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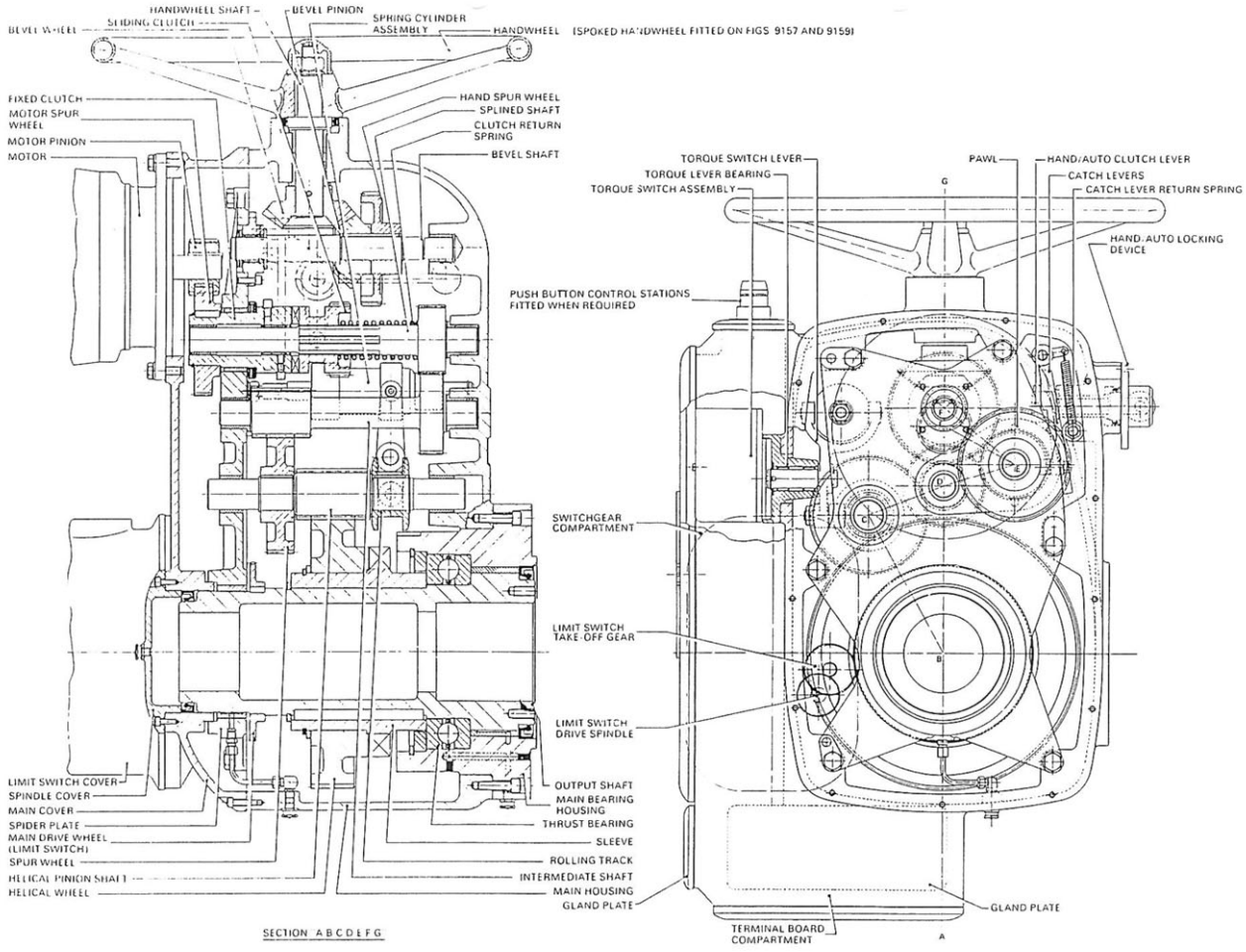
Standard Operating & Maintenance Instructions

Hopkinsons Fig 9156, 9157 & 9159 Issue 1981 ELECTRIC ACTUATOR



SECTIONAL ARRANGEMENT OF GEARBOX ASSEMBLY FOR FIG, 9156, 9157 AND 9159 ACTUATORS (3.2 FIG. 2)

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Section 1

Section 2

Drawings

Hopkinsons Fig 9156, 9157 & 9159
ELECTRIC ACTUATOR

Section 1

1.1 GENERAL

The actuator consists of a motor driving an output shaft through a spur gear train incorporating an automatic mechanical device for changing the drive from manual to power. The actuator includes a travel limit switch unit and torque switch unit with combined torque indicator 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 design fitted with 'packed for long life' grease lubricated ball bearings. Dimensions and performances are in accordance with the appropriate British Standard specifications. Class "B" insulation is provided as standard. 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 motor is mounted on the top cover of the gear box, and the reduction gear shafts and final output shaft bearings are located in the main housing and spider plate. The final drive 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 a power failure. The handwheel is easily engaged with the output shaft via the gear train by pulling the hand/auto clutch lever towards the handwheel at the same time turning the handwheel slowly until the clutch is engaged.

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 As the clutch is withdrawn completely from manual before engaging power drive the operator is ensured complete safety should the actuator be started during hand operation.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

A bevel wheel on the handwheel shaft meshes with a bevel pinion on the bevel shaft which also carries a hand spur wheel. The motor spur wheel is fitted to a fixed clutch member which is axially located and is provided with pawls to disengage the catch levers and dog teeth to engage the sliding clutch. The sliding clutch is mounted on the splined shaft which forms the second reduction pinion at the lower end and a journal bearing of the fixed clutch at the upper end. The sliding clutch is provided with a groove for the hand/auto clutch lever roller and during power operation is held in engagement with the fixed clutch by the clutch return spring. The hand/auto clutch lever is fixed to a spindle carried in bearings through the wall of the main housing to the external clutch handle. One arm of the hand/auto clutch lever carries the roller and the other arm determines the position of the spring loaded catch levers.

To engage hand operation the clutch lever is pulled approximately 30° towards the handwheel whilst slowly turning the latter to allow the gear of the sliding clutch member to engage with the hand spur wheel. Do not attempt to force the lever into the manual position as this should be easily and smoothly attained. With the lever in the manual position the motor pinion and motor gear are bypassed for hand operation. By this action, the catch levers, which are clear of the fixed clutch pawls during power operation, are allowed to make contact with the fixed clutch and the sliding clutch is retained in mesh with the hand spur wheel against the action of the clutch return spring by slots in the catch levers engaging the free arm of the clutch lever. Two catch levers are employed, and two pawls positioned at 180º on the fixed clutch member in order to ensure that one catch lever engages the clutch lever in the event of the stationary position of the fixed clutch being such that a pawl is directly in line with a catch lever. (See Fig. 2).

To return to power operation the motor is energised and during the first rotation of the fixed clutch member the free arm of the clutch lever is released from the slot(s) of the catch lever(s) by the action of the pawl(s) striking the catch lever(s). As the clutch lever also carries the roller which positions the sliding clutch member the latter is disengaged from the handspur wheel and engaged with the dog teeth of the fixed clutch by the clutch return spring to immediately take up the power drive. With the clutch engaged the free arm of the clutch lever maintains the catch levers clear of the fixed clutch pawls with the hand lever in the power position, i.e. parallel with the output shaft. **Do not attempt to disengage the hand/auto clutch when power driving.** As the sliding clutch is clear of the hand spur wheel before engaging the dog teeth of the fixed clutch, it is impossible to transmit rotary motion from motor to handwheel.

1.4 TORQUE LIMITING DEVICE

The final reduction stage in the actuator drive consists of a single helical pinion shaft which is capable of axial movement against a spring. Upon a predetermined torque being exceeded the end thrust component causes axial movement of the helical pinion shaft. This movement is transmitted to the indicator and switches off the torque switch assembly by means of a roller mounted on the torque switch lever and positioned between flanges on the helical pinion shaft. The final reduction gear is axially located on the actuator output shaft and the face width of the helical pinion shaft is sufficient to allow axial movement while remaining in mesh with the gear. (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 on to a bracket which is fitted in a separate compartment adjacent to the motor. The cross pin of the limit switch drive gear and a slot in the limit switch driven 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 intial 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 AND 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 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 switch 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 '0' 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" (0.254 mm) 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 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 13 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. (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 reset when the actuator motor stops driving.

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).

Set limits and torque switches as described previously.

2.6 LUBRICATION

The actuator requires the minimum of lubrication as the bearings are packed for long life. A grease gun nipple is provided for the output shaft thrust bearings. 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 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 and torque switch unit.

RECOMMENDED LUBRICANTS:

SHELL ALVANIA GREASE No. R3 - Grease gun nipples and indicator gears.

SHELL VITREA OIL No. 32 - Gears and moving parts of limit switch and torque switch assemblies.

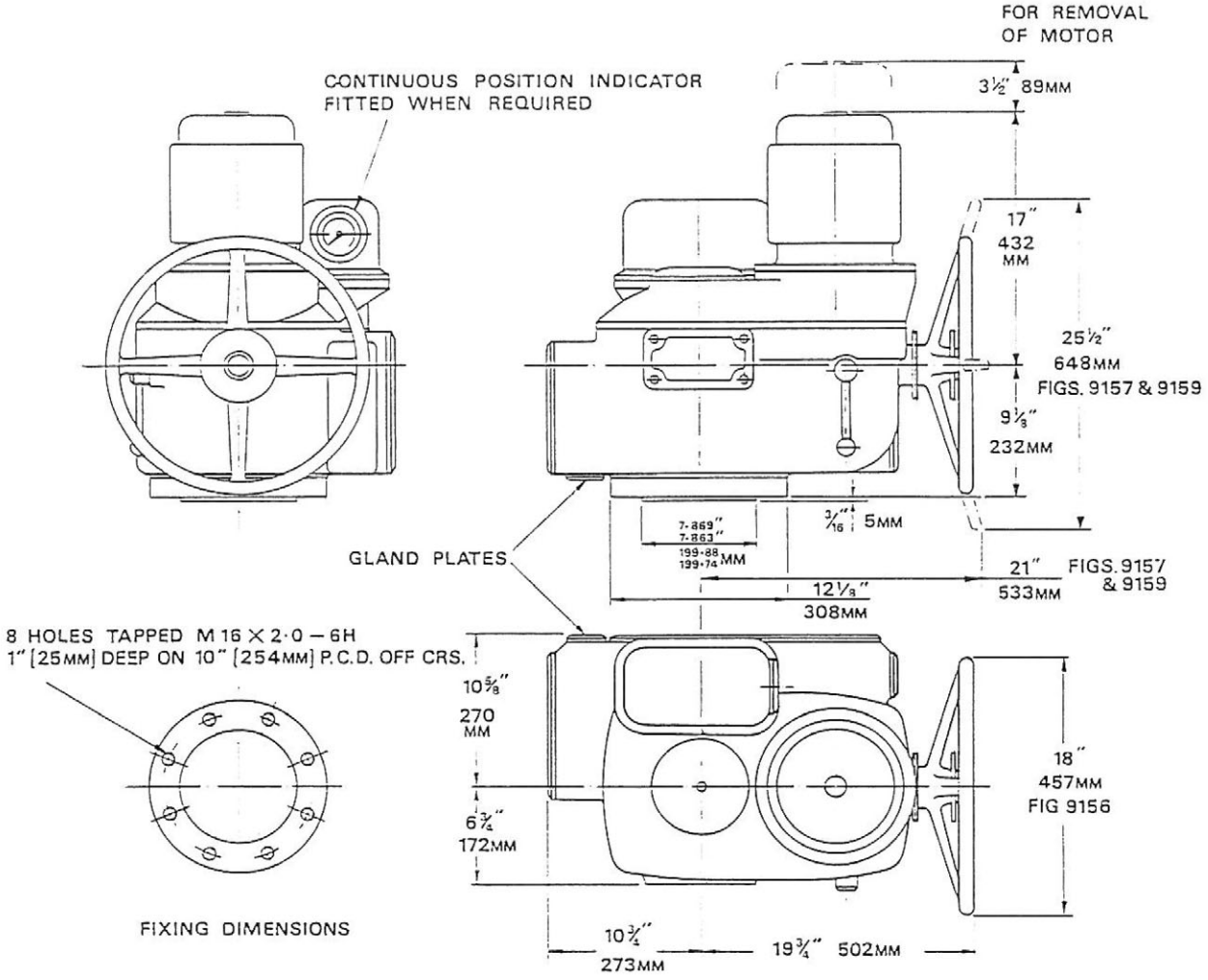
ROCOL MOLYGEAR - Internal power and hand gear pre-lubricated at works sufficient for normal life of actuator. (Dependent upon usage and operating conditions).

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

HOPKINSONS ELECTRIC ACTUATORS FIGS. 9156, 9157 AND 9159



DRIVE SLEEVE DETAILS

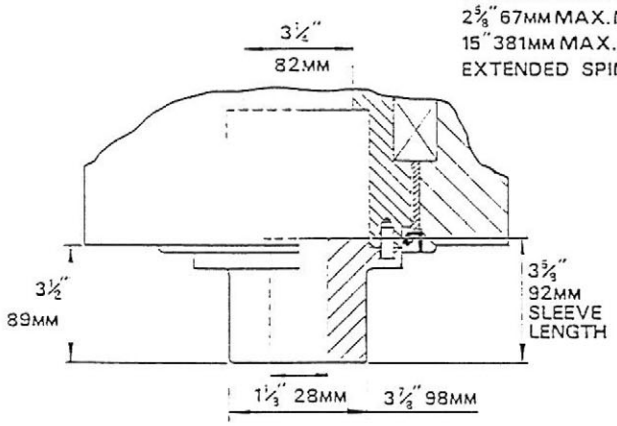
SLEEVE SECURED TO OUTPUT SHAFT BY SOCKET HEAD CAP SCREWS

SPINDLE ACCEPTANCE:

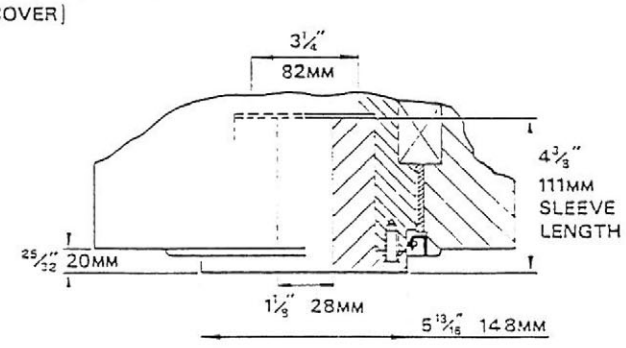
3" 76MM MAX. RISING SPINDLE DIA.

2⅝" 67MM MAX. NON – RISING SPINDLE DIA.

15" 381MM MAX. SPINDLE LIFT (WITHOUT EXTENDED SPINDLE COVER)

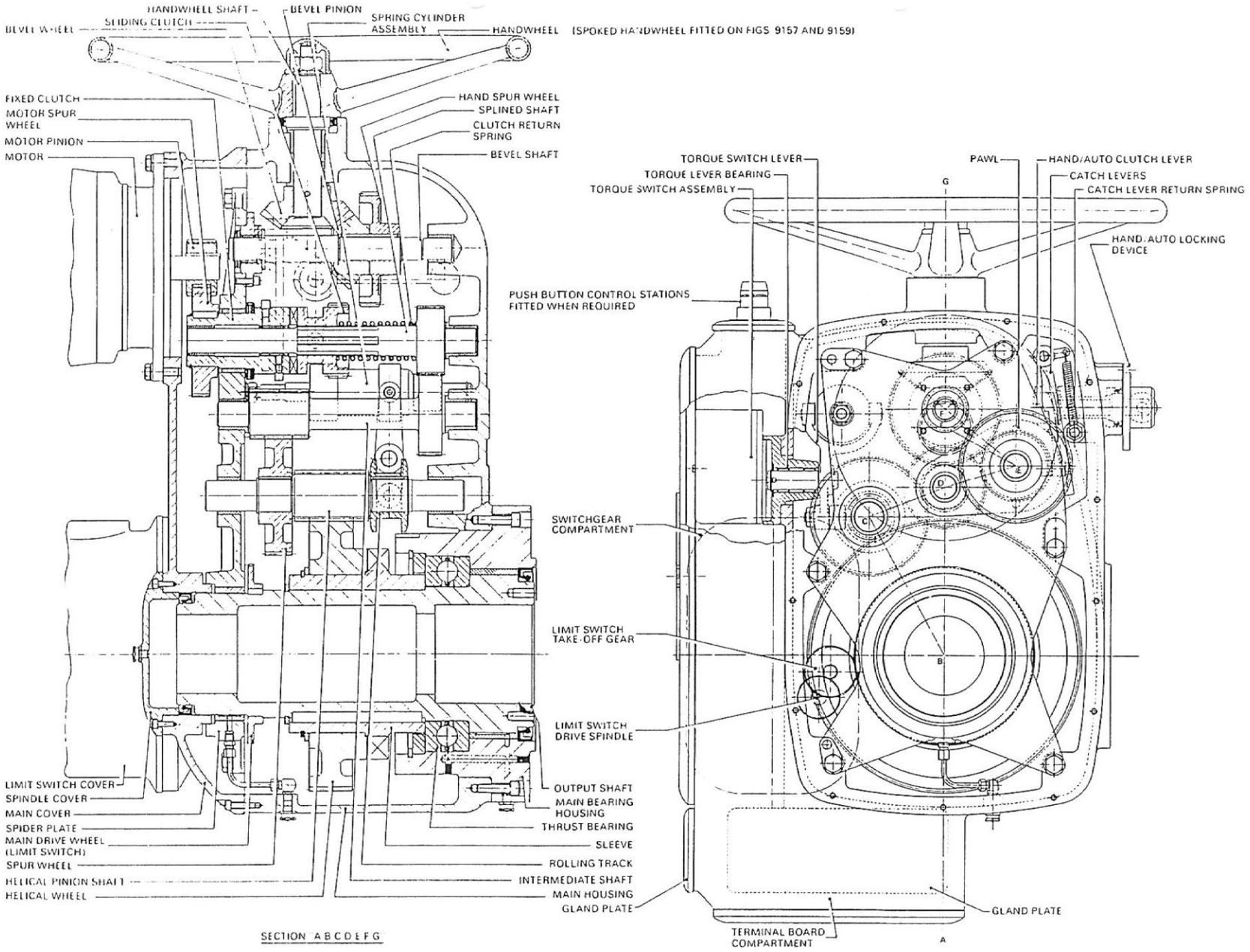


EXTERNAL DRIVE SLEEVE
REF. A – STEEL
REF. C – BRONZE

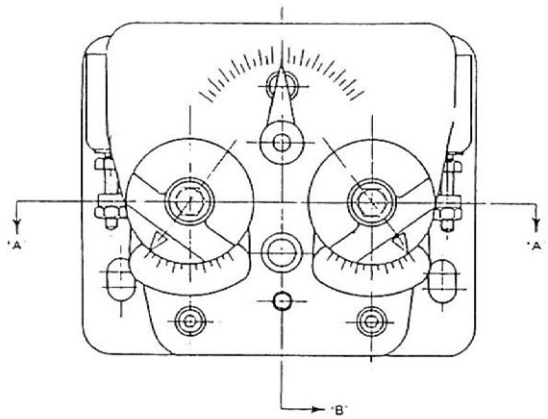


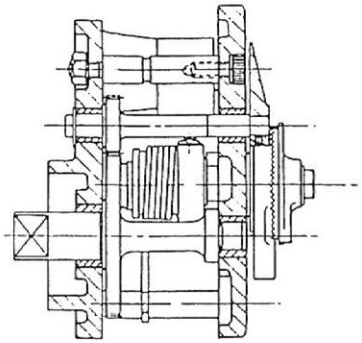
INTERNAL DRIVE SLEEVE
REF. B – STEEL
REF. D – BRONZE

ARRANGEMENT OF FIG. 9156, 9157 & 9159 ACTUATOR (3.1. FIG, 1).

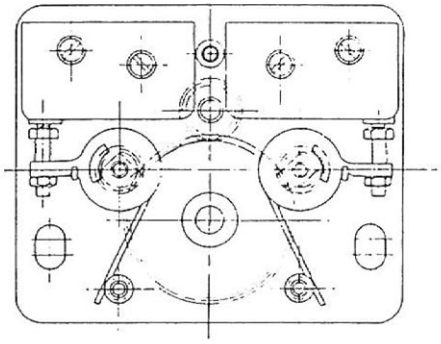


SECTIONAL ARRANGEMENT OF GEARBOX ASSEMBLY FOR FIG. 9156, 9157 & 9159 ACTUATORS (3.2 FIG. 2)

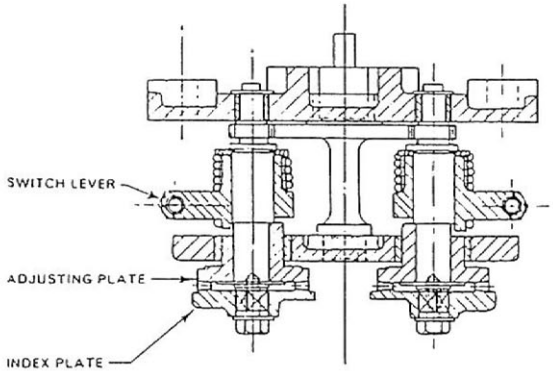




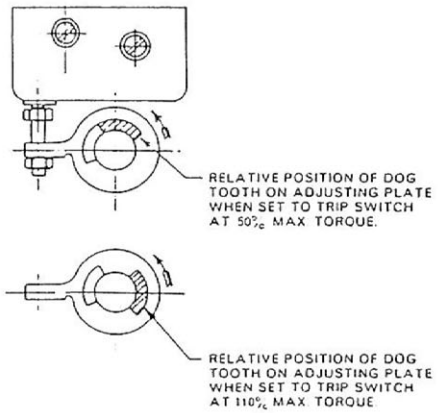
SECTION 'B'-'B'

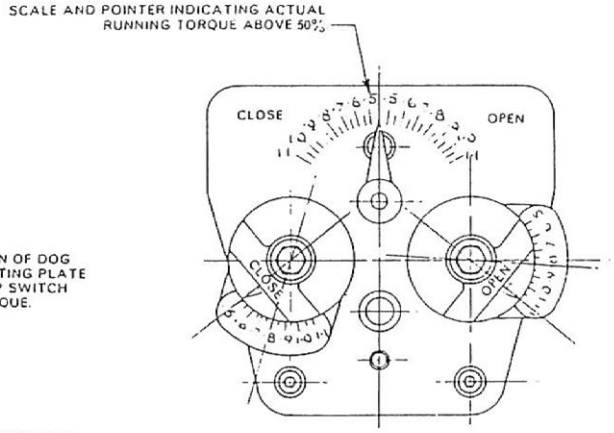


FRONT ELEVATION WITH TOP PLATE ADJUSTING PLATES INDEX PLATES AND POINTER REMOVED



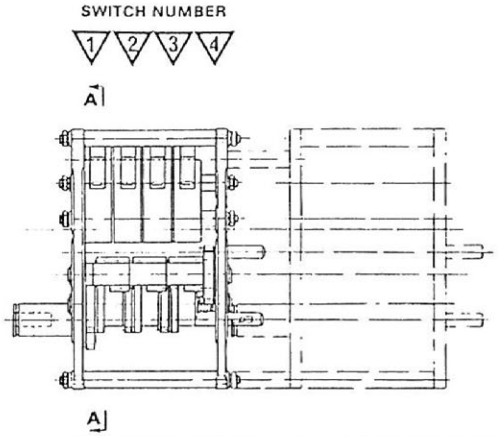
SECTION 'A'-'A'





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
(3.3. FIG. 3)



2 BANK LIMIT SWITCH ADDITIONAL SWITCH BANKS AS REQD.

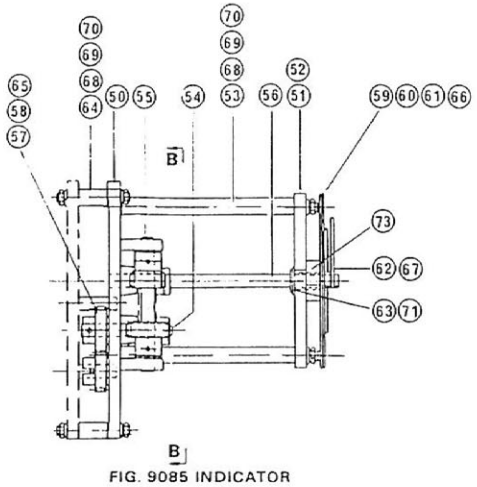


FIG. 9085 INDICATOR

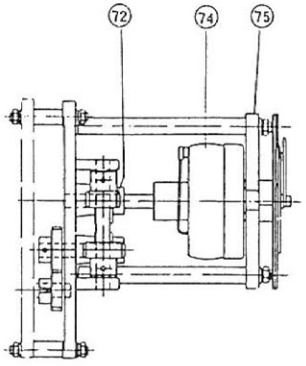
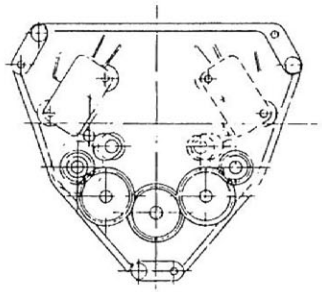
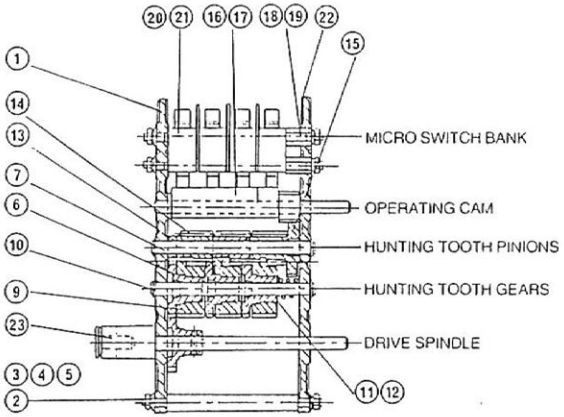


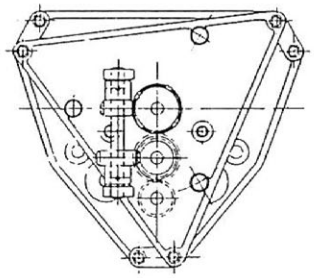
FIG. 9086 INDICATOR TRANSMITTER



SECTION 'A—A'



TYPICAL DEVELOPED SECTION OF LIMIT SWITCH GEAR TRAIN AND CAM



SECTION 'B—B'

ITEM No	DESCRIPTION	No OFF
1	BASEPLATE	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	7
9	HUNTING TOOTH WHEEL OPEN	3
10	HUNTING TOOTH WHEEL CLOSE	3
11	PLAIN WASHER	2
12	SPRING	2
13	SPACER	2
14	PINION	4
15	SPUR WHEEL	2
16	CAMSHAFT	2
17	THRUST WASHER	3
18	TIE ROD	4
19	SPACER	4
20	SWITCH	8
21	INSULATING PLATE	6
22	TOP PLATE	1
23	DRIVE SPINDLE	1

ITEM No	DESCRIPTION	No OFF
50	INDICATOR BOTTOM PLATE	1
51	BEARING	1
52	TOP PLATE	1
53	PILLAR	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	POINTER	1
63	THRUST WASHER	7
64	PILLAR	3
65	SPRING PIN	6
66	SCREW—C'SUNK HD	2
67	SCREW CHEESE HD	1
68	NUT	12
69	SPRING WASHER	12
70	PLAIN WASHER	12
71	CIRCLIP	1
72	SPIRAL CHANGE GEAR	4
73	DISTANCE PIECE	2
74	POTENTIOMETER	1
75	TOP PLATE	1

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

FIG. 9156, 9157 AND 9159 PEDESTAL MOUNTED ACTUATORS

All universal joints shown are size Nº 3 (for details see data sheet)

θ 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, ℄ of universal joint 8" 203MM below floor level
REF. D – Downward drive, ℄ of universal joint 12" 305MM below floor level

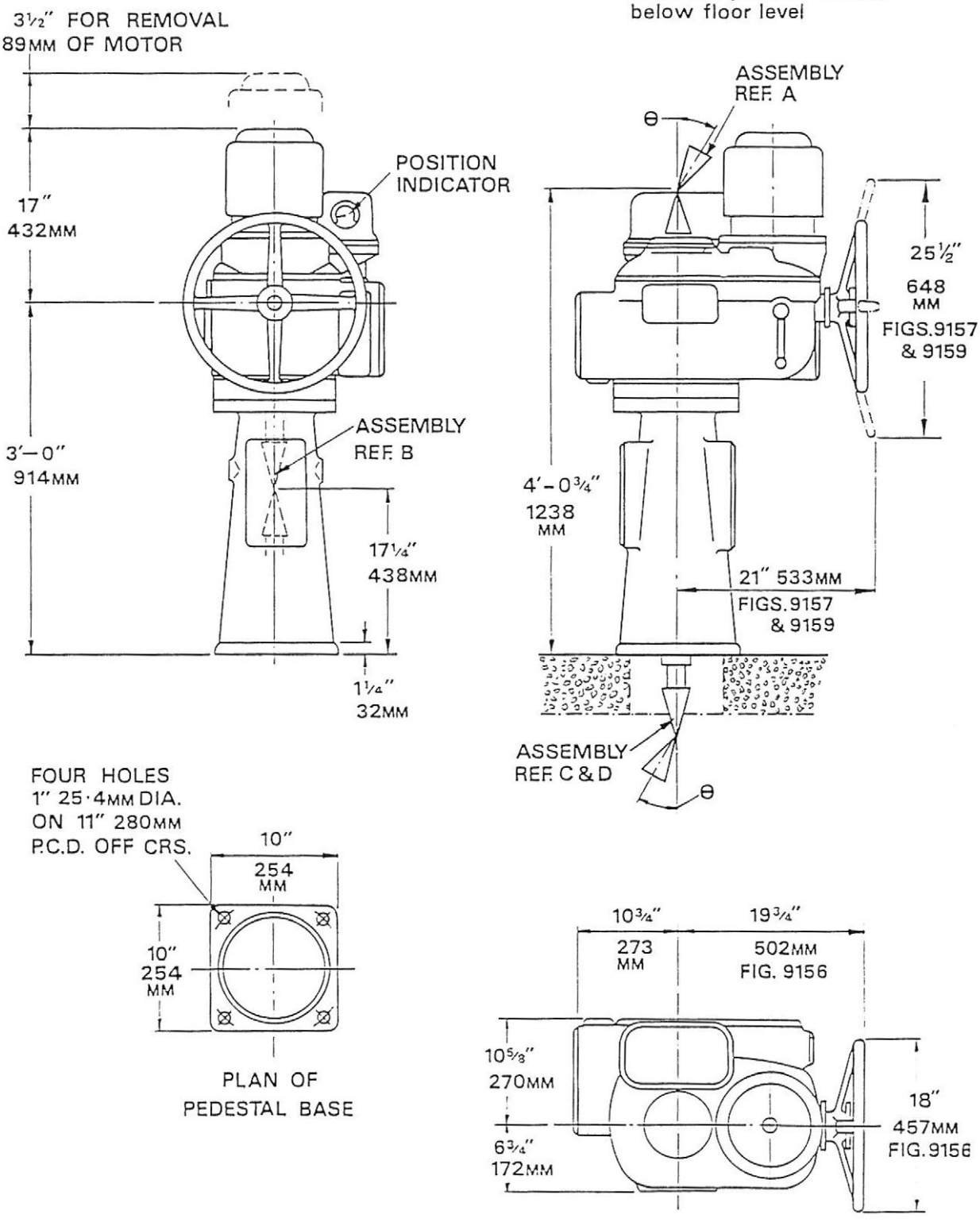


FIG. 9156, 9157 & 9159 PEDESTAL MOUNTED ACTUATORS (3.6. FIG. 5)

For spares or service enquiries please contact:

North America
Valve Customer Support Group
Weir Power and Industrial
2360 Millrace Court
Mississauga, Ontario
L5N 1W2, Canada
Tel: +1 905 625 7202
Servicecall: (877) 797 WEIR (9347)
Fax: +1-905-766-4048
E-mail: valveservices@weirgroup.com
Web: www.weirpowerindustrial.com

Rest of World
Weir Power and Industrial
The Harlands
Alloa FK10 1TB
United Kingdom
Telephone: +44 (0)1259 727550
Fax: +44 (0)1259 727570
E-mail: sales.coordinator@weirgroup.com
Web: www.weirpowerindustrial.com

Excellent
Power & Industrial
Solutions

POWER & INDUSTRIAL

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