



OPERATING AND MAINTENANCE MANUAL

MM MINK
Rotary Claw Vacuum Pumps
AV Series - Models MM1102, MM1104, MM1142, MM1144

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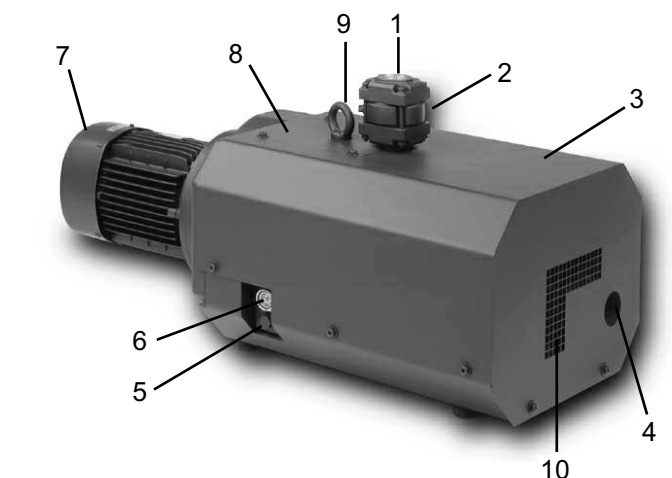
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INTRODUCTION

This manual is written to provide information on the following models:

MM1102AV, MM1104AV, MM1142AV and MM1144AV



- | | |
|------------------------|-------------------------|
| 1 Gas inlet | 6 Oil sight glass |
| 2 Anti-suck-back valve | 7 Motor |
| 3 Pump cover | 8 Oil fill access panel |
| 4 Gas outlet | 9 Lifting eye |
| 5 Oil drain plug | 10 Inlet cooling air |

Fig. 1 - MM1142AV

Identification

For model identification, see the nameplate mounted on the pump. When ordering parts, it is necessary to include the model and serial number identification stamped into the nameplate.

Operating Principles

The MM Mink is an air-cooled, rotary claw, single stage, positive displacement vacuum pump. The claw rotors rotate in opposite directions within a cylinder, drawing in and compressing gas. The shape of each claw is such that a small clearance is maintained between the claw tips and the cylinder walls and also adjacent lobe surfaces. As the claws rotate, a void is created, causing the gas to be drawn into the cylinder chamber, compression takes place with continued rotation due to the reduction of the gas confinement area, and finally, the higher pressure gas is discharged at the end of the cycle (see Fig. 2). The evacuation of the vessel connected to the inlet of the pump will continue until the desired pressure is reached or the pump capacity is reached. Since the pumps are dry running, it is not necessary to lubricate the pump with oil or grease in the compression chamber, although the gear housing does contain oil used to constantly lubricate the gears and bearings. Process gases do not mix with the oil in the gear housing.

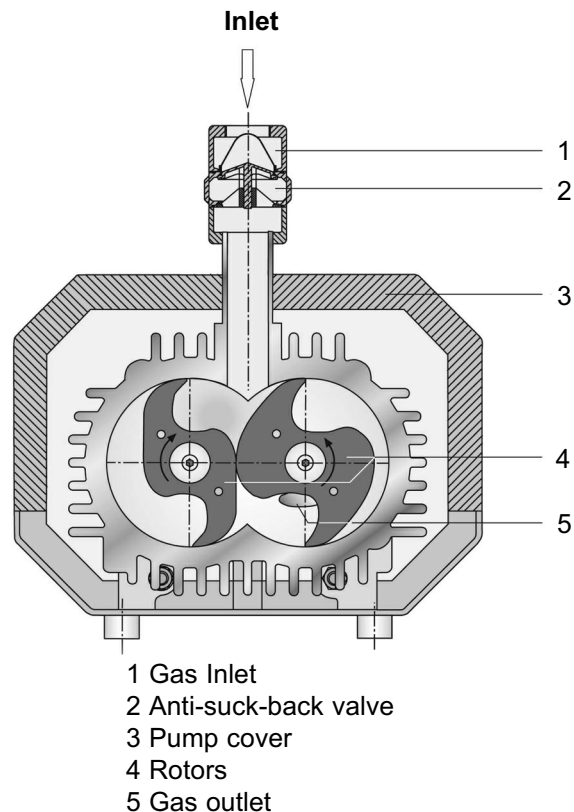


Fig. 2 - Basic Operating Principle

1.0 INSTALLATION

1.1 Unpacking

Inspect the crate and pump for signs of damage incurred in transit. Pumps are usually shipped FOB our factory, and such damage is normally the responsibility of the carrier and should be reported to them.

Open the crate and remove the pump.

The inlet port of the pump is covered prior to shipment to prevent dirt and foreign material from entering the pump. Do not remove this cover until the pump is actually ready for connection to the system.

1.2 Location

The pump should be installed in a horizontal position on a level surface. The bottom of each mounting foot has a threaded hole that could be used to mount the pump to the floor. Allow adequate space between the pump and any obstructions to permit servicing the pump. Also, adequate ventilation must be provided for the fans on the pump and the motor. Do not locate the pump in a stagnant air location.

The pump is constructed to operate at normal atmospheric pressure and at a temperature between 12 to 40°C (54 to 104°F).

WARNING: During operation the surface temperature of the pump can exceed 70°C (158°F).

1.3 Power Requirements

The schematic diagram for the electrical connections is located in the junction box or on the nameplate of the pump motor.

The motor must be connected according to the electrical codes through a fused switch to provide protection for the motor against electrical or mechanical overloads. The motor starter has to be set consistent with the ampere rating listed on the motor nameplate. Also, note the motor rotation arrow located on the motor fan housing.

CAUTION: The best and most reliable safeguard for the pump is the motor starter overload protection. It is very important that the starter be set to trip at the correct load rating. Consult the motor nameplate, starter manufacturer and the latest edition of the National Electrical Code to arrive at the correct trip setting.

Open the inlet port and jog the motor briefly to make sure the rotation is correct. **Allow the pump to make no more than 6 to 8 revolutions.** Looking at the motor fan cover, the direction of rotation is counter-clockwise. If it is backwards, reverse any two leads of the three at the power connection.

CAUTION: Damage can result from running the pump backwards.

1.4 Process Gas Stream

It is a good operating practice to install an inlet filter. It is necessary to install an inlet filter if the process contains solids or any material that is 10 microns or larger. It is also necessary to install a knock-out pot in the inlet piping if there is any chance of liquid entering the pump.

WARNING: Do not allow aggressive, corrosive or explosive gas, liquids or solids to enter the pump. Contact the factory in Virginia Beach, Virginia if in doubt.

Note: Consult the factory if there is any doubt about the quality of the process gas in your application, or if the process gas in your application will exceed 40°C (104°F) at the pump inlet.

1.5 Process Piping Connections

If the gas that is pumped contains dust or other foreign particles, a suitable inlet filter (10 micron rating or smaller) should be connected to the inlet port. Consult the factory for a recommendation.

CAUTION: Piping connected to the pump flanges must be adequately supported to prevent stressing the flanges.

Remove the plastic protective cap from the inlet port prior to connection of the pump to the system.

If the gas stream contains any liquid or vapor that will condense in the piping, install a knock-out pot on the horizontal piping, or a drip leg and a drain on the vertical pipe near the pump inlet. Drain the knock-out pot/drip leg often to prevent liquid from entering the pump.

The inlet flange of the pump can be connected with a vacuum-tight flexible hose or pipe. The nominal diameter of the connecting piping must be at least the same as the diameter of the pump inlet flange. Smaller lines will result in pumping speeds lower than the rated values.

If more than one pump is connected to a common header, each pump must have its own inlet isolation valve or inlet check valve.

The pumps come equipped with an anti-suck-back valve. The valve is used to prevent the pump from running backwards when it is shut off. Without this valve, air at atmospheric pressure will rush back through the pump exhaust (when it is shut off) to the lower pressure of the system under vacuum, causing the pump to run backwards and potentially damaging the pump.

WARNING: Do not use the anti-suck-back valve as a check or shut-off valve for your system.

1.6 Exhaust Piping

Discharge piping should be the same size as the outlet of the pump. Provide a drip leg if there is any possibility of liquid forming in the exhaust. Install the exhaust piping so that it slopes away from the pump. Use a flexible connector when piping to a manifold or exhaust gas stack.

WARNING: Do not touch the exhaust system when the pump is, or has recently been, in operation. The exhaust system can reach high temperatures and can get extremely hot, therefore, it should be insulated for personnel protection.

CAUTION: Do not allow liquid to back up into the pump from the exhaust piping.

Shut-off valves located on the exhaust discharge side of the pump(s) are not recommended; however, if more than one pump discharges into a common exhaust header, care should be taken in order to prevent back-up into any other pump. If shut-off or check valves are installed, special care must be taken to make sure the pump cannot start unless its check valve and any shut-off valves associated with that pump are open. *Any exhaust discharge valving must be interlocked to prevent operation of the pump when the valving is closed.* Failure to abide by this instruction will void the pump warranty.

2.0 ROUTINE MAINTENANCE

2.1 Inlet Filter

The optional inlet filter requires cleaning at regular intervals, depending on the amount of dust in the air being pumped. If the cartridge is too dirty to be cleaned, it must be replaced.

An inlet screen is integrated in the inlet housing (Ref. 713). This screen must be cleaned at regular intervals; therefore, if the screen needs to be cleaned, remove the four hex head screws and lockwashers, remove and clean the screen, and reassemble valve internal parts if they were removed or replaced.

2.2 Gear Box Oil

The gear box is completely separated from the rest of the pump. The gears and bearings are lubricated by oil contained within the gear box. The lower gears are partially covered by the oil. The rotating gears splash the oil onto all the mating surfaces within the gear box.

The oil level can be checked by monitoring the oil sight glass located on the lower side of the gear box.

The gear oil must be changed every 20,000 working hours, or sooner depending on conditions. Busch recommends the use of Busch Part No. 0831.128.556, a synthetic, extreme pressure gear oil with a viscosity of ISO 220. See Section 3.2 for instructions on adding and changing the oil.

2.3 Routine Cylinder and Rotor Inspection

If you wish to make a routine inspection of the rotors and cylinder, this can be accomplished by removing the oil access panel (see Fig. 3) and lifting eye. **DO NOT** drain the oil. Next, refer to Section 3.3 to remove the upper shroud only (see Fig. 5). **DO NOT** remove the motor, motor mounting bracket or lower base. Skip directly to Section 3.6 to remove the silencer housing/chamber. After the housing has been removed, remove the "B-side" end-plate as described in Section 3.7. If no repairs are required, reassemble in reverse order.

3.0 DISASSEMBLY

The MM Mink pumps are easily dismantled and reassembled. Certain steps are recommended to be followed in the sequence outlined. Reasonable caution must be exercised to prevent damage to the parts during the operation and to insure proper pump performance after the repair.

You will note the reference numbers called out on the drawing in the back of this manual. Throughout the disassembly and assembly procedures, these reference numbers are used as an identification aid to the technician.

Also, the photos and descriptions given in this manual are

based on a specific model, and specific details may vary slightly from model to model. Drawings and parts lists are given for all models, so by following these instructions, the technician should be able to apply the procedures to the entire model line.

3.1 Tools

To completely disassemble/assemble the MM Mink pumps, the following tools are recommended:

Emory cloth or ScotchBrite™ pad
Allen wrenches, socket end wrenches, torque wrench
Bearing/seal installation tools
Vernier calipers
Rubber mallet, wooden blocks and rags
Loctite™ 242
Gear puller, pick, brass punch, large screwdrivers
Electric hot plate
Feeler gauge .04, .08, .10, .12 mm
Acetone
Liquid Moly spray (Busch Part No. 0832.909.058)
Hylomar PL32M sealer (Busch Part No. 0485.902.275)
Gear Oil (approx. 1/2 liter), (Busch Part No. 0831.128.556)

3.2 Draining and Changing the Oil

To drain and change the oil, the following steps must be followed:

Remove the lifting ring (Ref. 615). Remove the four screws (Ref. 426) and washers (Ref. 425) from the oil fill access panel (see Fig. 3). Remove and set the panel aside.



Fig. 3 - Removing the Access Panel

Open the oil fill plug (Ref. 072) located on top of the gear housing (Ref. 001) to allow air to enter the system. This depressurizes the gear box. After the oil fill plug has been removed, remove the oil drain plug (Ref. 080) and gasket (Ref. 081).

Allow the oil to drain completely (see Fig. 4). Reinstall and tighten the drain plug and gasket.



Fig. 4 - Draining the Oil

If you are merely changing the oil, refill the gear box with fresh oil until the oil level reaches the middle of the sight glass (Ref. 076). Reinstall and tighten the fill plug and reinstall the oil access panel with the screws and washers.

3.3 Motor and Shroud Removal

To separate the motor (Ref. 550) and shrouds from the motor mounting bracket (Ref. 500), remove the hex head bolts and lockwashers (Ref. 551/552), which attach the motor to the motor mounting bracket.

Remove the four screws and flat washers (Ref. 425/426) from the oil fill access panel. Remove the eye bolt (Ref. 615). The access panel can now be removed.

Remove all the shroud screws and washers (425/426/428), and then lift off the shroud (Ref. 424) (see Fig. 5).

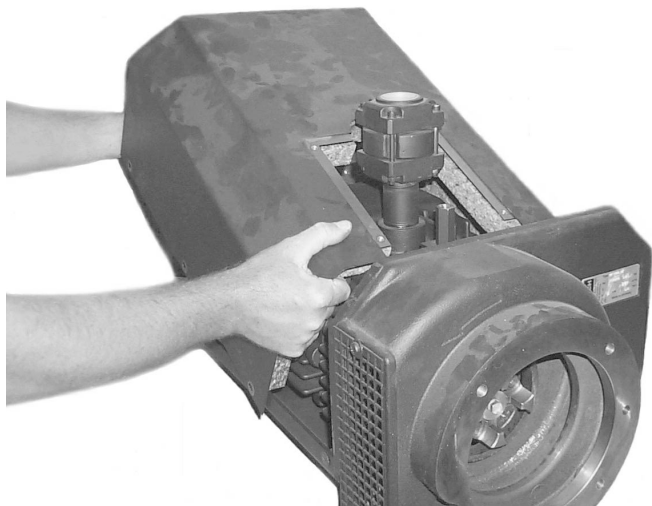


Fig. 5 - Removing the Shroud

Stand the pump on the motor mounting bracket (Ref. 500). This allows access to the three hex head cap screws and washers (Ref. 611/613) holding the lower base (Ref. 620) to the pump (see Fig. 6). Remove the lower base, and set it aside.

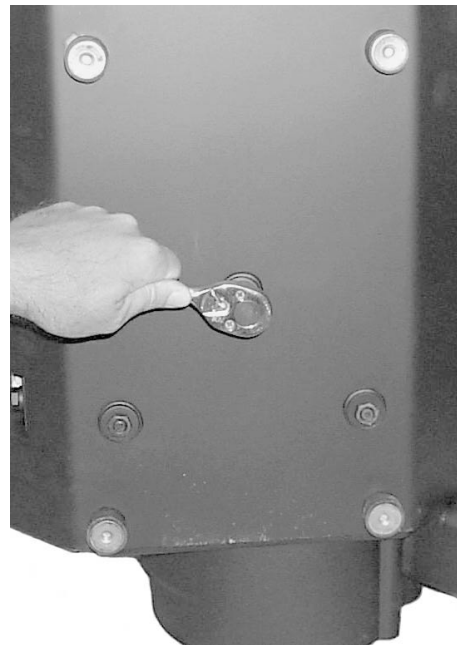


Fig. 6 - Removing Lower Base Nuts

3.4 Removing the Motor Mounting Bracket

Remove the two lower hex head nuts and lockwashers (Ref. 505/506) from the studs (Ref. 504) holding the motor mounting bracket to the pump (see Fig. 7). Set the pump back down and remove the two remaining hex head nuts and lockwashers from the two remaining studs (see Fig. 8). Remove the motor mounting bracket (Ref. 500) and set it aside (see Fig. 9).

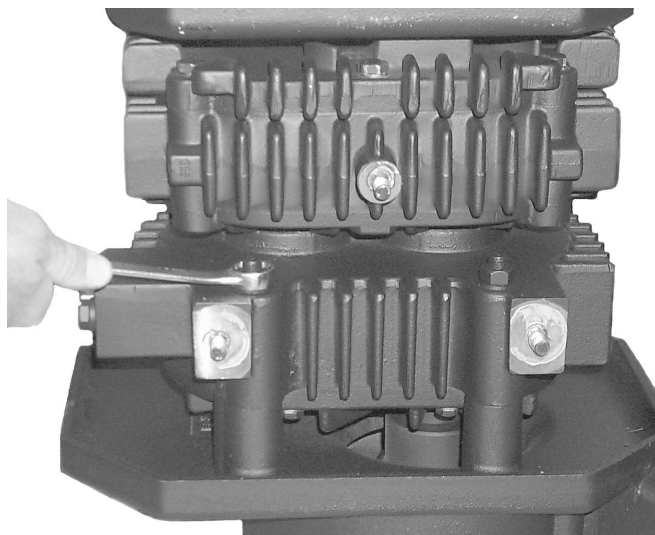


Fig. 7 - Removing Motor Mount Bracket Lower Nuts

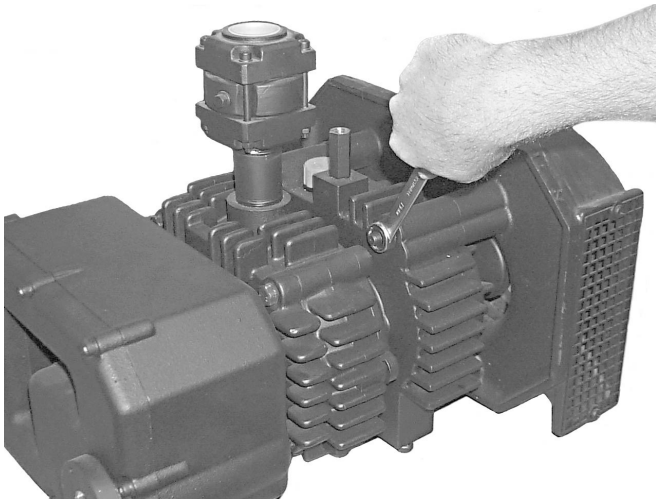


Fig. 8 - Removing Motor Mount Bracket Upper Nuts

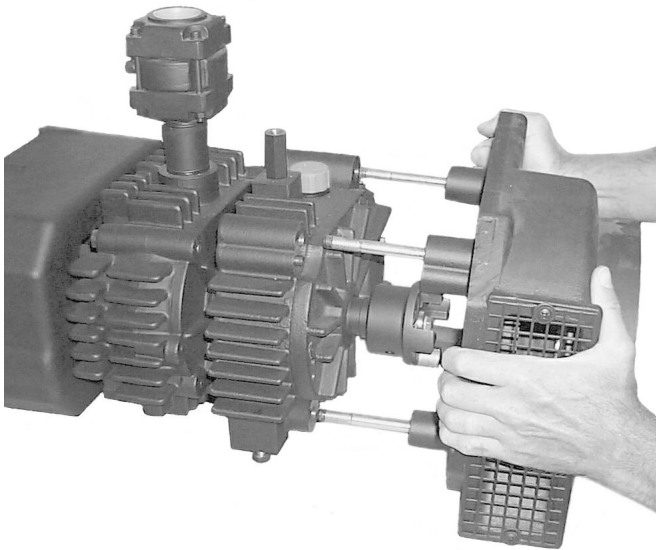


Fig. 9 - Removing Motor Mounting Bracket

3.5 Removing the Pump Side Coupling Half

Remove the pump side coupling half retaining disk, coupling half and shaft key (Ref. 51/52/525) (see Fig. 10). The retaining disk bolt has usually been secured with Loctite™ and may be hard to remove. The coupling half should now slide off the rotor shaft (Ref. 008).

Pull the shaft seal sleeve (Ref. 064) from the shaft by prying it loose with a screwdriver, or use a gear puller if necessary. The sleeve is a slip fit and has an O-ring (Ref. 042) sealing it to the shaft. If any burrs were created on the keyway while removing the coupling half, lightly file them away at this time.

3.6 Removing the Silencer Housing/Chamber

Turn the pump around and begin by removing the eight socket head cap screws and flat washers (Ref. 803/804) from the silencer housing cover (Ref. 850) (see Fig. 11).

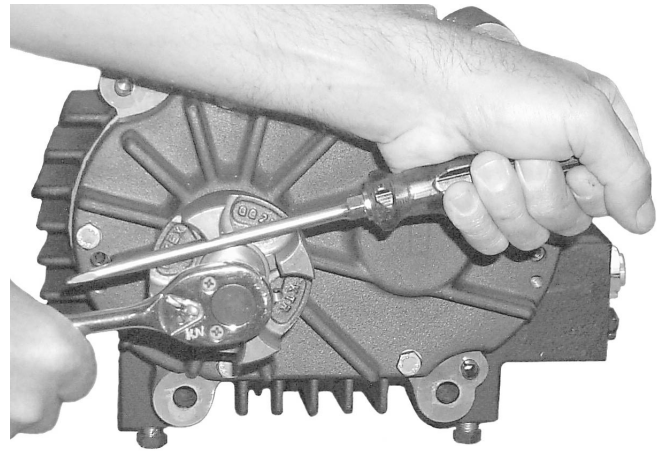


Fig. 10 - Removing Pump Coupling Half

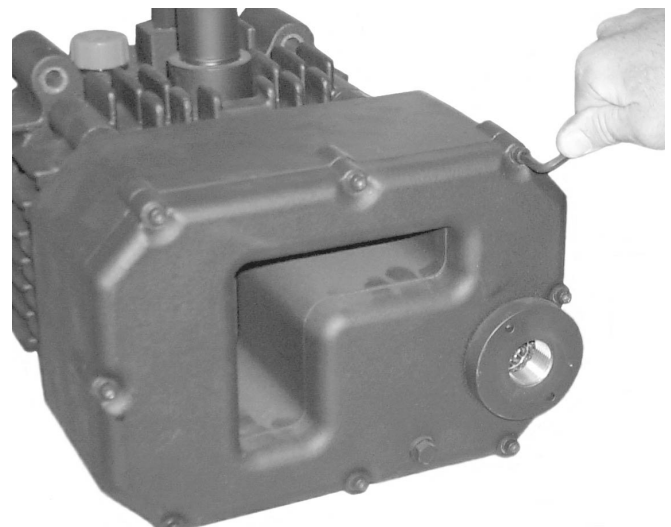


Fig. 11 - Removing Silencer Housing Cover

Remove the four hex head nuts (Ref. 825) and lockwashers (Ref. 805) from the studs inside the depression of the silencer housing (Ref. 800). The housing can now be separated from the "B-side" endplate (Ref. 160) (see Fig. 12).

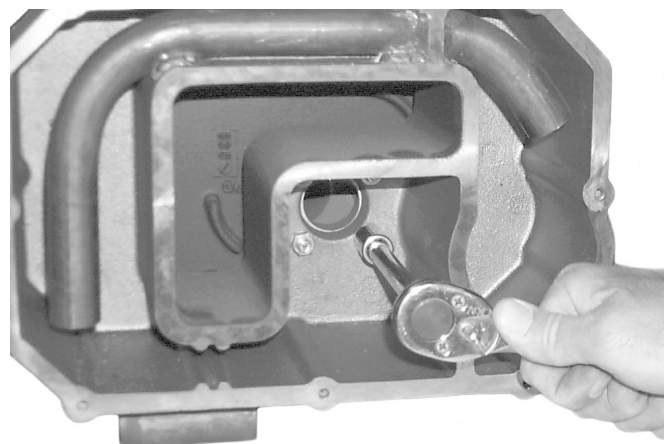


Fig. 12 - Removing Silencer Housing

3.7 Removing the “B-side” Endplate

Remove the five hex head cap screws (Ref. 182) and lock-washers (Ref. 181) from the “B-side” endplate. Separate the endplate from the cylinder (Ref. 155) and set it aside (see Fig. 13). This gives you access to the inner pump chamber.

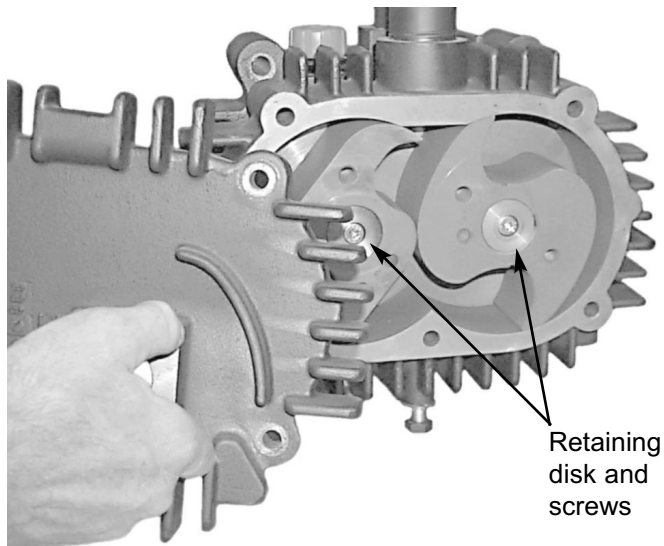


Fig. 13 - Removing “B-side” Endplate

At this point you can inspect the rotor claws (Ref. 150/151) and the cylinder for wear, such as run-in or rotor lockup, caused by process gases or contaminants. After inspection and up to this point, the pump could be reassembled if no problems were found without disrupting cylinder and claw clearances.

3.8 Removing the Claws

Remove the retaining disks and socket heads cap screws (Ref. 184/186) from each shaft end (see Fig. 13). Jam a rag or piece of wood between the rotor claws to keep the claws from rotating while you remove the retaining disks. You should now be able to freely slide the rotors off the shafts. If necessary, a puller can be used to facilitate this by using the two threaded holes on each rotor to pull the rotors off the shaft (see Fig. 14).

3.9 Removing the Cylinder

Proceed with removing the cylinder (Ref. 155) from the endplate. There are two notches on each side of the cylinder that can be used for prying (see Fig. 15). The cylinder is aligned to the endplate with two alignment pins (Ref. 066).

The shaft keys for each claw can be removed next.

Note: The shaft keys are precision fitted; therefore, it is very important that each key is properly labeled in order to insure each can be returned to its proper position.

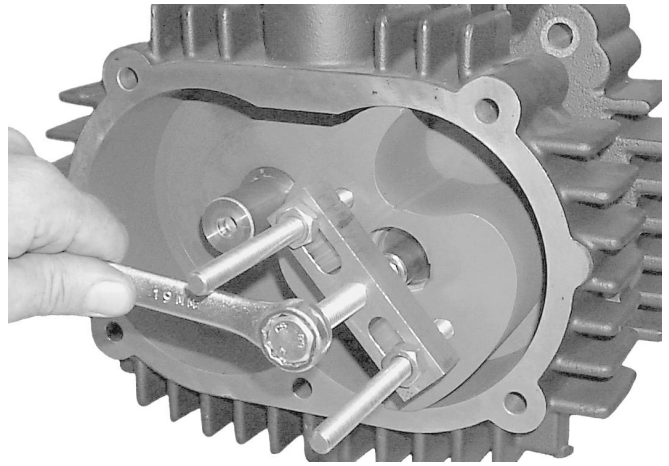


Fig.14 - Pulling the Rotors

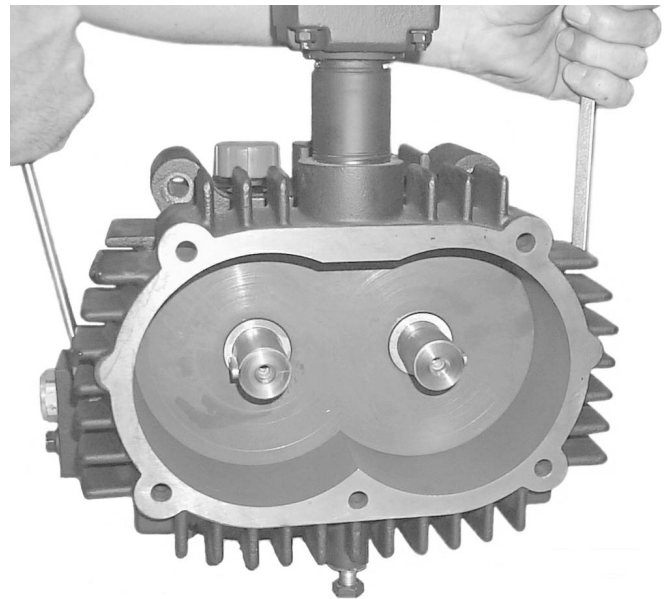


Fig. 15 - Prying Cylinder from Endplate

The shaft keys can now be removed by inserting a jacking screw into the hole in the key and tightening until the key is pulled out of the keyway. Be careful not to damage the key or keyway (see Fig. 16).

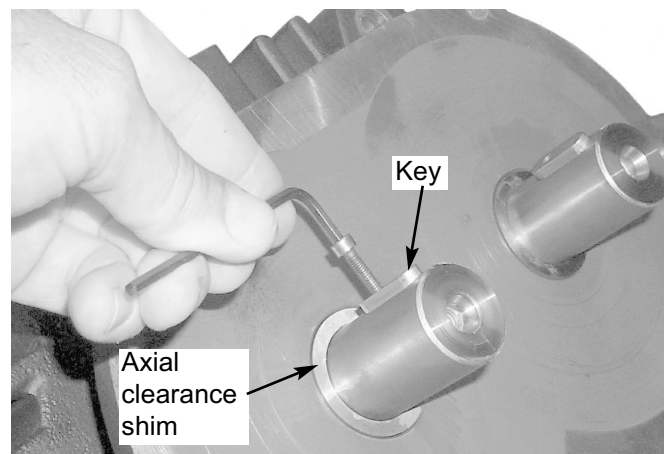


Fig. 16 - Removing Keys and Axial Clearance Shims

Next, remove the axial clearance shims (Ref. 120) from each shaft (see Fig. 16). Each one is precision ground to a specific thickness to properly set the gap (axial clearance) between the claw and the A-side endplate. Mark each shim accordingly.

Using a pick as necessary, remove the shims, and set them aside.

3.10 Removing the Gears and Motor Side Bearings

Move to the other side of the cylinder to remove the bearing cover plate (Ref. 060). Proceed by removing the six hex head cap screws and lockwashers (Ref. 69/70). There are two threaded holes in the cover (see Fig. 17). Screw a bolt (Ref. 070) into each jacking hole and jack the cover off the gear box (Ref. 001). Set the cover aside.

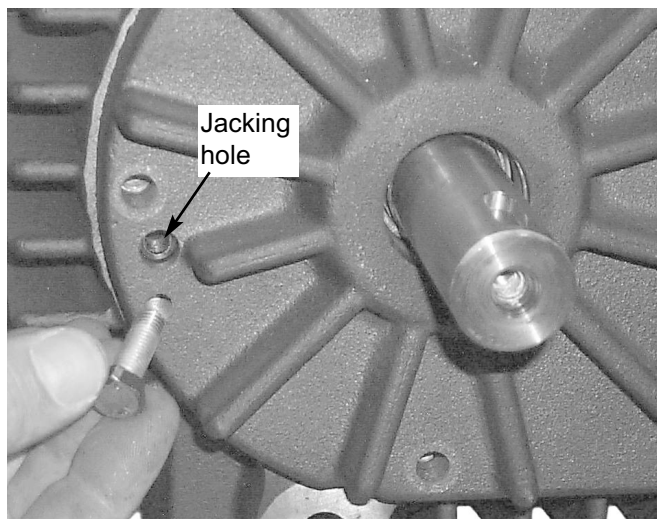


Fig. 17 - Removing the Bearing Cover Plate

In the bearing cover plate you will find two roller bearings (Ref. 040) and a shaft seal (Ref. 064). Remove the two hex head screws and lockwashers (Ref. 027/028) from each bearing retaining plate (Ref. 23/25) (see Fig. 18).

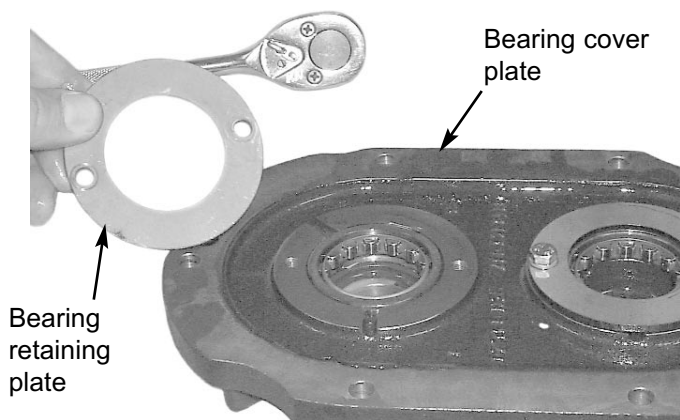


Fig. 18 - Removing Bearing Retaining Plates

One of the bearings can be pressed out from the outside by turning the cover over and tapping out the bearing from the backside (see Fig. 19). The other bearing can be

removed using a bearing puller. Remove the shaft seal (Ref. 064) in the same way.

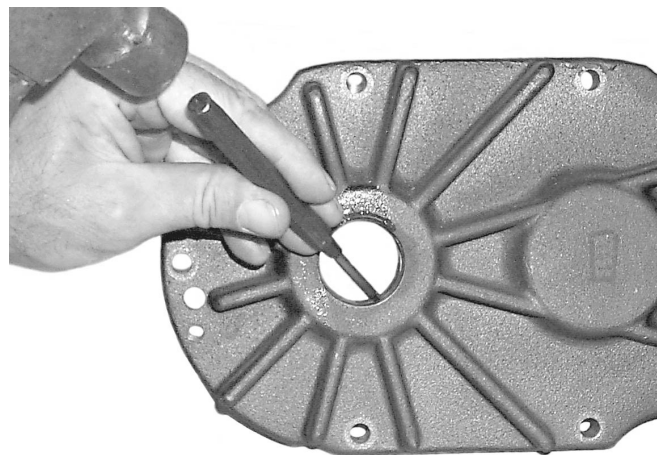


Fig. 19 - Driving Seal and Bearing from Cover

Proceed with disassembly of the gear box (Ref. 001) by removing the hex head cap screw (Ref. 052) and lockwasher (Ref. 051) from the retaining disk (Ref. 050) on the driven gear (Ref. 032).

Using a gear puller, pull both spacers and bearing sleeves (Ref. 039) off of each shaft by hooking the jaws of the puller on the shoulder of each spacer and pulling the spacers and sleeves off the shafts (Ref. 008/012) (see Fig. 20).

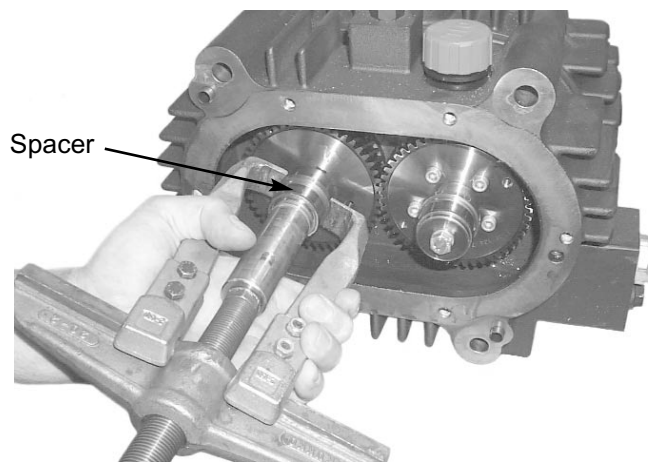


Fig. 20 - Pull Bearing and Spacer Sleeve form Shaft

Remove the O-ring (Ref. 042) located on the drive shaft (Ref. 008) just in front of the bearing sleeve (Ref. 039) (see Fig. 21).

Using a scribe or punch, match mark the gears so that the teeth can be realigned in the exact position upon reassembly.

Slide the drive gear (Ref. 033) off the drive shaft. The gear is keyed to the shaft and should be able to be pulled off the shaft by hand. If the gear is stuck, insert screws into the threaded holes on the face of the gear and use a puller to remove it. **Note:** Because the gear teeth are helical,

pulling the drive gear off will cause the driven gear and shaft to turn. If for any reason the shafts will not turn it will be necessary to loosen the driven gear mecha lock so that the gear will turn freely as the drive gear is pulled off.

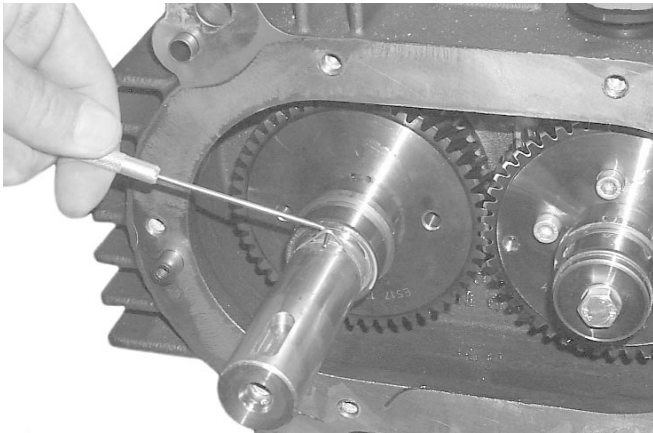


Fig. 21 - Remove the O-ring

Move to the driven gear and begin loosening the five hex head socket screws (Ref. 035) from the mecha lock (Ref. 034) (see Fig. 22). Gentle tapping of the screws might be needed to free the mecha lock from the shaft. Remove the gear and separate the mecha lock from the gear. Inspect the gears and mecha lock for signs of damage or wear (see Fig. 23). If the screws of the mecha lock have been torqued repeatedly, they should be replaced.

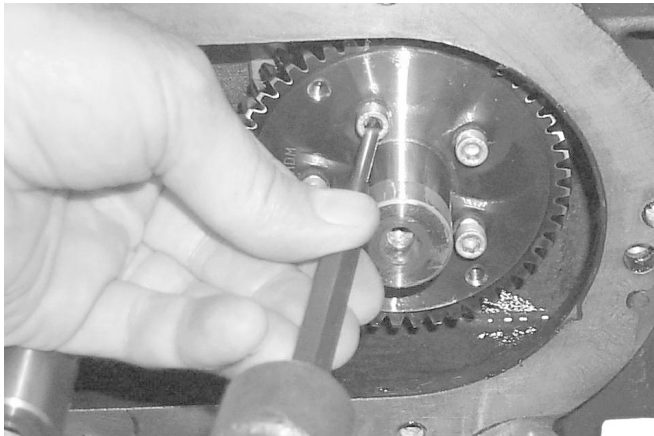


Fig. 22 - Removing the Mecha Lock

3.11 Removing the Bearings, Shafts and Seals

Remove the two hex head cap screws (Ref. 028) and lock-washers (Ref. 027) from each bearing retaining plate (Ref. 23/25). Notice the oil splash plate on the driven retainer plate (Ref. 023). Once the retainer plates have been removed, you should easily be able to slide the shafts (Ref. 008/012) and bearings (Ref. 020) from each bore (see Fig. 24).

Slide both shafts and bearings from each bore. Pull both labyrinth/shaft seal sleeves (Ref. 106) off each shaft (see Fig. 25). An O-ring (Ref. 102), which is located under each sleeve, might make removal of the sleeves a little more dif-

ficult. With the O-ring not in place, the sleeve should slide freely on the shaft as it is not a press fit. Inspect the labyrinth rings and replace as needed.

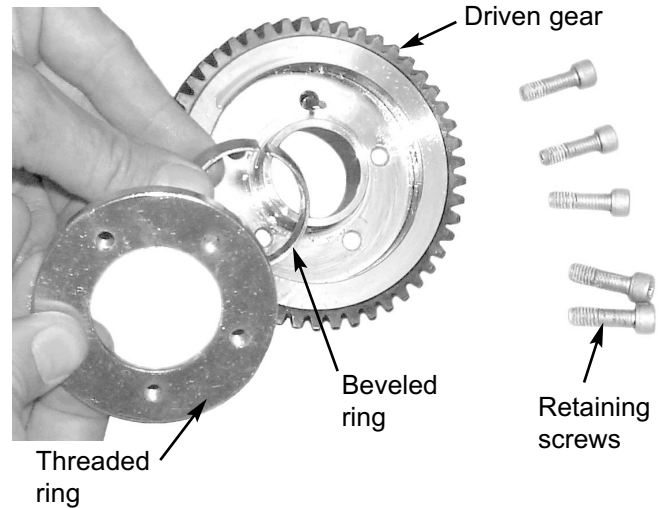


Fig. 23 - Mecha Lock

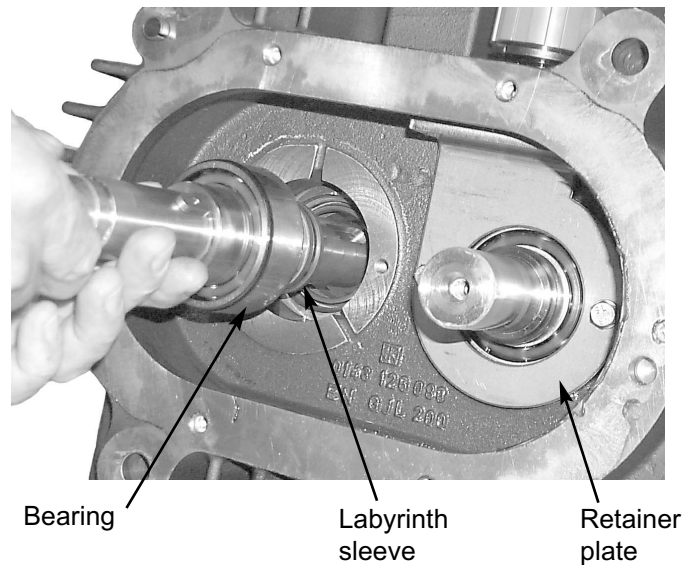


Fig 24 - Removing Bearings, Shafts and Seals

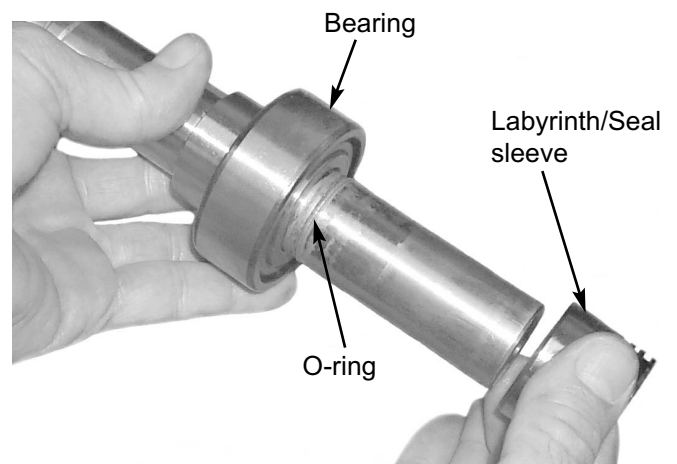


Fig. 25 - Remove Labyrinth/Seal Sleeve from Shaft

Slide an appropriate tool over the shaft and down to where it will butt up against the inner race of the bearing and drive the bearing off the shaft.

Move to the cylinder end of the gear box housing (Ref. 001), and tap the shaft seals (Ref. 004) out of their bores.

This completes the disassembly of the pump. Examine all the parts for damage and wear. Clean all coating off the cylinder, claws and endplates using solvent and a Scotchbrite™ pad.

Inspect both shafts for straightness. Runout should not exceed .025 mm (.001 inch). File and/or hone any nicks or dings on all claw and endplate surfaces.

Clean all parts thoroughly and prepare for assembly.

4.0 ASSEMBLY

For the purpose of this manual, it is assumed that the pump has been completely disassembled. After it has been determined what repair is required, and the necessary parts are on hand, the reassembly process can begin. Make sure all parts and mating surfaces are free of dirt, deposits, debris, nicks, burrs, etc.

4.1 Installing the Bearings, Shafts and Seals

Begin by installing a bearing onto each shaft using an appropriate tool that will slide down over the shaft and butt up against the inner race of the bearing. Drive the bearing down onto the shaft until it stops against the shoulder on the shaft.

Install an O-ring (Ref. 102) for each labyrinth/shaft seal sleeve.

Install a shaft seal into each gear box bore with the lip (spring side) of the seal facing towards the oil. Use a little Loctite™ on the outer diameter of the seal. Using a seal installation tool, drive the seals into position.

Slide both bearing/shaft assemblies into each bearing bore being careful not to tear either shaft seal. It is good practice to lightly oil the bearings prior to reassembly. Looking from the motor side of the gear box, the long drive shaft goes in the left bore and the short driven shaft goes in the right bore. It should be a slip fit in both instances.

With the shafts now in place, begin installing the bearing retaining plates. The retainer with the oil splash plate goes on the driven, right hand side. Secure each retaining plate with the four hex head cap screws and lockwashers (Ref. 027/028).

Position the gear box/endplate assembly on two wooden blocks with the endplate surface and two short shafts pointing upward.

4.2 Installing the Labyrinth/Shaft Seal Sleeves

Slide a labyrinth sleeve over each shaft. Make sure the gaps of the labyrinth rings are staggered 180° apart. Tap each labyrinth/shaft seal sleeve firmly into place (see Fig. 26).



Fig. 26 - Installing the Labyrinth/Seal Sleeve

4.3 Setting the Fixed Axial Clearance

Measure the thickness of each axial clearance shim for reference and reinstall the shims into their original positions.

Measure the claw and cylinder length and record these dimensions. The difference between the two dimensions will be the total axial clearance. Write down all of your measurements for future reference.

Slide one of the claws onto its respective shaft and secure it using a retaining disk and screw. **Note:** The shaft key should not have been installed on the shaft at this time.

With the claw secured with the retaining disk, measure the clearance between the claw and the endplate using a feeler blade inserted underneath the bottom of the claw (see Fig. 27). **Note:** The claw and shaft will wobble from side to side because of the bearing play, so it is important to use the feeler blade on both sides of the claw at the same time to prevent wobble and to obtain an accurate reading.

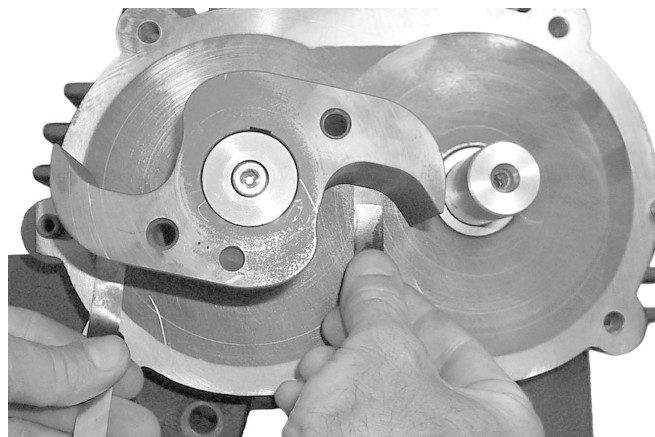


Fig. 27 - Measure Fixed Axial Clearance

Refer to the clearance chart for allowed clearances (see Fig. 34) and compare the measurements to those you just made. Repeat this procedure with the other claw.

As mentioned in the Disassembly instructions, all of the internal pump surfaces should be free of coating when establishing the clearances. **Note:** *The coating is to be applied after clearances have been set.*

By increasing or decreasing the shim thickness, you will either increase or decrease the gap (fixed axial clearance) between the claw and the endplate. Subtracting the fixed axial clearance from the previously measured total axial clearance will give you the remaining clearance between the claw and B-side endplate. Refer to the clearance chart (Fig. 34) for specific dimensions.

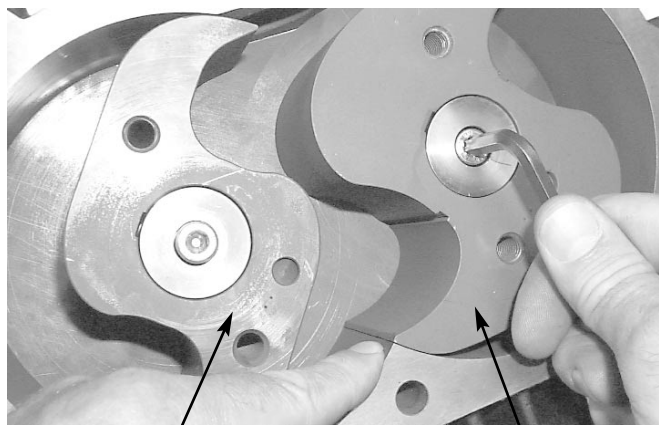
After the fixed axial clearance has been set, remove the claws and shims from the shafts. Remember to mark the shims for reassembly.

Install both shaft keys (Ref. 147) into their slots on both shafts. Make sure they go back in the positions from which they were removed. Slide both claws onto their shafts and loosely fit the retaining disks and screws.

Place the cylinder over both claws and tap it down securely onto the endplate using a soft hammer. The alignment pins allow the cylinder to fit one way only.

4.4 Setting the Claw Tooth Clearance

Rotate the drive claw (Ref. 150) until its tooth is flush with the circumference of the opposing bore (see Fig. 28). With the tooth perfectly flush, carefully tighten down the drive claw retaining disk (Ref. 184/185/186) while making sure not to move the claw.



Driven claw

Drive claw

Fig. 28 - Adjusting the Claws

Rotate the driven claw (Ref. 151) until the correct clearance is maintained at the tooth-to-tooth clearance and heel-to-heel clearance (see Figs. 29 and 34). Tighten the retaining disk (Ref. 184/185/186) without moving the claw. With both claws firmly tightened and clearances main-

tained, lay the pump over on its feet and prepare to install the gears.

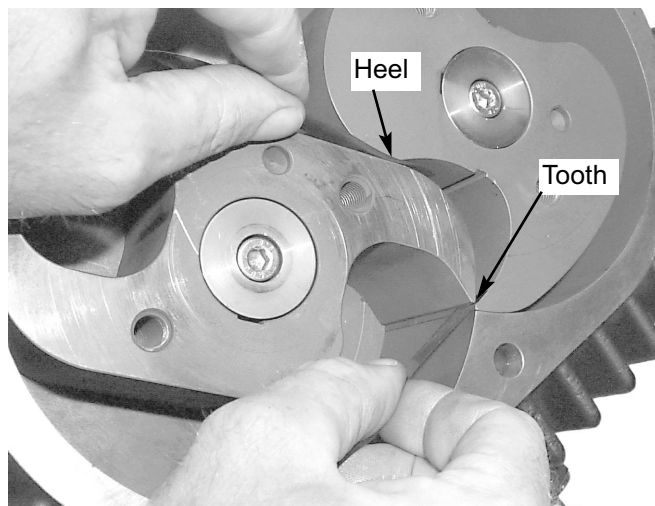


Fig. 29 - Setting the Tooth Clearance

4.5 Installing the Gears

Slide the drive gear (Ref. 033) onto its shaft until it stops. Align the teeth marks on the gears and slide the driven gear (Ref. 032) onto its shaft. Remember the mecha lock screws must be loose.

Temporarily install 2 spacers (Ref. 039) against the driven gear. The spacer(s) should be long enough to put pressure on the gear when the retaining disk is tightened. Tighten the disk firmly putting pressure against the gear prior to tightening the mecha lock screws.

With the driven gear in place, start tightening the mecha lock screws in a crisscross pattern. Tighten the screws to approximately 30 inch-pounds of torque (see Fig. 30).

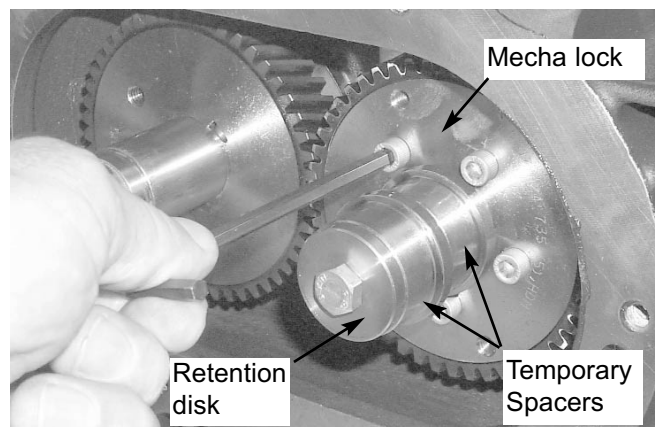


Fig. 30 - Mecha Lock and Spacers

Double check the tooth clearances to make sure that the claws have not moved during the tightening process.

Remove the temporary spacer(s), screw and retaining disk from the driven shaft, and proceed with tightening the mecha lock screws. Torque the screws to 78 inch-pounds.

Remove both of the retaining disks and claws from their shafts. Pry the cylinder from the endplate. Remove both shaft keys from the shafts. **Note:** As you remove them, remember to mark them and not to damage them.

Reinstall the axial clearance shims onto each shaft, and then reinstall both shaft keys in the same position from which they were removed.

Reinstall the cylinder making sure that it is properly fitted to the endplate and aligning pins.

4.6 Coating the Endplates and Rotor Claws

Slide a protective tube over each shaft to protect the shims and shafts from coating. Plug the bores in the claws to protect them as well.

Lightly apply two coats of Liquid Moly spray lubricant to both claws, inside surfaces of the cylinder and both endplates. Make sure that the overspray does not make contact with the shaft and bores.

After the coating has been applied, remove the protective tubes and reinstall both claws, securing them in place with the retaining disks and screws. **Note:** It is quite possible to have enough coating applied so that the clearances are affected to a point where drag may be felt when turning the shafts by hand. This is normal.

Reinstall the "B-side" endplate to the cylinder using the five long hex head cap screws (Ref. 182) and lockwashers (Ref. 181). **Note:** There is no gasket or sealant used between the endplate and the cylinder.

4.7 Installing the "A-side" Bearings and Cover

Install a bearing spacer (Ref. 039) on each shaft, and push it back fully against the gears. The shoulders of the spacers face outward.

Heat up both bearing races (Ref. 040) to approximately 250°F using a hot plate or appropriate device, and drive them firmly into position on the shafts up against the spacers using an appropriate sleeve tool. Install the retaining disk (Ref. 050) onto the driven shaft, and secure it with the hex head cap screw (Ref. 052) and lockwasher (Ref. 051).

Install a new shaft seal (Ref. 064) and bearing (Ref. 040) into the drive side bore of the bearing cover plate (Ref. 060). Install only a bearing into the driven side bore, as it has no shaft seal. Place a bearing retaining plate (Ref. 023) over each bearing, and secure each plate with two hex head cap screws (Ref. 028) and lockwashers (Ref. 027). The bearings, drive shaft and shaft seal should be oiled prior to installing the endplate to the gear box. Be sure to install an O-ring (Ref. 042) on the drive shaft.

Apply a thin coating of Hylomar sealer around the mating surfaces of the gear box and gear box cover. Let it set up

until the solvent has evaporated, usually two or three minutes (see Fig. 31).

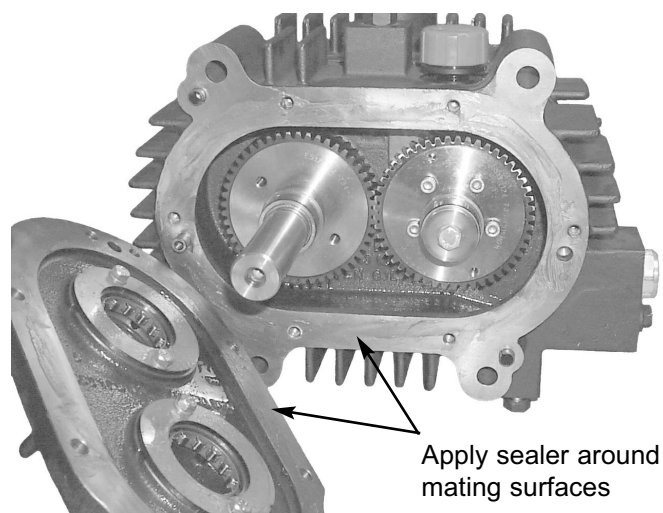


Fig. 31 - Apply Sealer to Gear box and Cover

After the sealer has set up, install the cover onto the gear box housing and tap it into position. Secure it with six hex head cap screws (Ref. 070) and lockwashers (Ref. 069).

With the gear box cover secured, lightly oil the outside diameter of the drive side shaft seal sleeve (Ref. 046) and gently tap it into position over the O-ring and shaft and into the bore of the gear box cover.

4.8 Installing the Motor Mounting Bracket

Tap the shaft key (Ref. 525) into position on the drive shaft keyway. Slide the pump side coupling half onto the shaft and over the key. You will likely have to tap the coupling half into position. Install the retaining disk (Ref. 050) onto the shaft, and fully secure the disk with the hex head cap screw (Ref. 052) and lockwasher (Ref. 051) (see Fig. 32).

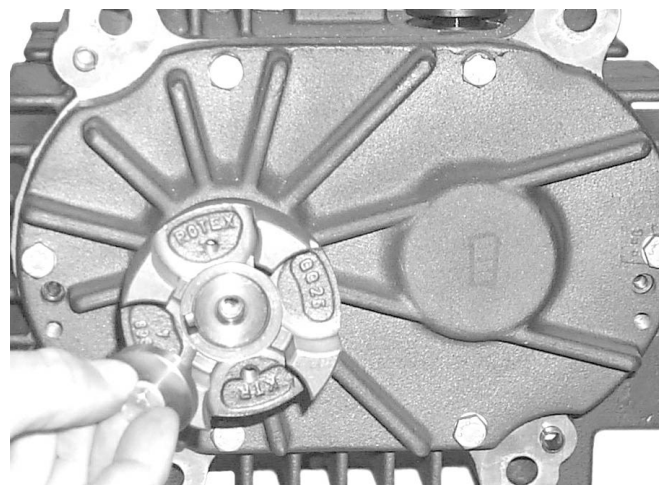


Fig. 32 - Attach the Coupling to the Shaft

Align the motor mounting bracket studs (Ref. 504) with the holes and alignment pins, and slide it into position. Secure it with four lockwashers (Ref. 505) and hex head nuts (Ref. 506).

4.9 Installing the Silencer Housing

Install the silencer gasket (Ref. 801) over the four studs (Ref. 806) protruding from the endplate (see Fig. 33). Position the silencer housing (Ref. 800) over the four studs, and secure it to the B-side endplate with four hex head nuts (Ref. 825) and lockwashers (Ref. 805).

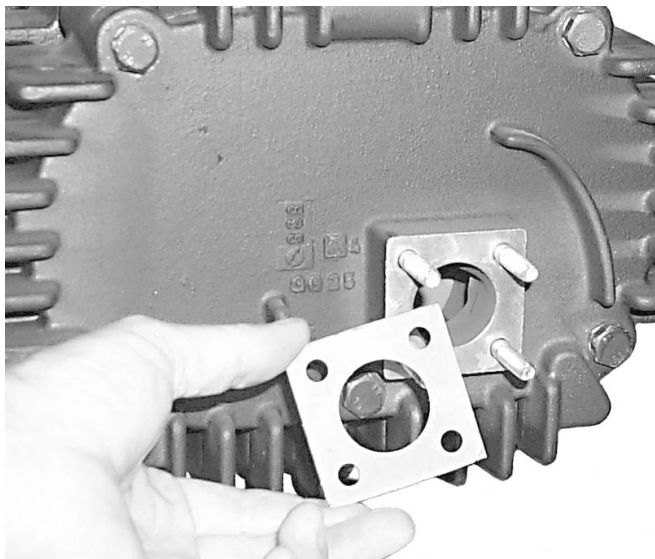


Fig. 33 - Installing the Silencer Gasket

Install the silencer coverplate (Ref. 850) and secure it to the exhaust chamber with eight socket head cap screws (Ref. 804) and flat washers (Ref. 803).

4.10 Installing the Pump Covers

Stand the pump up on the motor mounting bracket, and install the pump base (Ref. 620). Secure it with three hex head cap nuts (Ref. 613) and washers (Ref. 611).

Set the pump back down on its feet. Slide the top shroud cover over the pump. Secure it with pan head screws (Ref. 428) and flat washers (Ref. 425).

Install the anti-suck-back valve/inlet assembly (Ref. 713) into the pump inlet. Prior to installing it, inspect the inlet screen on the valve assembly for signs of wear or damage.

Place the oil fill access cover into position on top of the pump shroud, and secure it with four screws (Ref. 426) and flat washers (Ref. 425). Install the lifting eyebolt (Ref. 615).

4.11 Installing the Motor

Install the coupling insert into position on the pump coupling half. Make sure the motor coupling half is secured properly to the motor shaft. Make sure to check for proper coupling spacing.

Slide the motor into position, aligning the coupling halves, and secure the motor to the motor mounting bracket using four hex head screws (Ref. 551) and lockwashers (Ref. 552). Assembly is now complete.

5.0 LIMITED STANDARD WARRANTY

Busch, Inc. warrants that all products furnished by it are free from defects in material and workmanship at the time of shipment for a period of 18 months from the date of shipment, or 12 months from the date of installation, whichever occurs first. For Mink and Merlin pumps the warranties are extended to 42 and 36 months, whichever comes first. Claims must be made during that period and are limited to the replacement or repair of parts claimed to be defective.

In the case of components purchased by Busch, Inc., such as starters, controls, mechanical seals, motors, couplings, etc., the warranty of that manufacturer will be extended to the purchaser in lieu of any warranty by Busch, Inc. The replacement of wear items including, but not limited to, seals, bearings, couplings, exhaust cover gaskets, oil drain plugs, oil fill plugs etc., made in connection with normal service, are not covered by this Warranty.

The Limited Standard Warranty is valid only when the product has been properly installed, used in a normal manner, and serviced according to the operating manual. This warranty shall not extend to products that have been misused, neglected, altered, or repaired without factory authorization during the warranty period. We highly recommend the use of Busch oils and parts to achieve documented performance and efficient operation. The use of oils or parts other than Busch could limit the life expectancy of the equipment and could void any warranties if they are the cause of any damage. Operating conditions beyond our control such as improper voltage or water pressure, excessive ambient temperatures, or other conditions that would affect the performance or life of the product will also cause the warranty to become void.

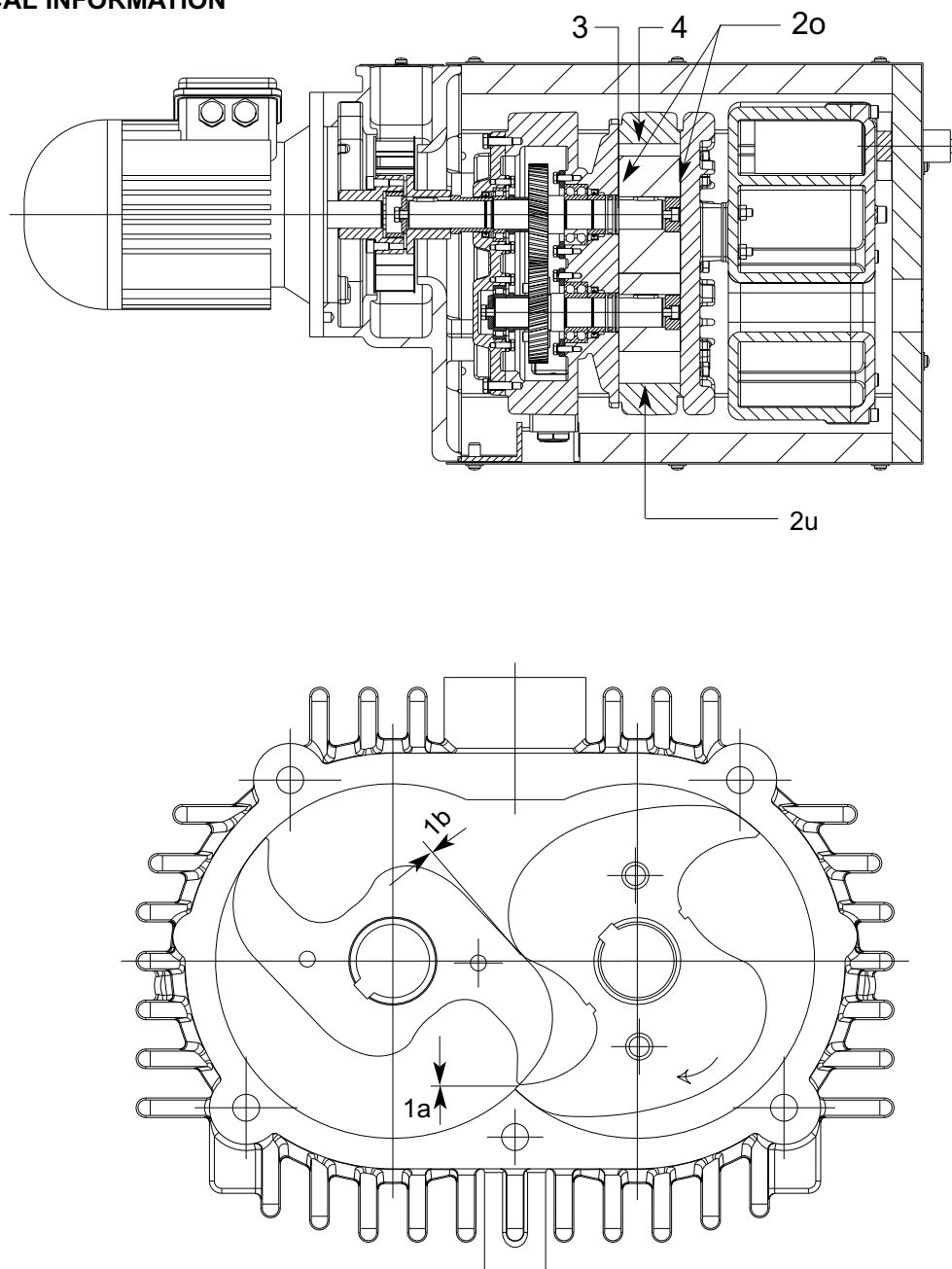
Permission to return parts for warranty repair must be obtained, and all returns must be prepaid to the factory. If, after examination, the product or part is found to be defective, it will be repaired or replaced on a no-charge basis and returned, FOB the factory. If it is determined that the Warranty has not been breached by Busch, Inc., then the usual charges for repair or replacement will be made, FOB the factory. Parts or products that are obsolete or those made to special order are not returnable.

This Limited Standard Warranty applies only to the above and is for the period set forth. Busch, Inc.'s maximum liability shall not, in any case, exceed the contract price for the product, part, or component claimed to be defective; and Busch, Inc. assumes no liability for any special, indirect, or consequential damages arising from defective equipment.

THERE ARE NO WARRANTIES IMPLIED OR EXPRESSED THAT EXTEND BEYOND THOSE CONTAINED IN THIS LIMITED STANDARD WARRANTY.

Note: For extended warranties on your new equipment, contact Busch Headquarters at 1-800-USA-PUMP.

6.0 TECHNICAL INFORMATION



Pos.	Clearance	MM1142AV	MM1144AV	MM1102AV	MM1104AV
1a	Tooth clear.	0.07-0.10	0.07-0.10	0.07-0.10	0.07-0.10
1b	Tooth clear.	0.07-0.10	0.07-0.10	0.07-0.10	0.07-0.10
2o	Total axial clear.	0.261-0.3	0.231-0.27	0.261-0.3	0.231-0.27
2u	Total axial clear.	0.261-0.3	0.231-0.27		0.231-0.27
3	Fixed axial clear.	0.04-0.06	0.04-0.06	0.04-0.06	0.04-0.06
4	Radial clear.	0.07-0.12	0.04-0.09	0.07-0.12	0.04-0.09

Note: Tolerances are in millimeters

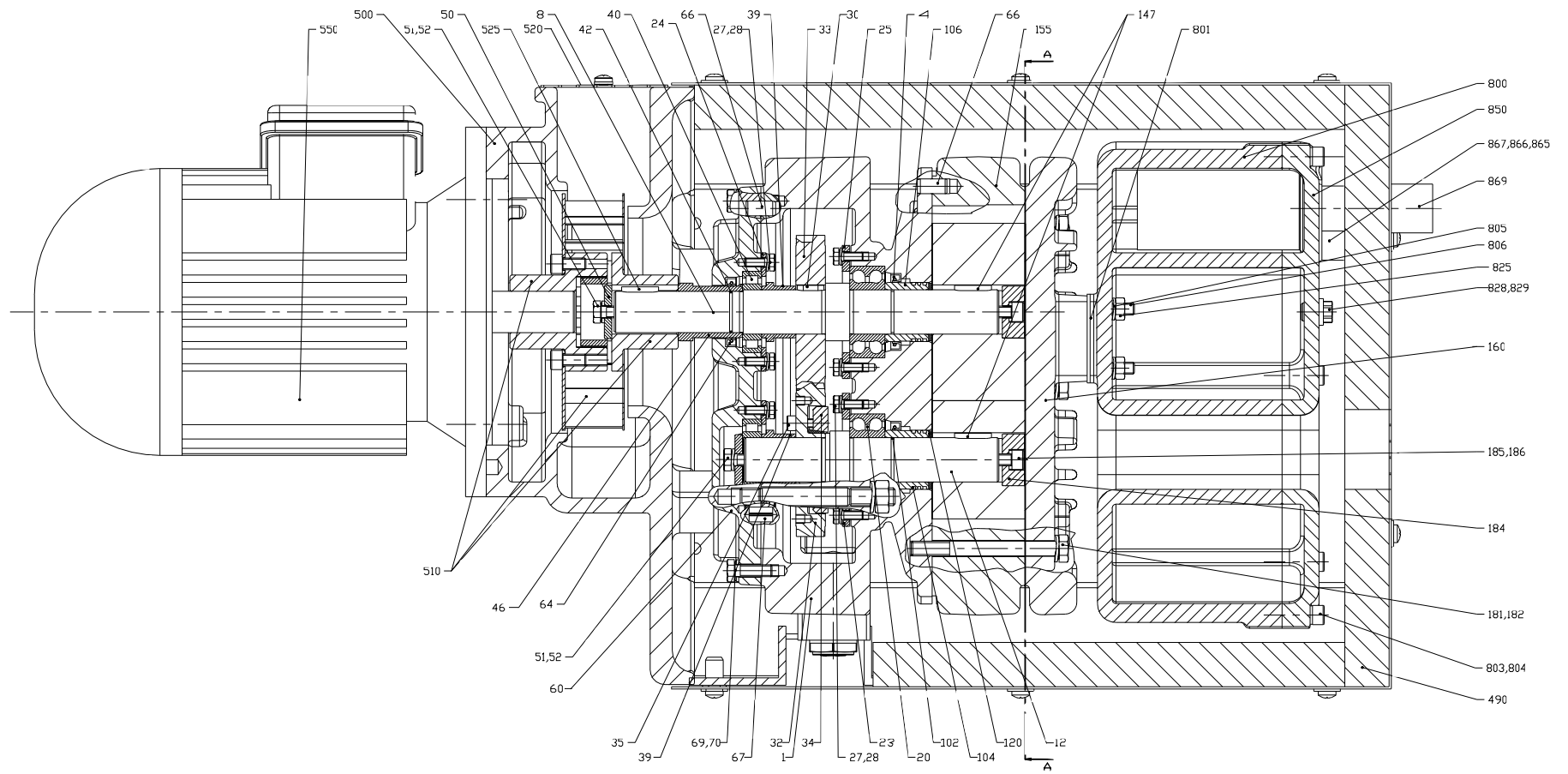
Fig. 34 - Clearances

Ref.	Description/Qty.	MM1104AV	MM1144AV	MM1102AV	MM1142AV
001	Gear/bearing housing, A-side	1	1	1	1
004	Shaft seal	2	2	2	2
008	Rotor shaft, drive side	1	1	1	1
012	Rotor shaft, driven side	1	1	1	1
020	Double ball bearing	2	2	2	2
023	Bearing retaining plate, driven side	1	1	1	1
024	Bearing retaining endplate plate	2	2	2	2
025	Bearing retaining plate, drive side	1	1	1	1
027	Lockwasher	8	8	8	8
028	Hex head cap screw	8	8	8	8
030	Shaft key	1	1	1	1
032	Gear, driven side	1	1	1	1
033	Gear, drive side	1	1	1	1
034	Mecha-lock	1	1	1	1
035	Socket head cap screw	5	5	5	5
039	Bearing sleeve	2	2	2	2
040	Roller bearing	2	2	2	2
042	O-ring, Viton	1	1	1	1
046	Shaft seal sleeve, motor side	1	1	1	1
050	Retaining disk	2	2	2	2
051	Lockwasher	2	2	2	2
052	Hex head cap screw	2	2	2	2
060	Bearing cover plate	1	1	1	1
064	Shaft seal, Viton	1	1	1	1
066	Alignment pin	4	4	4	4
067	Straight spring pin	2	2	2	2
069	Lockwasher	6	6	6	6
070	Hex head cap screw	6	6	6	6
072	Oil fill plug	1	1	1	1
076	Oil sight glass	1	1	1	1
077	Ring gasket	1	1	1	1
080	Plug	1	1	1	1
081	Copper ring gasket	1	1	1	1
102	O-ring, Viton	1	1	1	1
104	Labyrinth seal	4	4	4	4
106	Labyrinth sleeve	2	2	2	2
120	Shim	2	2	2	2
147	Shaft key	2	2	2	2
150	Drive claw rotor	1	1	1	1
151	Driven claw rotor	1	1	1	1
155	Cylinder	1	1	1	1
160	Endplate	1	1	1	1
181	Lockwasher	5	5	5	5
182	Hex head cap screw	5	5	5	5
184	Claw retaining disk	2	2	2	2
185	Lockwasher	2	2	2	2
186	Socket head cap screw	2	2	2	2
424	Pump cover	1	1	1	1
425	Flat washer	12	12	12	12
426	Slotted head screw	4	4	4	4
428	Pan head screw	8	8	8	8
490	Foam block	1	1	1	1
491	Foam block	1	1	1	1
492	Foam block	2	2	2	2
493	Foam block	1	1	1	1
494	Foam block	1	1	1	1
495	Foam block	1	1	1	1

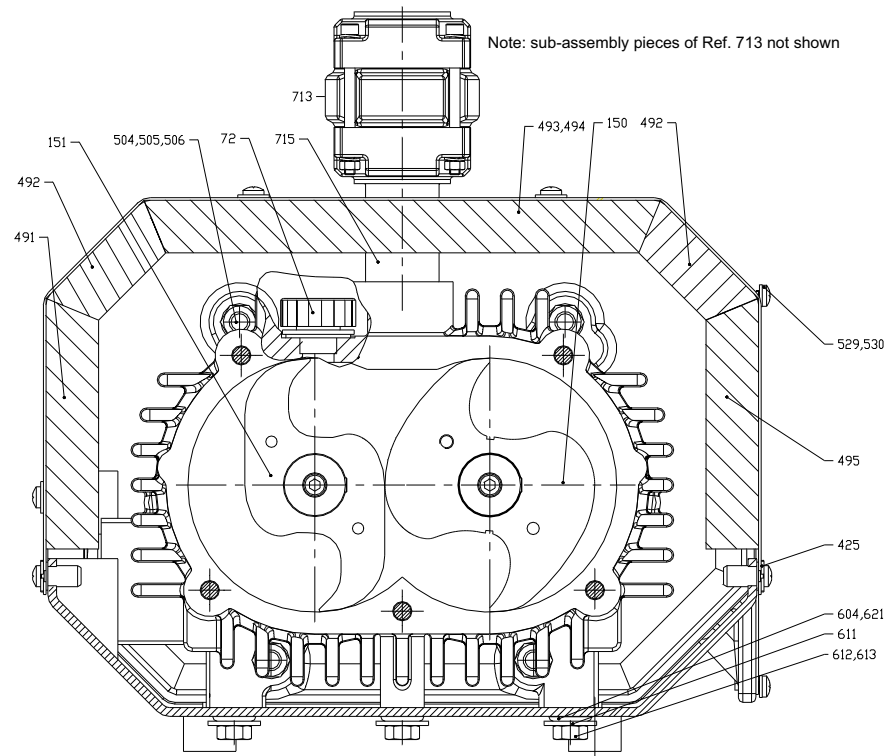
Ref.	Description/Qty.	MM1104AV	MM1144AV	MM1102AV	MM1142AV
500	Motor mounting bracket	1	1	1	1
504	Stud	4	4	4	4
505	Lockwasher	4	4	4	4
506	Hex head cap nut	4	4	4	4
510	Coupling complete with fan	1	1	1	1
517	Lockwasher	4	4	4	4
518	Hex head cap screw	4	4	4	4
520	Pump cover screen	1	1	1	1
525	Shaft key	1	1	1	1
529	Flat washer	2	2	2	2
530	Slotted head screw	2	2	2	2
550	Motor	1	1	1	1
551	Hex head screw	4	4	4	4
552	Lockwasher	4	4	4	4
600	Rubber foot	4	4	4	4
604	Cable bushing	3	3	3	3
611	Washer	3	3	3	3
612	Stud	3	3	3	3
613	Hex head cap nut	3	3	3	3
615	Eye bolt	1	1	1	1
620	Pump base	1	1	1	1
621	Pump mounting spacer	3	3	3	3
622	Hexagon bolt	1	1	1	1
713	Inlet flange assembly	1	1	1	1
715	Nipple	1	1	1	1
800	Silencer housing	1	1	1	1
801	Silencer gasket	1	1	1	1
803	Flat washer	8	8	8	8
804	Socket head cap screw	8	8	8	8
805	Lockwasher	4	4	4	4
806	Stud	4	4	4	4
822	Domed screen (part of Ref. 713)	1	1	1	1
825	Hex head nut	4	4	4	4
828	Hex head plug	1	1	1	1
829	Copper ring gasket	1	1	1	1
850	Silencer coverplate	1	1	1	1
865	Baffle strainer	1	1	1	1
866	Support for baffle frame	1	1	1	1
867	Exhaust pipe	1	1	1	1
869	Nipple	1	1	1	1
900	Nameplate	1	1	1	1

STANDARD SPECIFICATIONS FOR VACUUM MODELS

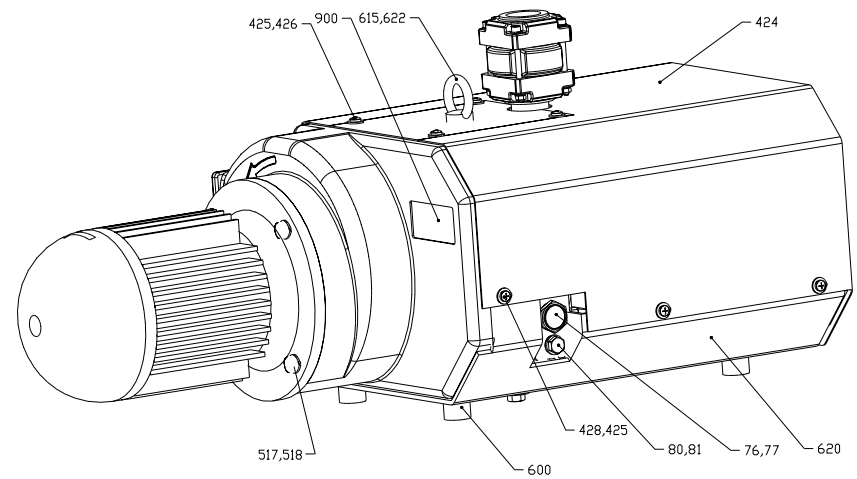
Model	MM1104AV	MM1144AV	MM1102AV	MM1142AV
Nom. pump. speed (ACFM)	40	53	74	97
Free air displacement (CFM)	43	58	86	116
SCFM@ 15" Hg	18	25.5	35.5	48
SCFM@19" Hg	13	18	25	34
SCFM@25" Hg	4.8	7.4	9.4	14
End vacuum ("Hg) (<torr>)	28.5 <37.5>	28.5 <37.5>	28.5 <37.5>	28.5 <37.5>
Motor rating (HP) (<kW>)	2 <1.5>	3 <2.2>	4 <3.0>	5 <4.0>
Motor speed (RPM @ 60Hz)	1800	1800	3600	3600
Approximate weight (lbs)	320	330	330	352
Inlet pipe connection (NPS)	1 1/4"	1 1/4"	1 1/4"	1 1/4"
Discharge pipe connection	1"	1"	1"	1"
Sound level dBA	78	79	84	85
Gear box oil capacity (approx. liters)	.45	.45	.45	.45



MINK MM1102 - 1144 AV
Cross Section



SECTION A-A



MINK MM1102 - 1144 AV
Section A-A



Busch Inc. Factory Service Centers

California

13826 Struikman Road
Cerritos, CA 90703
Phone (562) 926-8422
Fax (562) 926-7262
service.ca@buschinc.com

Illinois

430 Windy Point Drive
Glendale Heights, IL 60139
Phone (630) 545-1310
Fax (630) 545-1384
service.il@buschinc.com

New Jersey

39 Davis Street
South Plainfield, NJ 07080
Phone (908) 561-3233
Fax (908) 561-3909
service.nj@buschinc.com

Puerto Rico

420 E Street, Suite 4
Minillas Industrial Park
Bayamon, PR 00959-1901
Phone (787) 798-5045
Fax (787) 798-5033
service.pr@buschinc.com

Texas

15411 Vantage Pkwy W., Suite 216
Houston, TX 77032
Phone (281) 449-2381
Fax (281) 449-2383
service.tx@buschinc.com

Virginia

516 Viking Drive
Virginia Beach, VA 23452
Phone (757) 463-7800
Fax (757) 463-7407
service.va@buschinc.com

P/N 0872.911.505
Models MM1102-MM1144 AV
MM MINK OM-10/02-500



Busch, Inc.
516 Viking Drive
Virginia Beach, Virginia 23452
Phone: (757) 463-7800
FAX: (757) 463-7407