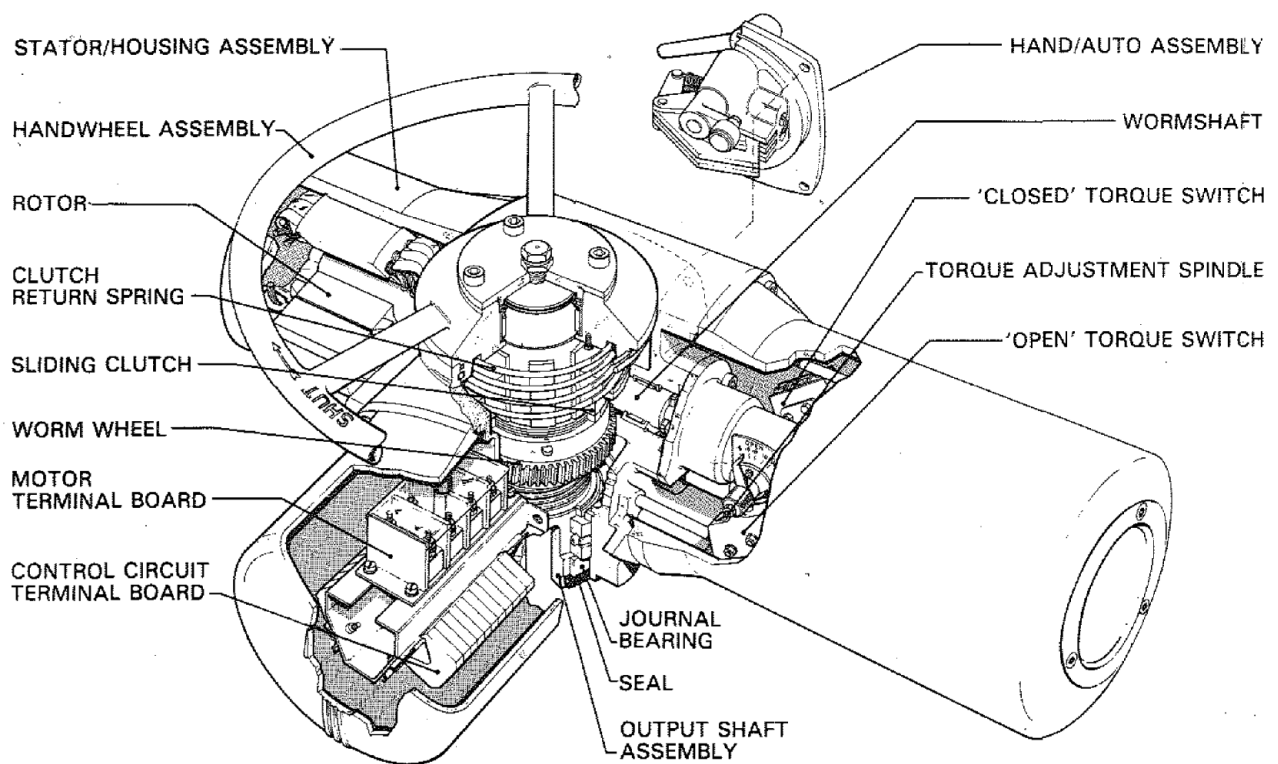


Standard Operating & Maintenance Instructions

Hopkinsons Fig 9151 Issue 1980 ELECTRIC ACTUATOR



CUT AWAY OF FIG. 9151 ELECTRIC ACTUATOR

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Hopkinsons Fig 9151 ELECTRIC ACTUATOR

Section 1

1.1 GENERAL

The actuator consists of a rotor stator unit driving an output shaft through a single stage worm reduction, which incorporates an automatic mechanical device for changing the drive from manual to power. The actuator includes a travel limit switch unit and a torque switch unit and is of totally enclosed weatherproof construction, suitable for mounting at any angle or inverted (see Fig. 1).

1.2 MOTOR AND GEAR TRAIN

A.C. 3 phase motors are of squirrel cage rotor stator design. Class '8' or 'F' insulation is provided. The windings are terminated on stud type terminals in the actuator terminal box. Motor winding thermostats are provided to protect the motor against burn out.

The stator is mounted in a housing forming an integral part of the actuator housing and the rotor is mounted directly onto the wormshaft which is mounted on "packed for long life" grease lubricated needle roller bearings.

The output shaft bearings are located in the main housing and the output shaft assembly incorporates a lost motion, or hammer blow device which allows the motor to run up to speed before transmitting full torque to the output shaft (see Fig. 2).

1.3 MANUAL OPERATION

The actuator is equipped with a handwheel to operate in event of power failure. The handwheel is easily engaged with the output shaft by moving the hand/auto lever from right to left and at the same time slowly turning, the handwheel.

An automatic device is incorporated which transfers the drive from manual to power immediately the motor starts to rotate. As the sliding clutch is withdrawn completely from manual before engaging power drive the operator is ensured complete safety should the actuator be started during hand operation.

IMPORTANT

It is impossible to engage power drive by using the hand/auto lever, and no attempt should be made to force the lever to power position.

The sliding clutch is mounted on the splined output shaft and a compression spring ensures that the dog teeth on the underside are fully in mesh with the dog teeth on the top side of the

wormwheel thus transmitting the drive from wormshaft to the wormwheel, from the wormwheel to the sliding clutch via the dog teeth lost motion device and from the sliding clutch to the output shaft. The hand/auto lever operates a lever and roller which makes contact with the sliding clutch in order to lift it out of engagement with the wormwheel and into engagement with the dog teeth on the handwheel (see Fig. 2).

The hand/auto lever is maintained in the hand position by 2 spring loaded catch levers.

To return to power operation the motor is energised and as the wormshaft rotates, 2 pawls fitted into the wormwheel strike the 2 spring loaded catch levers which release the hand/ auto lever allowing it and the sliding clutch to return to the auto position.

1.4 TORQUE LIMITING DEVICE

The wormshaft of the actuator is capable of axial movement against a disc spring pack.

The design of the spring pack is such that a limited deflection is permitted allowing axial movement of the wormshaft in either direction corresponding to 40% to 120% output torque of the actuator in the opening or closing direction (see Fig. 3).

1.5 LIMIT SWITCH ASSEMBLY

The limit switch and indicator units are mounted on plates which embody an indicator take-off spindle from the limit switch drive gear.

The complete assembly is fitted to the end of the actuator, opposite to the motor, the cross pin of the limit switch take-off spindle and a slot in the limit switch drive spindle forming the coupling for the gear drive from the actuator output shaft (see Fig. 4).

The standard limit switch assembly comprises 4 'open' position and 4 'close' position micro switches of which only 3 'open' position and 2 'close' position micro switches are wired to the actuator terminal board. The additional switches may be wired to the actuator terminal board depending upon customers requirements. Each bank of lever-roller actuated switches is operated by a cam positively driven by the hunting tooth gear train. Switches 1, 2 and 3 are designed to operate simultaneously with switch 4 operating last by means of a small step on the cam. As such, switch 4 should always be used as the actuator travel limit switch.

Intermediate position switches or additional open and close switches may be fitted when required by the addition of another limit switch assembly (see Fig. 4).

The hunting tooth gear trains are so arranged that each bank is independently adjustable to provide any limit switch setting from zero to 100 turns in steps of 0.1 of a turn. Special assemblies can be provided to count from zero to 1000 actuator turns in adjustable steps of 1 turn.

The limit switch gear train consists of a drive spindle driven by internal actuator gears, to a spur gear pinned to the drive shaft, which drives the first stage spur wheel and hunting tooth wheel.

The latter being located and driven by the spur wheel with a double pentagon recess in the hunting tooth wheel which can be located in any of ten positions on the pentagon spigot of the spur wheel. These positions correspond to the numerals on the hunting tooth flange.

The drive is transferred to the hunting tooth pinions through three stages of hunting tooth wheels and then back to the final hunting tooth pinion which has a spur gear moulded as an integral part which drives the cam. A spring on the hunting tooth spindle keeps the spur wheel and the hunting tooth gear locked together in the normal driving or set position but permits them to be separated for initial setting (see Fig. 4).

1.6 CONTINUOUS MECHANICAL INDICATOR UNIT (WHEN FITTED)

The indicator unit consists of two plates separated by pillars, input and output spindles, change gear, spur gears, index plates, pointer and pointer spindle. An indicator unit supplied with an actuator includes change gears of the correct ratio for the number of output turns of the actuator. No adjustment is required to the indicator other than setting the pointer to the 'shut' index of the scale with the valve in the full shut position after setting the limit switch and adjusting the index plates if necessary (see Fig. 4).

1.6.1 VALVE POSITION TRANSMITTER (WHEN FITTED)

The addition of a transmitter, used for the purpose of remote indication, is the only difference between continuous mechanical indicator unit and the valve position transmitter.

To prevent damage to the transmitter fitted to an actuator which has not been direct mounted to a valve and commissioned by Hopkinsons the final drive gear attached to the transmitter shaft should be left out of mesh with the other indicator gears. The final drive gear should be left to the commissioning engineer to couple up and adjust after setting the limit switches (see Fig. 4).

Section 2

2.1 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 'close' 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 'close' operating button and immediately after that stop the actuator and then 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, then restore electrical supplies and repeat the procedure.

2.2 LIMIT SWITCH SETTING UP PROCEDURE

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 or actuators for fitting direct on to valves at site are despatched with each switch bank set at 50 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, taking care not to damage or misplace the rubber 'O' ring seal. Hand operate the valve to within 1% of the full shut position and observe that the limit switch cams are in the correct position i.e. switch rollers at the top of the cam with the black setting line on the cam visible and under the rollers. Set the close bank hunting tooth wheels to 00.0 and then operate the actuator handwheel 1/4 of a turn more and observe that the limit switch cam moves away from the micro switch rollers and allows the micro switches to operate. Check that switches have operated using a suitable measuring instrument.

On a parallel slide valve, check that 1/16" (1.6 mm) to 1/8" (3.2 mm) clearance exists between the bottom of the valve stop and the shoulder of the valve pillars. If this clearance is not observed re-adjust limit switch setting as above. Then operate the valve to within 1% of the full open position and set the open bank hunting tooth wheels to 00.0 and repeat the setting procedure. If for any reason the cam is not in the correct position it can be easily adjusted by separating and rotating the hunting tooth wheel, which registers 10s turns indicated by the continuous white line on barrel, one complete revolution will cause the spur wheel which is moulded to the pinion to rotate, and this can be assisted by hand, rotating the spur wheel causes the operating cam to move 144°. Continue until such time as the black line on the cam is positioned under the micro switch rollers. NOTE: Always rotate the hunting tooth wheel in an ascending order i.e. 1, 2, 3, etc. There is *only one correct position* of the black line allowing correct re-engagement of the hunting tooth wheel with its mating spur wheel.

In certain inaccessible site locations it may be difficult to observe that the black line on the operating cam is in the correct position. This can be checked using a multimeter or bell and

battery across the terminals corresponding to the open and close travel limits. (Normally open limit is numbered 3 and 5 and close limit 4 and 6). Ascertain that connections have been made correctly to limit switch. With the valve in mid travel position a circuit should exist between terminals 3 and 5, and 4 and 6. If this is not the case the cam is in the wrong position.

Now set the intermediate 'open' and 'close' bank limit switches (when fitted) to the correct number of turns from the respective zero at which these switches are required to operate.

Operate the actuator and check operation of all switches, indicators etc., replace the limit switch cover and 'O' ring seal with care.

2.2.1. REPLACEMENT OF MICRO SWITCHES

It is recommended that adjustments or repairs that are carried out on site are restricted to the replacement of micro switches only. To do this the following procedure **must** be followed to ensure correct future operation.

(i) Isolate the actuator from the electrical supplies, remove faulty limit switch assembly to workshop.

(ii) Set the limit switch assembly to mid-travel, i.e. cams depressing switch plungers.

(iii) Remove the micro switch securing nuts and rods, replace faulty switches and re-tighten the rods ensuring that all the switches are pulled away as far as possible from the operating cam. A minimum clearance of 0.010" (0.254mm) should exist between the cam and the switch rollers when the black line on the cam is under the rollers and the rollers are hard up to the switch moulding. Check operation of assembly to ensure that the drive spindle can be turned by hand and that the switches can be operated freely.

(iv) Replace limit switch in actuator, re-connect and follow setting up procedure.

2.3 TORQUE SWITCH ASSEMBLY

The actuator is fitted with a torque switch assembly which incorporates 'open' and 'close' torque switches which are fitted with adjusting features easily set to limit the actuator torque in increments of 20% within the indicated range. The torque switch assembly is spigot mounted on the actuator housing and the open and close pinions are engaged with the drive sleeve fitted on the end of the wormshaft. Torque indication in terms of axial displacement of the wormshaft is transmitted via the pinions to the 'open' and 'close' torque switch operating spindles.

Withdrawal of the operating spindle by means of the knurled knob permits the adjusting pointer to be set in any 5 positions from 0.4 to 1.2 (40%-120%) output torque. The operating spindles are spring loaded and therefore are held in position after re-engaging with the drive sleeve. The switch is normally tripped with the 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 action of the cam attached to the pinion spindle. (see Fig. 3).

The actuator torque switches are normally set at works to suit the particular application, therefore no adjustment should be necessary.

N.B. If the predetermined torque switch settings or the actuator application is not known, the torque switches will be set at a minimum and left to the commissioning engineer to set.

The torque switches operate independently and do not reset until actuator is reversed.

2.4 FITTING 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. Do not remove any covers at this stage but engage manual operation in preparation for fitting to the valve.

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 drive sleeve 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 or distance pieces is/are flush with the top face of the adaptor flange. Fit the nuts to the mounting studs and secure. A grease gun nipple is provided for lubricating the sleeve and valve stem this should be charged with grease when commissioning with the valve in the full open position to the specification, referred to in paragraph 2.6.

Set limits and torque switches as described previously.

2.5 FITTING PEDESTAL MOUNTED ACTUATORS

First ascertain that the valve is in the full shut position i.e. on a parallel slide valve that the stop is 1/16" (1.6 mm) to 1/8" (3.2 mm) clear of 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 joints on the intermediate shafts are in line and not at 90° to each other. (see Fig. 5).

2.6 LUBRICATION

The actuator requires the minimum of lubrication as the bearings are packed for long life. 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 drive gearing and bearings on the limit switch assembly.

RECOMMENDED LUBRICANTS:

SHELL ALVANIA GREASE No. R3 - Indicator gears, grease gun nipple, hand/auto assembly, internal gearing etc., except worm and wheel.

SHELL VITREA Oil No. 32 - limit switch cam shafts, drive spindle, gear spindles and torque switches.

ROCOL MOLYGEAR - Worm and wheel only. All equipment will be initially charged with lubricant before despatch.

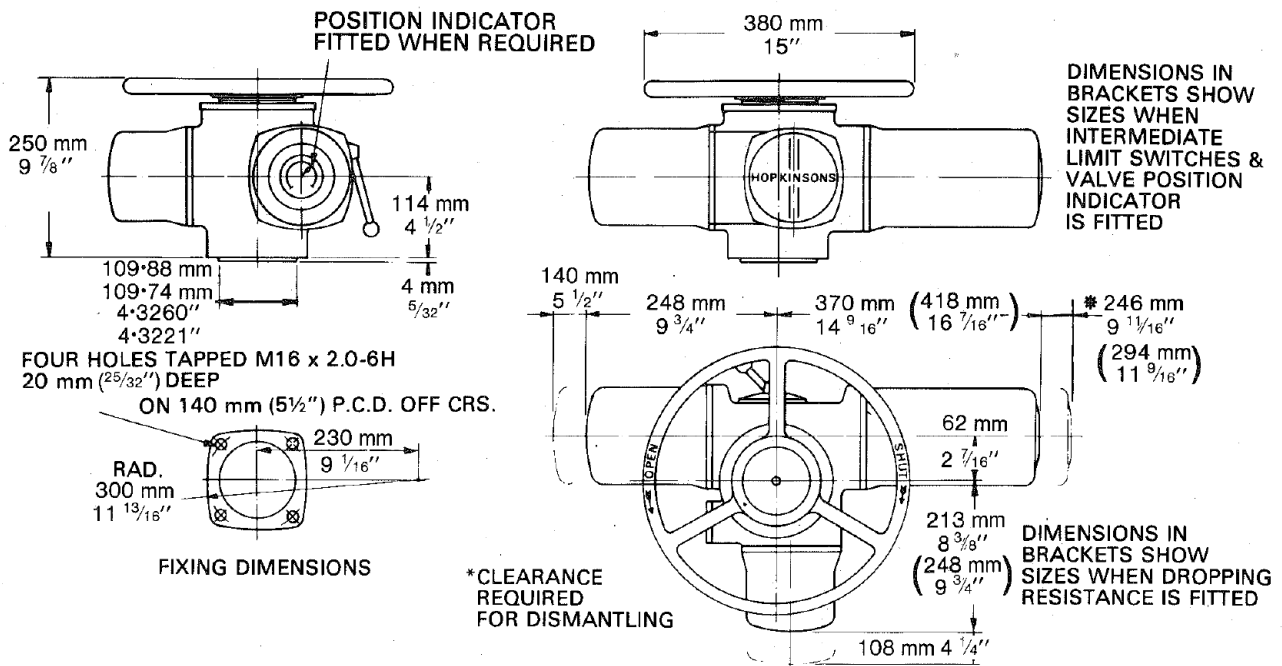
It is advisable to set up a routine maintenance schedule, particularly in cases when actuators are operated infrequently.

2.7 SPARES

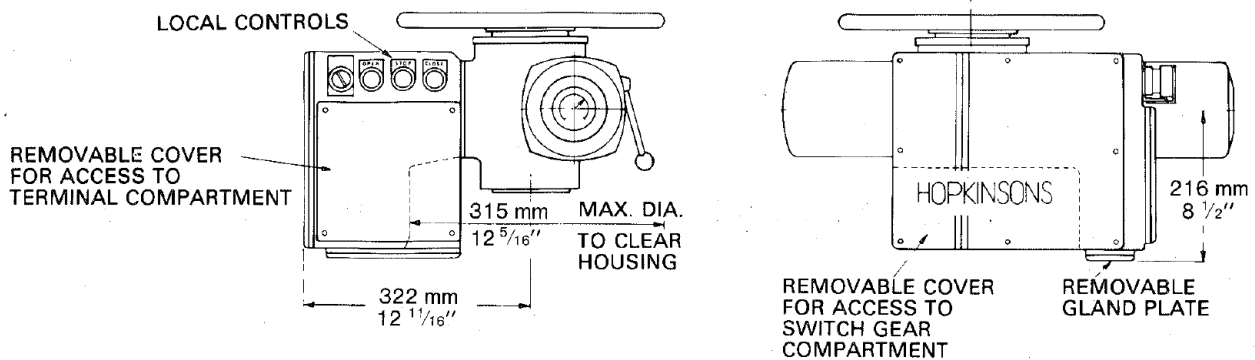
If at any time any spares or additional optional extras are required it would assist us to identify your requirements if the following information was given, which can be found on the identification plate attached to the actuator

- a) Actuator Figure Number
- b) Actuator Serial Number ADT
- c) Name of part required

Actuator without Switch-gear

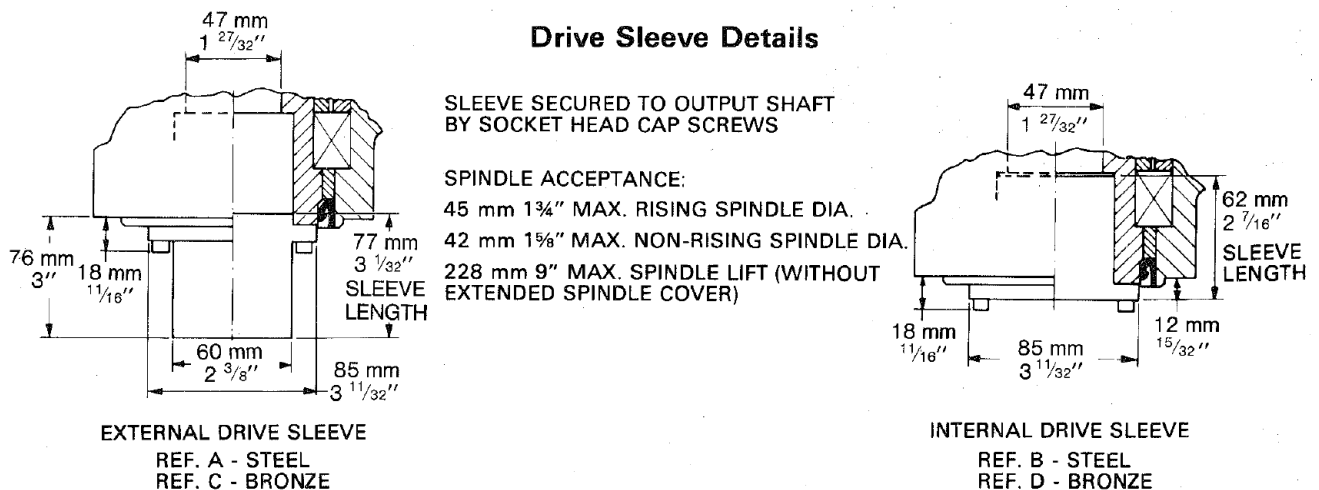


Actuator with Switch-gear

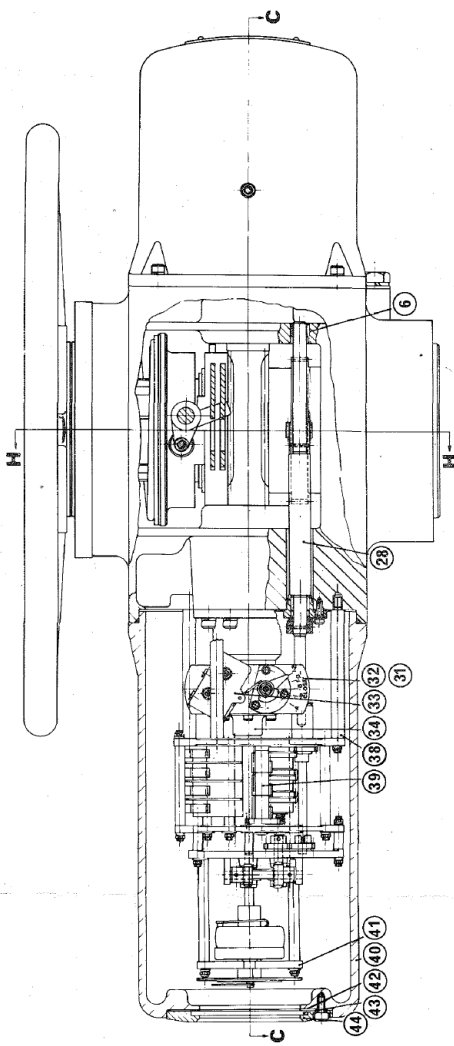


FOR OTHER DIMENSIONS SEE DETAILS OF ACTUATOR WITHOUT SWITCH GEAR (ABOVE)

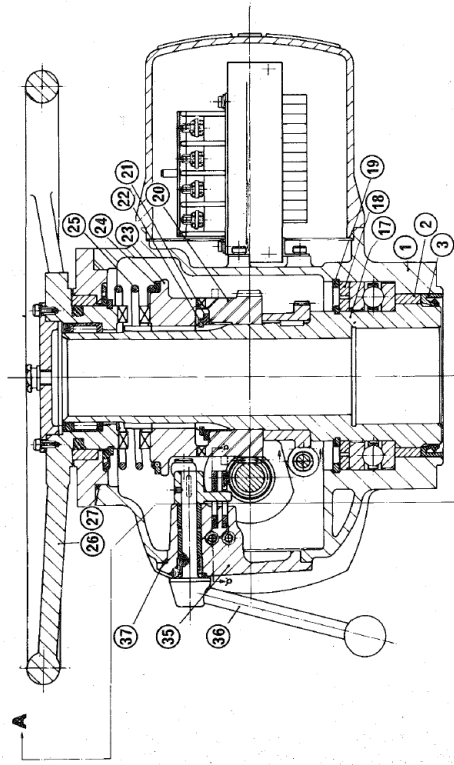
Drive Sleeve Details



ARRANGEMENT OF FIG. 9151 ACTUATOR (3.1. FIG. 1)



SECTION 'A-A' AND PART SECTION 'B-B' THROUGH LIMIT SWITCH DRIVE WITH 'OPEN' AND 'CLOSE' BANKS OF LIMIT SWITCH REMOVED.

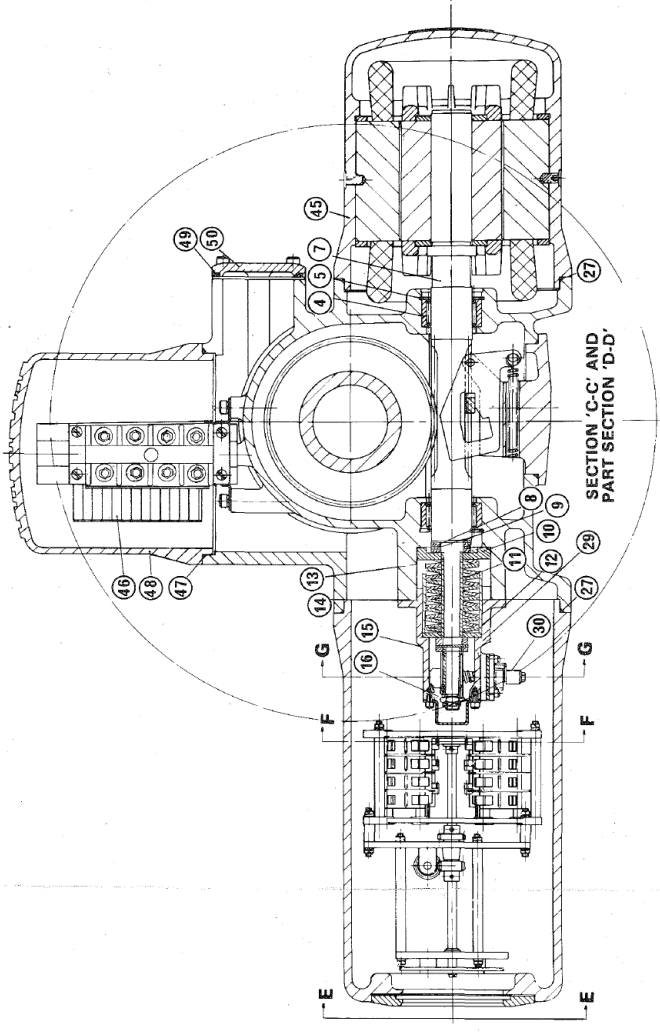


SECTION 'H-H'

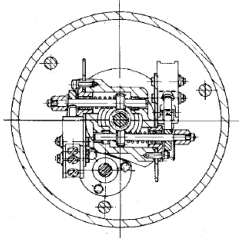
REF. No.	NAME OF PART	No. OFF
26	HANDWHEEL BRG. HSG. SUB-ASSY	1
27	'O'-RING	3
28	LIMIT SWITCH TAKE OFF SUB-ASSY	1
29	WORMSHAFT SUB-ASSY	1
30	T.S. BRIDLE SUB-ASSEMBLY	2
31	INDEX PLATE (L.H.)	1
32	INDEX PLATE (R.H.)	2
33	SWITCH	2
34	END COVER	1
35	'O' SUB-ASSEMBLY	1
36	OPERATING LEVER SUB-ASSY	1
37	'O'-RING	1
38	LIMIT SWITCH SUPPORT PILLAR	3
39	LIMIT SWITCH ASSEMBLY	1
40	LIMIT SWITCH COVER	1
41	GASKET	1
42	POSITION INDICATOR	1
43	WINDOW	1
44	WINDOW CLAMP	1
45	MOTOR HOUSING SUB-ASSY	1
46	TERMINAL BLOCK SUB-ASSY	1
47	TERMINAL BOX COVER	1
48	'O'-RING	1
49	GLAND PLATE	1

REF. No.	NAME OF PART	No. OFF
1	MAIN HOUSING	1
2	BEARING	1
3	OIL SEAL	1
4	NEEDLE BEARING	2
5	BEARING	1
6	BEARING	1
7	WORMSHAFT SUB-ASSEMBLY	1
8	THRUST RACE	4
9	THRUST BEARING	2
10	RETAINING SLEEVE	1
11	WASHER	1
12	WASHER	1
13	DISC SPRING	28
14	STOP SLEEVE	1
15	SLEEVE	1
16	COCKLE	1
17	WORMSHAFT SUB-ASSY	1
18	OUTER WASHER	1
19	CIRCLIP	1
20	WORMWHEEL SUB-ASSEMBLY	1
21	WORMWHEEL WASHER	1
22	CIRCLIP	1
23	SLUTCH	1
24	SPRING SEAT WASHER	1
25	SPRING	1

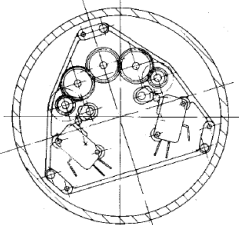
OPTIONAL EXTRA FOR STANDARD ARRANGEMENT USE ALUMINUM BLACKING PLATE LOCK OFF AND NEBAR GASKET OFF



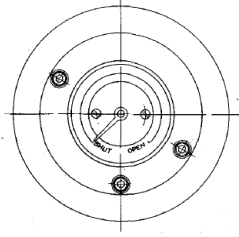
SECTION 'C-C' AND PART SECTION 'D-D'



SECTION 'G-G'

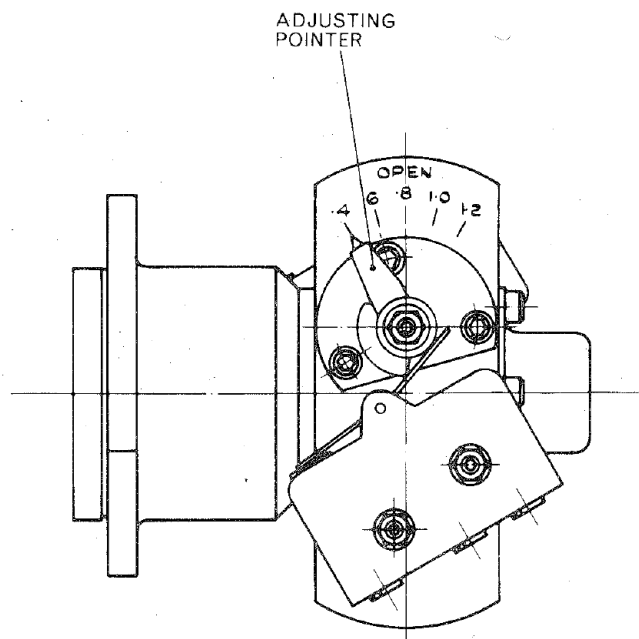
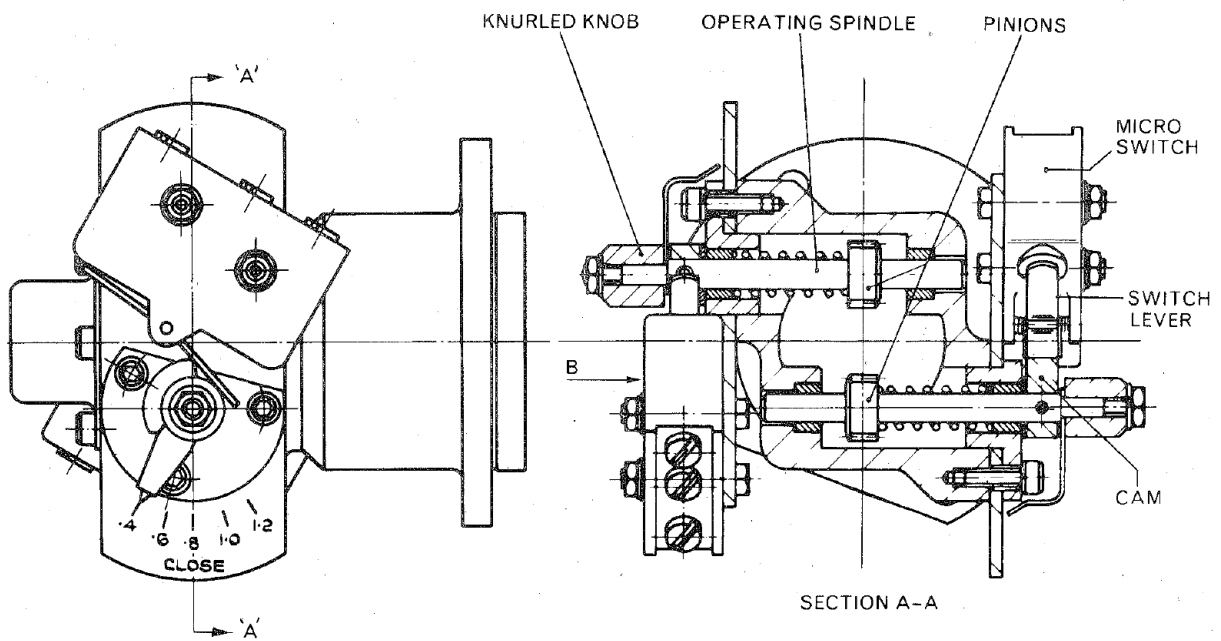


SECTION 'F-F'



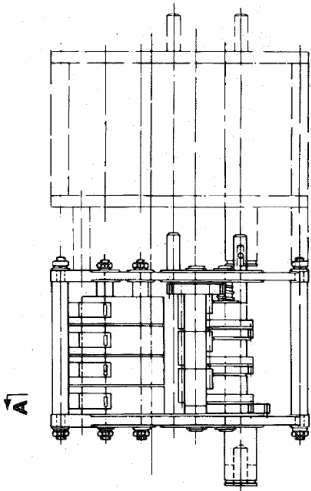
SECTION 'E-E'

SECTIONAL ARRANGEMENT OF FIG. 9151 ACTUATOR (WITHOUT SWITCHGEAR) WITH MECHANICAL VALVE POSITION INDICATOR - (OPTIONAL EXTRA) AND TRANSMITTER (OPTIONAL EXTRA) (3.2. FIG. 2).



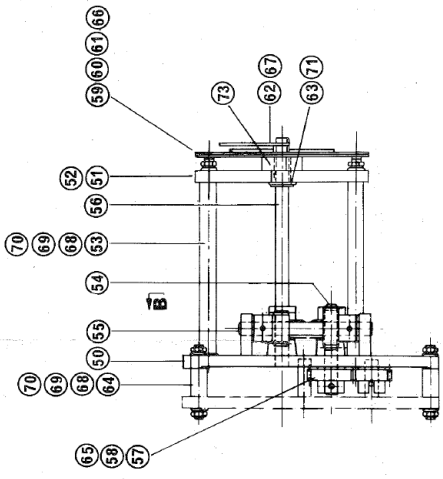
**TORQUE SWITCH ASSEMBLY FOR
FIG. 9050 & 9151 ACTUATORS (3.3. FIG. 3)**

SWITCH NUMBER



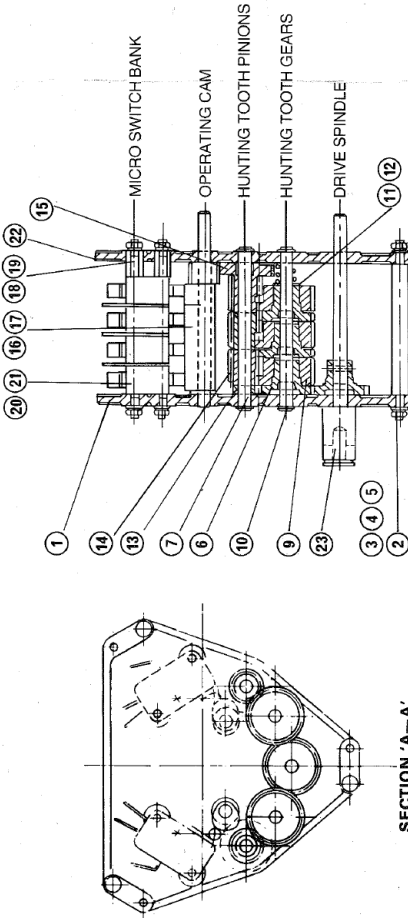
A1
2 BANK LIMIT SWITCH

ADDITIONAL SWITCH BANKS AS REQD.



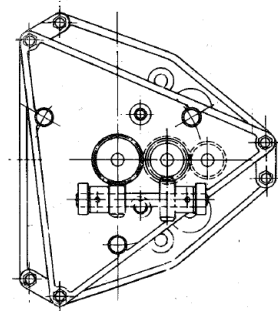
B1

FIG. 9085 INDICATOR



TYPICAL DEVELOPED SECTION OF
LIMIT SWITCH GEAR TRAIN AND CAM.

SECTION 'A-A'



SECTION 'B-B'

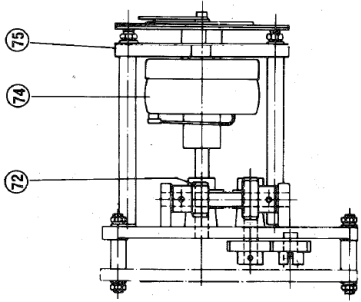


FIG. 9086 INDICATOR TRANSMITTER

ITEM No.	DESCRIPTION	No. OFF
50	INDICATOR BOTTOM PLATE	1
51	BEARING	1
52	TOP PLATE	1
53	PLAIN WASHER	3
54	CHANGE GEAR SPINDLE	1
55	CHANGE GEAR SPINDLE	1
56	POINTER SPINDLE	1
57	SPUR GEAR	1
58	SPUR GEAR	1
59	INDEX PLATE - OPEN	1
60	INDEX PLATE - SHUT	1
61	CLAMPING PLATE	1
62	SPUR GEAR	1
63	THRUST WASHER	7
64	PILLAR	3
65	SPRING PIN	6
66	SCREW - C/SUNK HD	2
67	SCREW - CHEESE HD	12
68	NUT	12
69	SPRING WASHER	12
70	PLAIN WASHER	12
71	PLAIN WASHER	4
72	SPIRAL CHANGE GEAR	4
73	DISTANCE PIECE	2
74	POTENTIOMETER	1
75	TOP PLATE	1

ITEM No.	DESCRIPTION	No. OFF
1	BASE PLATE	1
2	PILLAR	3
3	PLAIN WASHER	10
4	SPRING WASHER	14
5	NUT	14
6	HUNTING TOOTH SPINDLE	4
7	CIRCLIP	8
8	SPUR WHEEL	3
9	HUNTING TOOTH WHEEL - OPEN	7
10	HUNTING TOOTH WHEEL - CLOSE	2
11	PLAIN WASHER	2
12	SPRING	2
13	SPACER	2
14	PIVON	4
15	SPUR WHEEL	2
16	CAMSHAFT	2
17	THRUST WASHER	3
18	SPACER	4
19	SPRING	6
20	SWITCH	4
21	INSULATING PLATE	6
22	TOP PLATE	1
23	DRIVE SPINDLE	1

GENERAL ARRANGEMENT & PARTS LIST OF 2 BANK LIMIT SWITCH & INDICATOR (3.4. & 3.5. FIG. 4)

FIG. 9050 & 9151 PEDESTAL MOUNTED ACTUATORS

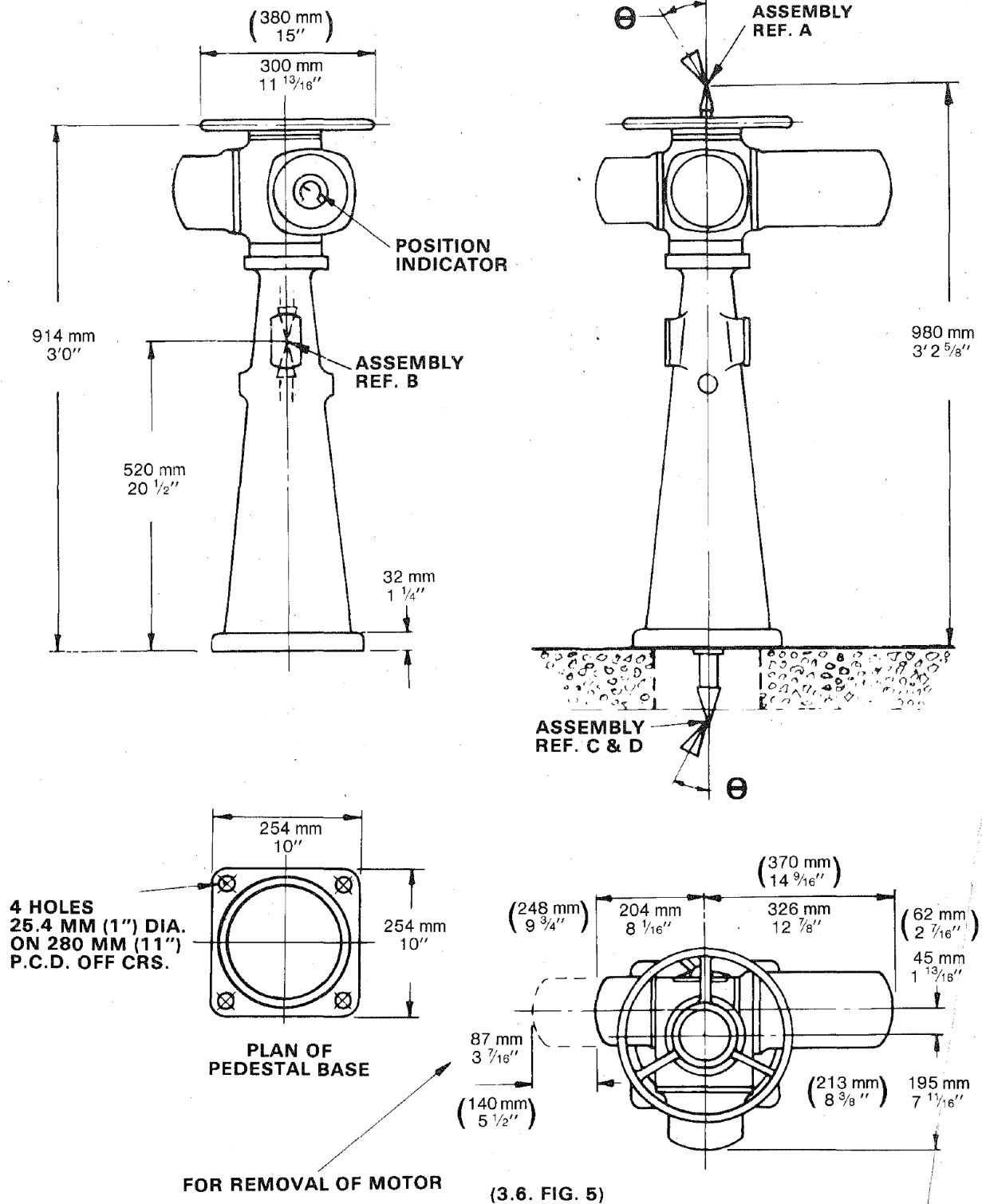
FIG. 9151 DIMENSIONS SHOWN IN BRACKETS
 Illustrations show Actuator without Switchgear

All universal joints are size No 1 (for details see data sheet)

Ø Represents the maximum included angle of 30° (for other angles refer Hopkinsons)

Assemblies available

- REF.A — Upward drive
- REF.B — Downward drive, universal joint within pedestal
- REF.C — Downward drive, Ø of universal joint 152 mm 6" below floor level
- REF.D — Downward drive, Ø of universal joint 305 mm 12" below floor level



ARRANGEMENT OF FIG. 9151 ACTUATOR PEDESTAL MOUNTED

For spares or service enquiries please contact:

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Weir Power and Industrial
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L5N 1W2, Canada
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Servicecall: (877) 797 WEIR (9347)
Fax: +1-905-766-4048
E-mail: valveservices@weirgroup.com
Web: www.weirpowerindustrial.com

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Web: www.weirpowerindustrial.com

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Solutions

