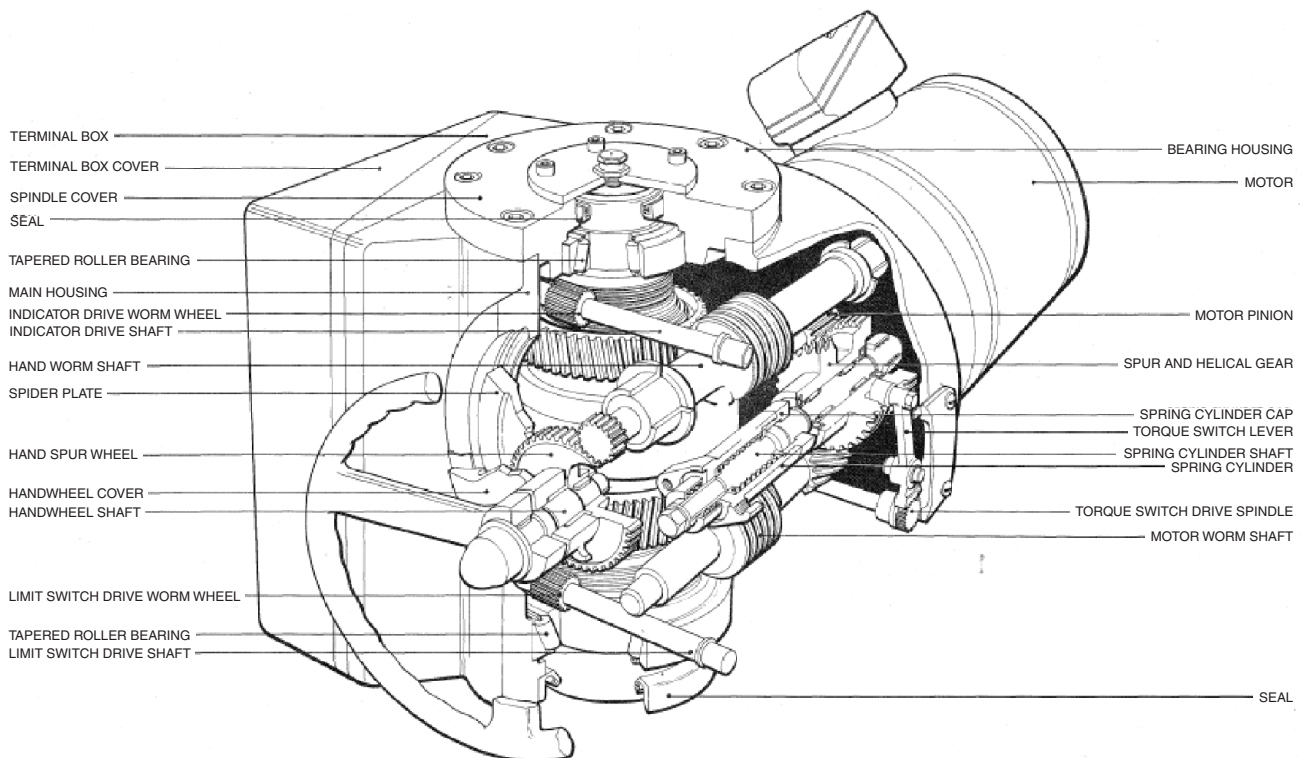


Standard Operating & Maintenance Instructions

Hopkinsons Fig 9051 VALVE ACTUATOR



CUT AWAY OF FIG. 9051 VALVE ACTUATOR

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Hopkinsons Fig 9051

VALVE ACTUATOR

Section 1

1.1 GENERAL

The actuator consists of a motor driving an output shaft through a spur and worm gear train, which incorporates a torque indicating mechanism and is so arranged that manual operation is always available in the event of power failure. The handwheel does not revolve when the valve is power operated. The actuator includes a valve travel limit switch unit and a torque switch unit with combined torque indicator and is of totally enclosed weatherproof construction, suitable for mounting at any angle or inverted.

1.2 MOTOR AND GEAR TRAIN

A.C. 3 phase motors are of squirrel cage design fitted with 'packed for life' grease lubricated ball bearings. Dimensions and performance are in accordance with BS170 and B. S. 2048. Class 'B' insulation is provided as standard and the machines are ½ hour rated. The windings are terminated on 2.B.A. stainless steel stud type terminals in an integral terminal box.

The motor is mounted on the main housing and the power gear train consists of a motor pinion in constant mesh with a combined spur and helical gear which is also in constant mesh with a helical pinion on a second stage worm reduction gear shaft. The worm wheel is axially located on the output shaft assembly and the drive to the final reduction gear in the form of an epicyclic unit is via a lost motion or hammer blow device which allows the motor to run up to speed before transmitting full torque to the valve. The manual gear train consists of a spur drive from the handwheel spindle to a worm reduction shaft and gear the latter being an integral part of the ring gear of the aforementioned epicyclic unit on the output shaft assembly.

1.3 TORQUE LIMITING DEVICE

The spur and helical gear of the actuator power drive is axially located on a shaft which is capable of axial movement against a spring. Upon a predetermined torque being exceeded the end thrust component of the single helical drive causes axial movement of the spring cylinder shaft. This movement is transmitted to the indicator and switches of the torque switch assembly by means of a roller, mounted on the torque switch lever and positioned between flanges of the spur and helical gear. The motor pinion and the helical pinion on the motor worm shaft are axially located, the face width in each case sufficient to allow axial movement of the spur and helical gear. The design of the spring cylinder assembly is such that a limited deflection of the compression spring is permitted allowing axial movement of the spur and helical gear in either direction corresponding to 50% to 110% output torque of the actuator in the opening or closing directions.

1.4 MANUAL OPERATION

A handwheel is provided to enable the valve to be operated in the event of a power failure. The handwheel is permanently coupled to the output shaft, but is so arranged that under power operation it will not revolve.

1.5 LIMIT SWITCH ASSEMBLY

The standard limit switch assembly comprises 4 'open' position and 4 'close' position micro switches, each bank of switches being simultaneously operated by a lever actuated by a cam on the pinion shaft of a hunting tooth gear train. An intermediate position bank is fitted when required providing 2 micro-switches operated simultaneously by a switch lever actuated by a cam on the pinion shaft of an additional hunting tooth train.

The hunting tooth gear trains are so arranged that each bank is independently adjustable to provide any limit switch setting from zero to 1000 actuator turns, i. e. valve fully closed to fully opened, with the 'intermediate' bank set at any position between the open and close limits, the accuracy of the settings being 0.1 actuator turns.

Each hunting tooth gear train consists of a pinion shaft with a cam pinned to the non-driving end, 4 pinions on the shaft within the housing and a drive pinion in mesh with the compound gear train coupled to the limit switch drive spindle. The pinions within the housing are in mesh with 4 spur wheels each of which embodies a ball drive to a hunting tooth gear mounted on the spur wheel boss. The bore of the gear is formed to permit the ball drive to be in any of 10 positions corresponding to the numerals on the gear flange, and the spur wheels are mounted on a hunting tooth spindle. The spindle is provided with a series of grooves, circlips to limit the engagement and withdrawal, and a knurled end to facilitate withdrawal. A spring loaded ball axially locates the spindle in the engaged or disengaged positions.

In the normal driving or set position the hunting tooth spindle is engaged and in this position the ball drive of the hunting tooth gear and spur wheel is locked in position by the spindle. Resetting of a switch bank is effected by pulling out the hunting tooth spindle to allow the spring loaded ball in the housing to register the disengaged position and also to bring the grooves in the spindle in line with the drive ball of each hunting tooth wheel. With the spindle in the disengaged position the hunting tooth wheels can be turned to any combination of digits on the flanges as each driving ball is allowed to move clear of the hunting tooth wheel bore profile into the spindle groove. Reading from left to right or non-driving end to driving end the flange numbers are in multiples of hundred, ten, unit and tenth turns respectively. It is important that the digits of the required combination are in a straight line and in line with the centres of the pinion shaft and hunting tooth spindle, before pressing home the hunting tooth spindle.

The engaged position of the spindle is attained without the use of excessive force. If the spindle does not readily snap home the four digits are not lined up correctly. It is possible to reset a bank with the tenth counter flange only in any radial position, but it is essential that when reset, the correct relationship of this hunting tooth wheel and spur wheel is maintained in respect of the ball drive. This means that the radial position of the tenth digits must be the same before and after setting irrespective of the actual numerals. As the numerals of each flange must be

adjacent to alternate tooth spaces of the spur wheels it is possible to inadvertently position a tenth digit opposite the incorrect tooth space which will prevent engagement of the hunting tooth spindle. If this occurs the tenth digit wheel should be rotated one tooth space thereby allowing engagement of the spindle.

1.6 TORQUE SWITCH ASSEMBLY

The actuator is fitted with a torque switch assembly which incorporates a torque indicator, (the scale of which is calibrated to indicate 50% to 110% output torque of the actuator) and 'open' and 'close' torque switches which are fitted with adjusting features easily set to limit the actuator torque in increments of 5% within the indicated range. The torque switch assembly is spigot mounted on the torque lever bearing and the main spindle is coupled to the torque lever spindle. Torque indication in terms of angular displacement of the torque lever spindle is transmitted via the main spindle to the indicator spindle and the 'open' and 'close' torque switch operating spindles. An adjusting screw permits the adjusting plate to be set in any of 12 positions from 0.5 to 1.1. (50% - 110%) output torque by simply releasing the adjusting screw sufficiently to allow the teeth of the adjusting plate to clear the teeth of the index plate, rotating the adjusting plate to the required figure and tightening the adjusting screw. The driving dog tooth of the adjusting plate is thereby positioned relative to the driven dog tooth of the switch lever to allow angular displacement of the operating spindle corresponding to the set torque figure. The switch is normally tripped with circuit closed and retained in this position by the switch lever and torsion spring. The switch is re-set and the circuit opened at the set torque figure by the aforementioned action of the adjusting plate dog tooth.

1.7 INDICATOR UNIT (WHEN FITTED)

The indicator unit consists of a housing, base, input and output spindles, change gears, range gears, index plate, pointer and pointer spindle. An indicator unit supplied with an actuator includes range and change gears of the correct ratio for the number of output turns of the actuator and no adjustment is required other than setting the pointer to correspond to the position of the valve.

Section 2

2.1 LIMIT SWITCH

The limit switch assembly of an actuator fitted direct on to a valve is set for the correct number of turns before despatch and should not be disturbed.

Pedestal type actuators and actuators for fitting direct on to valves at site are despatched with each switch bank set at 500.0 turns so that any mal-operation of the handwheel before the actuator is coupled or fitted to the valve should not disturb the correct relationship of cams to rollers. After coupling or fitting the actuator to the valve remove the limit switch cover and the limit switch housing cover. Hand operate the valve to the full shut position, and observe that the limit switch cams are in the correct re-set position, i.e. maximum cam throw 72° clockwise of roller assembly. If for any reason the cams in any other position, the correct position is easily attained by withdrawing the hunting tooth spindle and rotating only the hunting tooth wheel which registers multiples of 100 turns in a clockwise or anti-clockwise direction until the correct cam position is obtained and the spindle re-engaged. This should be carried out without disturbing the remaining digits. After noting the actual number of turns indicated on the 'close' bank hand operate the valve in the open direction 0.3 turns of the limit switch counter mechanism to the nearest 0.1 turn which will give a complete number in a straight line, in line with the pinion and hunting tooth spindles. Withdraw the hunting tooth spindle of the 'close' bank and re-set to 0000 turns (in line) and re-engage the spindle. Now set the 'intermediate' and 'open' banks to the correct number of actuator output shaft turns from zero at which these switches are required to trip. Check by hand operation the tripping positions of the switch banks.

2.2 COMMISSIONING PEDESTAL UNITS

First ascertain that the valve is in the full shut position i.e. the stop is resting on the lower shoulder of the valve pillars. Connect the valve and unit mechanically by the extension spindle supplied taking care not to move the valve from the full shut position and also ensure that the universal forks on the intermediate shaft are in line and not at 90° to each other.

2.3 COMMISSIONING DIRECT MOUNTED ACTUATORS

Valves which are to be fitted with direct mounted actuators at site are fitted with a circular adaptor plate secured to the valve by the pillar nuts. If a standard hand operated valve is to be motorised by means of a direct-mounted actuator, remove the existing handwheel gearing (when fitted) sleeve and bridge, leaving the valve pillars and spindle only for application of the actuator. Remove the circular adaptor plate from the base of the actuator and fit this item on the valve pillar ends and secure by means of the existing pillar nuts.

Sling the actuator by means of overhead tackle and carefully lining up the actuator with the valve spindle axially and radially, lower the actuator on to the valve until the output shaft begins to engage the valve spindle. Rotate the handwheel in the opening direction, and, at the same time, gradually lower the actuator until the base face within the spigot location is flush with the top face of the adaptor flange. Fit the nuts to the mounting studs and secure.

2.4 MECHANICAL VALVE POSITION INDICATOR (WHEN FITTED)

Set the pointer to the 'shut' index of the scale with the valve in the full shut position after setting the limit switch.

2.5 MOTOR

The adjustment for wear of brushes for D.C. motors is the only attention required.

2.6 ALTERNATING CURRENT

For A.C. 2 and 3 Phase.

It is very important to ascertain that the direction of travel of the valve corresponds to the 'open' and the 'shut' button of the controller.

Carefully check the direction of travel of the valve with the movement of the controller by having the valve in mid-position. Then press the 'open' or 'shut' operating button and immediately after that stop the actuator and ascertain whether the valve has moved to correspond to the button which was operated. If the valve has travelled in the opposite direction, reverse any two of the supply leads in the contactor.

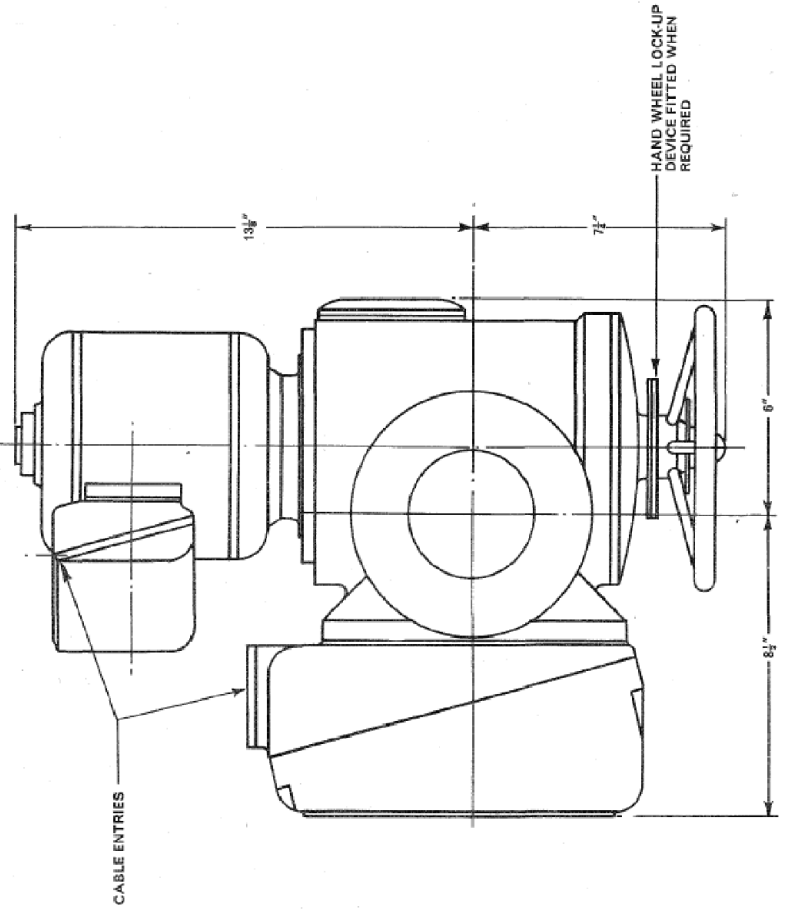
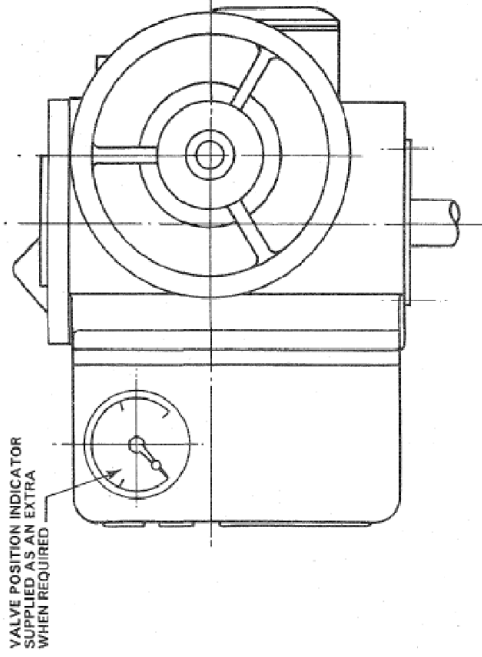
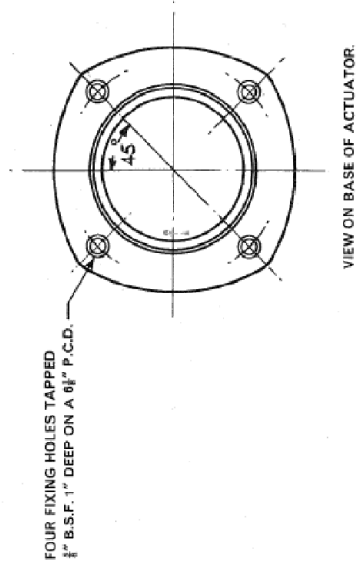
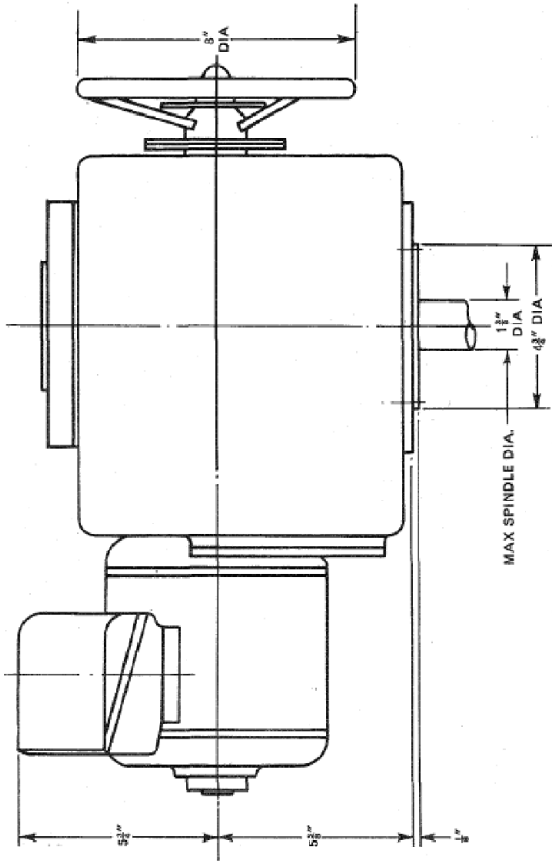
2.7 LUBRICATION

The actuator requires the minimum of lubrication and the motor bearings are packed for life. Grease gun nipples are provided for the output shaft thrust bearings, and actuators for mounting direct on to a valve are fitted with a grease gun nipple for valve stem lubrication. When an actuator is fitted to a valve at site the latter nipple should be fully charged when commissioning, with the valve in the full open position, and not excessively lubricated during service with the valve full shut. It is advisable to lubricate sparingly the limit switch and torque switch and torque switch unit gearing and moving parts.

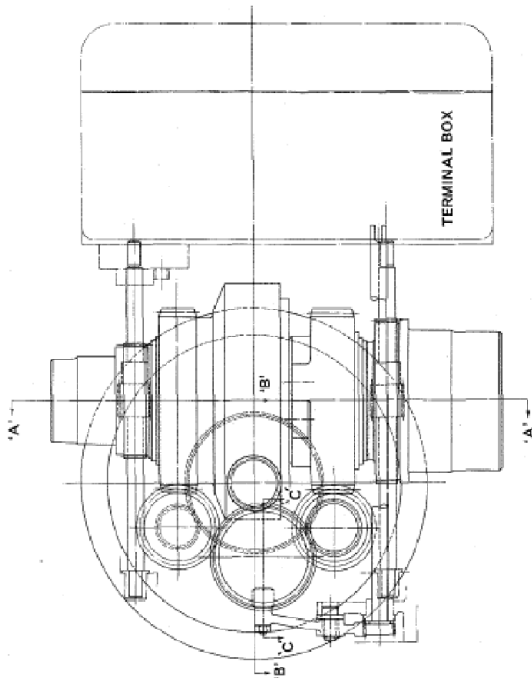
RECOMMENDED LUBRICANTS:

SHELL ALVANIA GREASE No.3 - Grease gun nipples, power and hand gears.

SHELL VITREA OIL No. 27 - Gears and moving parts of limit switch and torque switch assemblies.

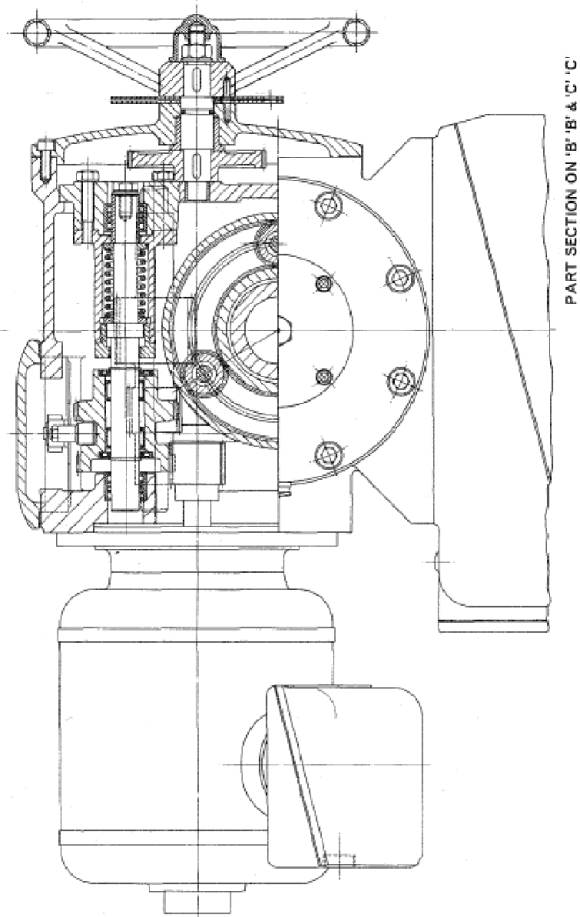
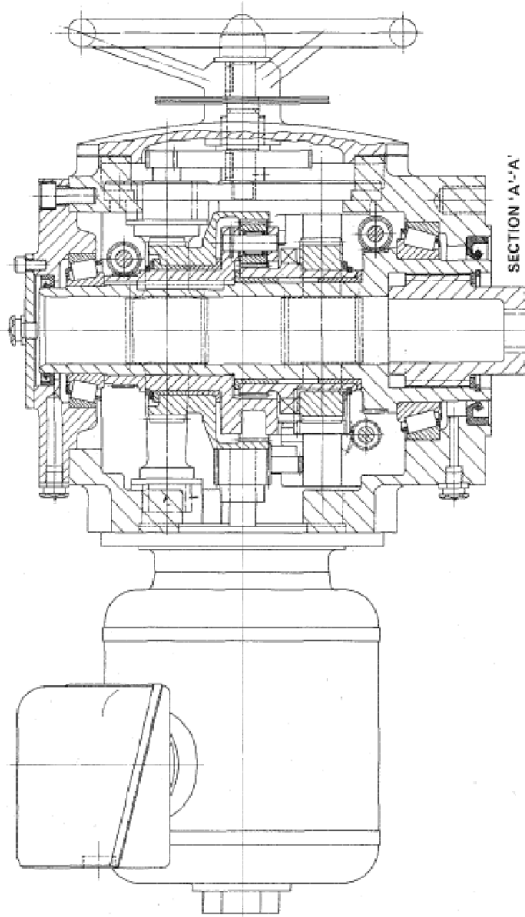


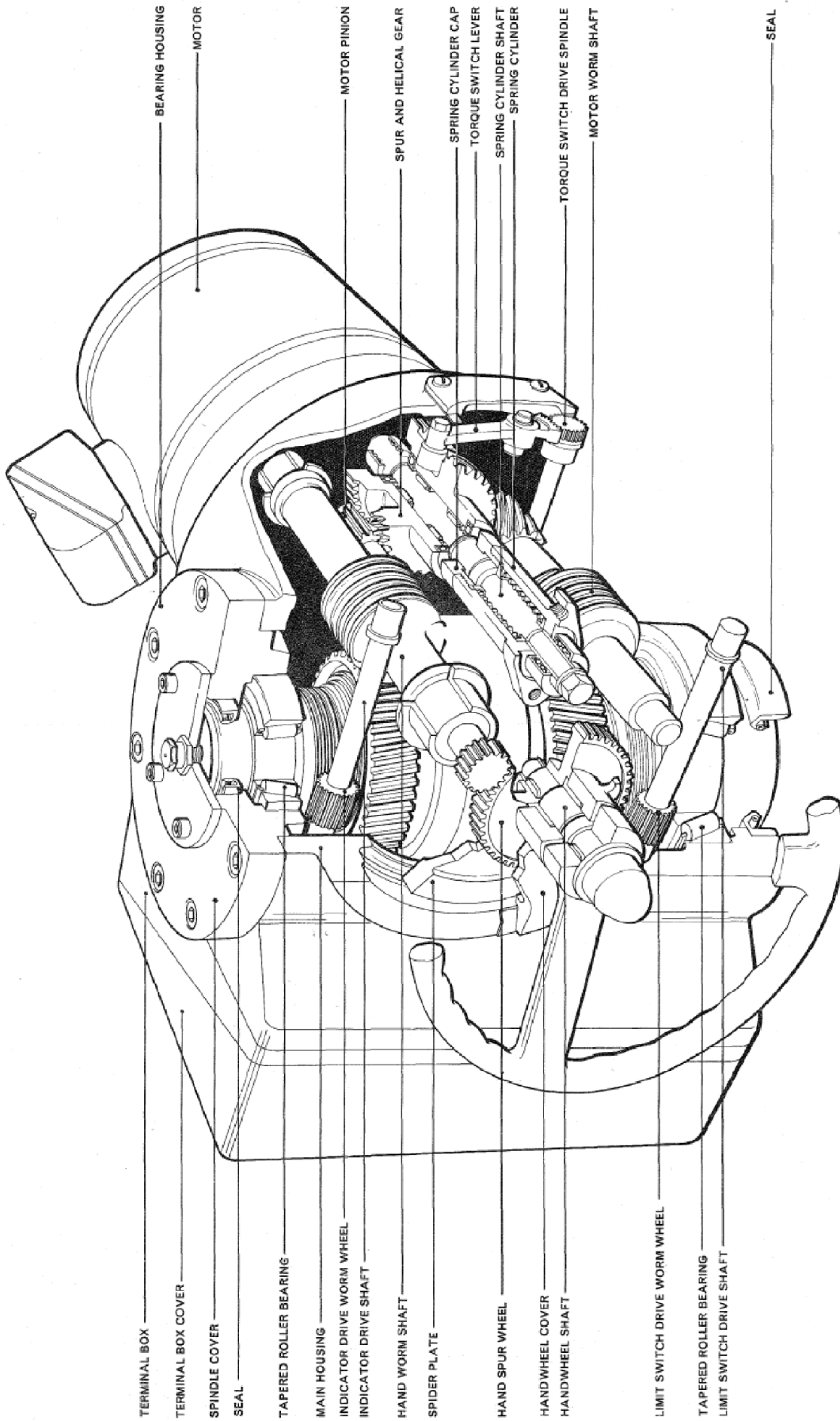
ARRANGEMENT OF FIG 9051 ACTUATOR



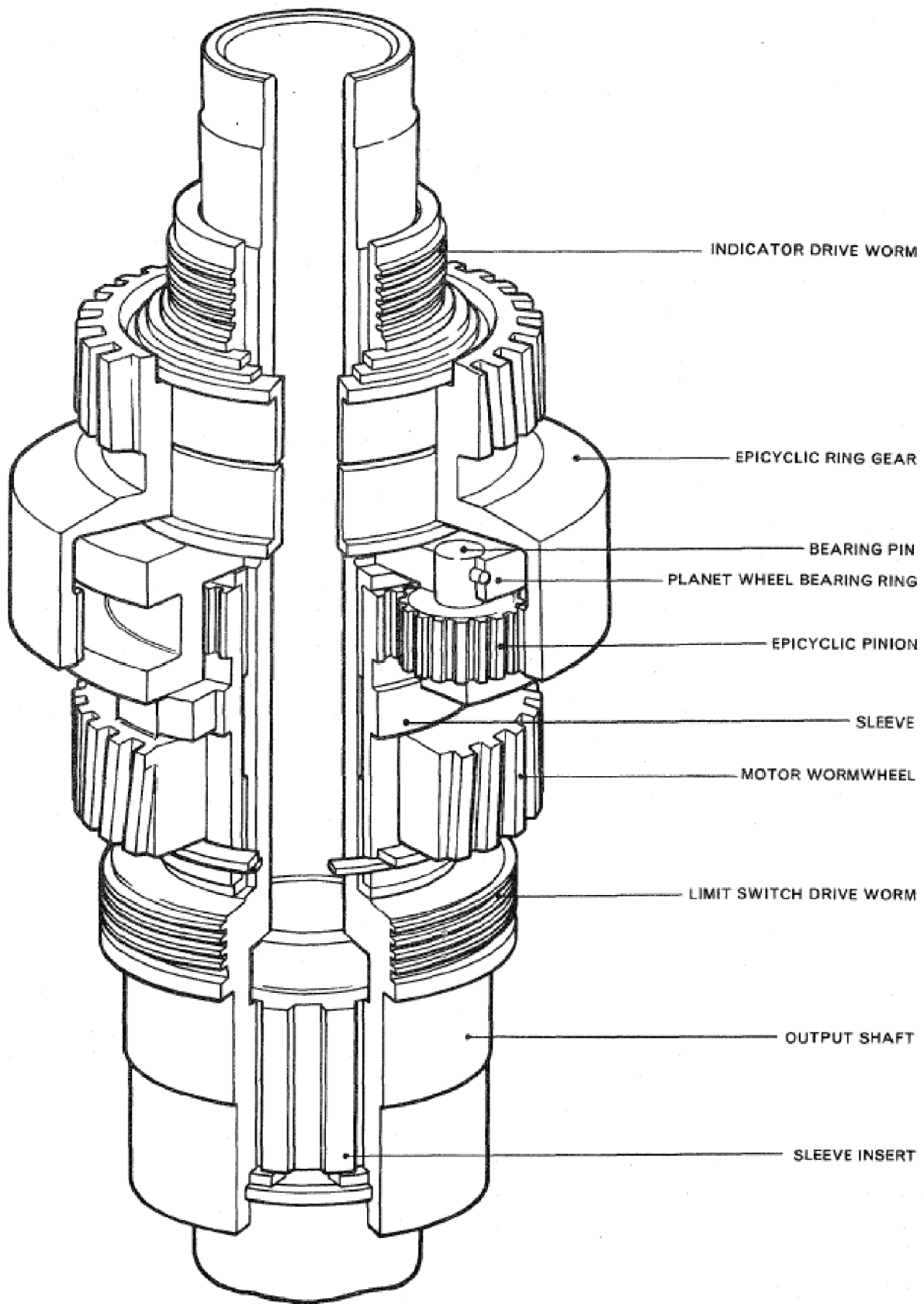
ARRANGEMENT OF GEARS VIEWED FROM MOTOR END

SECTIONAL ARRANGEMENT OF FIG 9051 ACTUATOR

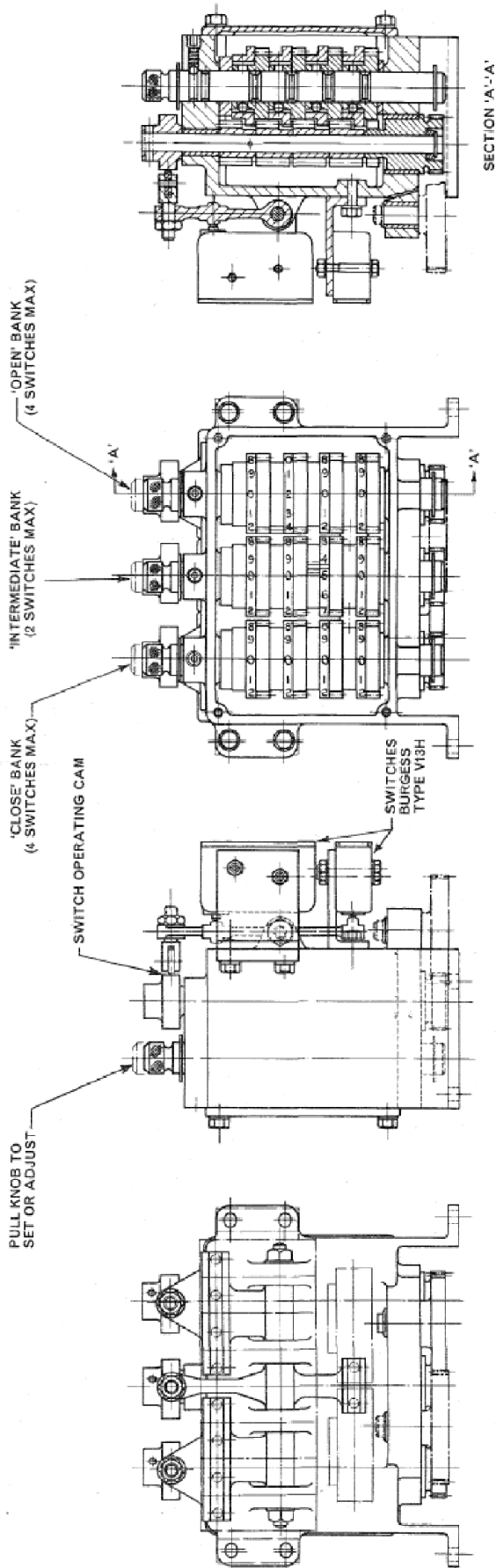




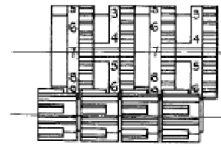
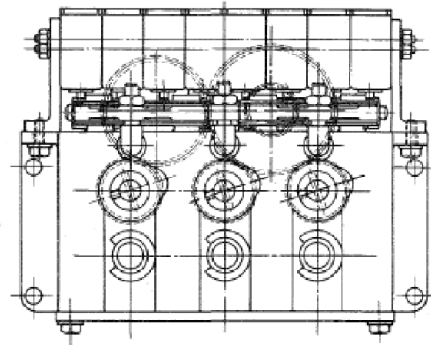
CUTAWAY OF FIG 9051 VALVE ACTUATOR



CUTAWAY OF FIG 9051 VALVE ACTUATOR OUTPUT SHAFT ASSEMBLY

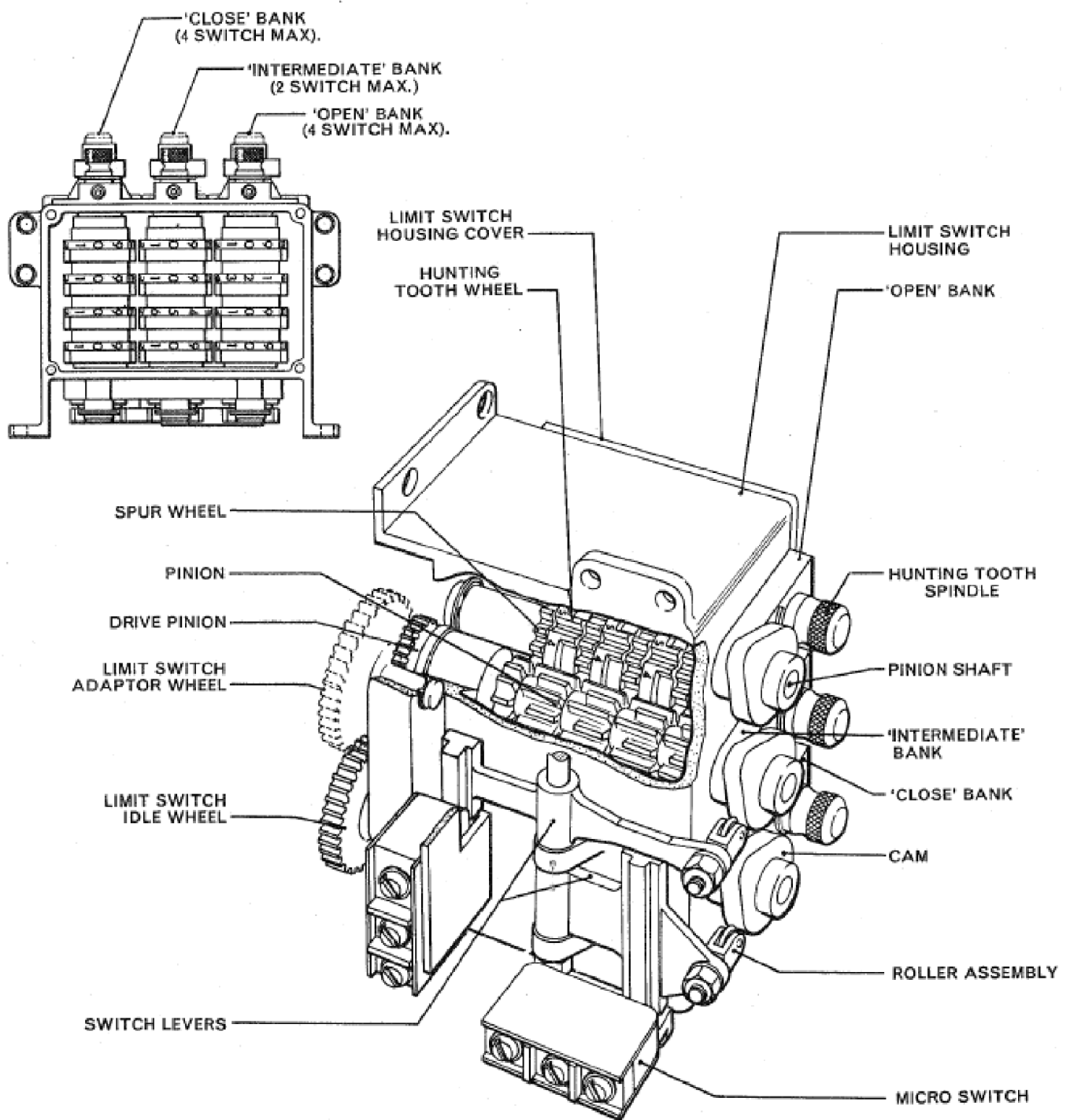


VIEW WITH HOUSING COVER REMOVED

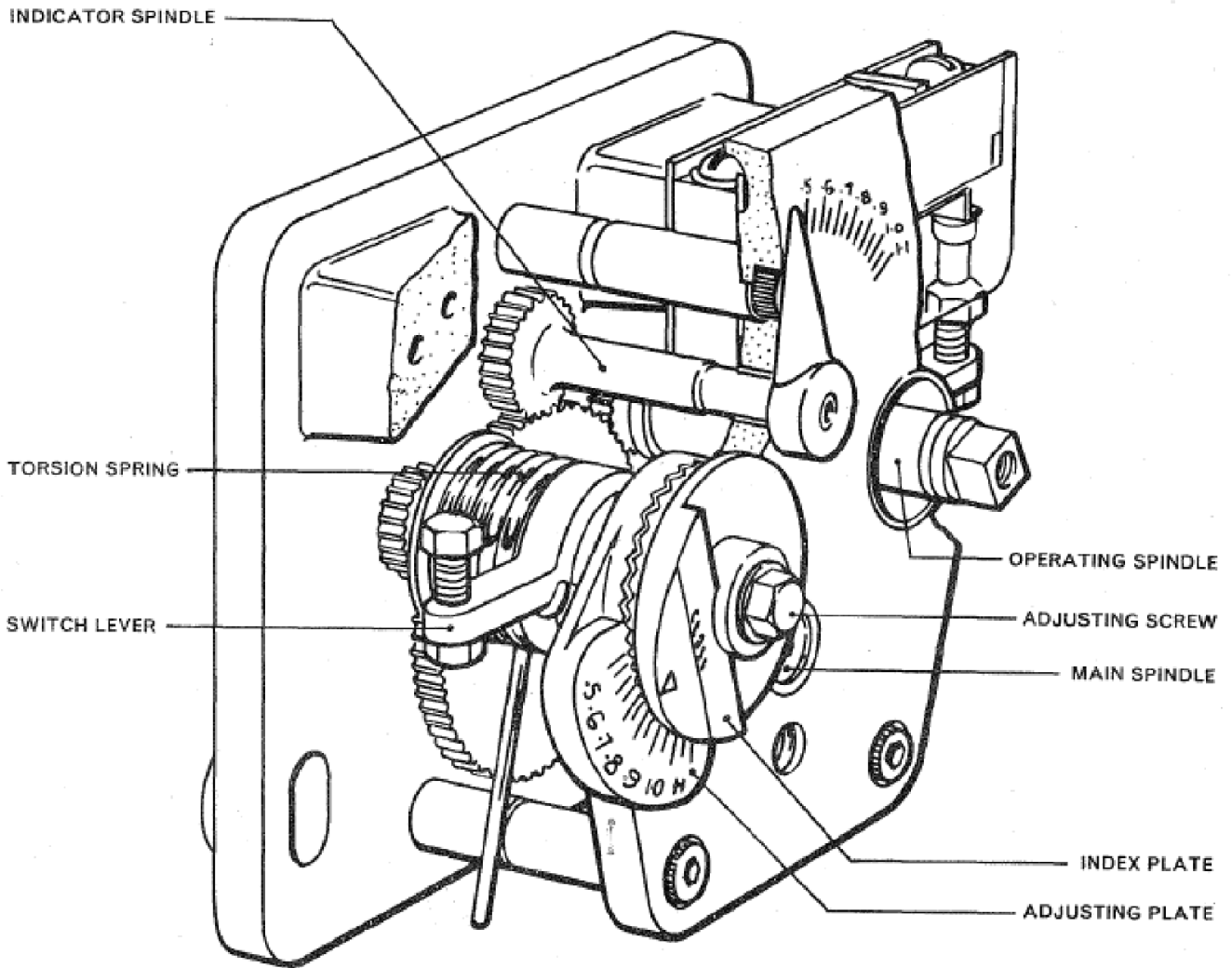


DETAIL OF INTERMITTENT GEAR TRAIN

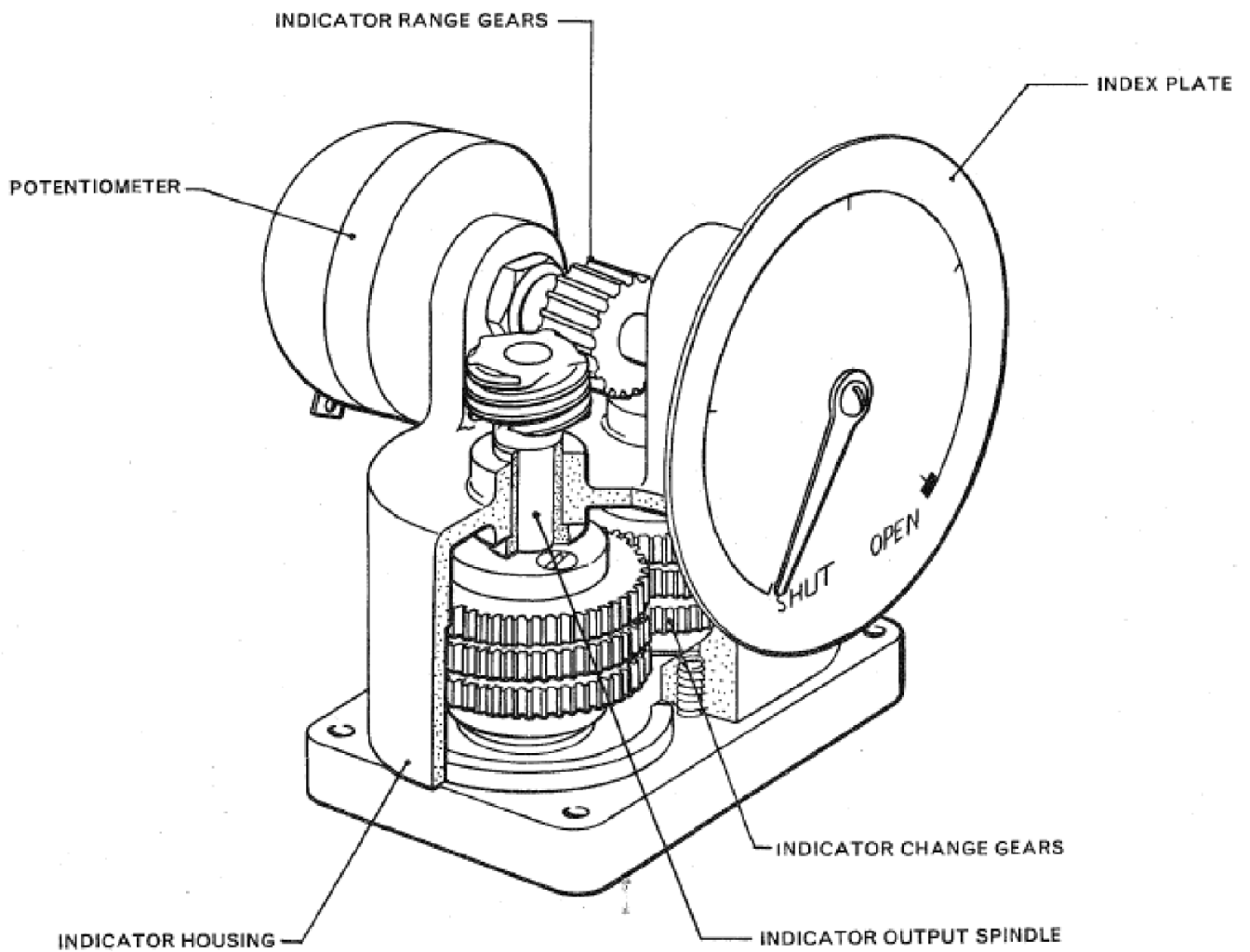
ARRANGEMENT OF LIMIT SWITCH SUITABLE FOR FIG 9051, 9052, 9053, 9054, 9055 & 9056 VALVE ACTUATORS



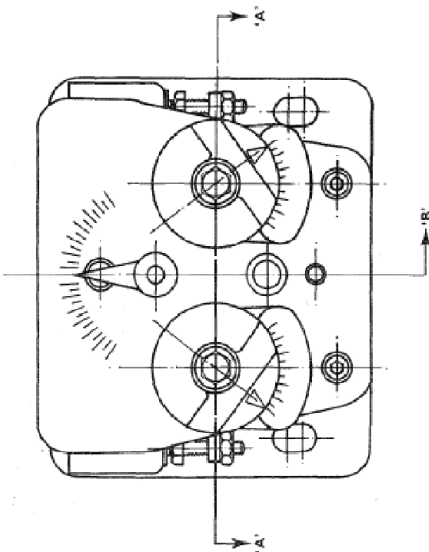
DIAGRAMMATIC CUT AWAY OF LIMIT SWITCH ASSEMBLY



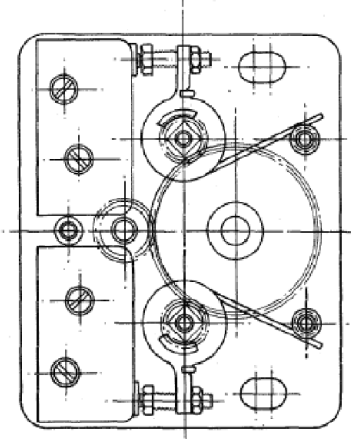
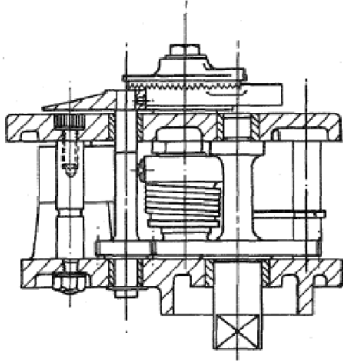
TORQUE SWITCH UNIT



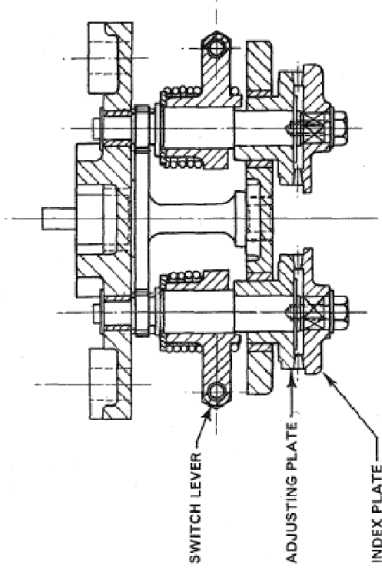
VALVE POSITION INDICATOR UNIT WITH POTENTIOMETER



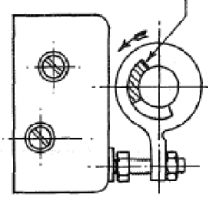
SECTION 'B-B'



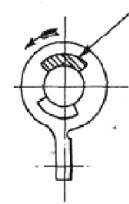
FRONT ELEVATION WITH TOP PLATE, ADJUSTING PLATES, INDEX PLATES AND POINTER REMOVED



SECTION 'A-A'

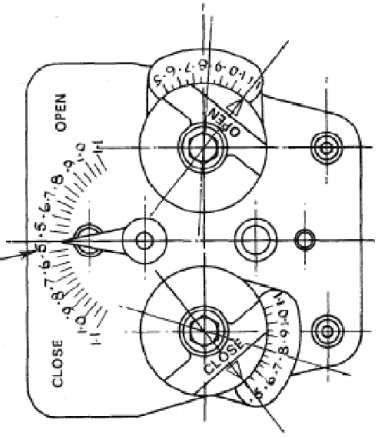


RELATIVE POSITION OF DOG TOOTH ON ADJUSTING PLATE WHEN SET TO TRIP SWITCH AT 50% MAX. TORQUE.



RELATIVE POSITION OF DOG TOOTH ON ADJUSTING PLATE WHEN SET TO TRIP SWITCH AT 110% MAX. TORQUE.

SCALE AND POINTER INDICATING ACTUAL RUNNING TORQUE ABOVE 50%.



VIEW OF TOP PLATE SHOWING 'CLOSE' SWITCH SET TO TRIP AT 50% MAX. TORQUE AND 'OPEN' SWITCH SET TO TRIP AT 110% MAX. TORQUE. EACH SWITCH CAN BE ADJUSTED BETWEEN 50% & 110% SETTINGS IN INCREMENTS OF 5%.

ARRANGEMENT OF TORQUE SWITCH

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