2.3.1 SMB-000 and 00

The two smaller sized Limitorque actuators, SMB-000 and SMB-00, are similar in design and operate essentially the same. The standard SMB-000 has a top-mounted handwheel directly connected to the drive sleeve with a 1:1 gear ratio.

The SMB-00 actuator includes an optional side-mounted handwheel with a 4:1 gear ratio. This arrangement is provided as standard equipment where torque requirements dictate. The Limitorque SMB-000 is the smallest version of the line, but its operation is closely matched by the SMB-00. Figure 2-10 is an exploded view of the SMB-000 actuator.

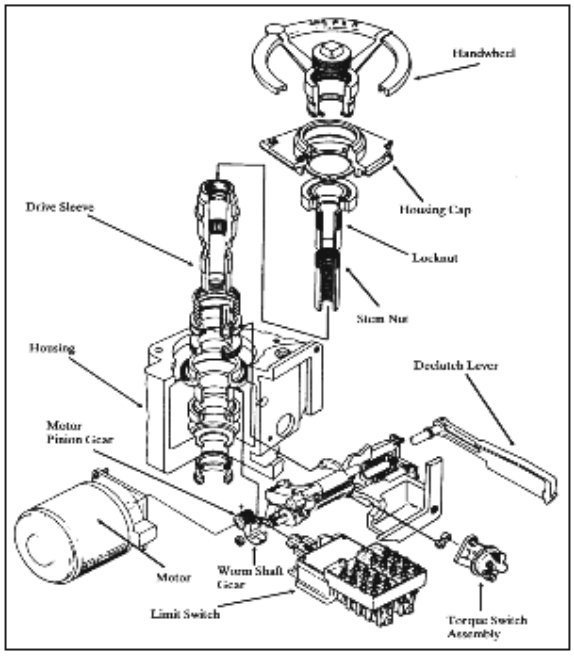

Figure 2-10 SMB-000 Actuator Exploded View

Electric Power Train

Refer to Figures 2-11 and 2-12. In the electric mode, operation begins with rotation of the motor. The motor shaft has a MOTOR PINION attached, which rotates a WORM SHAFT GEAR on the WORM SHAFT.

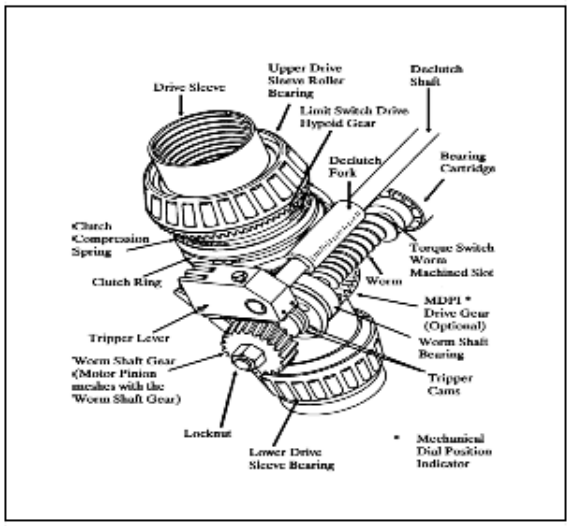

Figure 2-11 Electric Power Train

The worm shaft passes all the way through the actuator as a two piece shaft. Splines on the worm shaft rotate the WORM, which is half of a WORM/WORM GEAR set. The worm rotates the WORM GEAR, which is mounted around the drive sleeve. The worm gear has lugs on the upper side which engage the bottom of two CLUTCH KEYS. The clutch keys are operated by the CLUTCH RING which moves them to either the motor or manual position.

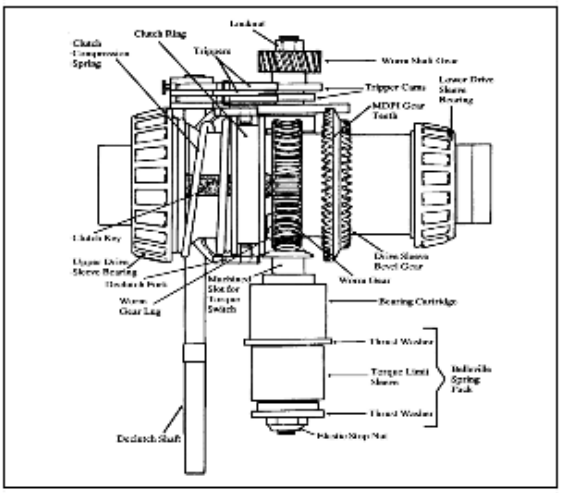

Figure 2-12 Electric Power Train Side View

Table 2-3 SMB-000 Electric Power Train

SMB-000 ELECTRIC POWER TRAIN

Motor
↓
Helical Gear Set
↓
Worm Shaft
↓
Worm
↓
Worm Gear
↓
Clutch Keys
↓
Drive Sleeve
↓
Stem Nut
↓
Valve Stem

As the clutch keys are driven, they drive the DRIVE SLEEVE which has internal splines. Those internal splines rotate the STEM NUT which can be threaded, splined, or keyed. The stem nut rotates around the valve stem or input shaft and the valve will be repositioned by the motion of the valve stem. In normal operation, this will continue until the limit switch engages and stops the motor.

In a failure mode this valve action will continue until the torque switch, manual stop, or motor overloads stop motor rotation, until the motor burns out, or the actuator or valve breaks. Table 2-3 outlines the SMB-000 Electric Mode Power Train.

Manual Power Train

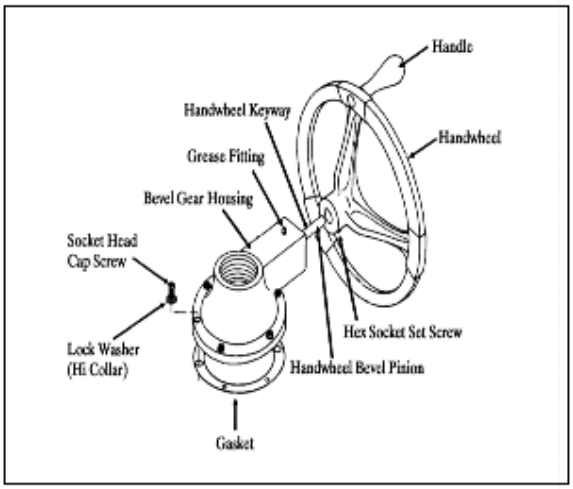

Figure 2-13 SMB-00 Side-Mounted Manual Power Train

The SMB-000 actuator is provided with only a top-mounted handwheel assembly. The SMB-00 is available in both a side-mounted (Figure 2-13) and top-mounted assembly (Figure 2-14). The SMB-00 actuator is provided with a side-mounted handwheel with a 4.38:1 ratio when the actuator torque rating is greater than 65 foot pounds.

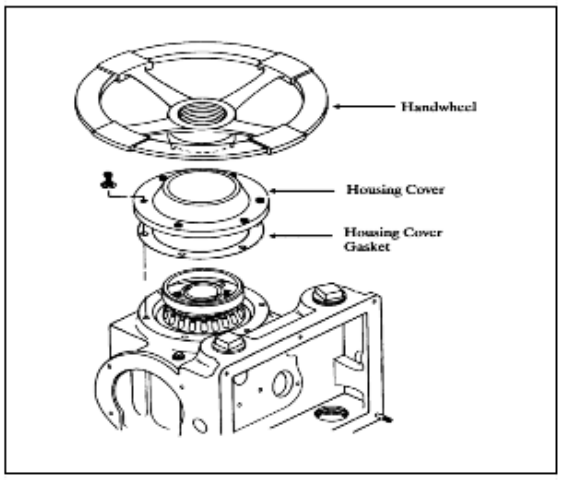

Figure 2-14 SMB-00 Top-Mounted Manual Power Train

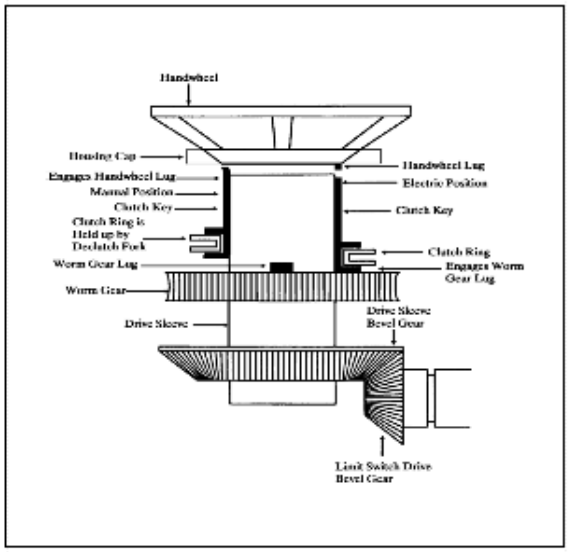

Figure 2-15 SMB-000/00 Handwheel Worm Gear Assembly

Refer to Figure 2-15 and Table 2-4. In manual operation, the HANDWHEEL rotates in the housing cap. The handwheel has lugs machined into the face which is located against the end of the drive sleeve. The lugs are positioned so that the CLUTCH KEYS, (on left side of Figure 2-15) which are lifted by the clutch ring, can be driven by the lugs on the handwheel.

Table 2-4 SMB-000 Manual Power Train

SMB-000/00 MANUAL POWER TRAIN
Handwheel
↓
Clutch Keys
↓
Drive Sleeve
↓
Stem Nut
↓
Valve Stem

From this point the power train in manual matches the power train in electric and the effect on the valve is the same. The only thing that protects the valve in this case, however, is a well-trained operator.

SMB-000/00 Declutch Mechanism

Refer to Figures 2-16 and 2-17. In order for the actuator to operate in manual, the DECLUTCH LEVER must be pressed. This rotates the DECLUTCH SHAFT, which rotates the DECLUTCH FORK. The declutch fork is engaged in the CLUTCH RING, which is lifted from its normal position next to the worm gear, to a higher position inside the actuator. This lifts the CLUTCH KEYS, which are mounted on the clutch ring, into engagement with the HANDWHEEL LUGS.

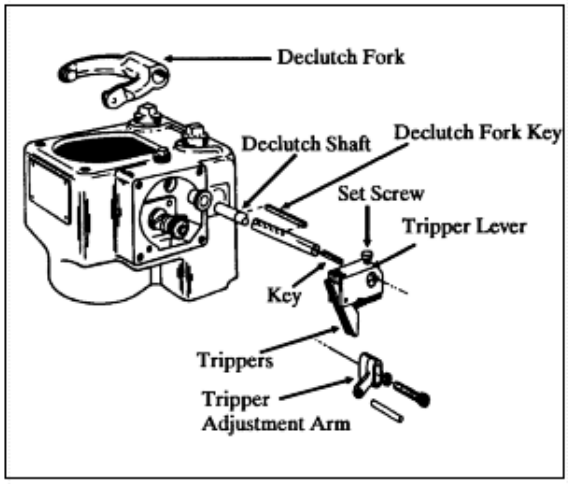

Figure 2-16 SMB-000/00 Declutch Mechanism

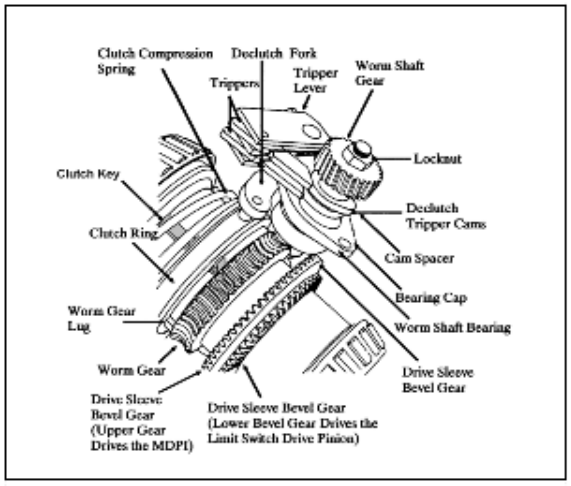

Figure 2-17 SMB-000 Actuator Drive Sleeve Assembly

This also separates the clutch keys from the worm gear lugs, which prevents the motor from operating the handwheel or drive sleeve, and protects the person operating the valve.

The declutch fork is held in the rotated position by the TRIPPERS which are spring loaded toward the worm shaft. The trippers will be pulled onto the TRIPPER ADJUSTMENT ARM. One of the two trippers will hold the actuator in manual until the trippers are pushed off the tripper adjustment arm when the motor starts. The rotation of the worm shaft that occurs when the motor rotates performs this function.

Two TRIPPER CAMS on the worm shaft push the trippers off the tripper adjustment arm, and the CLUTCH KEYS are pushed back into engagement with the worm gear lugs by the CLUTCH COMPRESSION SPRING.

Note that the only item keeping a rising stem from rising out of a pressurized system when the actuator is in manual is the stem nut/stem interface. This is true in both the SMB-000 and SMB-00 actuators.

SMB-000/00 Limit Switch

Refer to Figure 2-18. The electric controls (limit switch and torque switch) are both designed to stop the motor at the proper position. The LIMIT SWITCH also supplies valve position indication. The LIMIT SWITCH determines when the actuator has operated sufficiently to reposition the valve by counting turns of the drive sleeve assembly.

The drive sleeve has a DRIVE SLEEVE BEVEL GEAR keyed in place which rotates and operates the geared limit switch. When enough drive sleeve rotations occur, the limit switch operates and changes the indication, and may also stop the motor.

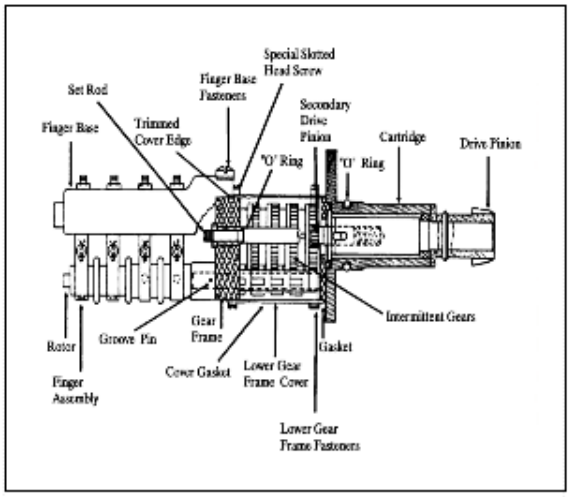

Figure 2-18 SMB-000/00 Limit Switch Assembly

The SMB-000 actuator's drive sleeve has a double-sided bevel gear (see Figure 2-17) which drives the limit switch and, if equipped, a mechanical drive position indicator (MDPI). If no MDPI is included, the bevel gear is one sided (teeth only for the limit switch).

Refer to Figure 2-19. The SMB-00 drive sleeve has separate single sided gears for the limit switch and MDPI. The drive for the limit switch is a hypoid arrangement (hypoid is a spiral bevel pinion placed offset of the centerline of its driven gear), with the single sided gear being located underneath the upper drive sleeve bearing. The drive for the MDPI is toward the bottom of the drive sleeve, in the same relative location as the SMB-000 drive. When no MDPI is used, a spacer is installed instead of the bevel gear.

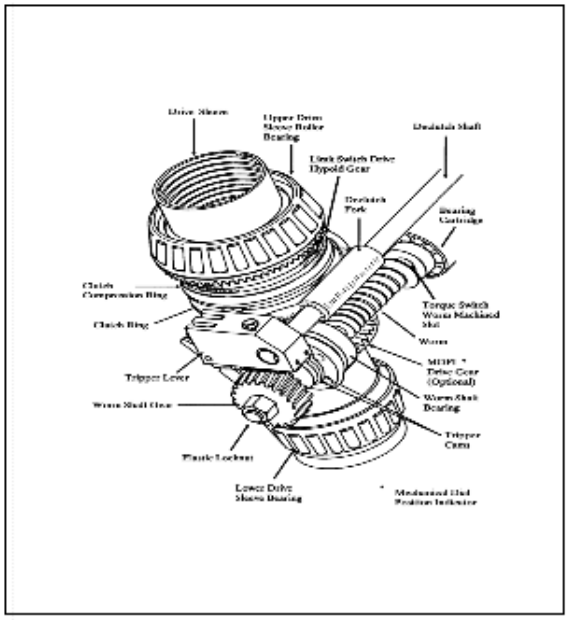

Figure 2-19 SMB-00 Actuator Drive Sleeve

The SMB-00 uses a hypoid gear and pinion to drive the limit switch due to the pinion being placed off center with respect to the gear. The SMB-000 uses a bevel gear and pinion. The limit switch gear frames are the same on both actuators.

SMB-000/00 Torque Switch

There are two types of torque switches which have been installed on SMB-000 actuators and three types of torque switches which have been installed on SMB-00 actuators. The oldest type (Figure 2-20) using a scissors action was installed on both SMB-000 and SMB-00 older models. Newer model SMB-00 and SMB-000 actuators had leaf type torque

switches (including all SMB-000 later models).

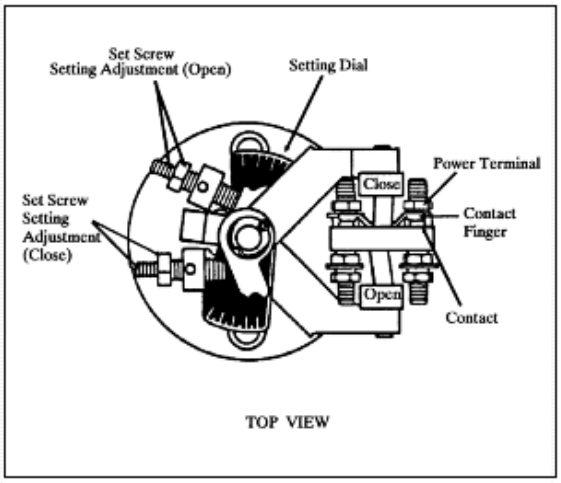

Figure 2-20 SMB-000/00 Scissor Action Torque Switch

The latest type used (and presently supplied replacement version) for SMB-00 actuators is a modified knee action torque switch (clam shell) type with a crank arm drive.

Figure 2-21 shows the leaf and knee type torque switches. The knee type is similar to the torque switches used in the SMB-0 through 5 actuators. This type is a direct replacement for the old leaf type torque switch, but requires an adapter plate available from Limitorque, when replacing the old scissors type.

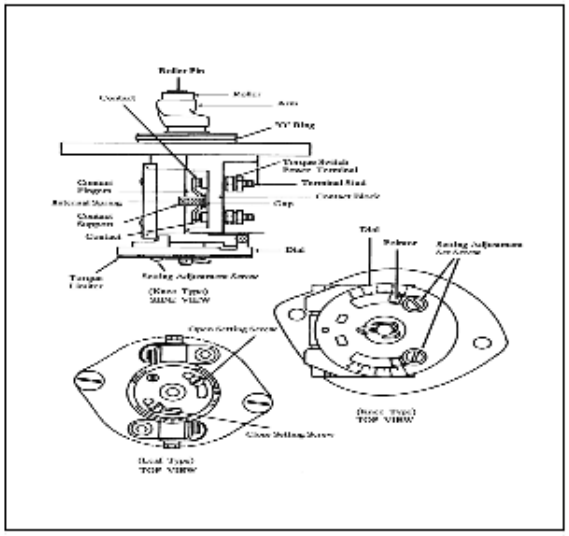

Figure 2-21 Modified Leaf and Knee Type Torque Switches

The TORQUE SWITCH, is also wired into the motor controls for closing and/or opening. All the torque switch sees is linear movement of the worm, caused by the actuator meeting resistance in its travel, and functions to stop the motor when the amount of allowable resistance is exceeded.

The resistance may be caused by the valve being on its main seat or backseat, or it may be due to some form of valve damage. In either case, the stem resistance is felt by the drive sleeve, which offers a higher resistance to turning. The worm gear feels the resistance and feeds it to the worm. The worm, although being rotated by the motor, is free to move in a linear direction on the splines located on the worm shaft. It is held in place by a form of spring (the SPRING PACK). The resistance of the worm gear to rotation allows the worm to overcome the spring resistance and move axially on the worm shaft (like a bolt

threading through a nut). When the worm moves axially, (called "walking") it moves a machined groove which has the torque switch arm riding in it.

The torque switch operates when a preset arm movement is exceeded and shuts off the motor. The torque switch does not really operate on torque, but on motion. It is important to understand this distinction when troubleshooting the actuator.

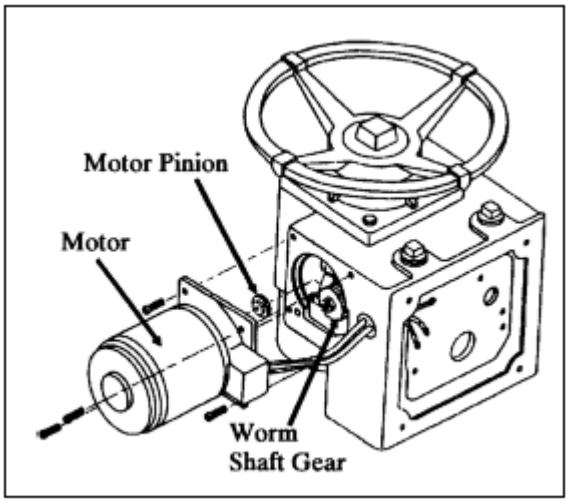

Figure 2-22 SMB-000 Motor

SMB-000/00 Motors

The function of the motor is to rotate the gear set which drives the entire power train. It mounts on a flange on the actuator housing, which is machined to position the motor in the proper location. There are several kinds of motors used by Limitorque. They include Squirrel Cage AC motors, both single and three phase, plus DC motors. The electric motors are available in several voltage levels and all are available to operate at various speeds to match the stroke and timing requirements of the system.

They are normally high torque motors with a 15 minute duty cycle. The electric motors have sealed bearings, which are lubricated for life. The motor output shaft has the driver gear (pinion) mounted to it with a key and set screw to lock it in place. Figure 2-22 shows a representation of an SMB-000 motor.

Motor sizes available on SMB-000 actuators are either 2 or 5 foot pounds. Sizes available on SMB-00 are 5, 7.5, 10, 15, and 25 foot pounds.

SMB-000/00 Helical Gear Set

The helical gear set is comprised of the motor pinion and the worm shaft gear (refer to Figure 2-22). The power train function of the helical gear set is to rotate the worm shaft. Motor rotation is transmitted through this gear set to the worm shaft, which causes it to rotate. They are a matched set, and are supplied as a pair by Limitorque. That's the way they should be replaced. For a given size actuator, the total number of teeth between the two gears is constant. Table 2-5 shows the number of teeth for a given size actuator. The distribution will vary depending on the gear ratio, but the total number will always be the same.

Table 2-5 SMB-000/00 Helical Gear Teeth Totals

SMB HELICAL GEAR TEETH TOTALS	
SMB-000	45
SMB-00	65
SMB-0	72
SMB-1	72
SMB-2	70
SMB-3	60
SMB-4	72

If the ratio is changed, it will have an effect on the speed and torque of the actuator. This should not be performed without an engineering review. The gear on the motor shaft is called the motor pinion, and the gear on the worm shaft is called the worm shaft gear or driven gear.

The pinion is keyed and set screwed to the motor shaft, and the setscrew is covered with a lockwire to prevent backing out. In addition, the end of the keyway should be staked to prevent the key from falling out of the actuator. The worm shaft gear is keyed to the worm shaft and is locked in place by an locknut. Refer to Figure 2-23.

SMB-000/00 Worm Shaft and Belleville Spring Pack Assembly

The function of the worm shaft assembly, Figure 2-23, and the worm/Belleville spring pack assembly, Figure 2-24, is to rotate the worm and allow operation of the torque switch. It is made up of two major pieces, supported by two bearings and are splined together to allow the worm to move axially. The motor end of the worm shaft assembly is normally called the worm shaft, and the worm end is called the worm/spring pack assembly. The worm shaft is positioned axially by a holder which presses on the outer race of the worm shaft bearing, called the worm shaft bearing cap.

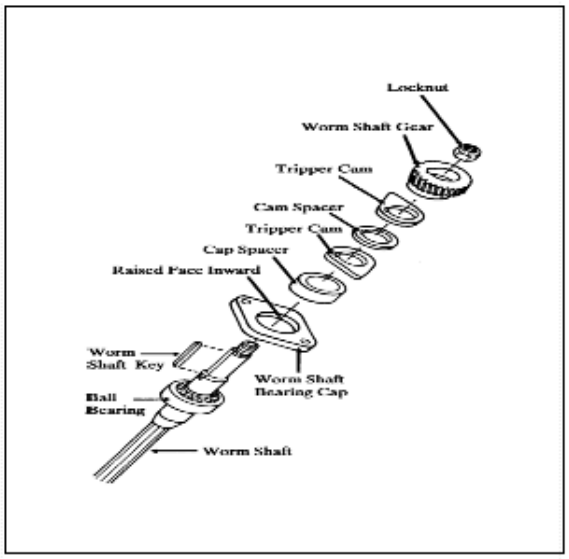

Figure 2-23 SMB-000/00 Worm Shaft Gear Assembly

The motor end bearing is locked on using the cams, spacers and motor driven gear and its locknut. This bearing is a press fit. In operation, the motor rotates the worm shaft, which will rotate the worm. The worm is held in a fixed location relative to the worm shaft by a spring pack, which controls the amount of force required to allow the worm to slide. The spring pack is made up of a series of BELLEVILLE SPRINGS, which are cone-shaped or dimpled washers that have good spring properties when stacked together.

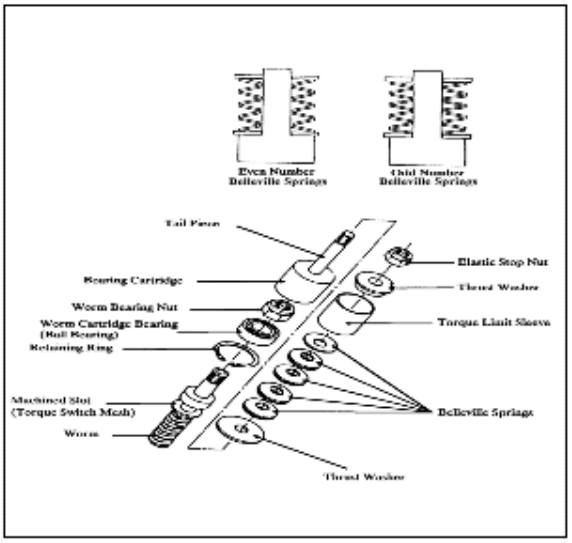

Figure 2-24 SMB-000/00 Worm/Belleville Spring Pack Assembly

The Belleville washer stack has THRUST WASHERS on either end. The spring pack is mounted on the BEARING CARTRIDGE and held together by either an ELASTIC STOP NUT (000) or by a nut with a set screw (00). The spring pack is held in place in the housing by a shoulder on the housing, and by a piece called the DECLUTCH SHAFT SPACER LOCKNUT (which is located in the spring cartridge cap). These two components press against the thrust washers located on either end of the stack of Belleville springs.

There is a TORQUE LIMIT SLEEVE around the Belleville springs which limits the travel of the WORM, plus places a compression limit on the Belleville springs. The worm is mounted into the BEARING in the bearing cartridge and is free to rotate. The worm is held inside the bearing by the WORM BEARING NUT.

The worm is capable of moving axially when the axial force on the worm overcomes the resistance, or preload, of the Belleville springs. This resistance can be changed by changing the compression of the spring pack with the elastic stop nut that holds the spring pack together or by compressing the spring pack with the declutch shaft spacer locknut.

If the spring pack is disassembled, it is imperative that the compression of the Belleville springs be reset correctly when it is reassembled. Failure to do so will result in improper preload which will cause a change in the torque supplied to the valve stem for a given setting of the torque switch.

There are two ways of determining the preload on the spring pack at the time of disassembly: by measuring the clearance between the torque limiting sleeve and a thrust washer, or by counting turns of the elastic stop nut when disassembling the spring pack. When reassembling the spring pack, the precompression should be returned to its recorded value.

If there is doubt about the original setting being correct, Limitorque should be called and given the required information to determine the correct setting. Limitorque will normally supply the information as turns of the nut past the point where the spring pack begins to load.

SMB-000/00 Worm and Worm Gear Set

The function of the worm and worm gear set is to change the direction of the rotational forces by 90 degrees. In addition, the worm is designed to thread itself out of the worm gear, like a bolt threads itself from a stationary nut, when the axial forces overcome the spring pack preload. There are several different worm/worm gear ratios available for each actuator.

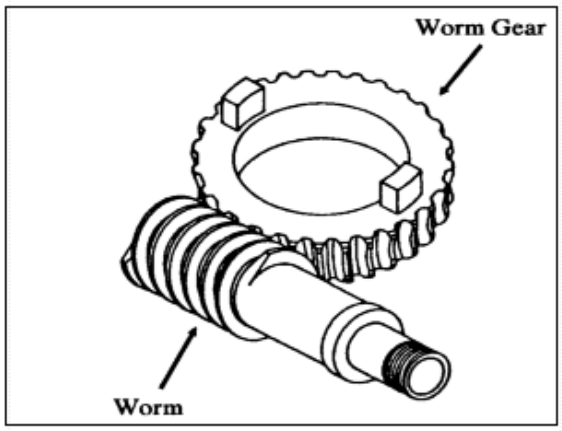

Figure 2-25 SMB-000/00 Worm and Worm Gear

It is worth noting that there is a major difference between low pitch and high pitch sets, which has to do with the ability of the worm gear to turn the worm. Low pitch, or NON-LOCKING sets, which require just a few turns of the worm to give one turn of the worm gear, can have the worm gear as the driver gear and the worm as the driven gear.

High pitch or LOCKING sets offer too much resistance for this to occur. Low pitch sets (requires a non-locking stem and stem nut combination) can have the valve disc "bounce" off the valve seat and leave the valve open due to recoil, or have the spring pack relax and the torque switch reclose after torquing out, with subsequent reclosing.

This is called HAMMERING. Low pitch worm and worm gear sets are usually used in high speed closing applications. The worm and worm gear set is critical to the speed and power of the actuator.

SMB-000/00 Worm

The power train function of the worm is to rotate the worm gear if there is no resistance to rotation, and to operate the torque switch if there is. This is one part of the worm/spring pack assembly, and is the driving gear of the worm/worm gear set.

The worm is cut from steel and has one or more external leads (threads) on the outside and splines on the inner bore. The internal splines slide over the worm shaft and transmit the rotation from the worm shaft to the worm. The worm is held in place axially by the spring pack assembly.

If the spring pack preload or washer combination is changed, the force required to move the worm axially along the worm shaft will change, and the torque supplied to the valve stem for a given setting of the torque switch will change.

SMB-000/00 Worm Gear

The worm gear functions to rotate the drive sleeve, with the rotational forces being transmitted through a set of "lugs" on the top of the worm gear to the clutch keys carried by the clutch ring. There are no splines or keys built into the drive sleeve for the worm gear to drive directly. If the clutch keys are pushed by the worm gear lugs, the drive sleeve will rotate.

The worm gear is driven by the worm, and is mounted around the drive sleeve. The worm gear is made out of brass, which is anti-galling and will usually fail before the worm. The worm gear teeth have a radius cut in the tops of the gear teeth which match the root diameter of the worm. This forces the worm to be removed first in the disassembly process, and to be installed after the drive sleeve assembly during reassembly.

The number of teeth on the worm gear and the leads and pitch of the worm determine the ratio of the gear set. As mentioned, the worm gear has lugs which engage the clutch keys carried by the clutch ring, but must rotate part way around the drive sleeve when the direction is reversed before reengaging the keys. This is called lost motion.

Lost motion in a machine is when there is motion of the prime mover (motor, hydraulic ram, etc.) but no motion of the load. When the worm gear lugs finally engage the clutch keys, they generate a "Hammer Blow" which may help in unseating certain valves. In addition, the lost motion allows the motor to reach operating speed before acquiring load.

The worm gear is free floating on the drive sleeve. The worm gear is held in place on the lower side of the drive sleeve by the bevel gear that drives the limit switch. On the upper side, the worm gear is held in place by a shoulder on the drive sleeve.

SMB-000/00 Drive Sleeve

Refer to Figure 2-26. The power train function of the drive sleeve is to transfer the power put into it by the worm gear or handwheel to the driven part of the valve causing the valve to operate. It is the primary moving part of an actuator. In SMB-000 actuators, it is usually constructed of steel. Occasionally it is a solid steel billet with a tailshaft.

There are keyways on the outside of the drive sleeve to mate with the clutch keys carried by the clutch ring. The keyways extend to the top of the actuator. When the actuator is engaged in manual, the clutch keys protrude out of the top of the drive sleeve to engage the handwheel lugs. The drive sleeve is normally splined internally as well as threaded. The splines drive the stem nut and the threads are for the locknut.

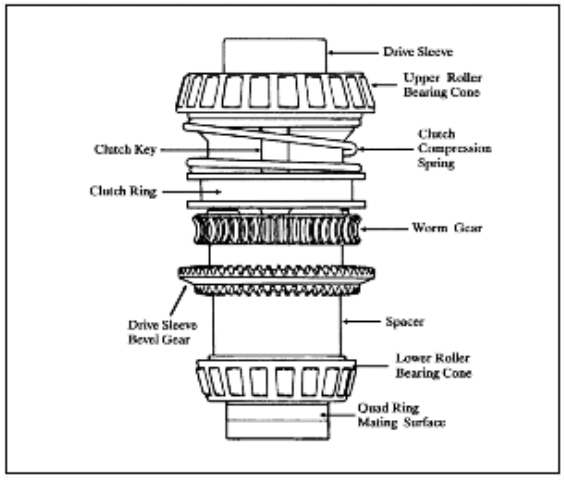

Figure 2-26 SMB-000/00 Drive Sleeve

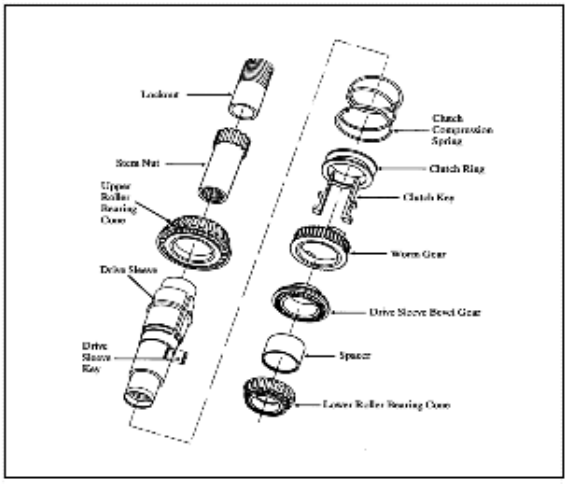

Figure 2-27 SMB-000/00 Drive Sleeve Exploded View

SMB-000/00 Drive Sleeve Assembly

Refer to Figure 2-27. The drive sleeve assembly is composed of several components. These are as follows: the drive sleeve itself, the worm gear and spacer, the drive sleeve bevel gear and the key that holds it in place, the clutch compression spring used to force the clutch ring toward the worm gear, the clutch ring and clutch keys, and the two roller bearing cones.

Inside the drive sleeve assembly are the stem nut and locknut. The drive sleeve has tapered roller bearings on both the upper and lower ends to absorb radial and axial thrust loads. If a rising stem valve is being opened, the drive sleeve pulls on the stem and loads the lower bearing. If the valve is being closed, the drive sleeve pushes the valve stem into the valve and loads the upper bearing.

SMB-000/00 Roller Bearing Cones

The roller bearing cones are tapered roller bearings (usually manufactured by TIMKEN) pressed onto the drive sleeve. They carry the thrust and radial loads on the drive sleeve and hold the drive sleeve in the proper position. In addition, the bearings hold the drive sleeve assembly together for installation. The outer races of the roller bearings are called the roller bearing cups. While not normally part of the assembly, they are important in that they locate the drive sleeve in the housing. The lower roller bearing cup is positioned by a set of shims under the race which properly positions the worm gear. The other roller bearing cup is carried in the housing cap.

SMB-000/00 Spacer

The drive sleeve has a spacer which is used to help hold the other drive sleeve

components in their proper relative positions.

SMB-000/00 Limit Switch Bevel Gear

The limit switch bevel gear, which is the lower gear of the drive sleeve bevel gear, is keyed to the drive sleeve, and drives the limit switch which senses the rotation of the drive sleeve. The drive sleeve bevel gear is a steel gear with gear teeth on both the upper and lower sides. The lower side gear teeth operate the limit switch, while the upper side gear teeth operate a local position indicator, if installed.

SMB-000/00 Clutch Keys

The drive sleeve is forced to rotate by a set of clutch keys which can slide up and down the drive sleeve in grooves. When the keys are in the lower position, they engage the lugs on the top of the worm gear and contribute to lost motion and hammer blow.

When the keys are in the upper end of their travel, they engage lugs on the bottom of the handwheel. The keys are made of steel and are captive behind the clutch ring. The hammer blow is also used by the handwheel when the actuator is in the manual mode of operation.

SMB-000/00 Clutch Ring

The function of the clutch ring is to shift the clutch keys between the electric and manual modes. The clutch ring is made of steel. The clutch ring, which is driven by the declutch fork rollers, moves the clutch keys which can slide in keyways cut into the drive sleeve. To prevent concurrent operation the dimensions of the clutch ring and clutch keys are set so that the clutch keys cannot engage both the worm gear lugs and the handwheel lugs at the same time.

SMB-000/00 Clutch Compression Spring

The clutch compression spring forces the clutch ring to bear against the worm gear lugs. The spring is a helical compression type, and is set against a shoulder of the drive sleeve. When the actuator is placed in manual, the clutch compression spring is compressed by the clutch ring. When the actuator goes from manual to motor mode, the clutch compression spring supplies the force that returns the components to the motor position.

SMB-000/00 Stem Nut

The function of the stem nut is to operate the valve stem, either by raising and lowering the stem in rising stem designs, or by turning the input shaft in quarter turn models. It is constructed of brass, which has self lubricating properties and can minimize galling.

(This is not meant to imply that it does not require lubrication.) The internal bore of the stem nut is either threaded, keyed, or splined, depending on how valve stem mating is accomplished.

For rising stem valves, the drive sleeve is threaded, usually with an ACME thread. The valve stem may have one, two, three, or four leads; this requires that the stem nut have matching leads. The number of leads of the stem or stem nut can be easily determined. This can be accomplished by placing a pencil or similar object at the start of the stem threads, then rotating the pencil along the threads for one revolution and count the number of exposed threads from the starting point to the finish point.

The number of threads exposed indicate the number of leads. A piece of string may also be used to wrap around a stem in a thread groove. For quarter turn valves and gearboxes, the internal bore is keyed. There are external splines for mating with the drive sleeve and the stem nut is held in the drive sleeve by the stem nut locknut.

The stem nut locknut threads into the drive sleeve and holds the stem nut solid against the stem thrust, and it may be staked in place. The stem nut locknut has slots to allow rotating the locknut with a special wrench. If the valve stem is being pushed into the valve, the stem nut tries to rise out of the drive sleeve. If the stem nut and stem nut locknut are not solid against each other, the stem nut will thread up or down on the valve stem depending on the travel direction and the limit switches will lose their relationship with the valve stem.

If the drive sleeve and stem nut splines come out of engagement, the limit switches and the valve stem will probably not move any further, but the motor may keep running and burn out after the motor duty cycle time has been exceeded.

The stem nut locknut is threaded into the drive sleeve using right handed threads, even though most stems themselves have left handed threads. The mating of the stem nut on the stem should be checked over the full threaded length of the stem before installing the stem nut in the actuator.

If the stem nut threads easily for some of the stem threads but then jams, either the stem threads or the stem nut threads are damaged. To determine which one, the stem should be turned over and tried again. Slight stretching of the stem or bending of the stem is all that is required for the stem nut to jam which could result in operation of the torque switch in mid-travel.

SMB-000/00 Handwheel and Housing Cap

The handwheel and housing cap, as seen in Figure 2-28 The worm is, are the main pieces for manual power input. The handwheel operates the drive sleeve through cast-in lugs which drive the clutch keys that protrude from the top of the drive sleeve. The handwheel is sized to supply the correct amount of force to the valve, and valve wrenches should not be required to properly seat the valve.

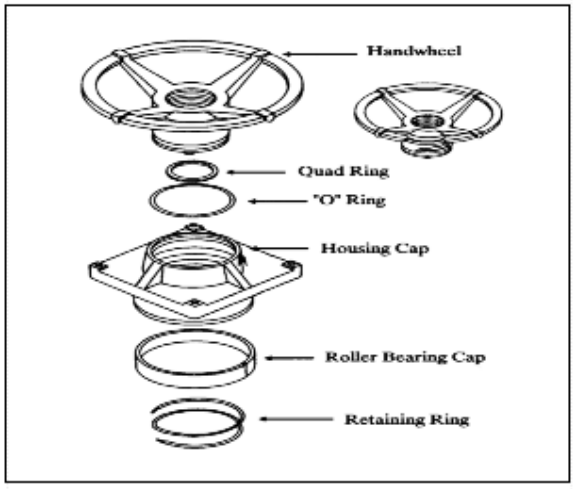

Figure 2-28 SMB-000/00 Handwheel and Housing Cap Assembly

Using valve wrenches can cause the lugs to damage the keys, or vice versa, resulting in the inability to operate in manual. Valve wrenches can also cause breakage in the area of the very narrow groove and retaining ring which are used to hold the handwheel in the housing cap.

Usually the handwheel has a cast-in arrow that indicates which way to turn the valve for opening or closing. The retaining ring and its groove are not capable of supporting the weight of the actuator. For this reason, the actuator should never be lifted by the handwheel.

There is a groove machined in the handwheel which seals the grease in the actuator through the use of an "O" ring, and a groove machined internally which holds a quad ring. These rings maintain the grease in the actuator in such a manner that the drive sleeve bore and the stem nut do not get lubricated with the rest of the actuator.

The valve stem should be lubricated with a recommended lubricant; the lubrication lessens the actuator output torque required for valve operation and lessens wear on the stem and stem nut.

When the handwheel is being inspected for wear, the most important inspections are the corners of the lugs, the groove and retaining ring area, and the "O" ring and quad ring. Worn lugs are caused by the use of excessive force in manual or improper tripper adjustment. The worn trippers will cause the actuator to slip when it is being operated in manual. "O"rings and quad rings should be replaced any time the actuator is overhauled.

The grease fitting on the housing cap directs grease to the quad ring groove for lubrication. Any grease that gets into the actuator housing has to be forced past the

retaining ring groove, which is extremely difficult.

SMB-000/00 Declutch Mechanism

Refer to Figure 2-29. The declutch mechanism is made of four separate pieces: the declutch lever (not shown), declutch shaft, declutch fork, and the fork key. The function of the mechanism is to lift the clutch keys from engagement with the worm gear to engagement with the handwheel, and to maintain the engagement until the motor starts.

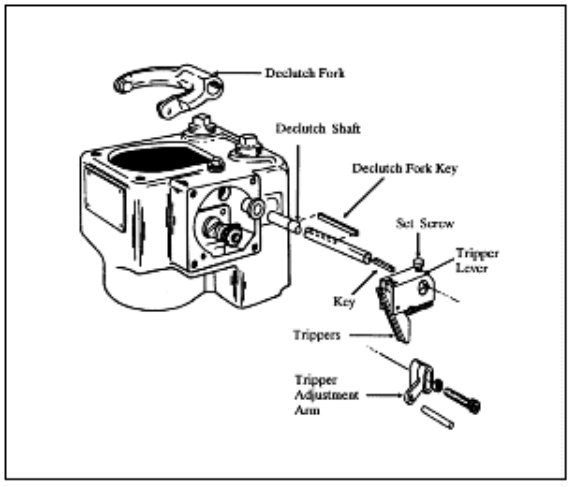

Figure 2-29 SMB-000/00 Declutch Mechanism

SMB-000/00 Declutch Lever

The declutch lever is keyed to the declutch shaft. The declutch shaft is keyed to the declutch fork. There is an arrow cast into the surface of the declutch lever which indicates proper direction of movement, and information on the declutch lever which states that the actuator cannot be forced into motor operation by use of the declutch lever.

SMB-000/00 Declutch Shaft

The declutch shaft is supported at the lever end by the spring cartridge cap with a bushing and at the motor end by a brass bushing. The motor end bushing allows room for the declutch fork key to pass out of the housing and permits the removal of the declutch shaft.

There are three keyways along the length of the declutch shaft: one for the declutch lever, one for the declutch fork, and one for the tripper assembly. The keyways are cut in a straight line. If the declutch shaft is twisted, the keys will not line up resulting in incorrect alignment of the declutch fork and tripper assembly. Excessive misalignment will create problems with placing and maintaining the operator in manual.

It is very easy for an operator to apply excessive force to the declutch lever and misalign the keyways causing engagement problems. Checking the keyway alignment can be accomplished by holding up the shaft and sighting down the keyways.

Any noticeable bends (not twists) seen on the handle end before disassembly will prevent removal of the shaft. The spring cartridge cap should be removed as far as possible and the shaft should be cut off behind the cap with a hacksaw. Before

trying to remove the shaft, the handle end should be deburred and smoothed.

SMB-000/00 Declutch Fork

The declutch fork is carried completely by the declutch shaft. It is not symmetrical, so it is possible to put the fork in the actuator upside down. The proper orientation of the declutch fork is to have the ends of the fork curving away from the handwheel end of the drive sleeve.

The declutch fork has two rollers pressed in the fork ends. These rollers carry the load of the clutch ring while it is rotating. The fork has a keyway which passes completely through the fork bore. When installed, the fork is prevented sideways movement by the rollers in the clutch ring.

In general, the only problem that develops with the declutch fork is that the rollers wear or pull out of the fork. The only solution is parts replacement. Be aware during disassembly, that if the declutch shaft sticks to the fork's interior and pulls the fork into the side of the housing, the fork can be bent.

SMB-000/00 Trippers

The trippers are the pieces that keep the actuator in manual. The trippers are made of steel, and are pinned into a steel block with a spring pin. There are two trippers, and there is supposed to be a slight difference in length between them.

The trippers are spring loaded toward the worm shaft by individual springs that are hooked on both ends. The trippers are pulled by the springs when the declutch lever is pressed, causing them to come to rest on the tripper adjustment arm and hold the actuator in manual.

When the motor starts to turn, the cams on the worm shaft push the trippers off the tripper adjustment arm and the clutch compression spring forces the actuator back into electrical operation mode.

The reason for two trippers is to ensure that the actuator can always be latched into manual, no matter what the worm shaft position is. If one tripper can't move onto the tripper adjustment arm because a cam blocks it, the other can because the cams on the worm shaft are mounted pointing 180 degrees apart.

The tripper lengths differ slightly to assure that whenever the longest tripper is pushed off the tripper adjustment arm it will drop slightly and cannot be pulled back on.

SMB-000/00 Tripper Adjustment Arm

The trippers are adjusted by positioning the tripper adjustment arm. The tripper adjustment arm is a boot-shaped piece that is positioned and clamped by a

long socket head capscrew holding the worm shaft bearing cap in place. It is adjusted after the actuator has been placed in manual as follows:

1. Place the actuator in manual.
2. Move the handwheel back and forth a few times to verify that the clutch keys are not butting against the handwheel lugs.
3. Line up the worm shaft so the cams are not pushing the trippers off the adjustment arm.
4. Hold the declutch handle depressed against the spring tension, then back off the end of the declutch handle approximately 1/8 inch to allow for some freedom in case the actuator is put in a hot environment or on a hot system.
5. Push the adjustment arm up against the end of the trippers. (gently, don't force)
6. Clamp in position using the socket head cap screw.
7. Release the declutch lever
8. Rotate the worm shaft gear to verify tripper release to motor mode.

During 1976, a modification to the housing underneath the tripper adjustment arm allowed a set screw to be used to hold the adjustment arm in position after adjustment. The set screw is held in place by a 1/8" pipe plug.

After adjustment, always grease the trippers and adjustment arm to assure the trippers will stay on the adjustment arm after setting. The trippers will wear their square ends off, thus having no flat to set on. If this occurs, file a small flat on the bottom of the trippers to provide a "footprint" to set on.

SMB-000/00 Housing

Refer to Figure 2-30. The housing holds all the operating pieces in their proper location and in alignment. It is made of five main pieces: the housing, housing cap (which holds the handwheel), limit switch compartment cover, spring cartridge cap, and cartridge cap cover. In addition, the motor and motor mounting flange serve to close off the housing in the area called the motor cavity.

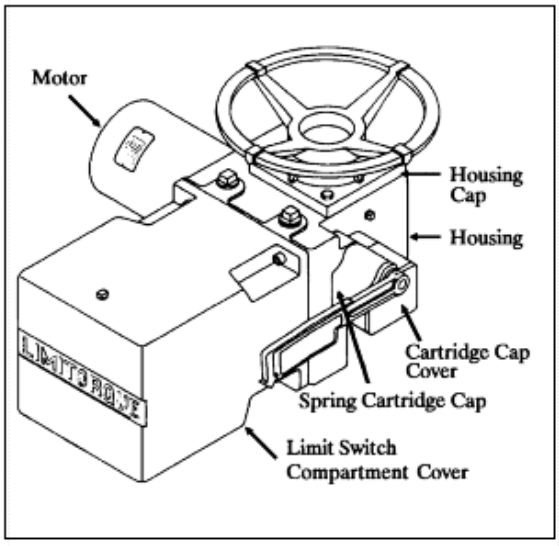

Figure 2-30 SMB-000 Housing

All of the components are made of cast steel. The baseplate of the housing is a

flange for mounting to the valve yoke. There are several ports for adding or checking lubricant. The housing cap, housing bottom, and shaft penetrations are sealed with either lip seals or quad rings. The housing cap is sealed with a gasket, and its thickness is critical to the operation of the actuator. The lower bearing race shims and the gasket for the housing cap set the operating position of the drive sleeve.

The housing should be inspected by looking for cracks which would indicate overloading and imminent failure. If overloading is suspected, the drive sleeve bearing cup bore should be inspected and its diameter measured and checked for roundness. The worm shaft bearing bore should also be measured and checked for roundness. All threaded holes should be checked to see if they are stripped.

The spring cartridge cap is threaded to accept the declutch shaft spacer locknut, which forms part of the chamber that holds the spring pack assembly. When assembling the actuator, it is necessary to loosen the declutch shaft spacer locknut, firmly mount the spring cartridge cap, and then run the declutch shaft spacer locknut into the spring cartridge cap until it just makes contact with the spring pack assembly thrust washer.

The declutch shaft spacer locknut is held in place by a lockscrew threaded in from the bottom of the spring cartridge cap. This lockscrew must be loosened before loosening the locknut, and tightened after the locknut is adjusted. The set screw is held in place by a 1/8" pipe plug.