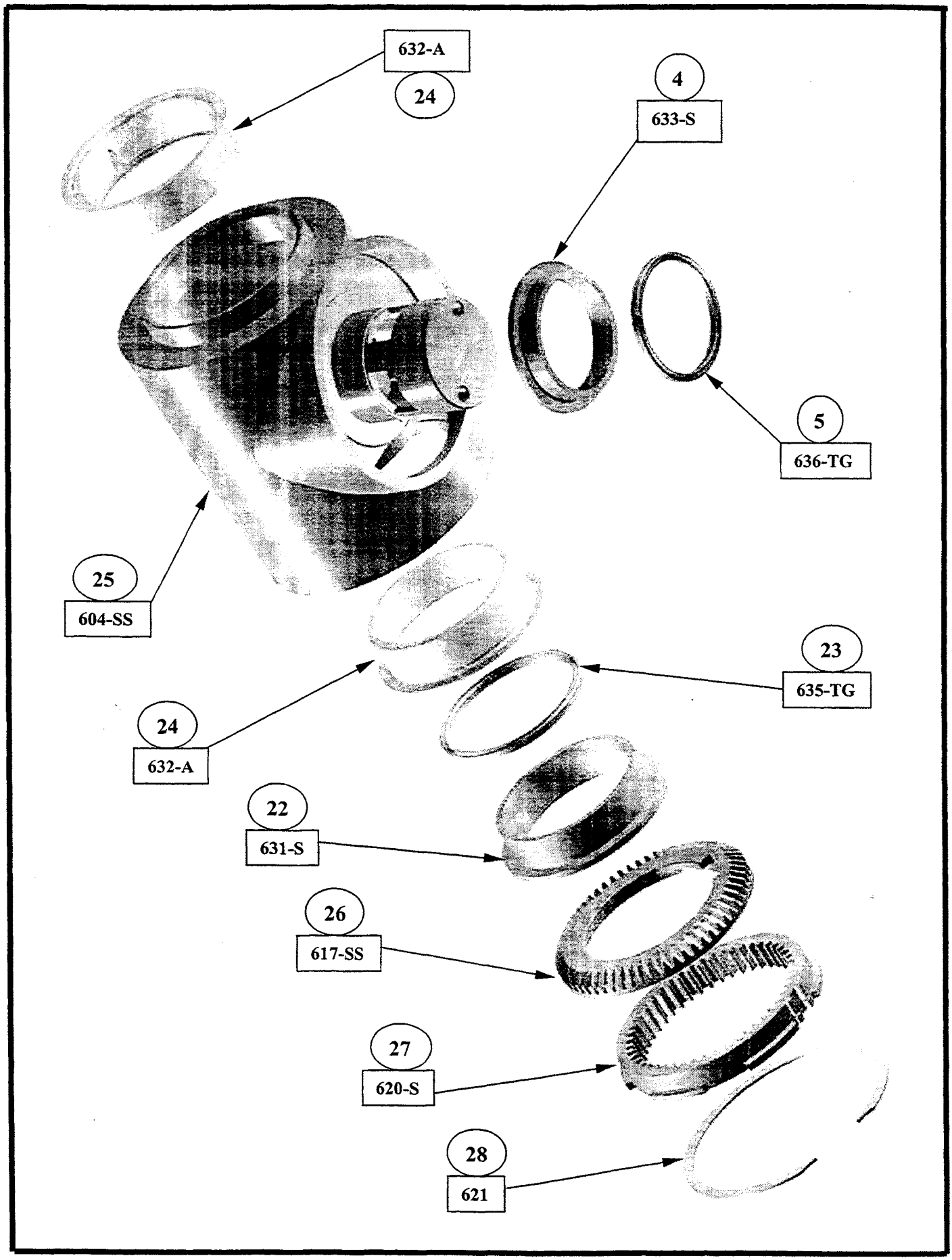
OIL MACHINE



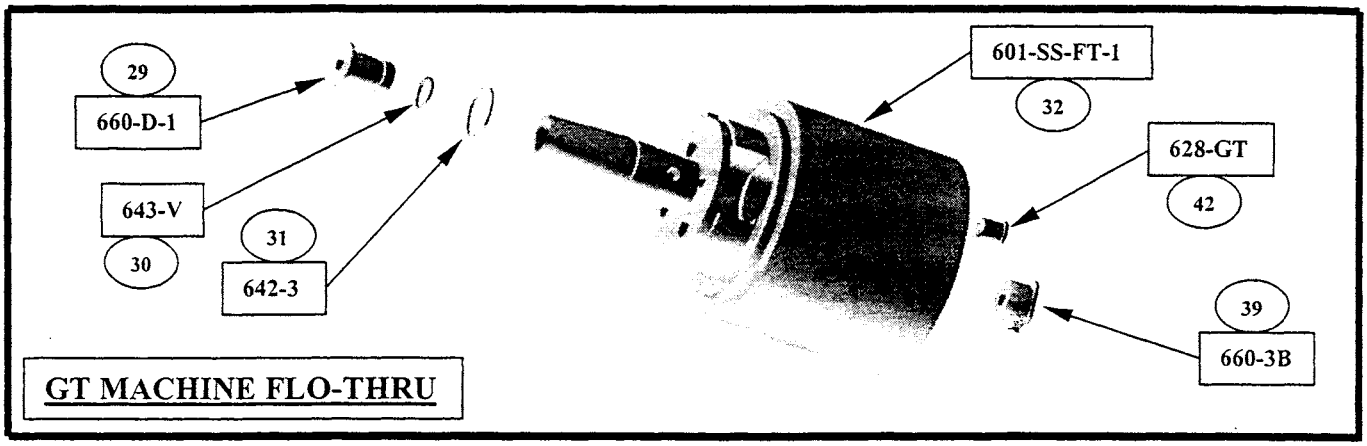
FLO-THRU MACHINE

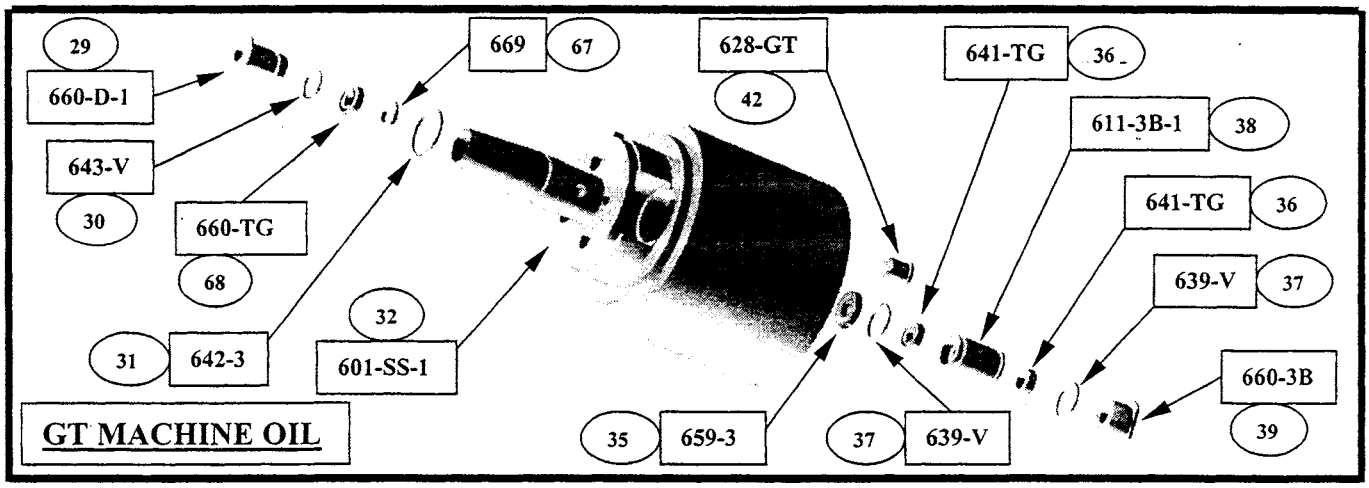


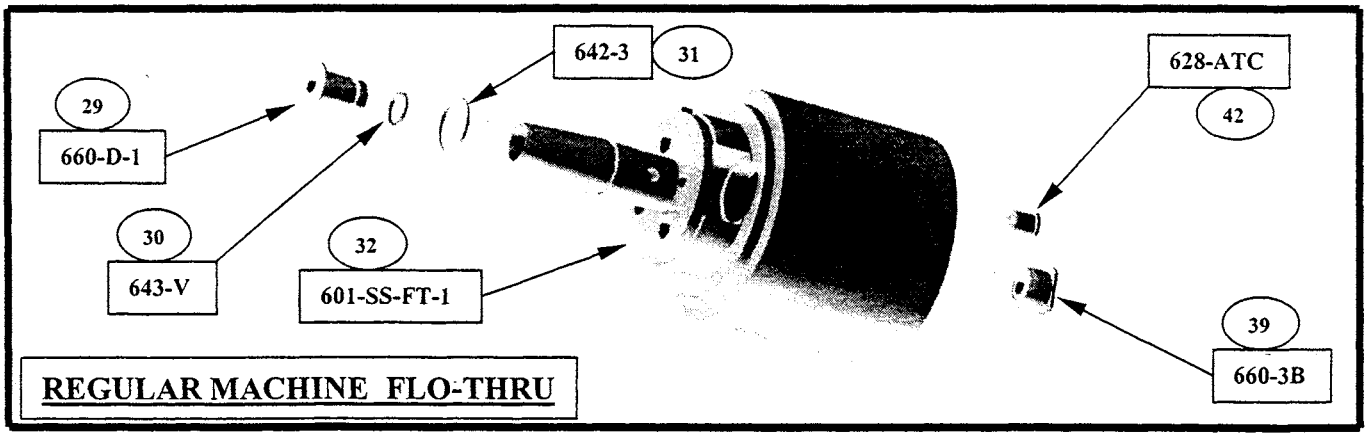
STEP 2: TEE HOUSING ASSEMBLY

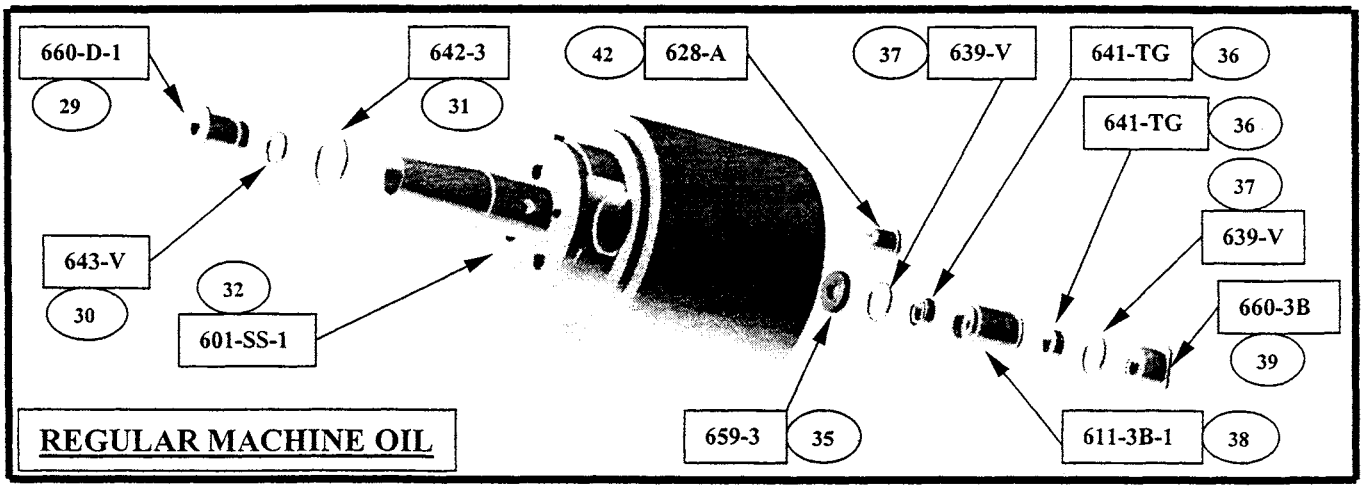


STEP 3: GEAR BOX ASSEMBLY

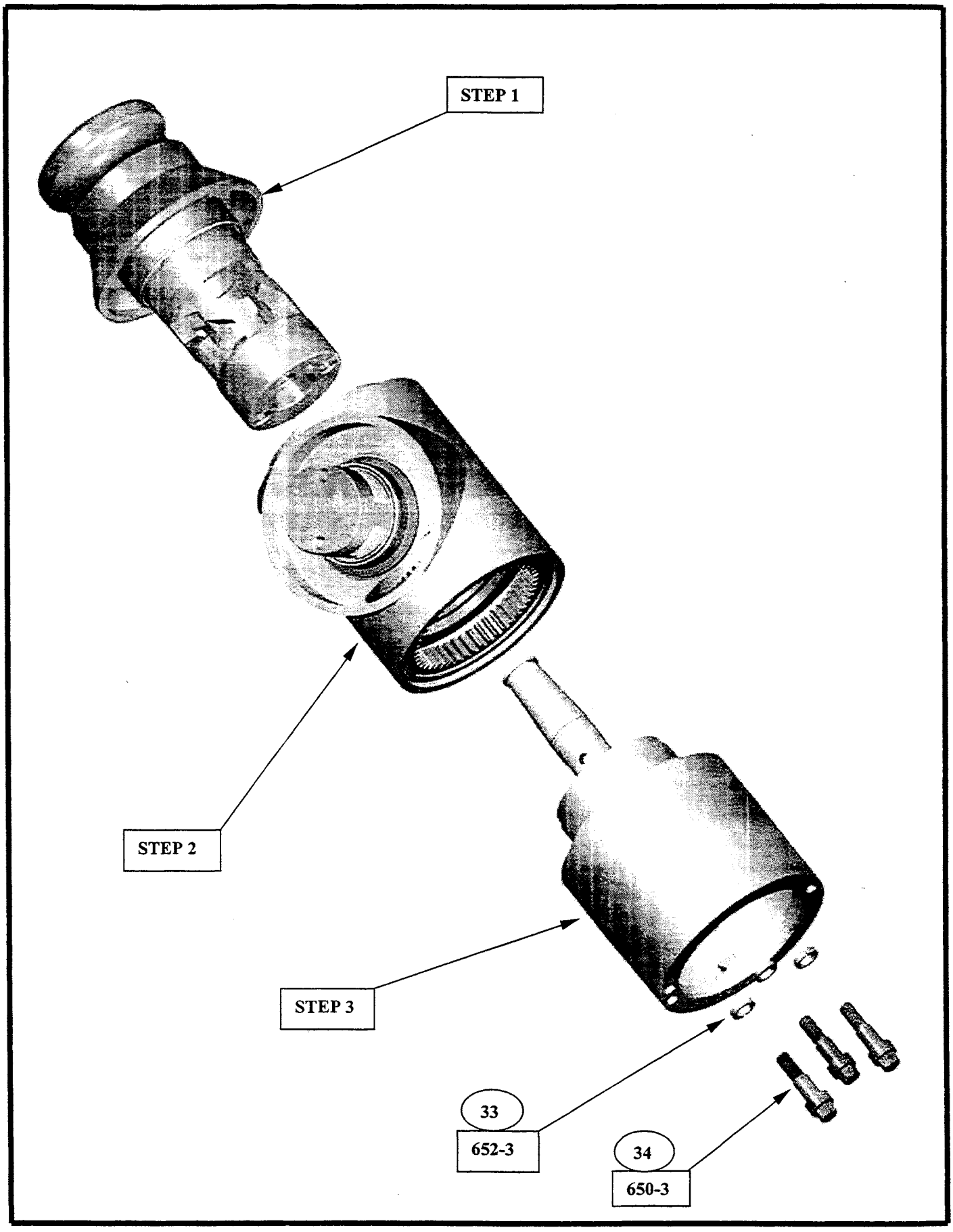




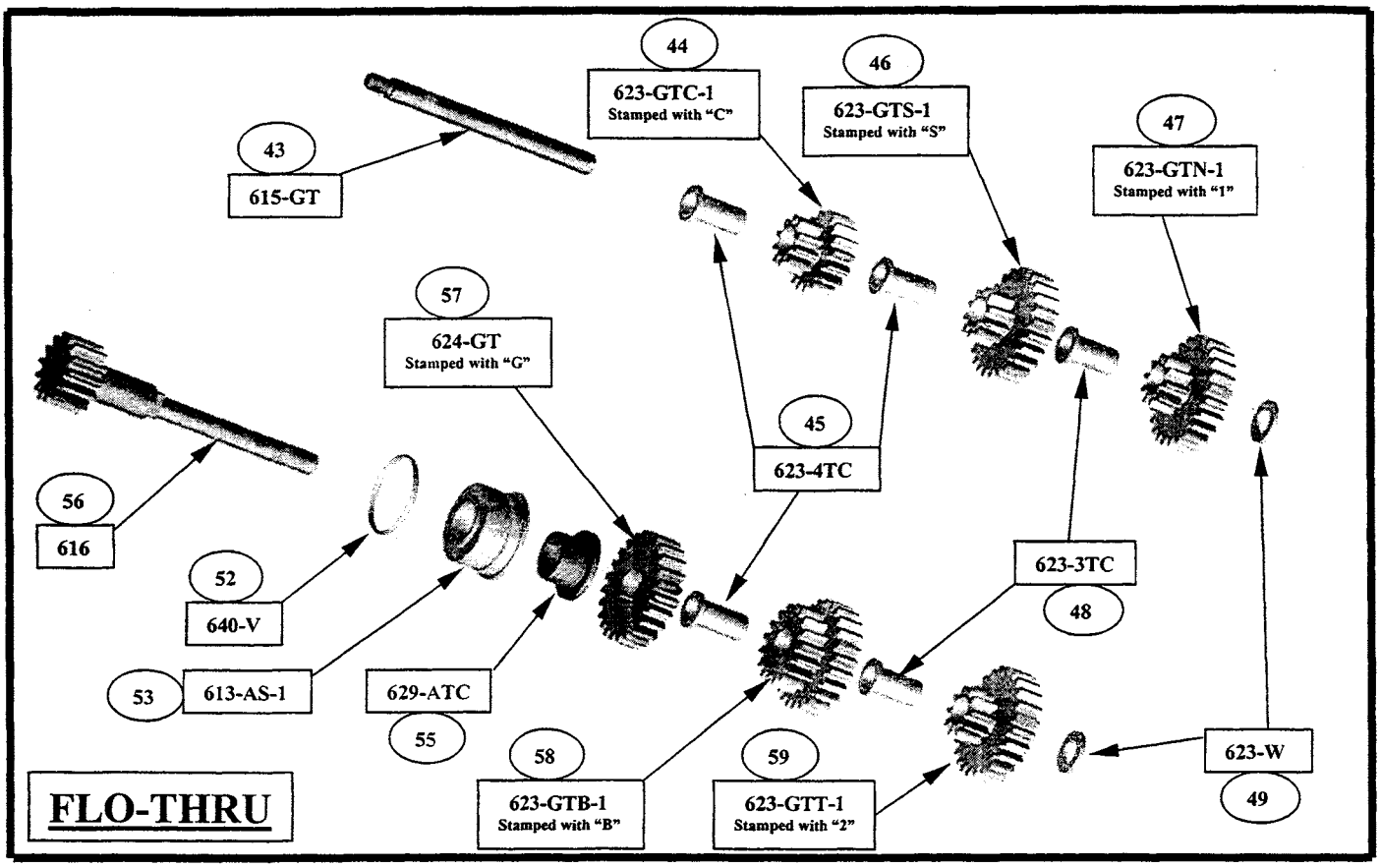


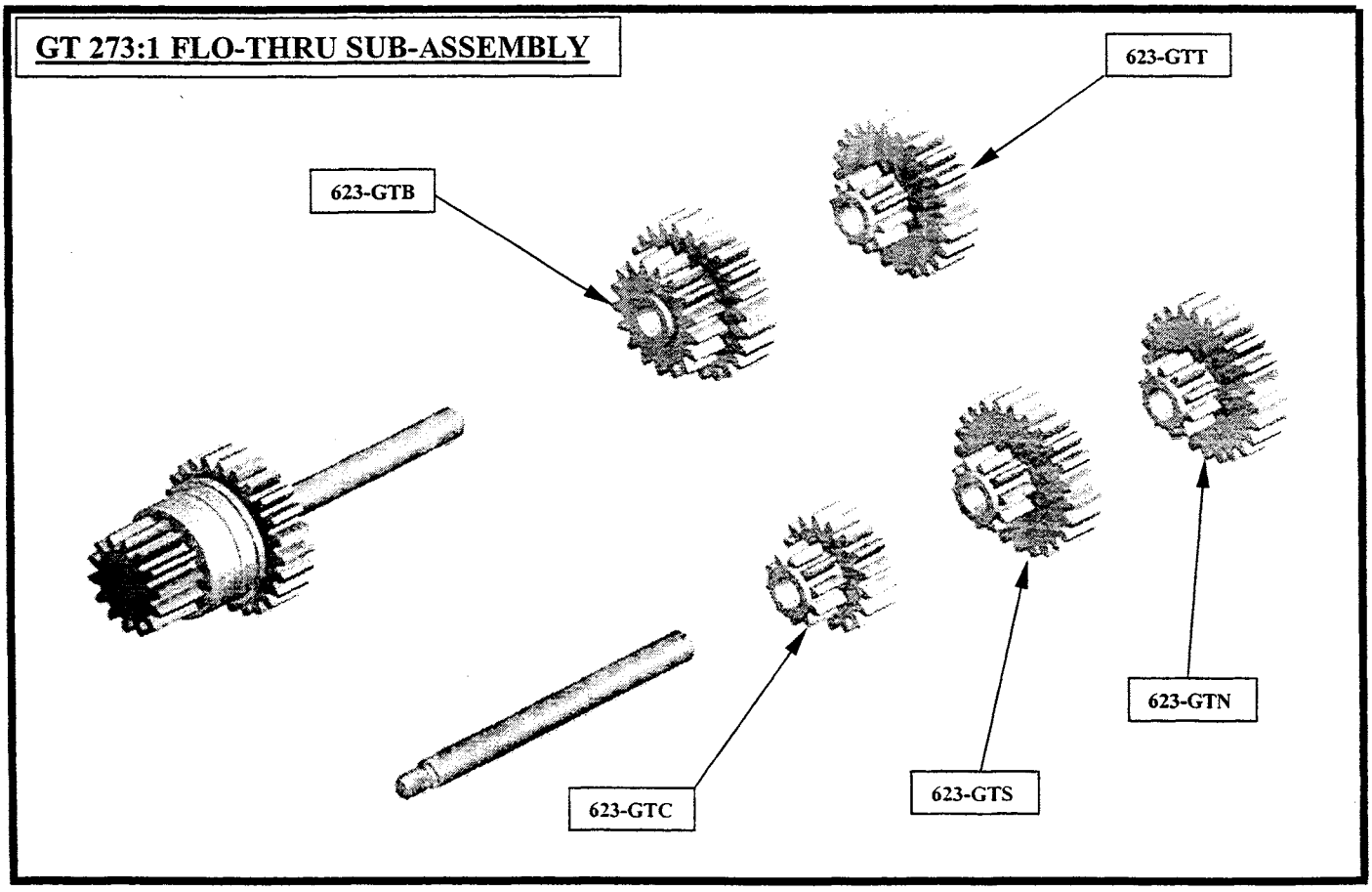


STEP 4: BODY ASEMBLY

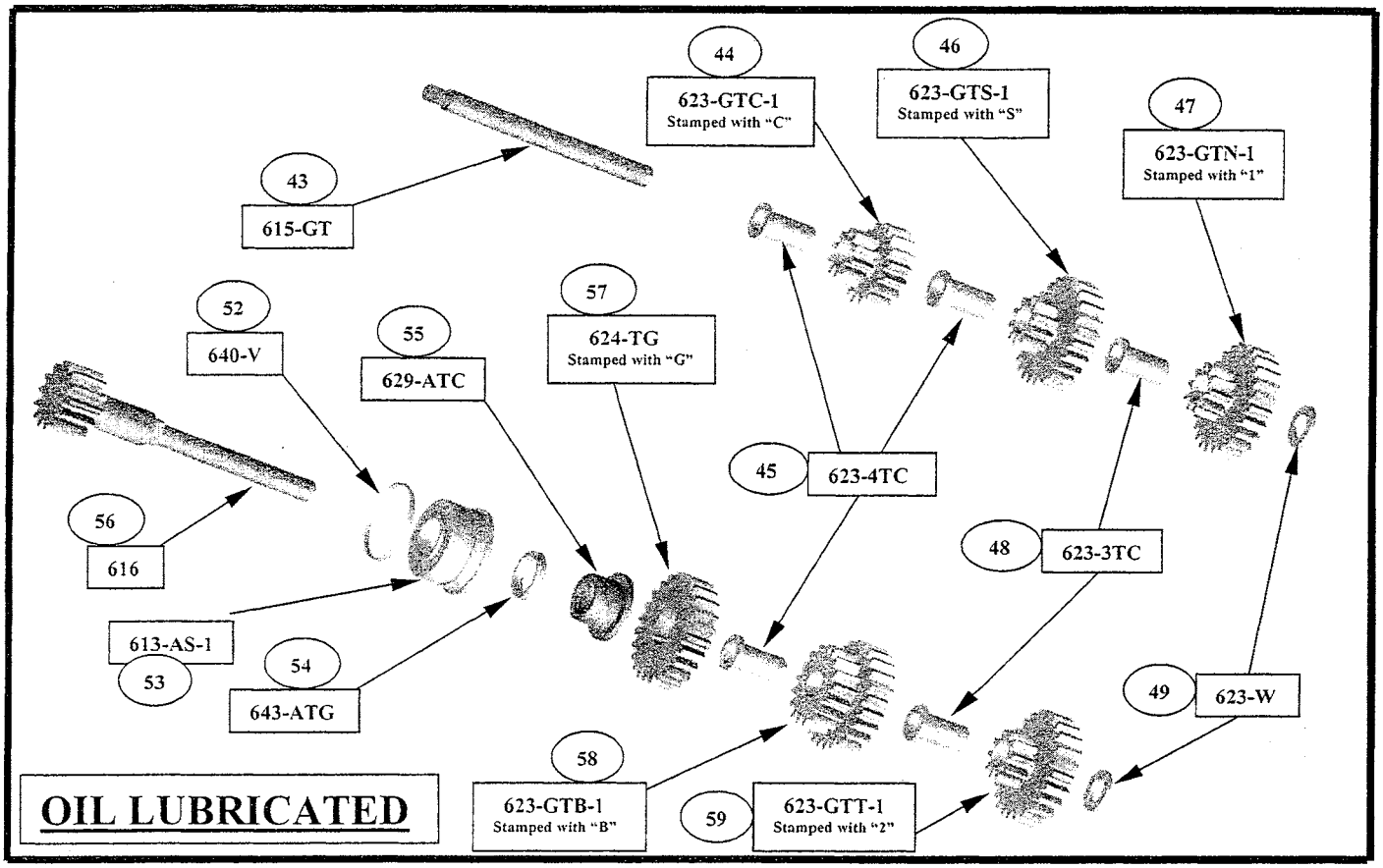


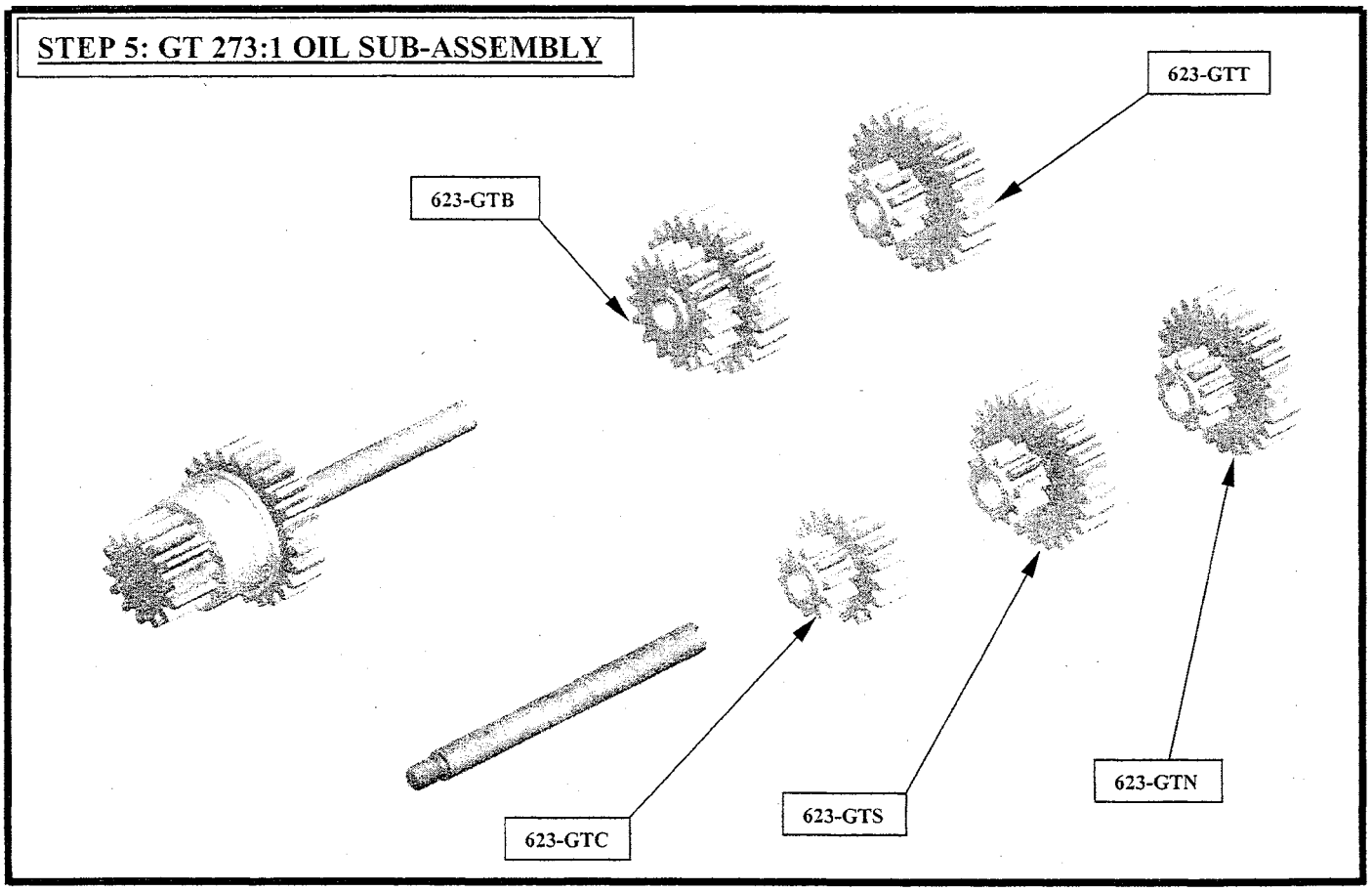
STEP 5: GT 273:1 FLO-THRU GEAR TRAIN ASSEMBLY



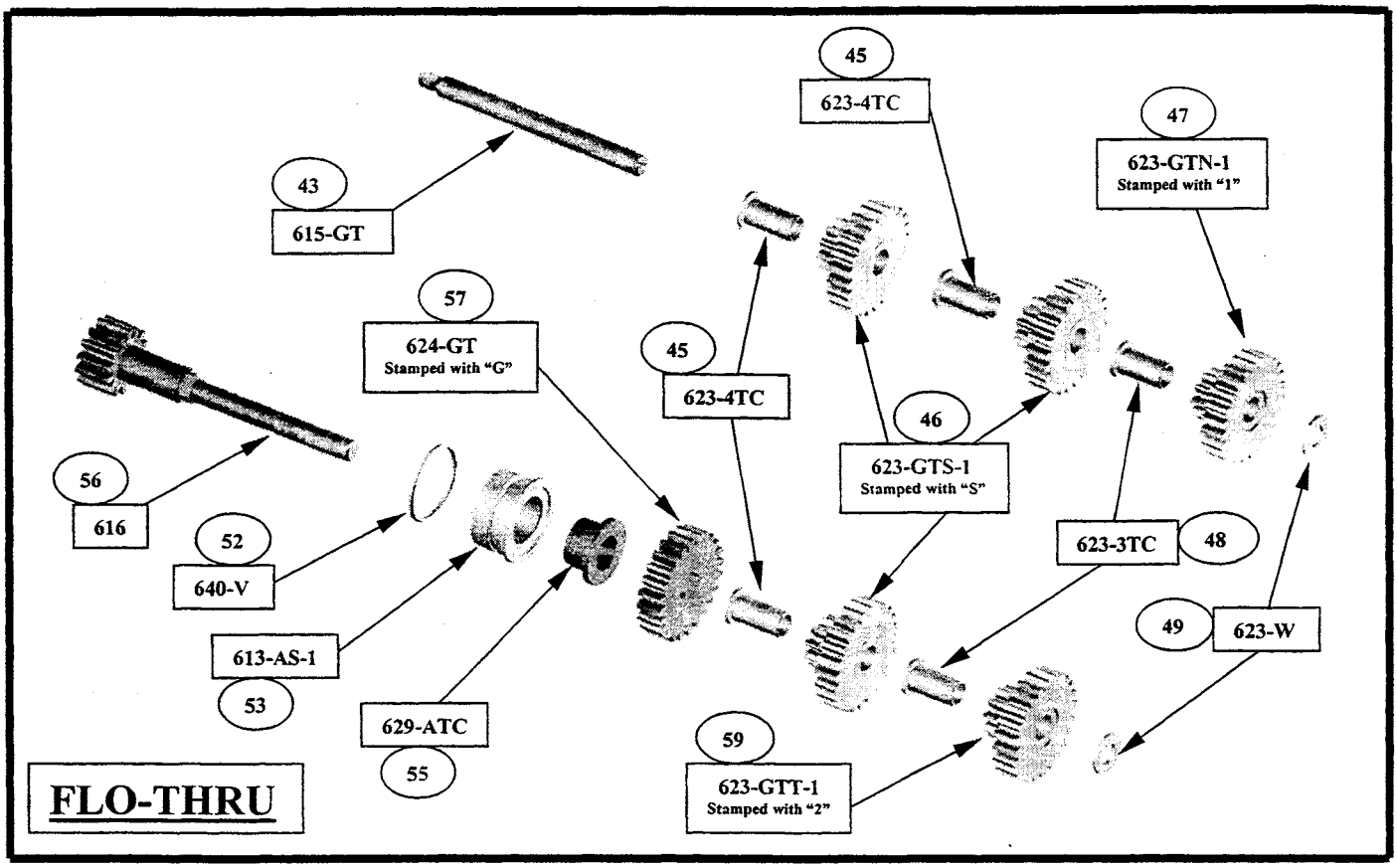


STEP 5: GT 273:1 OIL GEAR TRAIN ASSEMBLY

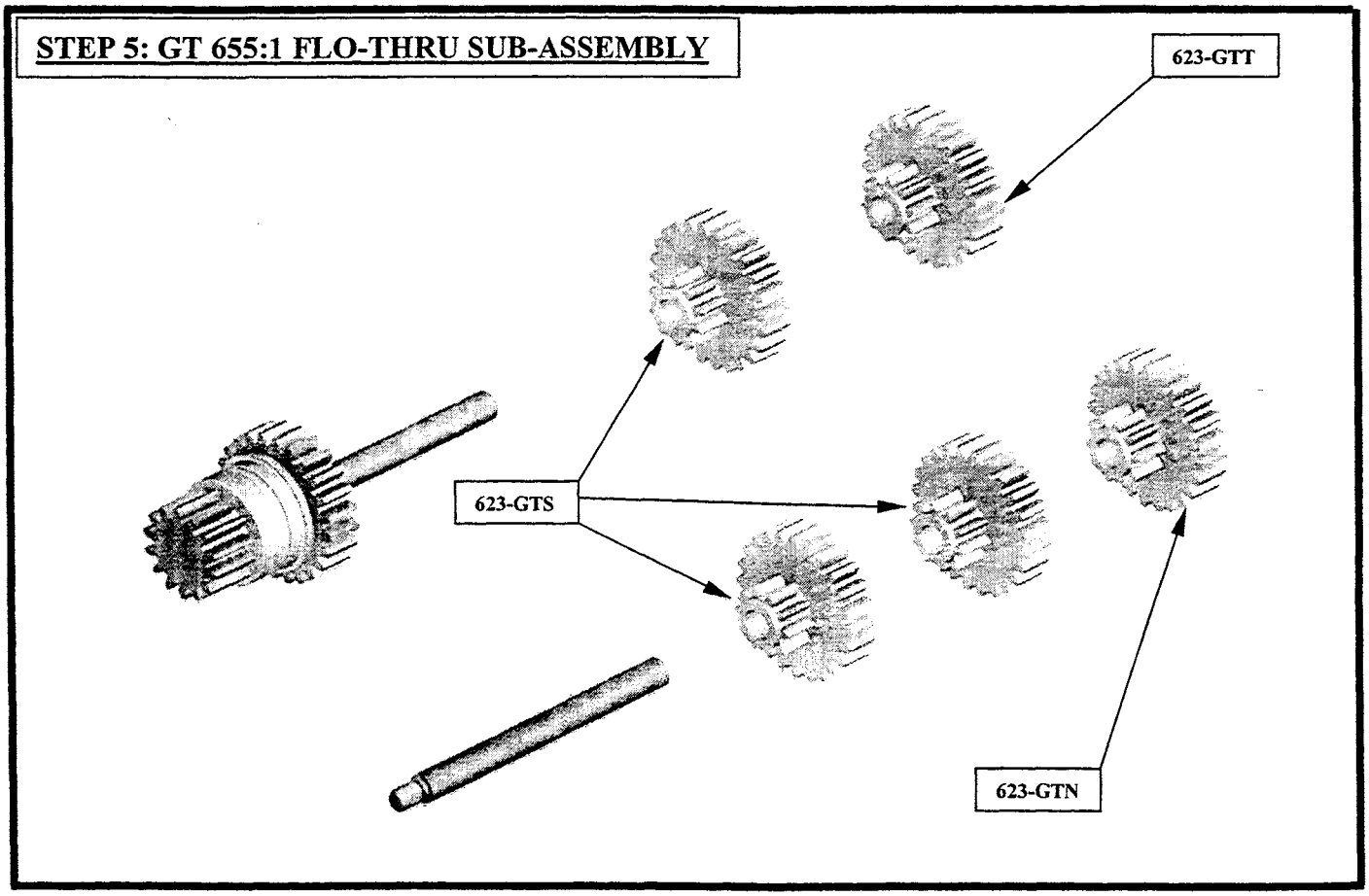




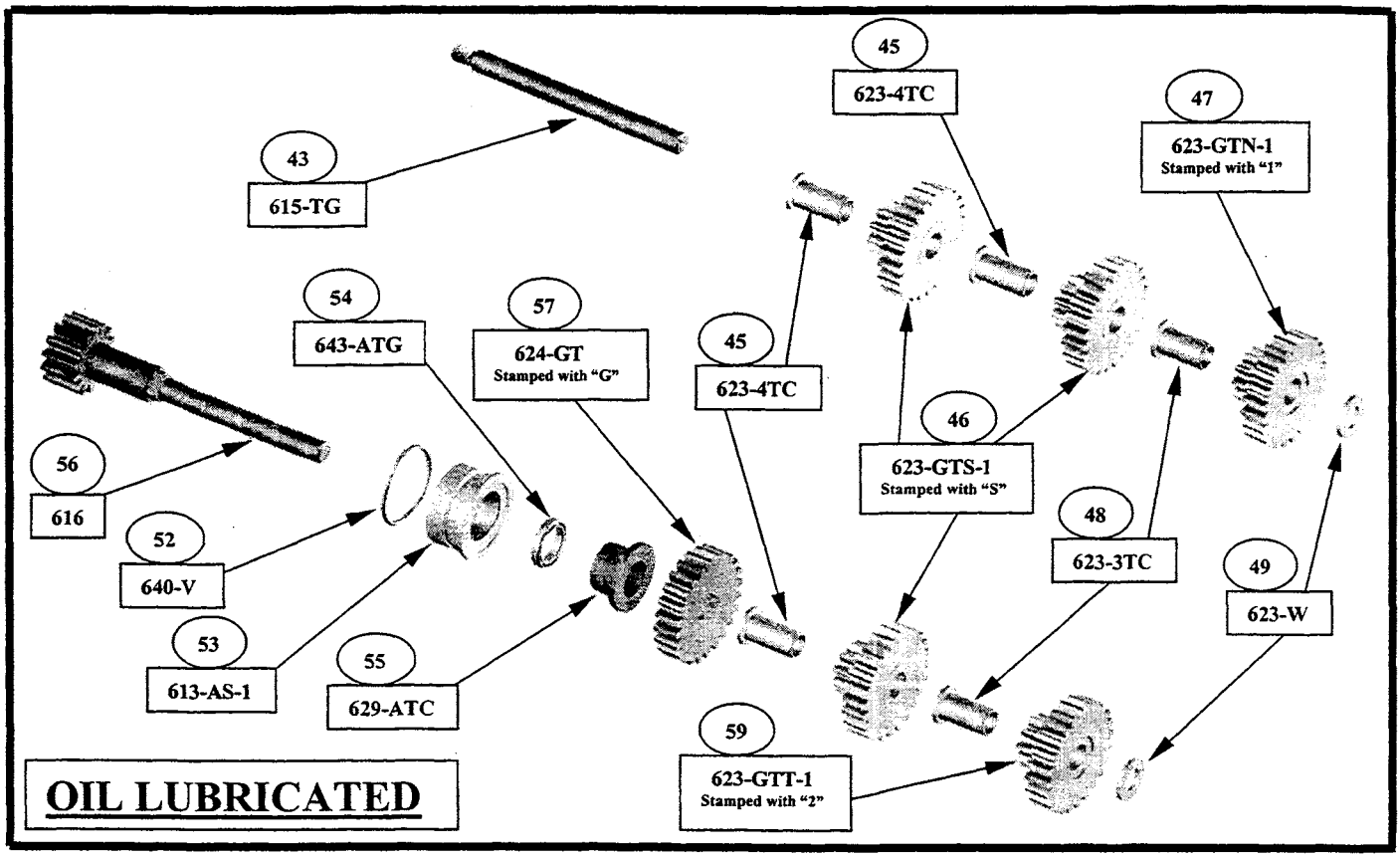
STEP 5: GT 655:1 FLO-THRU GEAR TRAIN ASSEMBLY

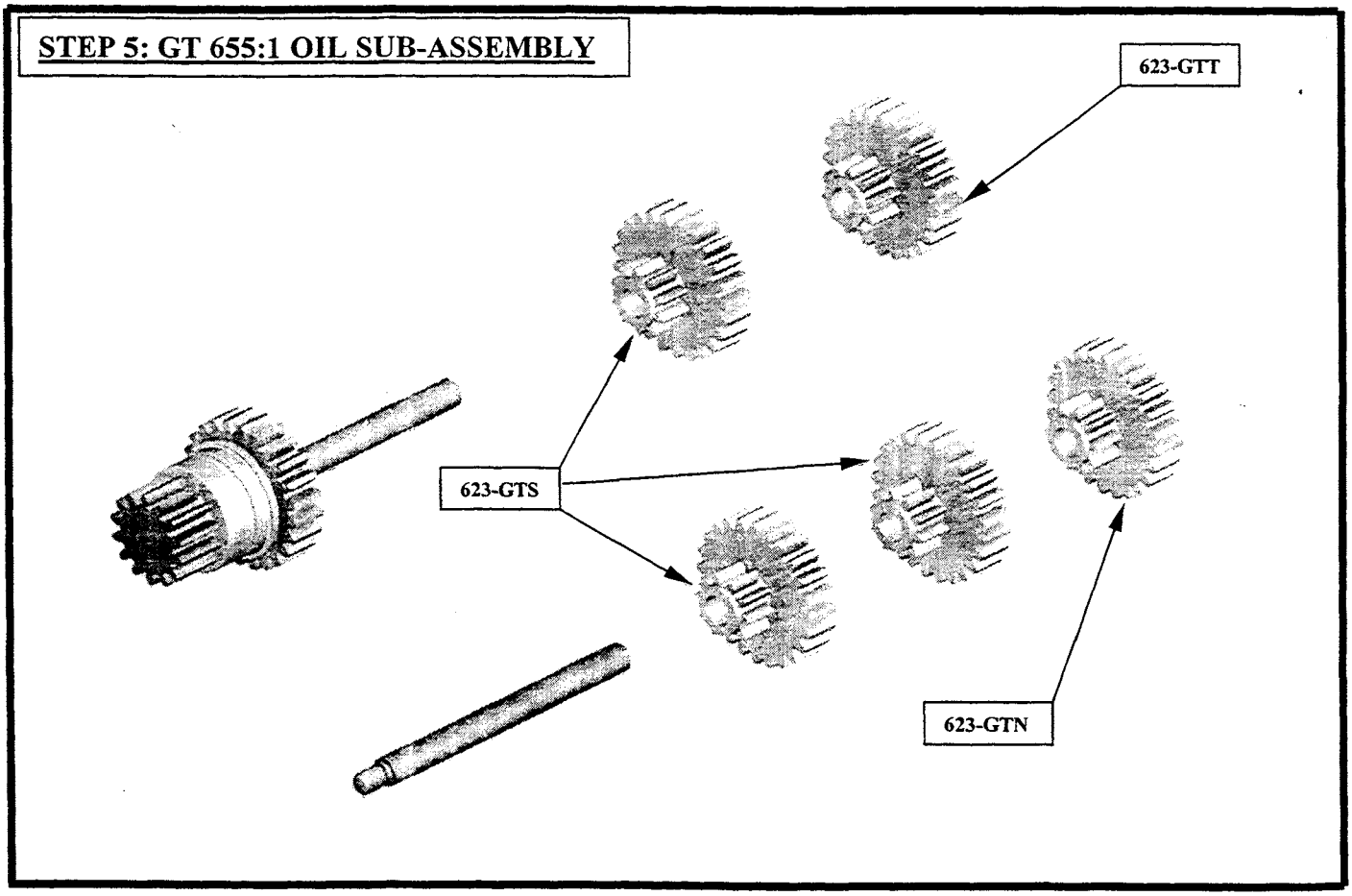


STEP 5: GT 655:1 FLO-THRU SUB-ASSEMBLY

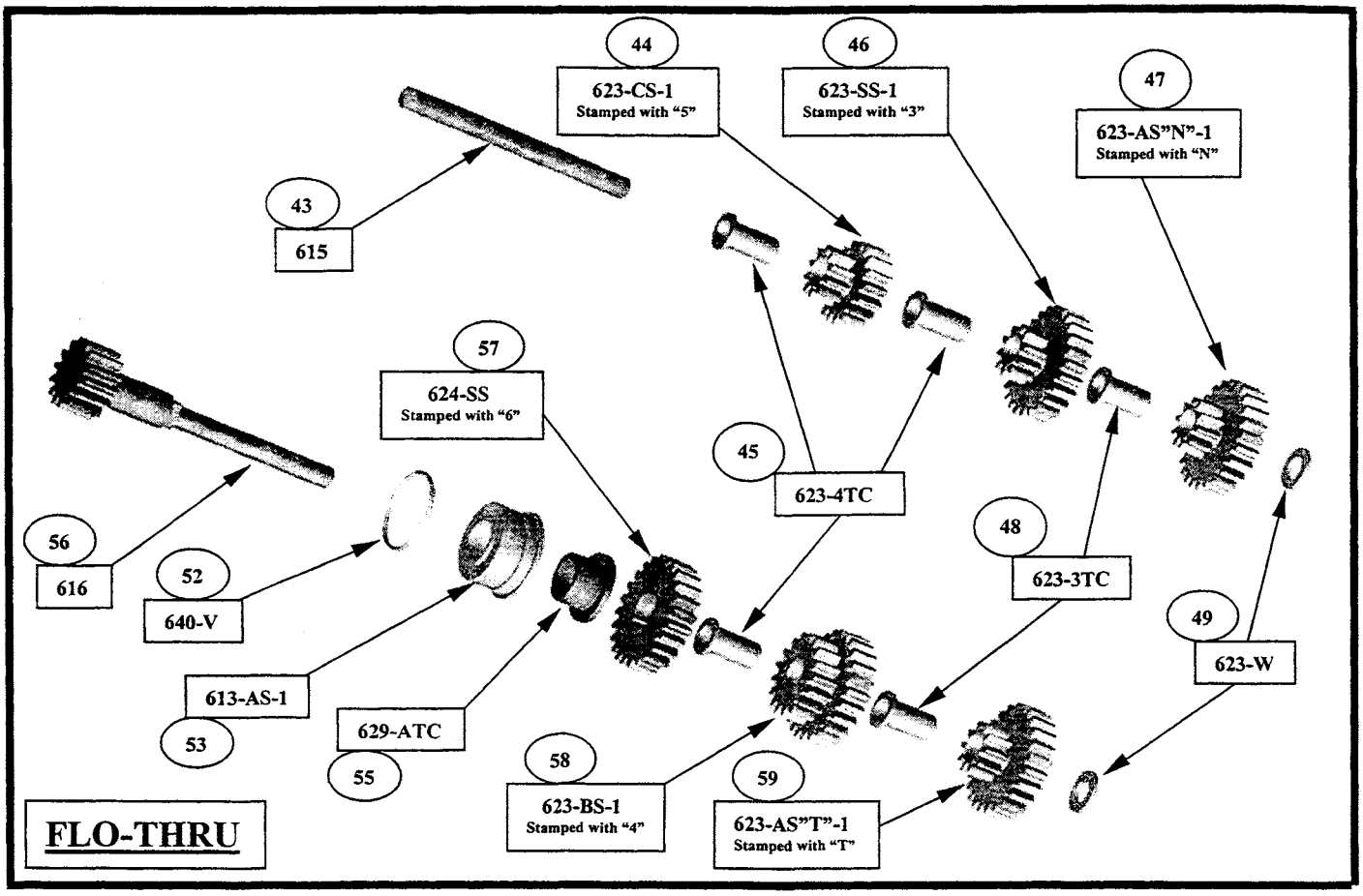


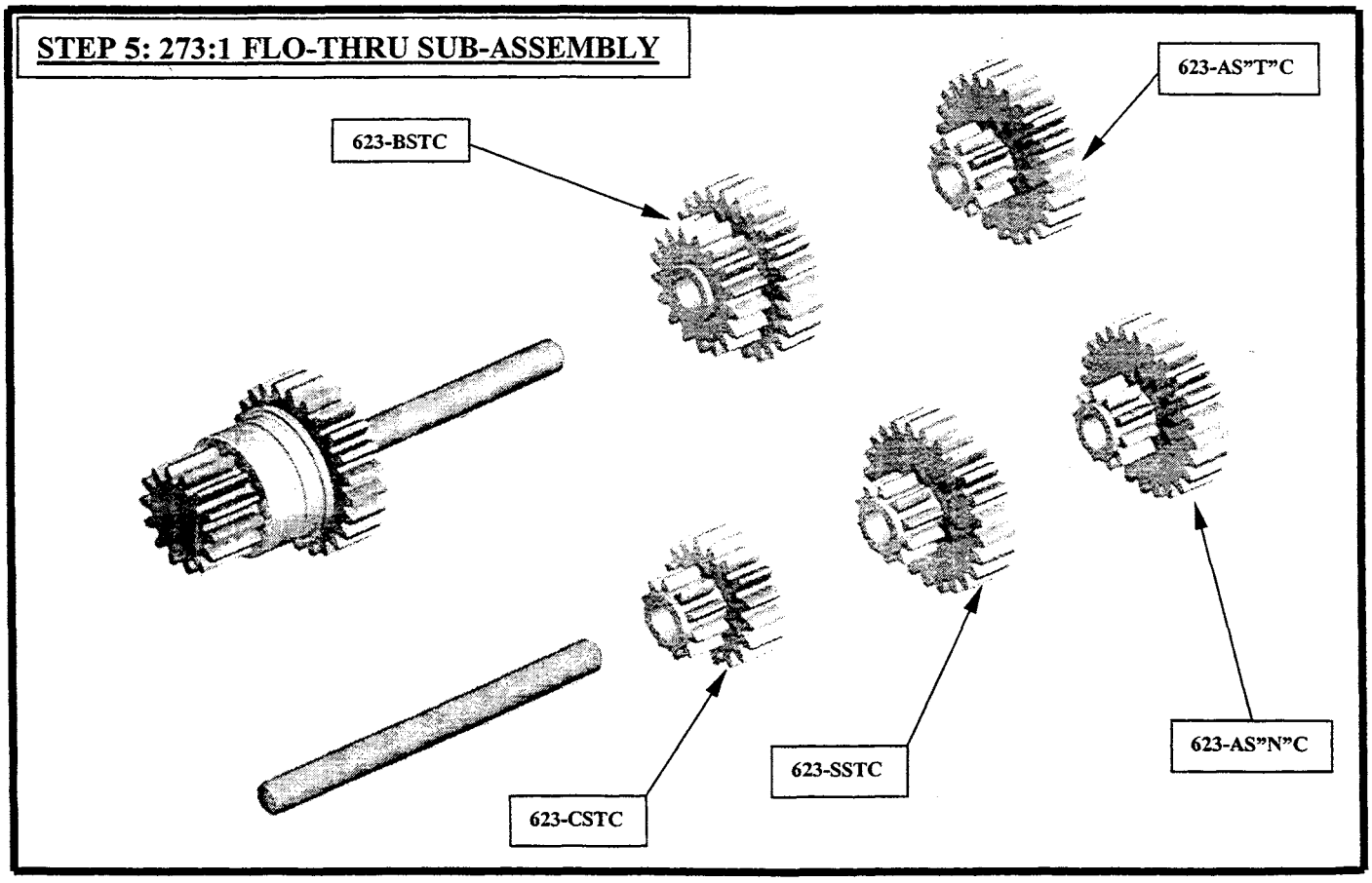
STEP 5: GT 655:1 OIL GEAR TRAIN ASSEMBLY



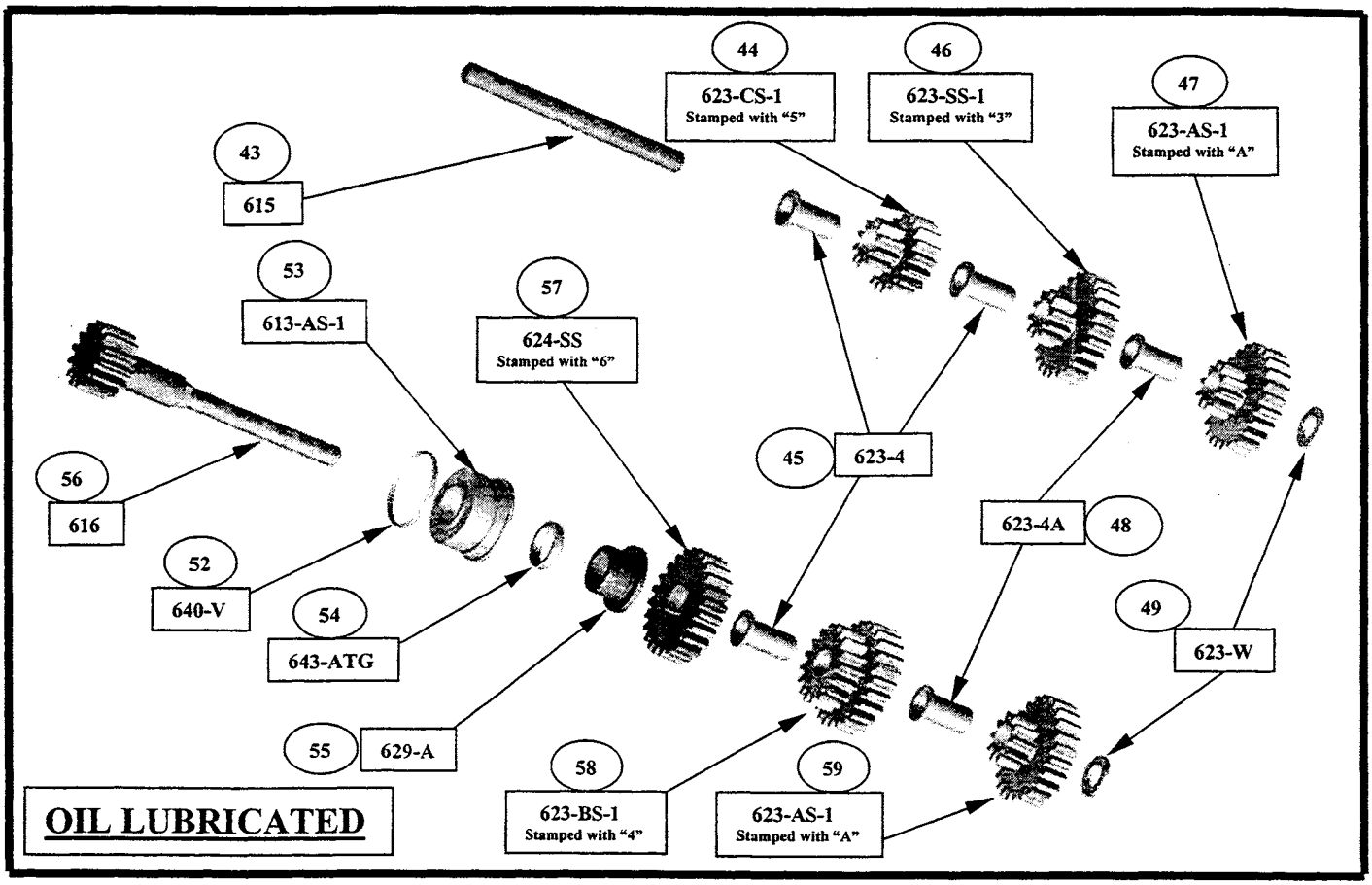


STEP 5: REGULAR 273:1 FLO-THRU GEAR TRAIN ASSEMBLY

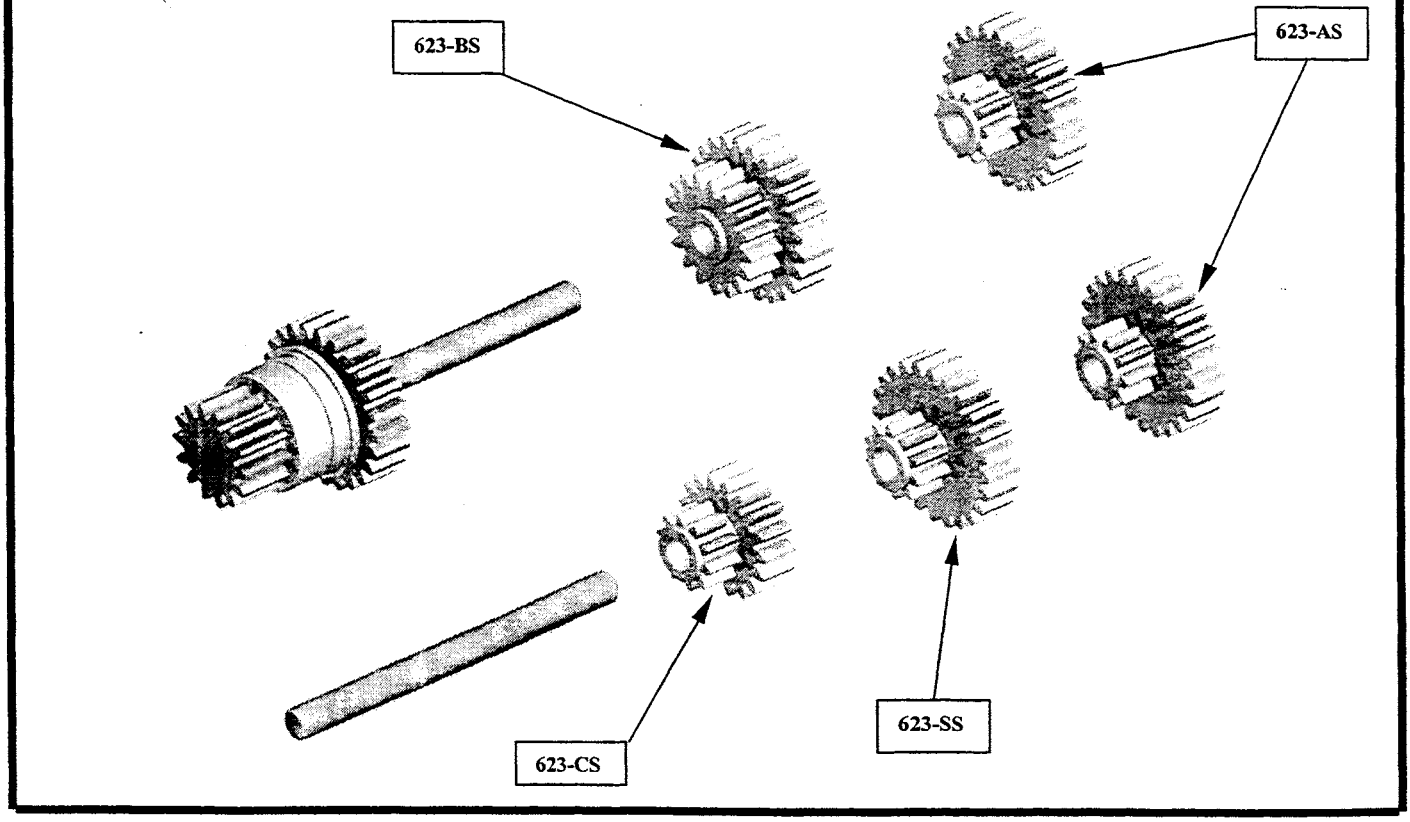




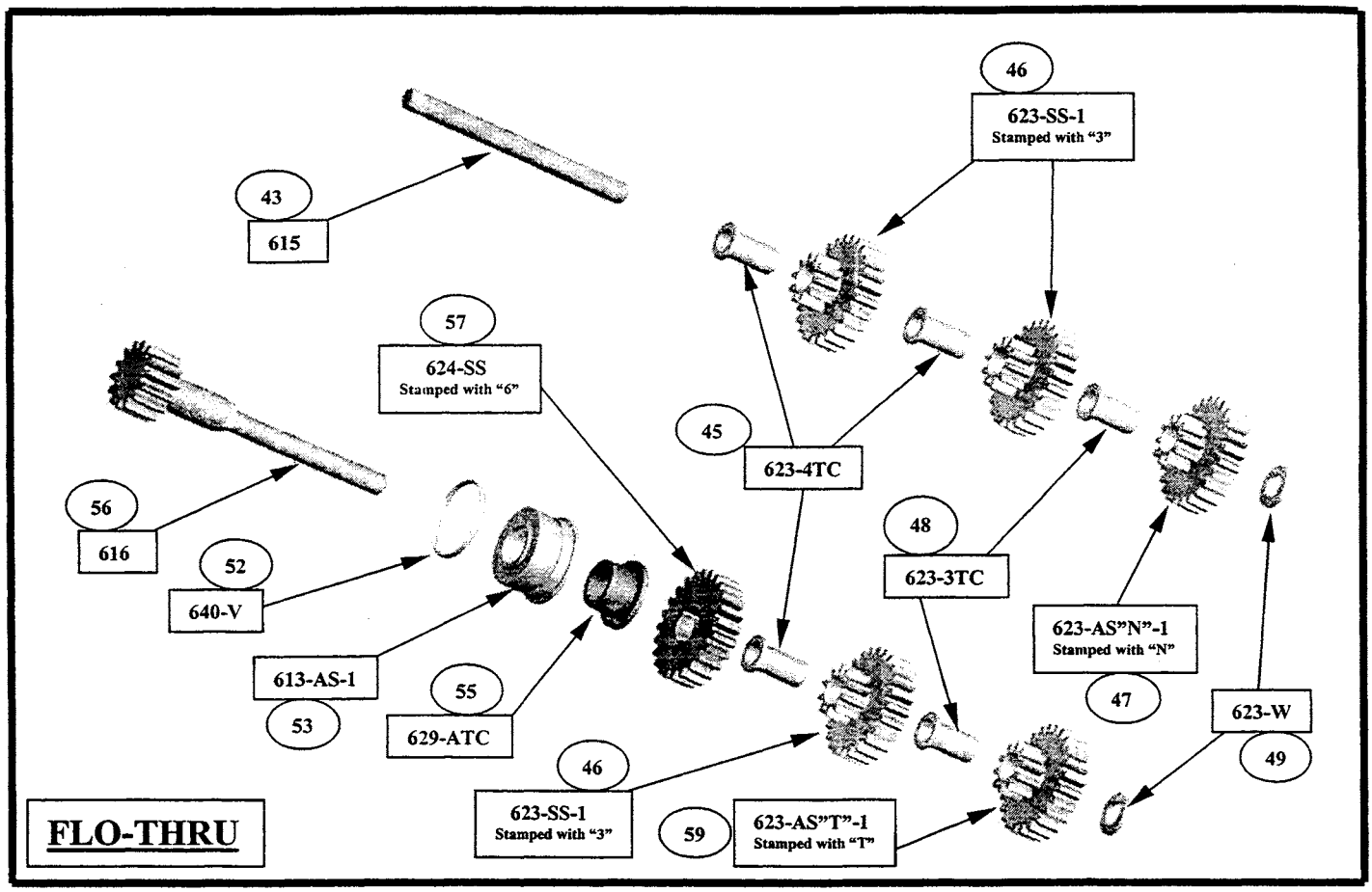
STEP 5: REGULAR 273:1 OIL GEAR TRAIN ASSEMBLY

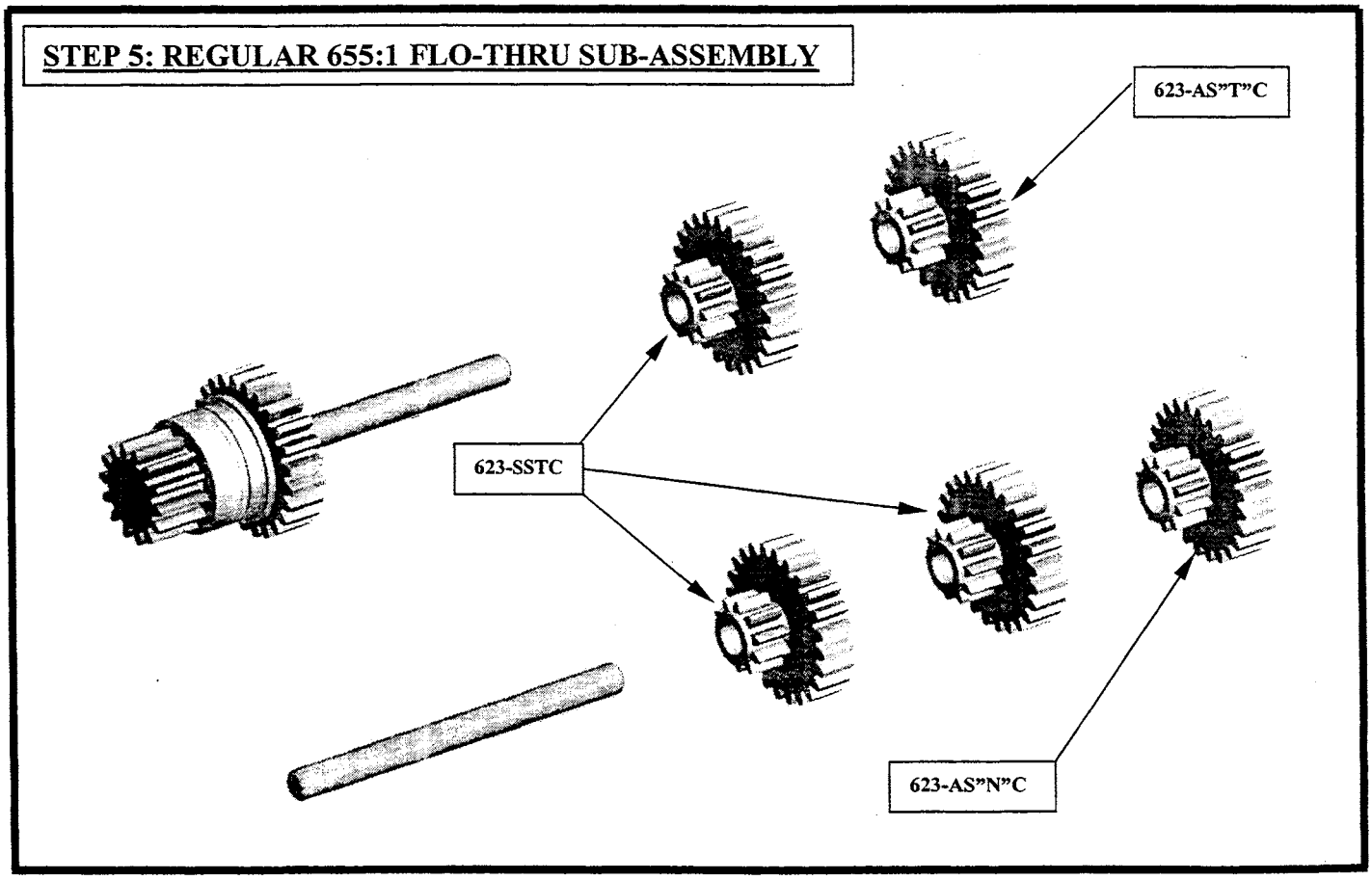


STEP 5: REGULAR 273:1 OIL SUB-ASSEMBLY

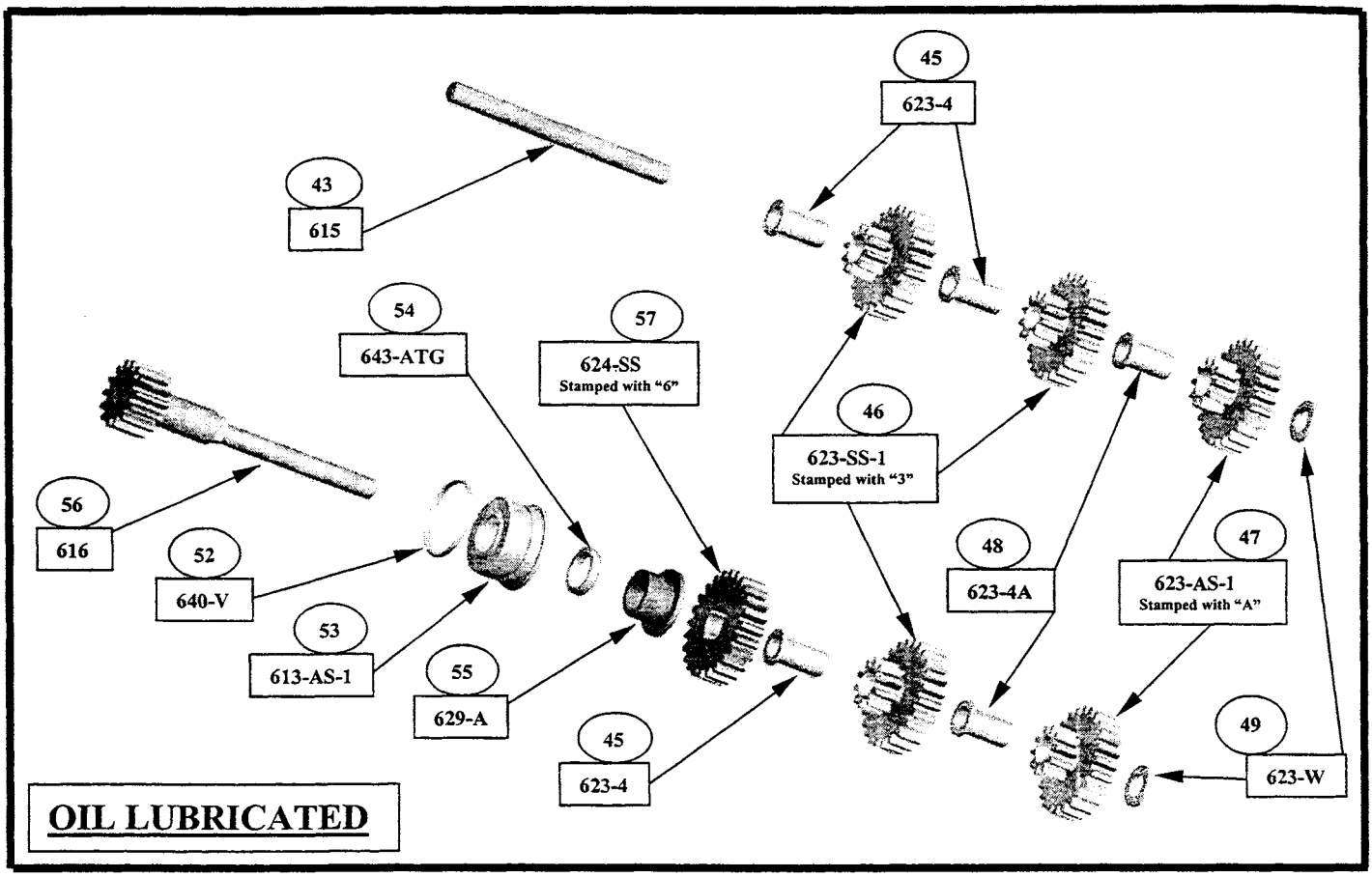


STEP 5 : REGULAR 655:1 FLO-THRU GEAR TRAIN ASSEMBLY

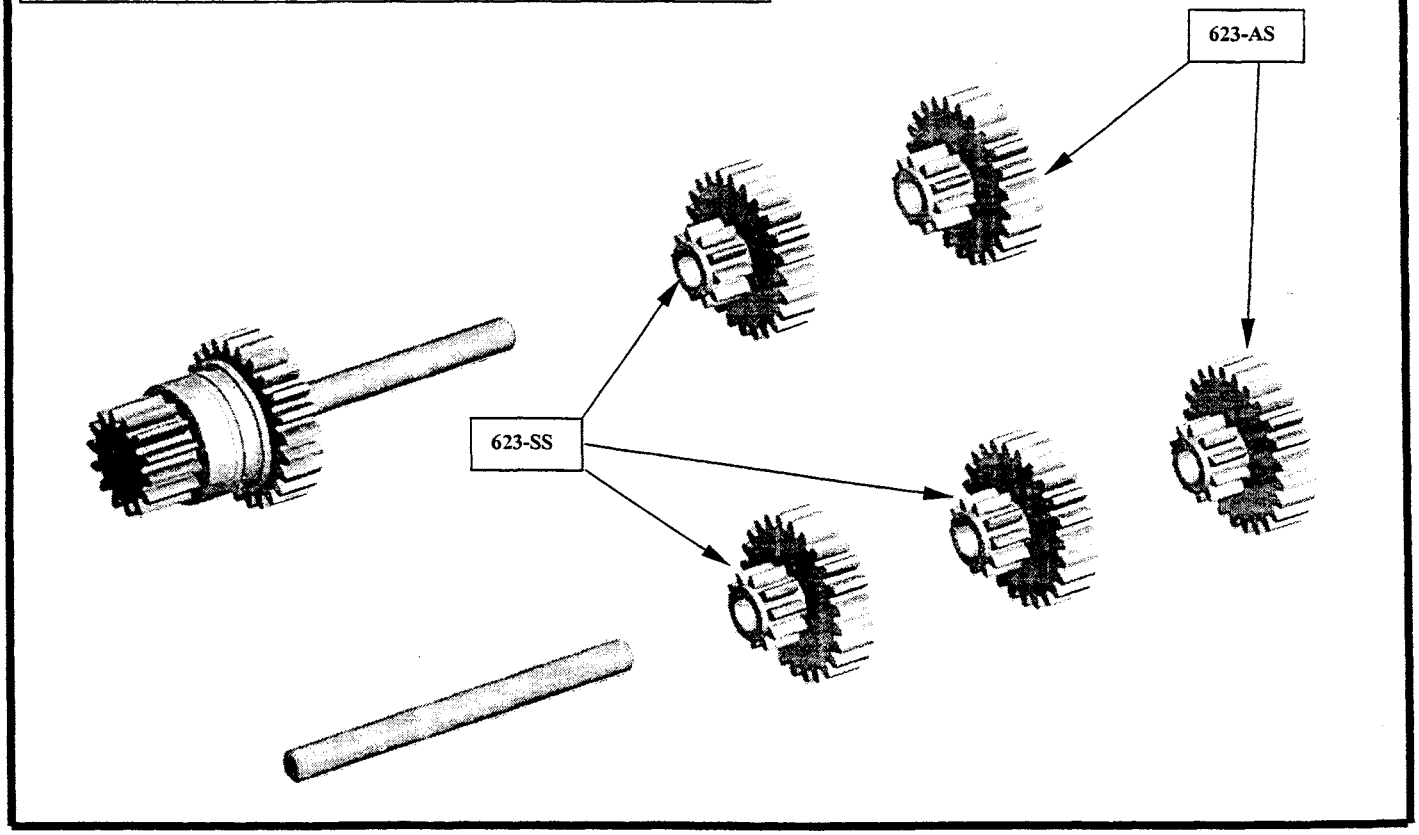




STEP 5: REGULAR 655:1 OIL GEAR TRAIN ASSEMBLY

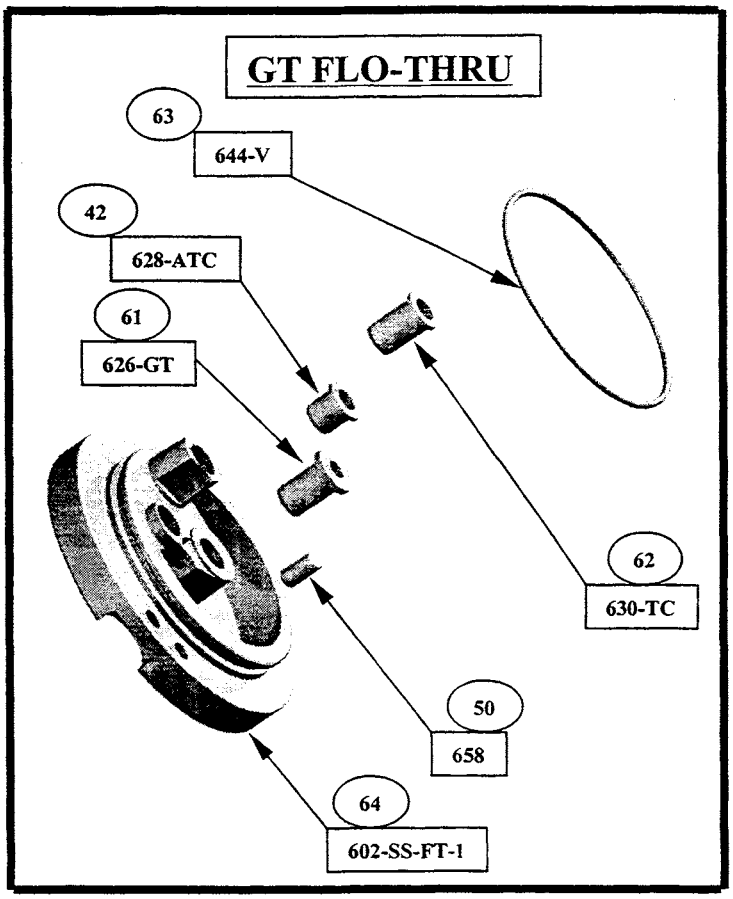


STEP 5: REGULAR 655:1 OIL SUB-ASSEMBLY

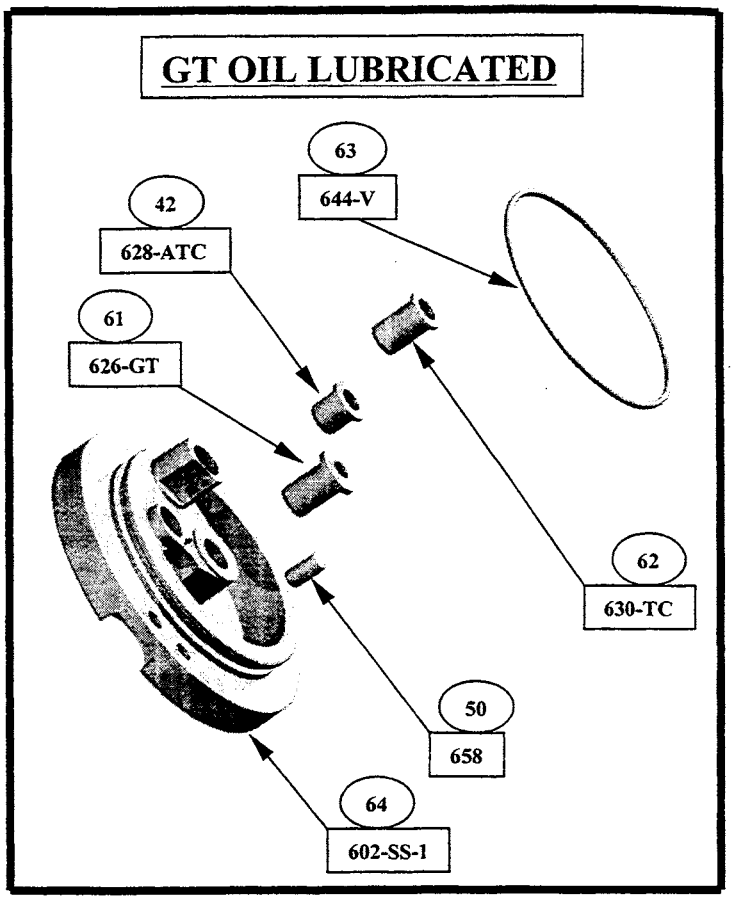


STEP 6: GEARBOX COVER ASSEMBLY

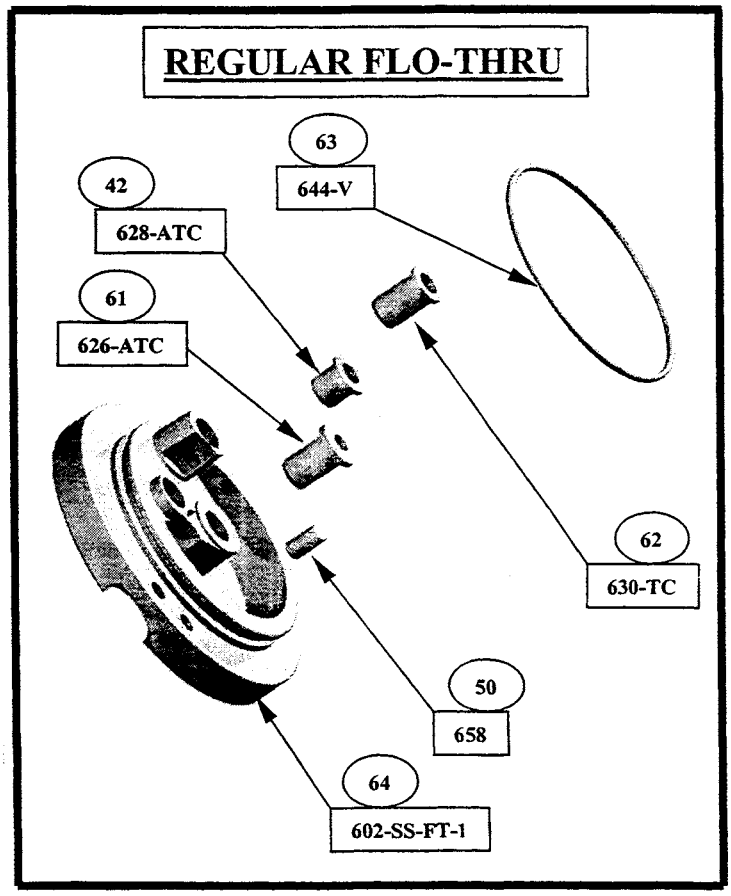
GT FLO-THRU



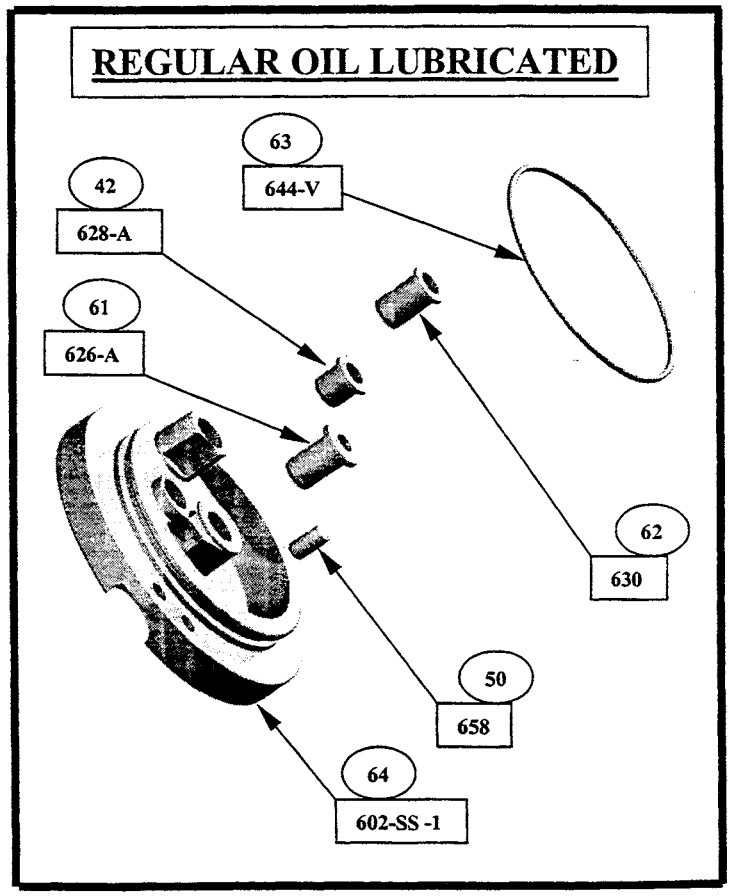
GT OIL LUBRICATED



REGULAR FLO-THRU

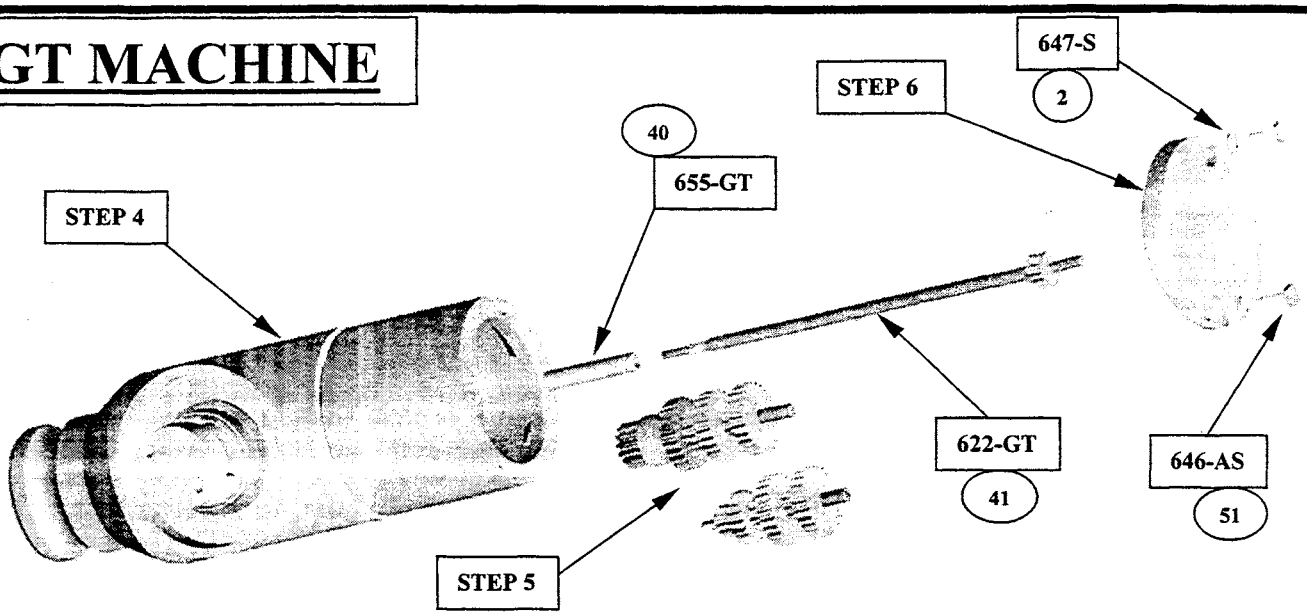


REGULAR OIL LUBRICATED

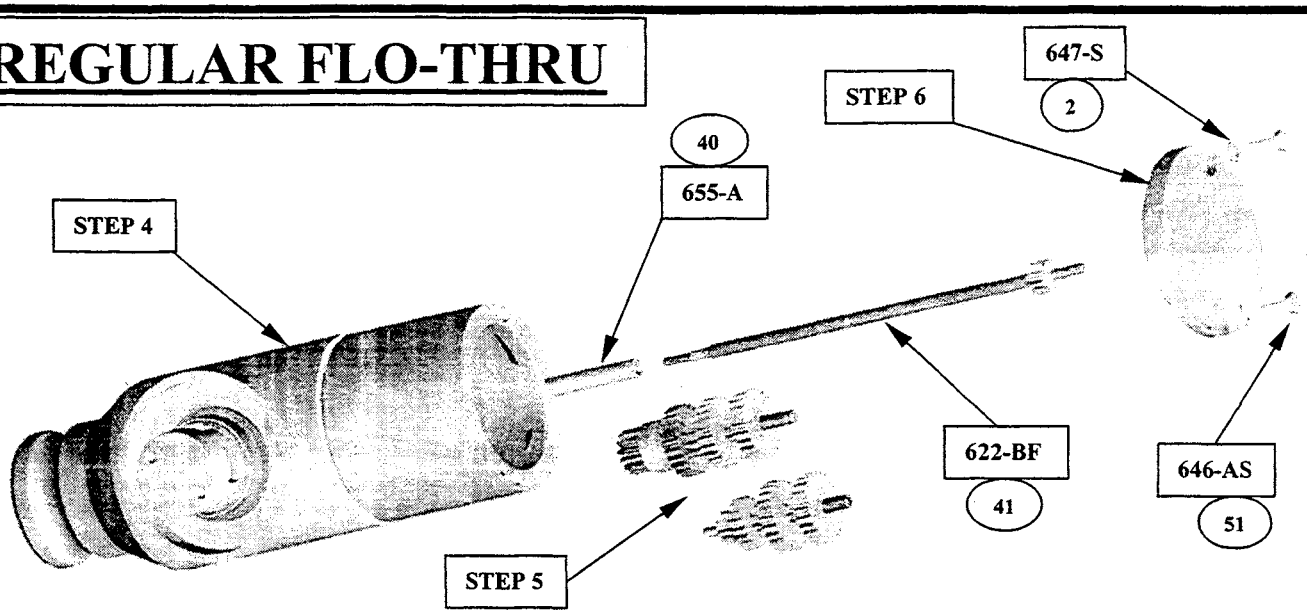


STEP 7: INSTALLING GEAR TRAIN

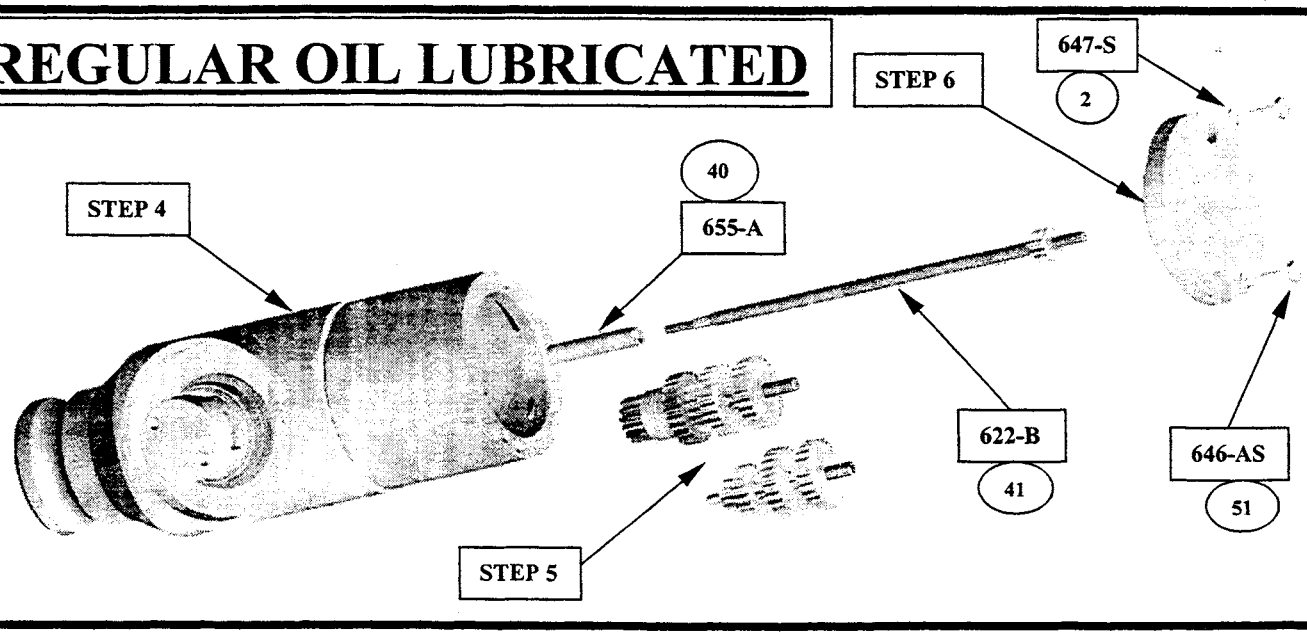
GT MACHINE



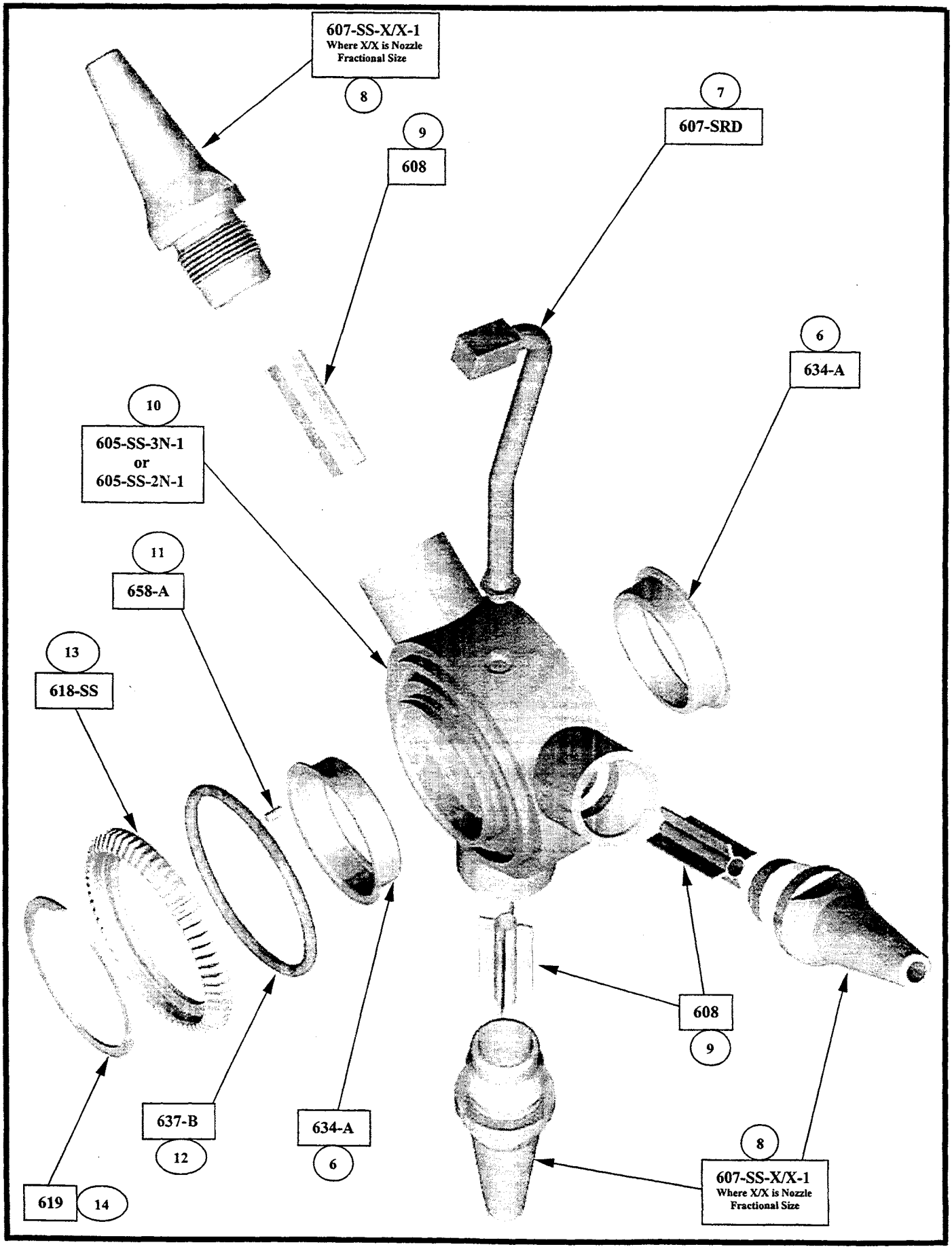
REGULAR FLO-THRU



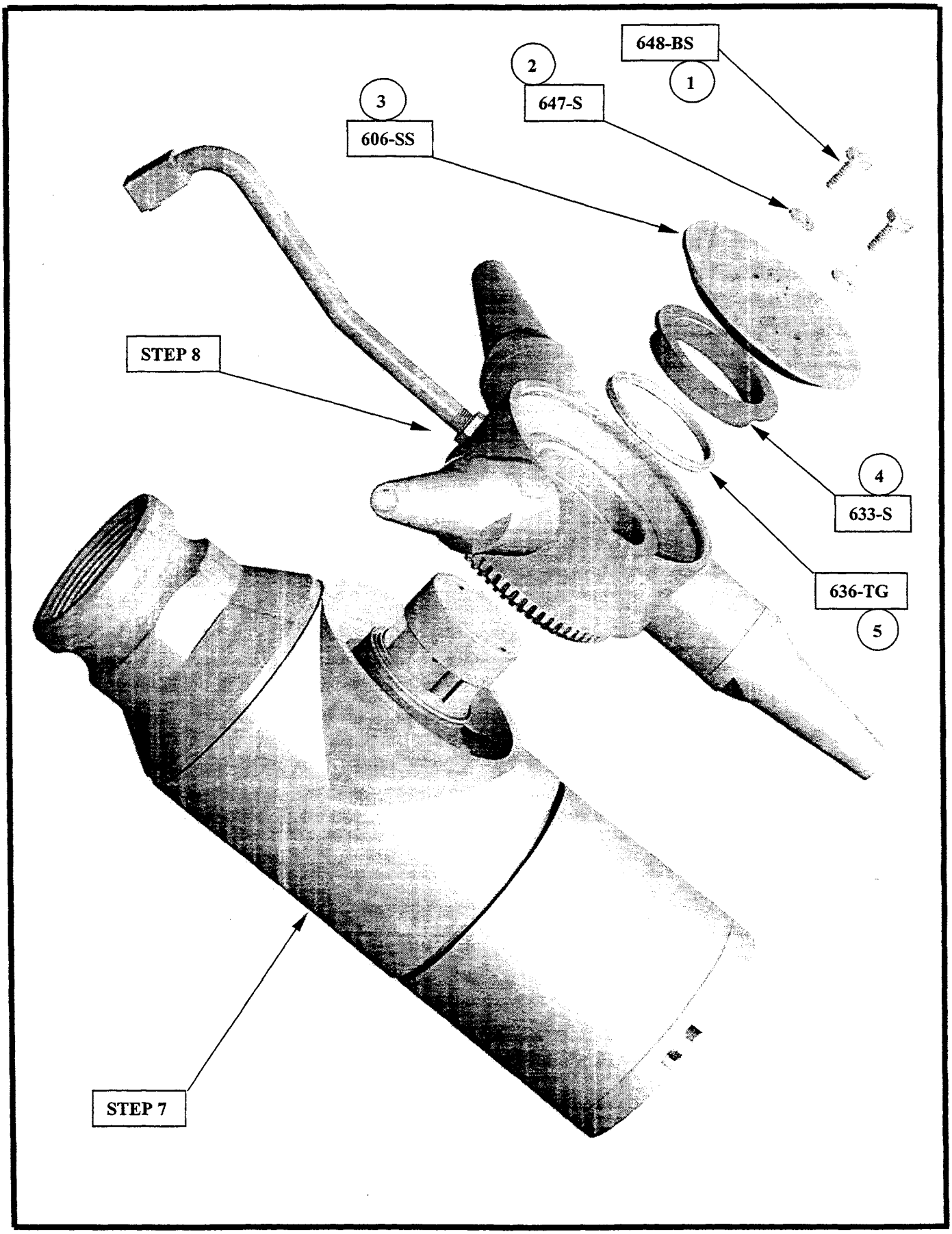
REGULAR OIL LUBRICATED



STEP 8: NOZZLE HOUSING ASSEMBLY



STEP 9: INSTALLING NOZZLE HOUSING ASSEMBLY



STEP 10: INSTALLING ROTOR & STATOR