Product Catalogue

Kent Introl
Power Cylinder

Kent Power Cylinder shown fitted with optional combined 4-20 MA output position transmitter and limit switches for travel indication

GENERAL INFORMATION AND SPECIFICATION

- **Comes complete with air filter to filter plant air supply**
- **Wide range available to meet most requirements -nine sizes and maximum thrusts, end- or trunnion-mounting**
- **Reversible-scale Indicator on Position-control Unit shows Percentage-control Pressure required to maintain Piston in any given position**
- **Equalizing Valve – enables Plant Regulating Unit to be moved manually in event of air failure**
- **Optional Units provide Remote Indication of Regulating-unit Position**
- **Reversal of Piston Direction, in relation to the Control Signal easily achieved on site**
- **Automatic air fail lock with de-clutchable handwheel manual overide facility available – details on request. See back page for photograph**

The KENT Power Cylinder accurately and positively positions all types of plant regulators such as throttle valves, dampers and butterfly valves.

The position control-unit of the power cylinder receives a 3 to 1 51bf/in^2 (0,2 to 1,0kgf/cm^2) pneumatic signal from a controller and converts it into regulator unit position - an independent high-pressure air supply providing the necessary power and speed of operation.

PRINCIPLE OF OPERATION

The position-control unit incorporated in the power cylinder receives a 3 to 15 lbf/in^2 (0,2 to 1,0kgf/cm^2) air signal from a controller and regulates the high-pressure air supply to the cylinder to give a corresponding displacement of the piston.

The position-control unit operates on the force-balance principle and comprises a bellows to receive the control signal, a control spring, one end of which is moved by the piston rod through a cam and bell crank; and a pilot valve to admit and exhaust the high-pressure air supply to the cylinder. When the control signal changes, the bellows expands or contracts opening the pilot valve and admitting air to the cylinder to move the piston; any force on the piston less than the designed maximum thrust of the power cylinder will not prevent movement as the pilot valve remains open until the restraining force is overcome and the position requirements are met. The change in the piston's position causes the control-spring force to increase or decrease until a state of equilibrium is reached between the opposing forces of the bellows and control spring; the pilot valve is then closed and the piston comes to rest in its new position.

Cams can be supplied to give either a linear or logarithmic relationship between the control signal and piston position. Power cylinders can be arranged so that increase in control pressure moves the piston either outwards or inwards. The direction of piston movement in relation to the control signal can be reversed on site simply by repositioning the changeover plate and reversing the cam and the scale. No extra pipes are required.

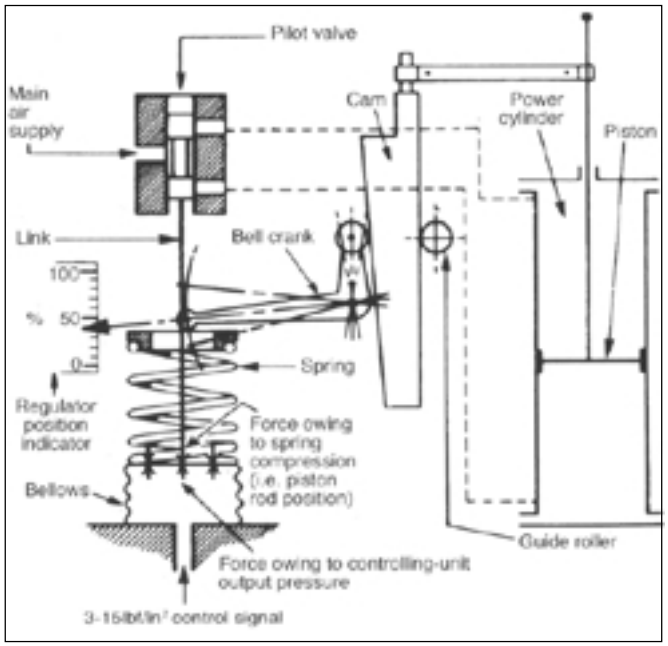


DIAGRAM OF OPERATION

SPECIFICATION

Maximum Working Pressure:
150 lbf/in^2 (11kgf/cm^2) clean air

Maximum Working Temperature:
130°C (266°F)

Sensitivity:
Better than 0.5% of full stroke

Control Signal Pressure Range:
3 to 15lbf/in^2 (0,2 to 1,0kgf/cm^2)

Static Air Consumption:
70ft^3/h (2,0m^3/h) in free air at supply pressure of 80lbf/in^2 (5,6kgf/cm^2)

Power Indication:
Regulator position indicator: Indicates regulator position in terms of percentage control effect and also control signal pressure required to maintain piston in any given position. Scale reversible on site.

Control Signal/Piston Position Relationship:
Linear or logarithmic - by fitting the appropriate cam to the position control unit. Logarithmic cams provide an equal percentage characteristic and are available in either convex or concave form for either direct or reverse acting response of the correcting condition to an increase in the control signal.

Piston Movement:
Direction of piston movement in relation to the signal can be reversed by movement of a changeover plate and reversing the power cylinder cam. No further piping changes are required.

Control-pressure Connection:
6mm O/D. $^1/_4$" BSP.

High-pressure Connection:
8mm O/D. $^3/_8$" BSP (for cylinders up to and including 7in bore) 12mm O/D. $^3/_8$" BSP (for cylinders of 10in bore).

Mounting Availability:
End Type
The cylinder can be mounted in any position (including vertically downward) on rigid cast-iron plate.

Trunnion Type
The trunnion bearing permits movement of the cylinder during its operation, the air connections are coiled about the bearing axis to allow for this movement.

All sizes below 24in stroke can be mounted in any position. 24in stroke sizes and above must only be mounted vertically or up to 20° from the vertical.

All cylinders can be supplied with an adjustable turnbuckle if required, to line up the power cylinder with the regulating unit.

Materials:
Piston and barrel: cast iron
Piston rod: stainless steel
Position-unit housing: die cast aluminium
Gland: brass
Wiping pad: rubber
Piston seal: rubber

Thrust: Based on 80 PSI air

POWER CYLINDER SIZE				70% OF MAX. THRUST AT	
Bore		Stroke		80lbf/in^2	5,6kgf/cm^2
in	mm	in	mm	lbf	kgf
3	76	6	152	352	160
3	76	12	305	352	160
5 1/2	140	6	152	1290	585
5 1/2	140	12	305	1290	585
5 1/2	140	24	610	1290	585
7	178	12	305	2080	943
7	178	24	610	2080	943
10	254	24	610	4200	1910
10	254	36	914	4200	1910

OPTIONAL INSTRUMENTATION:

Air Filter Regulator
I/P Convertor
Air Fail Lock Valve
Limit Switches
Position Transmitter
Full Manual Overide

Please consult the factory for further information, or any special requirements

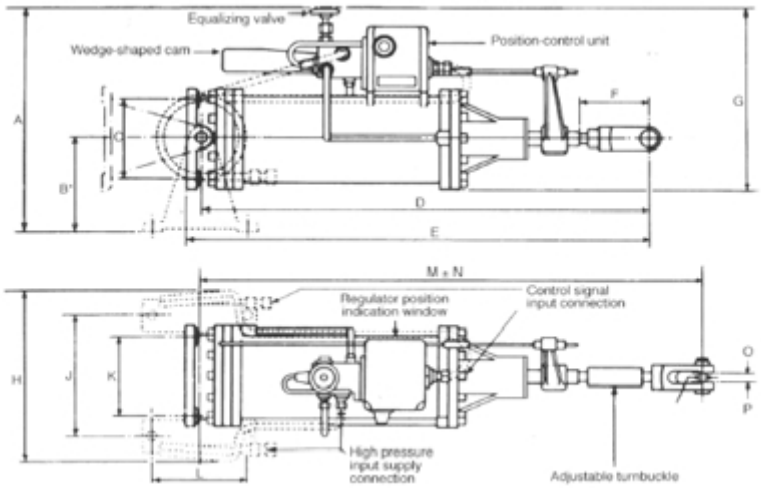
ORDERING CODE:
Please see back page for full order code details.

GENERAL NOTES:

1. MK6 Power Cylinder recommended spares lists and service kit lists are available. Please consult the factory for further information.
2. MK4 Power Cylinder spares are now obsolete except for the following parts:
   A. Piston Rod Wiper (one per cylinder)
   3in. bore + 5 1/2in. bore HPC0013
   7in. bore HPM0013
   10in. bore HPU0013
   B. Gland Packing (5 rings per cylinder)
   3in. bore + 5 1/2in. bore HPC0016
   7in. bore HPM0016
   10in. bore HPU0016
   C. Piston Ring (3in. bore only -two per cylinder) Y7337
   D. MK4 Position control unit bellows assembly (one per unit) HPP7000
3. MK4 to MK6 Piston rod and gland conversion kits are available.

Please consult the factory for further information.

DIMENSIONS

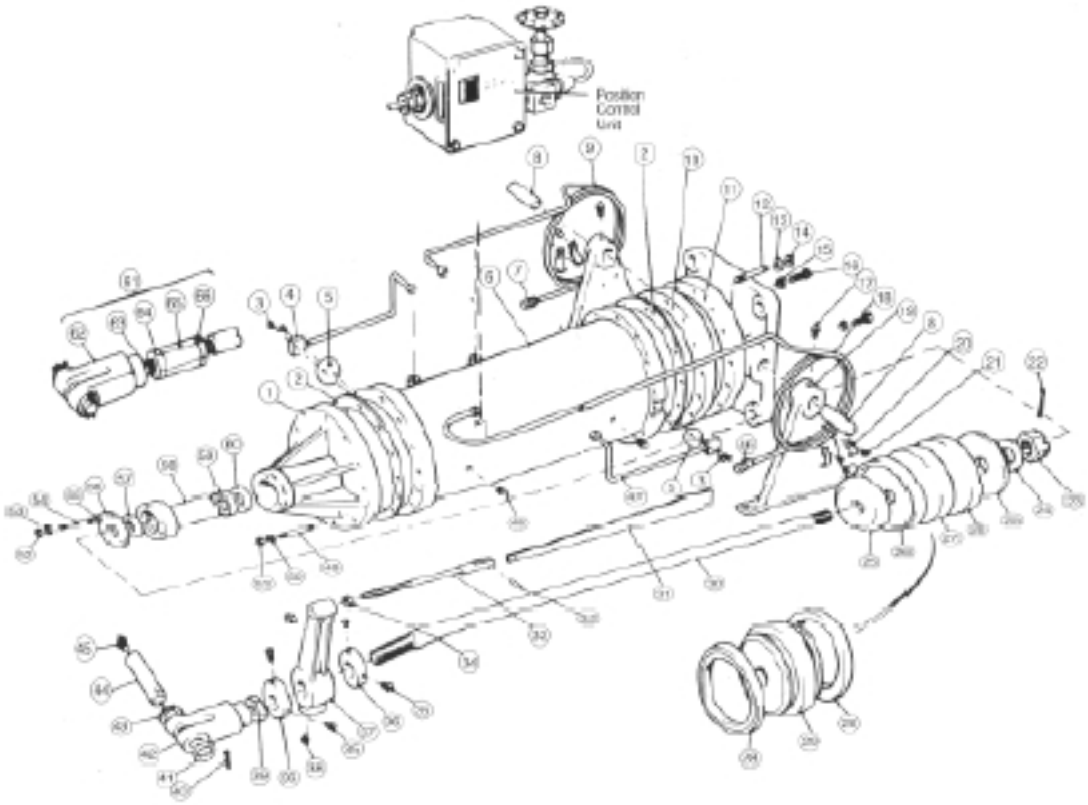


Side elevation of cylinder less turnbuckle (top) and plain view of cylinder plus turnbuckle. Extra components fitted on trunnion-mounted cylinders shown dotted

POWER CYLINDER SIZE (IN)																FIXING DETAILS (diams.)		NET WEIGHT
Bore x Stroke	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	4 Bolts	4 Holes	lb
3 x 6	12 5/16	4 1/4	4 1/4	24 1/8	24 7/8	4 3/4	10 3/4	8 1/2	6 1/8	4 1/4	4 1/4	28 3/8	± 1/2	5/8	0.623	3/8	13/32	56
3 x 12	12 5/16	4 1/4	4 1/4	30 1/8	30 7/8	4 3/4	10 3/4	8 1/2	6 1/8	4 1/4	4 1/4	34 3/8	± 1/2	5/8	0.623	3/8	13/32	62
5 1/2 x 6	16 3/4	6 5/8	6 5/8	24 3/4	25 1/2	4 3/4	13 7/8	11 3/4	9 1/4	6 5/8	6 1/2	29	± 1/2	5/8	0.623	1/2	9/16	112
5 1/2 x 12	16 3/4	6 5/8	6 5/8	30 3/4	31 1/2	4 3/4	13 7/8	11 3/4	9 1/4	6 5/8	6 1/2	35	± 1/2	5/8	0.623	1/2	9/16	140
5 1/2 x 24	16 3/4	6 5/8	6 5/8	42 3/4	43 1/2	4 3/4	13 7/8	11 3/4	9 1/4	6 5/8	6 1/2	47	± 1/2	5/8	0.623	1/2	9/16	168
7 x 12	18 7/8	8 1/2	8 1/8	35 7/8	36 7/8	6 5/8	15 5/16	14	11 1/4	8 1/8	10 1/4	42 5/8	± 1	7/8	0.998	5/8	11/16	210
7 x 24	18 7/8	8 1/2	8 1/8	47 7/8	48 7/8	6 5/8	15 5/16	14	11 1/4	8 1/8	10 1/4	54 5/8	± 1	7/8	0.998	5/8	11/16	252
10 x 24	24 1/8	12	11 1/2	53 3/8	55 7/8	7 1/8	19 1/8	20	16 1/4	11 1/2	14	61 5/8	± 1	7/8	0.998	7/8	1	588
10 x 36	24 1/8	12	11 1/2	65 3/8	66 5/8	7 1/8	19 1/8	20	16 1/4	11 1/2	14	73 5/8	± 1	7/8	0.998	7/8	1	652

For full cylinder length (piston retracted) add dimension B to dimension D. To allow access to equalizing valve add 3in to dimensions A and G. Dimension P is the mean diameter of the knuckle pin (tolerance ±0.001 in).

Dimensions D, E and M given, apply when cylinder is fully retracted. For equivalent dimensions when piston rod is fully extended add cylinder stroke.



MK.6 POWER CYLINDER

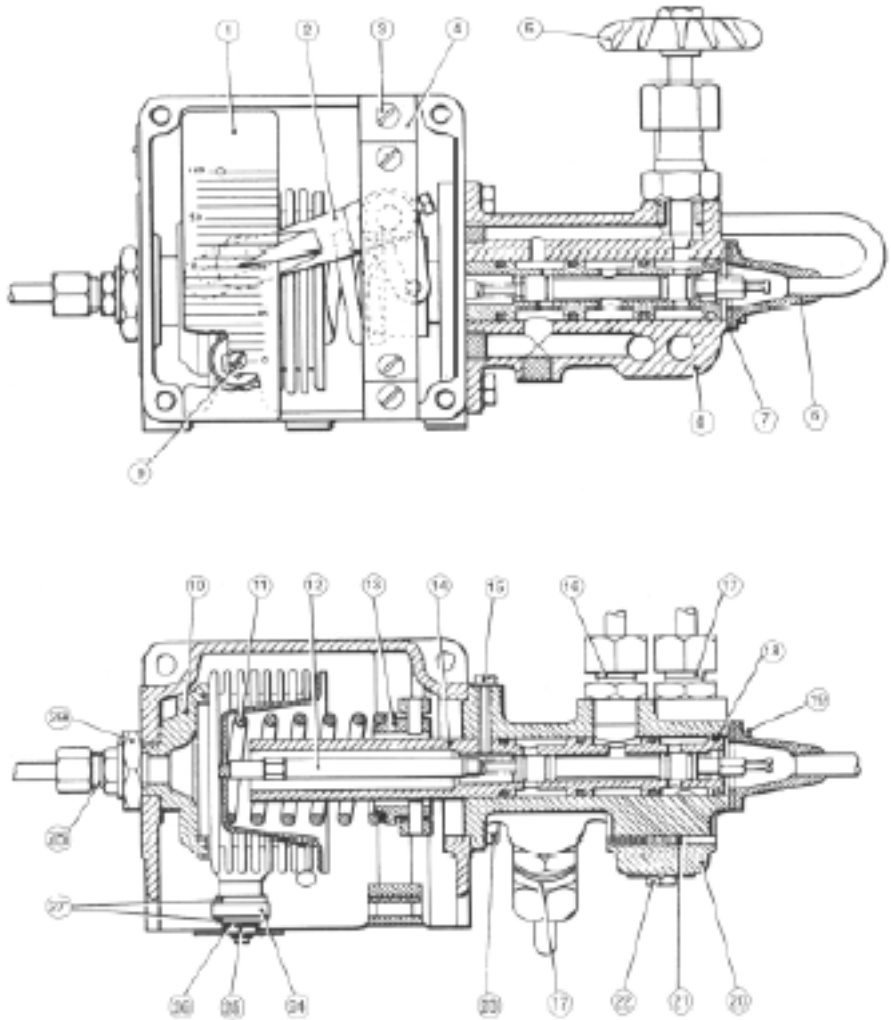
MK.6 POWER CYLINDER				
FIG. ITEM	DESCRIPTION		PART NO.	QTY.
	The following components are common to both MK' s of power cylinder unless otherwise indicated.			
1	Cylinder top cover	3in. bore	HPC0805	1
		5.5in. bore	HPG0805	1
		7in. bore	HPM0805	1
		10in. bore	HPU0805	1
2	Gasket	3in. bore	HPC0008	2
		5.5in. bore	HPG0008	2
		7in. bore	HPM0008	2
		10in. bore	HPU0008	2
3	Screw, hex.hd 2BA x $^{3}/_{4}$in.		Y3433	8
4	Connection pipe L.H.	3in. bore	HPC4009	1
		5.5in. bore	HPG4010	1
		7in. bore	HPM4008	1
		10in. bore	HPU4006	1
5	Connection washer	3in. bore, 5.5in. bore or 7in. bore	HPC0019	4
		10in. bore	HPU0019	4
6	Cylinder body	3in. bore 6in. stroke	HPC0832	1
		3in. bore 12in. stroke	HPD0832	1
		5.5in. bore 6in. stroke	HPG0832	1
		5.5in. bore 12in. stroke	HPH0832	1
		5.5in. bore 24 in. stroke	HPJ0832	1
		7in. bore 12in. stroke	HPM0832	1
		7in. bore 24in. stroke	HPN0832	1
		10in. bore 24in. stroke	HPU0832	1
		10in. bore 36in. stroke	HPW0832	1
*7	Coupling	3in. bore, 5.5in. bore or 7in. bore	Y8019	1
		10in. bore	Y8021	1
*8	Trunnion pin	3in. bore	HPC0010	2
		5.5in. bore	HPG0010	2
		10in. bore	HPU0010	2
*9	Mains inlet pipe	3in. bore 6in. stroke	HPC0817	1
		3in. bore 12in. stroke	HPD0804	1
		5.5in. bore 6in. stroke	HPG0815	1
		5.5in. bore 12in. stroke	HPH0804	1
		5.5in. bore 24in. stroke	HPJ0804	1
		7in. bore 12in. stroke	HPM0828	1
		7in. bore 24in. stroke	HPN0804	1
		10in. bore 24in. stroke	HPU0816	1
		10in. bore 36in. stroke	HPW0804	1
10	Bottom cover	3in. bore	HPC0809	1
		5.5in. bore	HPG0809	1
		7in. bore	HPM0809	1
		10in. bore	HPU0809	1
11	Mounting base	3in. bore	HPC0807	1
		5.5in. bore	HPG0807	1
		7in. bore	HPM0807	1
		10in. bore	HPU0807	1
12	Stud	3in. bore	Y0695	8
		5.5in. bore	Y0607	12
		7in. bore	Y0696	12
		10in. bore	Y0693	12
13	Washer	3in. bore	Y5001	8
		5.5in. bore	Y5002	12
		7in. bore	Y5003	12
		10in. bore	Y5005	12
14	Nut	3in. bore	Y0003	8
		5.5in. bore	Y0004	12
		7in. bore	Y0005	12
		10in. bore	Y0008	12
*15	Locknut		Y0004	2
*	For trunnion mounted power cylinders only.			

MK.6 POWER CYLINDER (Cont'd)				
FIG. ITEM	DESCRIPTION		PART NO.	QTY.
*16	Screw	3in.bore & 5.5in. bore	Y0148	2
		7in. bore	Y0149	2
		10in. bore	Y0150	2
*17	Grease nipple		YB1263	2
*18	Control pressure pipe	3in. bore 6in. stroke	HPC0803	1
		3in. bore 12in. stroke	HPD0803	1
		5.5in. bore 6in. stroke	HPG0803	1
		5.5in. bore 12in. stroke	HPH0803	1
		7in. bore 12in. stroke	HPM0803	1
		7in. bore 24in. stroke	HPN0803	1
		10in. bore 24in. stroke	HPU0803	1
		10in. bore 36in. stroke	HPW0803	1
*19	Trunnion mounting	3in. bore	HPC0811	2
		5.5in.bore	HPG0811	2
		7in. bore	HPM0811	2
		10in. bore	HPU0811	2
*20	Pipe clip, $^{1}/_{4}$in. dia.		YB4791	4
	Pipe clip, $^{5}/_{16}$in. dia.		YB4790	3
	Pipe clip, .471 in. dia.	10in. bore only	YB4792	3
*21	Screw		Y3420	7
22	Split cotter pin, $^{5}/_{32}$in. x 2in.	3in. bore & 5.5in. bore	Y5611	1
		7in. bore	Y5562	1
		10in. bore	Y5613	1
23	Slotted nut	3in. bore & 5.5in. bore	Y2030	1
		7in. bore	Y2031	1
		10in. bore	Y2032	1
24	Washer	3in. bore & 5.5in. bore	Y5007	1
		7in. bore	Y5009	1
		10in. bore	Y5011	1
25	Junk plate	3in. bore (not fitted)	–	
		5.5in.bore	HPG0007	2
		7in. bore	HPM0007	2
		10in. bore	HPU0007	2
26	Piston ring	3in. bore (not fitted, see item 26)	–	
		5.5in. bore	HPG0009	2
		7in. bore	HPM0009	2
		10in. bore	HPU0009	2
27	Backing plate	3in. bore (not fitted)	–	
		5.5in. bore	HPG0005	1
		7in.bore	HPM0005	1
		10in. bore	HPU0005	1
28	Distributor seal ext.	3in. bore only	YB1300	2
29	Piston	3in. bore only	HPC0824	1
30	Piston rod	3in. bore & 5.5in. bore, 6in. stroke	HPC0112	1
		3in. bore & 5.5in. bore, 12in. stroke	HPD0112	1
		5.5in. bore, 24in. stroke	HPJ0112	1
		7in. bore, 12in. stroke	HPM0112	1
		7in. bore, 24in. stroke	HPN0112	1
		10in. bore, 24in. stroke	HPU0112	1
		10in. bore, 36in. stroke	HPW0112	1
31	Cam –	Linear	HPC0822	1
	3in. bore, 6in. stroke only	Logarithmic concave	HPC0820	1
		Logarithmic convex	HPC0821	1
	Cam –	Linear	HPC0822	1
	5.5in. bore, 6in. stroke only	Logarithmic concave	HPG0820	1
		Logarithmic convex	HPG0821	1
	Cam –	Linear	HPD0622	1
	General, 12in. stroke	Logarithmic concave	HPD0820	1
		Logarithmic convex	HPD0821	1
*	For trunnion mounted power cylinders only			

MK.6 POWER CYLINDER (Cont'd)				
FIG. ITEM	DESCRIPTION		PART NO.	QTY.
31	Cam –	Linear	HPJ0822	1
	general, 24in. stroke	Logarithmic concave	HPJ0820	1
		Logarithmic convex	HPJ0821	1
	Cam –	Linear	HPW0822	1
	general, 36in. stroke	Logarithmic concave	HPW0820	1
		Logarithmic convex	HPW0821	1
32	Cam coupling pin		HPC0025	1
33	Cam coupling	3in. bore & 55in. bore	HPC4004	1
		7in. bore	HPM4004	
		10in. bore	HPU4004	1
34	Nut	3in. bore & 5.5in. bore	Y2002	2
		7in. bore	Y2003	2
		10in. bore	Y2004	2
(32-34)	Cam Coupling assembly	3in. bore & 5.5in. bore	HPC7004	1
		7in. bore	HPM7004	1
		10in. bore	HPU7004	1
35	Screw	3in. bore & 5.5in. bore	Y1962	4
		7in. bore & 10in. bore	Y1819	4
36	Support collar	3in. bore & 5.5in. bore	HPC0109	2
		7in. bore	HPM0109	2
		10in. bore	HPU01 09	2
37	Cam support arm assembly	3in. bore	HPC7813	1
		5.5in. bore	HPG7813	1
		7in. bore	HPM7813	1
		10in. bore	HPU7813	1
37	Cam support arm	3in. bore	HPC0850	1
		5.5in. bore	HPG0850	1
		7in. bore	HPM0850	1
		10in. bore	HPU0850	1
38	Grease nipple		YB1263	1
39	Nut	3in. bore & 5.5in. bore	Y2006	1
		7in. bore	Y2034	1
		10in. bore	Y2035	1
40	Split cotter pin	$^{3}/_{32}$in. x 1 in. 3in. bore & 5.5in. bore	Y5553	1
		7in. bore & 10in. bore	Y5614	1
41	Washer	3in. bore & 5.5in. bore	Y5006	1
		7in. bore & 10in. bore	Y5009	1
42	Knuckle	3in. bore & 5.5in. bore	HPC0815	1
		7in. bore	HPM0815	1
		10in. bore	HPU0815	1
(39 & 42)	Knuckle Assembly	3in. bore & 5.5in. bore	HPC7815	1
		7in. bore	HPM7815	1
		10in. bore	HPU7815	1
43	Circlip	3in. bore & 5.5in. bore	HPC0027	1
		7in. bore & 10in. bore	HPM0027	1
44	Knuckle pin	3in. bore & 5.5in. bore	HPC0028	1
		7in. bore & 10in. bore	HPM0028	1
45	Grease nipple		YB1263	1
(40, 41 & 43-45)	Knuckle pin assembly	3in. & 5.5in. bore	HPC7028	1
		7in. & 10in. bore	HPM7028	1
*46	Coupling – Metric (6mm)		Y8018	1
*	For trunnion mounted power cylinders only			

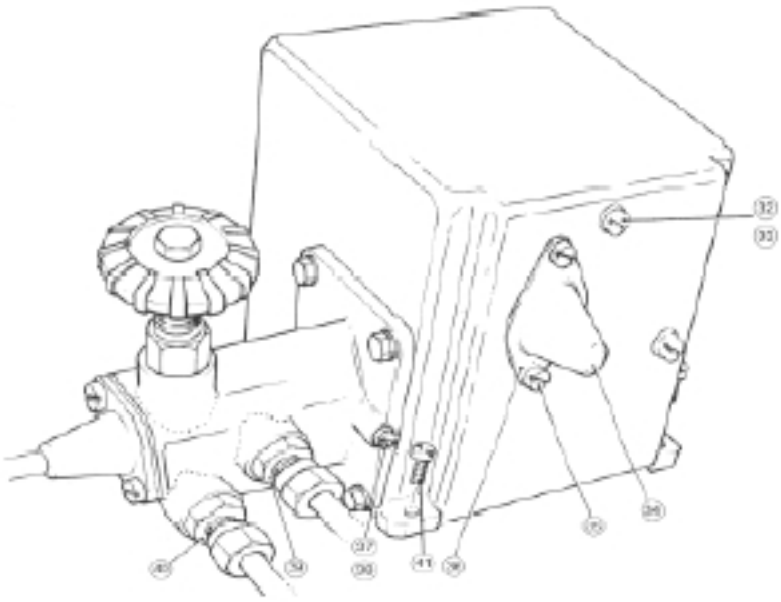
MK.6 POWER CYLINDER (Cont'd)				
FIG. ITEM	DESCRIPTION		PART NO.	QTY.
47	Connection pipe R.H.	3in. bore, 6in. stroke	HPC4008	1
		3in. bore, 12in. stroke	HPD4006	1
		5.5in. bore, 6in. stroke	HPG4011	1
		5.5in. bore, 12in. stroke	HPH4006	1
		5.5in. bore, 24in. stroke	HPJ4006	1
		7in. bore, 12in. stroke	HPM4009	1
		7in. bore, 24in. stroke	HPN4006	1
		10in. bore, 24in. stroke	HPU4007	1
		10in. bore, 36in. stroke	HPW4006	1
48	Grease nipple (covered)		HPC0029	2
49	Stud	3in. bore	Y0694	8
		5.5in. bore	Y0698	12
		7in. bore	Y0697	12
		10in. bore	Y0625	12
50	Washer	3in. bore	Y5001	8
		5.5in. bore	Y5002	12
		7in. bore	Y5003	12
		10in. bore	Y5005	12
51	Nut	3in. bore	Y0003	8
		5.5in. bore	Y0004	12
		7in. bore	Y0005	12
		10in. bore	Y0008	12
52	Locknut	10in. bore only	Y2023	3
53	Nut	3in. bore & 5.5in. bore	Y2000	3
		7in. bore 8 10in. bore	Y2002	3
54	Stud	3in. bore 8 5.5in. bore	Y2611	3
		7in. bore	Y2612	3
		10in. bore	Y2606	3
55	Washer	3in. bore	Y5001	8
		5.5in. bore	Y5002	12
		7in. bore	Y5003	12
		10in. bore	Y5005	12
56	Gland cover plate	3in. bore & 5.5in. bore	HPC0034	1
		7in. bore	HPM0014	1
		10in. bore	HPU0014	1
57	Piston rod wiper	3in. bore & 5.5in. bore	HPC0110	1
		7in. bore	HPM0110	1
		10in. bore	HPU0110	1
58	Gland bush	3in. bore & 5.5in. bore	HPC0111	1
		7in. bore	HPM0111	1
		10in. bore	HPU0111	1
59	Distributor seal (INT.)	3in. bore & 5.5in. bore	YB1298	1
		7in. bore	YB1299	1
	or Gland packing	10in. bore	YBM0666	1
60	Gland spacer	5.5in. bore	HPG0021	1
61	Turnbuckle assembly	3in. bore & 5.5in. bore	HPC7006	1
62	Cast Knuckle		HPC0815	1
63	Shank		HPC0030	1
64		Nut 3/4in. B.S.F. (left-hand)	Y2044	1
65		Turnbuckle	HPC0031	1
66		Nut, in. B.S.F. (right-hand)	Y2006	1
61	Turnbuckle assembly	7in. bore	HPM7006	1
62		Cast Knuckle	HPM0815	1
63		Shank	HPM0063	1
64		Nut, 1in. B.S.F. (left-hand)	Y2045	1
65		Turnbuckle	HPM0062	1
66		Nut, 1in. B.S.F. (right-hand)	Y2034	1

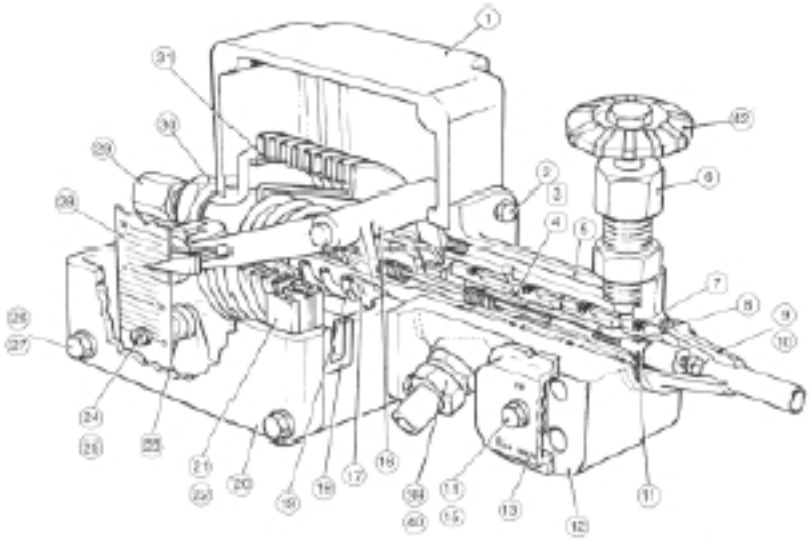
MK.6 POWER CYLINDER (Cont'd)				
FIG. ITEM	DESCRIPTION		PART NO.	QTY.
61	Turnbuckle assembly	10in. bore	HPU7025	1
62		Cast Knuckle	HPU0815	1
63		Shank	HPU0024	1
64		Nut, 11/4in. B.S.F. (left-hand)	Y2046	1
65		Turnbuckle	HPU0025	1
66		Nut, 1/4in. B.S.F. (right-hand)	Y2035	1
† 67	Gaiter (MK.6 power cylinder only)			
		3in. & 5.5in. bore, 6in. stroke	HPP0133	1
		associated hose clips	YB3000	1
			YB3009	1
		3in. 8 5.5in. bore, 12in. stroke	HPP0134	1
		associated hose clips	YB3000	1
			YB3009	1
		3in. & 5.5in. bore, 24in. stroke	HPP0135	1
		associated hose clips	YB3000	1
			YB3009	1
		7in. bore, 12 in. stroke	HPP0136	1
		associated hose clips	YB3007	1
			YB3008	1
		7in. bore, 24in. stroke	HPP0137	1
		associated hose clips	YB3007	1
			YB3008	1
		10in. bore, 24in. stroke	HPP0138	1
		associated hose clips	YB2995	1
			YB3008	1
		10in. bore, 36in. stroke	HPP0139	1
		associated hose clips	YB2295	
			YB3008	
†	Cam cover	5.5in bore, 24in. stroke	HPJ0003	1
		7in. bore, 24in. stroke	HPJ0003	1
		10in. bore, 24in. stroke	HPJ0003	1
		10in. bore, 36in. stroke	HPW0003	1
†	Bolt	5.5in., 7in., 10in. bore, 24in. stroke	Y2140	4
		10in. bore, 36in. stroke	Y2140	6
†	Washer	5.5in., 7in., 10in. bore, 24in. stroke	Y5001	4
		10in. bore, 36in. stroke	Y5001	6
		Nut 5.5in., 7in., 10in. bore, 24in. stroke	Y2000	4
		10in. bore, 36in. stroke	Y2000	6
†	Air filter	3in., 5.5in. & 7in. bore	PCA4804	1
†	Air filter	10in. bore	YB1070	1
†	Not illustrated			



MK.6 POSITION CONTROL UNIT

MK.6 POSITION CONTROL UNIT			
FIG. ITEM	DESCRIPTION	PART NO.	QTY.
1	Regulator position scale	HPP0055	1
2	Bell-crank assembly	HPP7811	1
	Roller bearing	HPP0015	1
	Bearing washer	HPP0017	2
	Bearing clamp screw	HPP0045	1
	Pointer	HPP0052	1
	Spindle (order separately)	HPP1022	1
	Bell-crank	HPP0811	1
	Circlip	Y1454	1
	Screw, 2BA x $^{5}/_{16}$in. hex. hd. (steel)	Y3175	1
	Insert (pin)	YB0041	1
3	Screw, 2BA x 3/8in. csk. hd (steel)	Y3438	1
4	Cam guide assembly	HPP7046	1
	Bell-crank strut	HPP0012	1
	Bearing strip spacer	HPP0046	2
	Inner bearing strip	HPP0047	1
	Outer bearing strip	HPP0048	1
	Screw, 2BA x $^{3}/_{4}$in. csk. hd. Cr. plt. (brass)	Y3498	2
	Locknut 2BA (brass Cr. plt.)	Y3036	2
5	Needle equalising valve	YA4003	1
6	End cover assembly (includes item 19)	HPP7013	1
7	End cover washer	HPP0059	1
8	Valve block assembly	HPP4814	1
9	Screw, 6BA x $^{1}/_{4}$in. ch. hd. (brass Cr. plt.)	Y3240	1
	Washer, 6BA (brass Cr. plt.)	Y5047	1
10	Bellows assembly	HPP4014	1
11	Control spring	HPP0010	1
12	Pilot valve assembly	HPP7128	1
	Space tube	HPP0126	1
	Spring retaining bush	HPP0127	1
	Setscrew 6BA x $^{1}/_{8}$in. hex.skt	Y1769	2
	Connecting rod assembly	HPP4128	1
	Adjustment spring	HPP0131	1
	Pilot valve	HPP0019	1
	Pilot valve adjustment nut	HPP0020	1
	Locking screw 6BA x $^{7}/_{8}$in. ch. hd.	Y3497	1
13	Spring pad	HPP0050	1
14	Valve liner (including item 18) (Up to and inc. 7in. bore)	HPP7808	1
15	Screw 2BA x 1 in. ch. hd. (steel cd. plt.)	Y3157	1
	Washer shakeproof 2BA (steel cd. plt.)	Y5053	1
16	Coupling $^{3}/_{8}$in. B.S.P. x 8mm O.D. (Up to and inc. 7in. bore)	Y8057	1
17	Coupling $^{3}/_{8}$in. B.S.P. x 8mm O.D. (Up to and inc. 7in. bore)	Y8057	2
18	O-ring	NPH0052	4
19	Screw, 4BA x $^{5}/_{16}$. ch.hd. (steel cd. plate)	Y3212	4
20	Changeover plate	HPP0095	1
21	Sealing washer	HPP0096	1
22	Screw, $^{1}/_{4}$in. -28 UNF x $^{7}/_{8}$in. hex.hd. (steel cd. plt.)	YU1415	1
	Washer $^{1}/_{4}$in. (steel cd. plt.)	Y5001	1
23	Screw $^{1}/_{4}$in. -20 UNF x $^{1}/_{2}$in. hex.hd. (steel cd. plt.)	YU6400	4
	Washer $^{1}/_{4}$in. (steel cd. plt.)	Y5001	4
24	Roller bearing	HPP0015	1
25	Bearing clamp screw	HPP0054	1
26	Washer 1/4in. (Brass cr. plt.)	Y5019	1
27	Bearing washer	HPP0017	2
28	Coupling 1/4in. B.S.P. x 6mm O.D.	Y8053	1
29	Backnut 1/2in. B.S.P.	Y6412	1
	The following assembly is not illustrated		
	Cover plate assembly	HPP7823	1
	Cover screw	YU5101	4
	Cover washer	Y5001	4





MK.6 POSITION CONTROL UNIT

MK.6 POSITION CONTROL UNIT (INC. PARTS NOT LISTED ON PREVIOUS DIAGRAM)			
FIG. ITEM	DESCRIPTION	PART NO.	QTY.
	MK.6 Position control unit complete		
	3in., 5.5in. & 7in. bore	HPP4819	1
	10in., bore	HPP4820	1
1	Mechanism case and bush assembly	HPP7812	1
	Bush	YB0124	
2	Screw, hex/hd., steel 1/4in. UNC x 1/2in.	YU6400	4
3	Washer 1/4in.	Y5001	4
4	Valve liner		
	(Up to and including 7in. bore)	HPP0808	1
	(10in. bore)	HPP0807	1
5	Valve block assembly	HPP4814	1
6	Equalising needle valve assembly	YA4003	1
7	O-ring seals	NPH0052	4
8	End-cover washer	HPP0059	1
9	End-cover	HPP4013	1
10	Screw chlhd. 4BA x 5/18in. steel	Y3212	2
11	Pilot valve assembly complete	HPP7128	1
12	Changeover plate sealing washer	HPP0096	1
13	Changeover plate	HPP0095	1
14	Screw hex/hd. 1/4in. UNF x 7/8in.	YU1415	1
15	Washer 1/4in.	Y5001	1
16	Bell-crank assembly	HPP7811	1
17	Control-spring pad	HPP0050	1
18	Cam guide	HPP0124	2
19	Control spring	HPP0010	1
20	Cover-plate assembly	HPP7813	1
21	Cam guide and bearing assembly	HPP7046	1
22	Screw csk/hd. 2BA x 3/8in.	Y3438	2
23	Cam guide roller (fixed) assembly	HPP7016	1
24	Screw chlhd., 6BA x 1/4in.	Y3240	1
25	Washer 6BA	Y5047	1
26	Screw hex/hd. 1/4in. UNC x 3/4in.	YU5101	4
27	Washer 1/4in.	Y5001	4
28	Position scale	HPP0055	1
29	Pipe connection 1/4in. BSP x 6mm O.D.	Y8053	1
30	Back nut 1/2in. BSP	Y6412	1
31	Bellows assembly	HPP4014	1
32	Screw chlhd. 4BA x 1/4in. steel	Y3207	2
33	Washer 4BA	Y5039	2
34	Bell crank spindle cover	HPP0056	1
35	Screw chlhd. 4BA x 3/16in. steel	Y3212	2
36	Cover washer	HPP0059	1
37	Screw chlhd. 2BA x 1 in.	Y3157	1
38	Shakeproof washer	Y5053	1
39 & 40	Pipe connection (For up to and including 7in. bore)		
	3/8in. BSP x 8mm O.D.	Y8057	3
†	Pipe connection (For 1 Oin. bore)		
	3/8in. BSP x 12mm O.D.	Y8062	3
41	Mounting bolt (external) - slotted head	Y0391	2
42	Handwheel	YA0088	1
	Mounting bolt (internal) - hex. head	Y0117	1
†	Not illustrated		

OPERATING AND MAINTENANCE

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1. INTRODUCTION

1.1 GENERAL

The KENT power cylinder consists basically of a cylinder-and- piston, process-control regulator actuator with a position control unit attached to the side of the cylinder.

The power cylinder has been designed to operate as the process regulator actuator in a pneumatic control system, its function being to position the process regulator in accordance with the controller output signal 31bf/in^2 to 1 51bf/in^2, 20kPa to 100kPa or 0.2kgf/cm^2 to 1.0kgf/cm^2. Examples of process regulators may include dampers, butterfly valves, shunt regulators furnace burner nozzles etc.

1.2 TECHNICAL DESCRIPTION

1.2.1 Principle of Operation

The power cylinder and position control unit together form a complete position controller in that the received control pressure signal is converted, by means of an independent high-pressure air supply (up to 150lbf/in^2 or 10kgf/cm^2) into an equivalent regulating-unit position. The position control unit is supplied for either a linear or a logarithmic control-signal to piston-position relationship in accordance with the characteristics of the process regulator; also this relationship may be either direct or reverse: i.e. a rise in control signal pressure will cause the piston rod to either extend or retract.

An equalizing valve permits the regulator and power cylinder to be operated manually in the event of air failure. The unit operates on the force balance principle in that the control signal, via a bellows, balances the force of a control spring compressed in accordance with the piston position. A pilot valve connected to the bellows directs high pressure air to one side or other of the piston to move it in the desired direction until the forces applied to the control spring are balanced. At the balance position the pilot valve is closed and the piston is in the steady state condition. Thus, any particular control signal pressure will result in a definite piston position within the cylinder.

In detail the unit operates as follows. Reference should be made to Fig. 1 which shows in diagrammatic form a power cylinder and position control unit in which an increase in control pressure causes the piston rod to retract. An increase (say) in the value of the control signal pressure causes the following events to take place. The increased pressure extends the bellows which, via the link repositions the spool of the pilot valve with respect to the ports, opening one port to the high pressure air supply and the other to atmosphere.

High pressure air now enters one end of the cylinder and the opposite end is vented to atmosphere thus causing the piston to move along the cylinder and retract the piston rod. The cam, attached to and moving with the piston rod, repositions the bell-crank to compress the control spring against the bellows force. As the piston rod continues to retract, the cam causes the bell-crank to further increase the control spring compression until finally the spring force and bellows force balance; at this point the pilot valve spool, because of its connection to the bellows, will be at the central, neutral position, both valve ports will be closed and the power cylinder in the revised position.

A decrease in control signal pressure value will have the opposite effect to that given above, this time a retraction of the bellows moves the valve spool in the opposite direction, causing the piston rod to extend and the cam to cause the bell-crank to reduce the control spring force until the balance is again achieved.

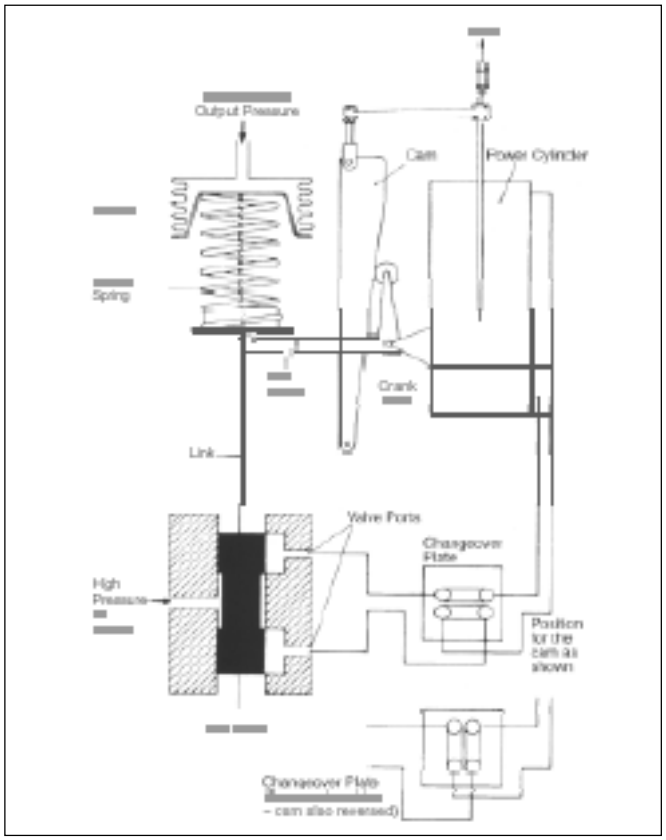


FIG. 1 DIAGRAMMATIC LAYOUT OF POWER CYLINDER AND POSITION CONTROL UNIT

Should the piston be subject to a restraining force, (within the designed thrust of the power cylinder) its movement will not be prevented as the pilot valve will remain open, increasing the pressure in the cylinder to overcome the restraining force, until the piston is in the required position with respect to the control signal pressure.

1.2.2. Direction of Operation

The position control unit can be arranged so that the power cylinder piston rod either retracts or extends for any given change in control signal pressure, by reversing the pilot valve connections to the cylinder and reversing the cam.

Reversal of the pilot valve connection to the cylinder is achieved by re-positioning a two-position changeover plate mounted on the pilot valve block.

The complete procedure for changing direction of operation is given in section 4.5.

1.2.3 Cam Characteristics

The cam may be either straight-edged as in Fig. 1 in which case the relationship between control signal and cylinder position is linear, or curved (concave or convex) to produce a logarithmic relationship. The logarithmic cam may be necessary in certain applications because of the process regulator characteristics.

The cam arrangements and configurations for specific power cylinder actions are given in Fig. 6.

1.2.4 Speed of Response

The shape of the pilot valve ports affect the speed of response of the power cylinder for a given change in control pressure. For this reason circular valve ports are used on power cylinders of up to and including 7 inch bore and square ports are used for cylinders of 10 inch bore. A small movement of the pilot valve piston will reveal only a small sector of a circular valve port but the same movement would reveal the full width of a square port resulting in a larger airflow; more suitable for the larger capacity cylinder, in the latter case.

1.2.5 Air Consumption

Under steady-state conditions the power cylinder air consumption, because of pilot valve leakage, is approximately 1.2ft^3/min (n.t.p.) (0.034M^{3}min). Under stroking conditions the air consumption of the power cylinder depends largely on plant conditions i.e. the number of reversals for a given time period and the static load applied to it. The air consumptions given in the following table are based on 20 stroke reversals per hour at a pressure of 100lbf/in^2 (7.0kgf/cm^2).

Power Cylinder Size		Air Consumption (n.t.p.)	
Bore (in inches)	**Stroke (in inches)**	**ft^3/min**	**m^3/min**
3	6	1.3	0.037
3	12	1.35	0.038
$5^1/_2$	6	1.4	0.040
$5^1/_2$	12	1.65	0.047
$5^1/_2$	24	2.0	0.057
7	12	1.9	0.054
7	24	2.6	0.074
10	24	4.0	0.103
10	36	5.5	0.156

1.2.6 Control Pressure Indicator

A pointer visible through the window of the position control unit cover gives, in terms of percentage, the control signal output pressure. The scale is reversible so that the markings may bear the correct relationship to pressure should the direction of operation of the cylinder be changed.

2. ERECTION

2.1 SAFETY MEASURES

WARNING: IN ORDER TO ENSURE OPERATOR SAFETY AND PLANT SAFETY IT IS IMPORTANT THAT:–

a) installation is carried out by suitably trained personnel

b) before selecting a location and installing the power cylinder all the relevant sections of this manual are read and the requirements of all associated equipment considered.

c) recommended pressures are not exceeded, that all piping and pressure connections are fitted correctly to give reliable pressure tight joints.

d) the power cylinder is securely mounted by one of the methods specified in paragraph 2.3.

e) if an electrical transmitter or limit switches are fitted normal safety precautions must be taken to avoid the possibility of electric shock.

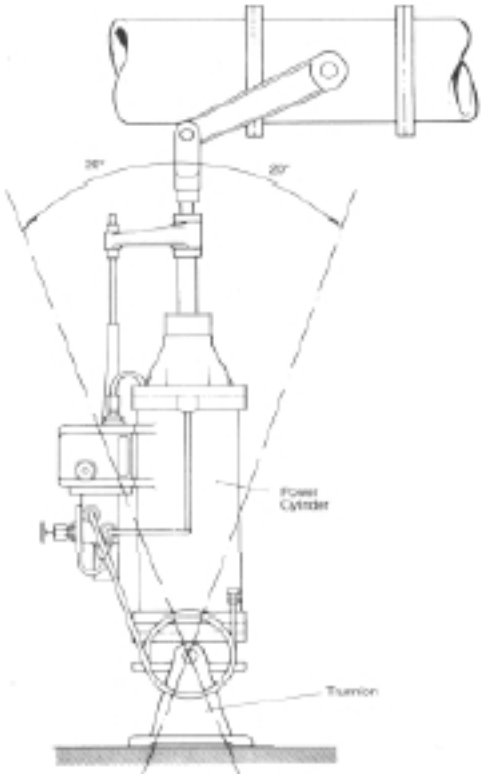


FIG. 2 TRUNNION MOUNTED POWER CYLINDER

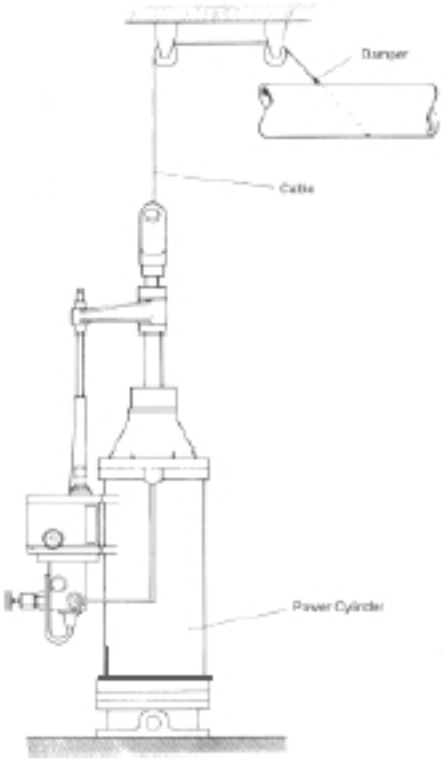


FIG. 3 END MOUNTED POWER CYLINDER

2.2 LOCATION

The following factors must be considered when selecting a location for the power cylinder.

a) The location must be such that accurate alignment of the linkage between power cylinder and process regulator unit is obtained.

b) The power cylinder and position control unit must be accessible for routine maintenance.

c) The position selected should be as clean and dry as possible and with an ambient temperature not exceeding 130°C (266°F).

2.3 MOUNTING

The power cylinder is supplied for trunnion mounting (see Fig. 2) or end mounting (see Fig. 3).

2.3.1 Trunnion Mounting (Fig. 2)

With this method the power cylinder is supported on trunnion bearings which permit self-alignment (in one plane) with the regulating unit linkage. The trunnion brackets must be bolted to a solid foundation.

The following points must be observed when mounting the power cylinder

a) The trunnion bracket must be arranged so that the trunnion pins are in a horizontal plane.

b) The position of the brackets must be such that the cylinder is not strained against either bracket when in operation.

c) The trunnion mounting position for $5^1/_2$" x 24", 7" x 24" and for all 10" bore cylinders must not be allowed to vary by more than 20° either side of the vertical whether the cylinder is mounted upright or inverted. Other sizes with shorter strokes may be mounted horizontally if required.

2.3.2 End Mounting (Fig. 3)

This method of mounting is shown in Fig. 3, the cylinder being supported on an end mounting plate which is bolted to a solid foundation.

2.4 PNEUMATIC CONNECTIONS

Two pneumatic connections are required to the position control unit: one from the controlling instrument for the 3lbf/in2 to 151bf/in2, 20kPa to 100kPa or 0.2kgf.cm^2 to 1.0kgf/cm^2 control signal and the other for the high pressure air supply driving the power cylinder.

The connection for the controller signal is at the union at the end of the position control unit case toward the piston end of the power cylinder. The union is suitable for 6mm O.D. copper pipe.

The high pressure air connection is located on the pilot valve block of the position control unit. The union size for this connection is as follows:-

a) 3 inch, 5.5 inch and 7 inch bore power cylinders – 8mm O.D. copper pipe.

or

b) 10 inch bore power cylinder - 12mm O.D. copper pipe.

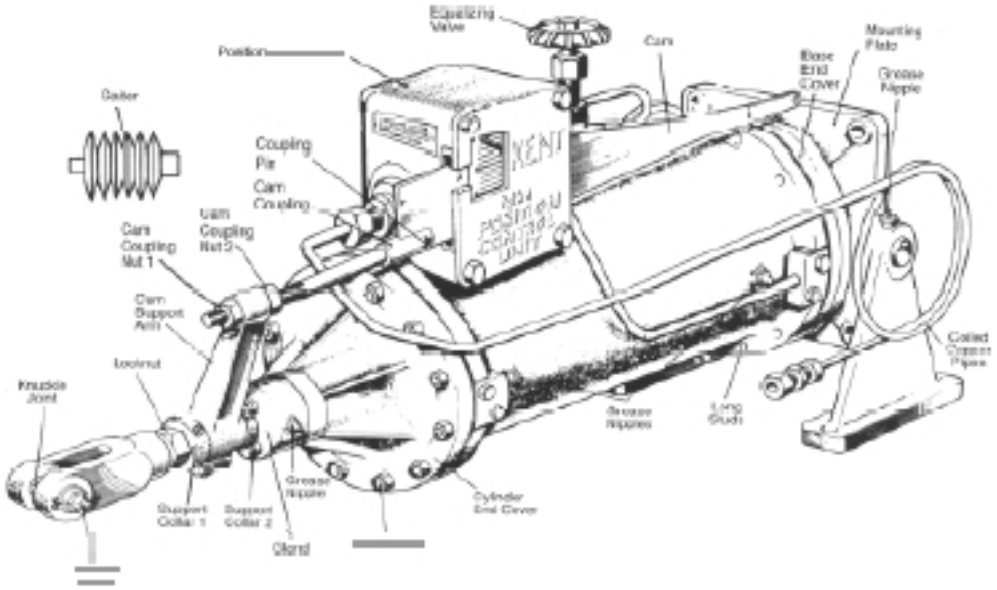


FIG. 4 POWER CYLINDER AND POSITION CONTROL UNIT

For end mounted power cylinders the connections are made directly to the unions at the position control unit.
For trunnion mounted power cylinders the connections are made to the free ends of the coiled copper pipes connected to these unions. (Fig. 4).

2.5 AIR FILTERS (High Pressure Air Supply)

Mount the air filter as close as possible to the power cylinder. Connect a clean dry air supply of not more than 150lbf/in^2 (10kgf/cm^2) to the filter inlet connection. Connect the filter outlet to the high pressure air supply union (Fig. 5) of the power cylinder.

2.6 CONVOLUTED GAITER

The convoluted gaiter is made from a neoprene rubberised fabric and is fitted to a power cylinder to stop the ingress of dust, dirt water or any other foreign matter. If a gaiter is required it is normally fitted by the manufacturer but if, because of exceptional circumstances, it becomes necessary to fit a gaiter at a later stage the following

instructions will assist the operation.

Note: The fitting of a gaiter is simplified if the task is performed under workshop conditions. If. however, this is not possible and the gaiter has to be fitted with the power cylinder sited on the plant ensure that all necessary safety precautions are implemented before proceeding.

To fit a gaiter to a power cylinder necessitates the removal of the knuckle joint and cam coupling arm. Theoretically, this will mean that the power cylinder will need re-aligning but if care is taken during the removal procedure this can be avoided. If however re-alignment is necessary refer to paragraph 4.4.1.

Refer to Fig. 4 and proceed as follows:-

a) Disconnect the linkage to the process regulating unit at the power cylinder knuckle joint.

b) Unscrew the locknut which secures the knuckle joint.

c) Remove the knuckle joint and the locknut.

d) Withdraw the piston to its fullest extent.

e) Use a pencil to indicate on the cam its position as it passes through the position control unit; this is to assist the reassembly procedure.

f) Unscrew the setscrews of the support collar (1) and remove the support collar.

Note: Do not disturb the remaining support collar (2); this will assist the reassembly procedure.

g) Unscrew and remove the cam coupling nut (1).

Note: Do not disturb the remaining cam coupling nut (2).

h) Remove the cam support arm.

j) Select the appropriate gaiter and slide the larger end of the gaiter over the extended piston and then position it over the boss of the cylinder end cover.

k) Secure the larger end of the gaiter with the appropriate hose clip (see Illustrated Parts Manual).

l) Position the smaller end of the gaiter on the support collar (2) and secure with the appropriate support clip.

m) Refit the cam support arm to abutt the support collar (2) and cam coupling nut (2).

n) Replace the cam coupling nut (I) and the support collar (I)

o) Check that the pencil marks on the cam (made prior to dis-assembly) align correctly with the position control unit.

p) Replace the locknut and knuckle joint.

3. PUTTING INTO SERVICE

Observe SAFETY MEASURES – WARNING as detailed in paragrah 2.1

3.1 LUBRICATION (Fig. 4)

All greasing points must be given an initial charge of high temperature. The grease nipples are located as follows:

a) One at each end of the cylinder wall.

b) In the piston rod gland bearing.

c) On the knuckle joint.

d) On the cam coupling arm bearing at the piston rod.

e) On the trunnion bearing (if the cylinder is trunnion mounted).

Note: When greasing the cylinder wall (point a) above) the piston must be at that end of the cylinder to which the grease gun is applied.

3.2 COMMISSIONING

Thoroughly check that the power cylinder is securely mounted in the correct position, that all pneumatic and any electrical connections have been correctly and securely made, that mechanical linkage or connections to the piston rod knuckle joint are correctly aligned and will operate the regulating unit correctly without binding or excessive friction.

Commission the power cylinder as follows:

a) Slowly open the air filter inlet valve.

b) Vary the control signal pressure from the controlling instrument via its manual control valve (or reducing valve) and check that the direction of operation of the power cylinder is as required. If it is found to be necessary to reverse the direction of operation carry out the procedure given in Section 4.5.

c) Complete the commissioning of the control system in accordance with the instructions supplied with the controlling instrument.

Note: The equalizing valve must always be fully closed when the power cylinder is in operation.

4. MAINTENANCE

Observe SAFETY MEASURES – WARNING as detailed in paragrah 2.1.

CAUTION: The following maintenance operations must be carried out when the plant is out of commission, or if this is not possible, with the equalizing valve on the position control unit open, the high pressure air supply switched off and the process regulator under local manual control.

4.1 LUBRICATION

Regular lubrication is essential for the efficient operation of the power cylinder and position control unit and should be carried out at monthly intervals.

Apply grease to all greasing points as described in Section 3.1.

4.1.1 Bell-Crank

Apply molybdenum grease sparingly to the following points in the position control unit, after first turning off the high pressure air supply and removing the unit top cover.

a) The bell-crank spindle bearing, immediately behind the front cover (the other spindle bearing is self lubricating).

b) The bell-crank pins at the base of the spring pad.

4.1.2 Cam Rollers

The fixed and follower roller bearings in the position control unit are packed with grease during assembly and should not require further attention. If however after prolonged service the rollers cease to rotate freely, dismantle them from the unit, thoroughly flush with petrol and repack with molybdenum disulphide grease. After refitting the rollers, position the follower roller at the centre of its adjustment slot and reset the position control unit alignment as described in Section 4.4.1.

4.1.3 Pilot Valve

Provided that the air filter is working efficiently the pilot valve should not require attention. If the valve has been ismantled the valve block, changeover plate, spool valve and liner should be carefully washed in clean paraffin, care being taken not to damage the liner bore. Lightly oil the piston with good quality clock-oil before reassembly.

4.2 AIR FILTER

The air filter drain should be opened at regular intervals and the air allowed to escape until all moisture is removed. The frequency of this will depend on the cleanliness of the supply.

4.3 GLAND LEAKAGE (Fig. 4)

4.3.1 3”, 5.5” and 7” Bore Power Cylinders

If after considerable service the gland shows signs of leakage, the gland seal should be removed and a new one fitted as follows:

a) Switch off the air supply and place the plant under local manual control.

b) Disconnect the knuckle from the regulator or regulator linkage and remove the knuckle, locknut and (if fitted) turnbuckle assembly from the piston rod.

c) Open the equalizing valve and push the piston rod into the cylinder as far as it will go. Undo the outer cam-coupling nut and, holding the cam-coupling arm, withdraw the piston rod sufficiently to free the arm from the coupling rod.

d) Note or mark the position of the support collars relative to the piston rod. Loosen the clamp screws on both support collars and carefully slide both collars and coupling arm from the piston rod.

e) Remove the three locknuts, nuts and washers from the gland bush and slide the gland bush assembly (bush, scraper ring and cover) from the rod.

f) Retrieve the worn seal from within the gland.

g) Carefully fit the new seal on to the piston rod, hollow face toward the cylinder and slide into the gland. Follow it in with the gland bush assemblies, pushing the bush fully home into position over the three studs and secure the assembly with the three washes, nuts and locknuts.

Reassembly of the remaining parts is a reversal of the procedure given in b) and d) above. Care must be taken that tthe coupling arm is replaced with the perpendicular face of the arm towards the cylinder and in the correct position along the piston rod. (See d) above).

After reassembly reset the position control unit alignment as described in Section 4.4.1.

4.3.2 10” Bore Power Cylinder

If leakage occurs at the piston rod gland, tighten the three nuts located on the gland bush evenly by an amount just 7 sufficient to prevent leakage; over-tightening the nuts will cause excessive gland friction.

4.3.3 Leaking Equalizing Valve Gland

Tighten the upper gland nut until leakage stops.

Do not over-tighten the gland.

4.3.4 Renewing the Equalizing Valve Gland Packing

Turn off the high pressure air supply to the power cylinder.

a) Hold the valve handle and with a spanner (9/16" A.F.) remove the handle retaining nut. Leave the handle in position.

b) Open the valve and completely unscrew the gland nut.

c) Continue opening the valve until the valve spindle may be removed from the valve body.

d) Lift off the handle and remove the gland sleeve and old packing. Place a new gland packing in position and follow with the sleeve and then the gland nut.

e) Replace the handle and lightly secure with the retaining nut. Screw the spindle into the valve as far as it will go and then screw down the gland nut until resistance is felt. Tighten the handle retaining nut.

f) Switch on the high pressure air and tighten the gland nut until it no longer leaks. Do not over-tighten.

4.4 POSITION CONTROL UNIT (Fig. 5)

4.4.1 Setting the Position Control Unit Alignment

The alignment is correctly set before despatch. If after some considerable service or after maintenance it is required to check or reset the alignment of the unit, proceed as follows:

a) Turn off the high pressure air supply to the position control unit.

b) Remove the top cover, indicator scale and end cover.

c) Disconnect the linkage to the process regulating unit at the power cylinder knuckle joint.

d) Open the equalizing valve and move the piston by hand to one end of its stroke until it is felt to contact the end cover. Position the cam via the locking nuts until the follower roller is just on the operating profile of the cam i.e. at point A or point B as shown in Fig. 4.

e) Turn on the high pressure air supply and close the equalizing valve. Set the controlling instrument to MANUAL and apply a control signal pressure of 3lbf/in^2, 20kPa 0.2kgf/cm^2 using the instrument reducing valve. Turn the pilot valve adjusting nut until the power cylinder piston is just clear of the cylinder end cover. Lock the adjusting nut in position via the locking screw.

f) Check for friction by slowly increasing the control signal pressure to 9lbf/in^2, 60kPa or 0.6kgf/cm^2 and note the position of the piston by measuring the piston rod protrusion from the gland. Increase the pressure by approximately 3lbf/in^2, 20kPa or 0.2kgf/cm^2, and then return the pressure to its previous value. Again measure the piston rod protrusion; both measurements should agree to within 1/2% of full piston travel. If outside this limit, check for excessive friction between the pilot valve spool and bore or the power cylinder piston and bore. Check lubrication at these points.

g) Full piston travel must be obtained over the control pressure range of 3lbf/in^2 to 15lbf/in^2 + 0.1lbf/in^2, 2 0 k P a t o 100kPa + 0.7kPa or 0.2kgf/cm2 to 1.0kgf/cm2 + 0.007kgf/cm2 with the power cylinder unladen. Apply a 15lbf/in2, 100kPa or 1 .0kgf/cm^2 control signal and check that the power cylinder has the full unladen travel.

h) If the piston travel is short, slacken the screw securing the follower roller and move the roller outwards along the bell-crank arm. Move the roller inwards if the power cylinder travel is too long. Tighten the screw. Reduce the control pressure signal to zero and when the piston has reached the end of its travel turn off the high pressure air supply. Increase the control pressure to 9lbf/in^2, 60kPa or 0.6kgf/cm^2 to move the pilot valve and vent the cylinder to atmosphere. Repeat steps d), e), f), g) and h) until the correct piston travel is obtained.

j) Repeat the friction test as in operation f) at 4lbf/in^2 and 14lbf/in^2, 25kPa and 95kPa or 0.25kgf/cm^2 and 0.95kgf/cm^2.

k) Refit the end cover, indicator scale and top cover. Connect the linkage to the regulating unit at the power cylinder knuckle joint.

4.4.2 Disassembly of the Unit (Fig. 5)

The procedure for dismantling the position control unit for the purpose of cleaning, replacement of parts, etc. is given below. If the operation only requires partial dismantling the procedure should be carried to the point required. This operation should be carried out with the plant out of commission or under local manual control and with the air supplies to the power cylinder turned off.

a) Remove the front cover (4 - $^1/_4$" B.S.W. hex. hd. screws and washers).

b) Remove the indicator scale (1- 6BA CH/HD screw and washer).

c) Remove the end cover and vent pipe and gasket (2 - 4BA CH/HD screws).

d) Disconnect the cam from the coupling by unscrewing the coupling pin. Support the coupling arm during this operation being careful not to allow the arm to fall or swing violently. Slide the cam out from the position control unit.

e) Slacken the locking screw, remove the pilot valve adjusting nut (4BA spanner) and slide out the spool valve. A wooden peg or matchstick may help in this latter operation; care must be taken not to damage the valve in any way. Disconnect all four pipes connecting to the valve block and mechanism case.

f) Remove the four $^1/_4$"B.S.W. setscrews and washers securing the valve block and carefully withdraw the valve block from the mechanism case being careful not to damage or bend the connecting link assembly which remains connected to the bellows. Remove the liner-retaining screw and spring washer from the valve body and slide out the liner from the body.

g) Lift the adjusting spring from the connecting link and with a 4BA box spanner (at least 7" long) unscrew the link assembly from the bellows.

h) Remove the cam guide assembly (2 - 2BA C/SK screws). Depress the control spring away from the spring pad and remove bell-crank, spindle and pad from the case, lift out the control spring.

i) Grip the shoulder of the bellows from inside the case with a 1 inch A.F. Spanner and undo and remove the 1/2 inch B.S.P. backnut. Remove the bellows from the case.

j) The mechanism case may be removed from the cylinder if so desired by removing two cheesehead screws at the rear of the case.

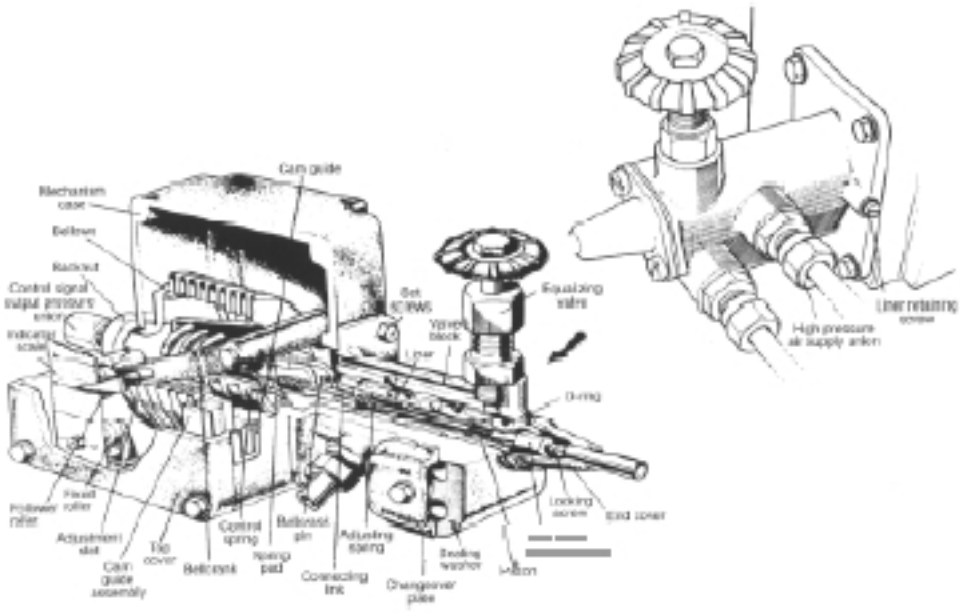


FIG. 5 POSITION CONTROL UNIT

4.4.3 Reassembly of the Unit

Wash all parts in clean paraffin.

Examine carefully each part before reassembly and replace any that show damage or excessive wear. If the unit has only been partly dismantled the instructions given below should be followed from that point.

a) If the mechanism case has been removed from the power cylinder remount it and secure firmly with the two cheesehead screws.

b) Enter the bellows into the mechanism case and secure in position with the $^{1}/_{2}$ inch B.S.P. backnut. The bellows should be held with a 1 inch A.F. Spanner across the flats on the bellows' neck during this operation.

c) Place the control spring in position in the bellows. Position the spring pad between the bell-crank lugs, compress the control spring and place the bell-crank and pad in position, entering the spindle into its bearing at the rear of the mechanism case. Allow the spring to expand and position itself against the shoulder of the spring pad.

d) If the cam follower roller has been removed, clean the roller ball-bearing in paraffin and repack with grease. Arrange the pointer, 1st washer, roller and 2nd washer, in that order, on the hexagon headed shoulder screw; position the rectangular nut behind the slot in the bell-crank arm and secure the screw/pointer/roller assembly to the arm half way along the slot and with the pointer pointing outwards from the bell-crank pivot centre.

e) With the long 4BA box spanner screw the connecting rod assembly into the bellows. If for any reason this assembly has been dismantled it should be reassembled so that there is a gap of 0.010 inch between the spacer tube and the collar before securing the collar with the two socket screws.

Examine the link rod and if bent straighten before re-assembly.

f) Examine the liner 'O'-rings and replace any that are damaged or worn. Give the liner a smear of grease and slide the 'O'-ring end of the liner into the valve block from the flange end (this is important) until the retaining screw holes in block and liner line up; secure in position with the retaining screw and spring washer.

g) Position the valve block and liner in the mechanism case with the connecting link within the liner. Secure the valve block in position with the four setscrews and washers.

h) Drop the adjusting spring over the end of the connecting link, visible within the piston liner, and follow with the spool valve (see Sect 4.1.3). Screw the adjusting nut and locking screw to the link thread visible through the centre of the piston.

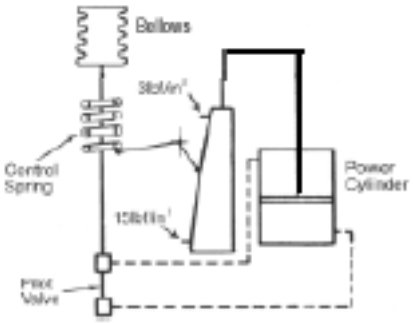
j) Place the cam guide assembly in position mating the end of the bell-crank spindle in the bearing hole at the rear of the cam guide. Secure the cam guide in position with the two countersunk screws.

k) Slide the cam into position, narrow end first and in the correct aspect, through the guides in the mechanism case and between the fixed and follower rollers. Swing the coupling arm and rod and into the correct position and connect coupling rod and cam with the threaded pin. If possible, and with the equalizing valve open, traverse the power cylinder backwards and forwards a few times by hand to ensure that the cam is working correctly through the position control unit without excessive friction.

l) Reconnect all the pneumatic connections to the unit.

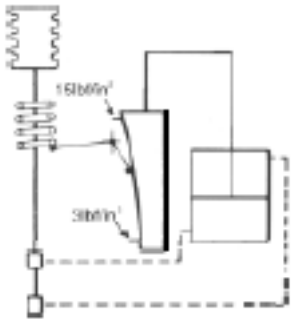
m) Set the position control unit alignment as described in Section 4.4.1. Finally replace the mechanism case cover, end cover and vent pipe, and recommission as described in Section 3.2.

LOGARITHMIC CAM (CONVEX)
Increase in control pressure moves piston rod outwards



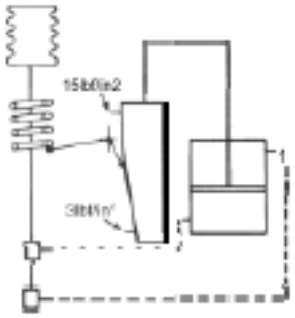
Regulating unit closes at 3lbf/in² (0.2kgf/cm²) – piston rod fully retracted

LOGARITHMIC CAM (CONCAVE)
Increase in control pressure moves piston rod inwards



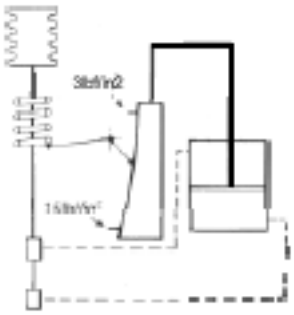
Regulating unit closes at 15lbf/in² (1 .0kgf/cm²) – piston rod fully retracted

LOGARITHMIC CAM (CONVEX)
Increase in control pressure moves piston rod inwards



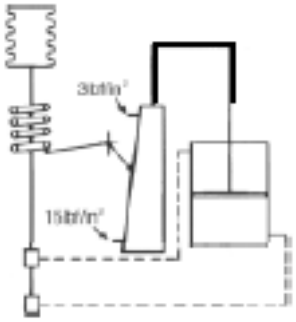
Regulating unit closes at 3lbf/in² (0.2kgf/cm²) – piston rod fully extended

LOGARITHMIC CAM (CONCAVE)
Increase in control pressure moves piston rod outwards



Regulating unit closes at 151bf/in² (1 .0kgf/cm²) – piston rod fully extended

LINEAR CAM
Increase in control pressure moves piston rod outwards



LINEAR CAM
Increase in control pressure moves piston rod inwards

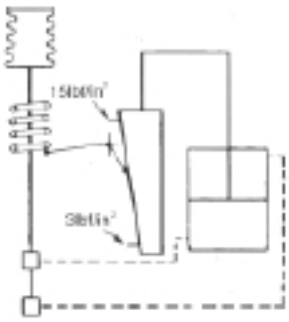


FIG.6 CAM TYPE AND ORIENTATION

4.5 CHANGING DIRECTION OF OPERATION OF POWER CYLINDER

4.5.1 Linear Cam (Fig. 5)

This operation must be carried out with the high pressure and signal air supplies to the power cylinder either disconnected or turned off and with the process regulator connection linkage disconnected from the knuckle point.

a) Open the equalizing valve and remove the position control unit top cover.

b) Unscrew the pin securing the cam to the cam coupling and withdraw the cam from the mechanism case. The coupling rod and coupling arm must be supported during this operation and not allowed to fall or swing round violently.

c) Reverse the cam and re-enter it into the mechanism case so that the opposite end may now be connected to the cam coupling ensuring that the cam operating profile is in contact with the follower roller. Re-connect the cam to the coupling with the threaded pin.

d) Remove the indicator scale and rotate it through 180° and refit in this position. The scale markings visible through the cover window will now be reversed to suit the new direction of operation.

e) Slacken the setscrew (7/16" A.F. Spanner) securing the changeover plate to the valve block until the plate is able to clear the locating dowel. If the cylinder piston rod is required to retract for an increase in control pressure, rotate the changeover plate so that the word 'IN' on the plate is adjacent to the dowel and vice versa. Locate on the dowel and tighten the securing screw.

Note: If the sealing gasket shows signs of damage it must be replaced with a new one.

f) Reset the position control unit alignment (see Section 4.4.1)

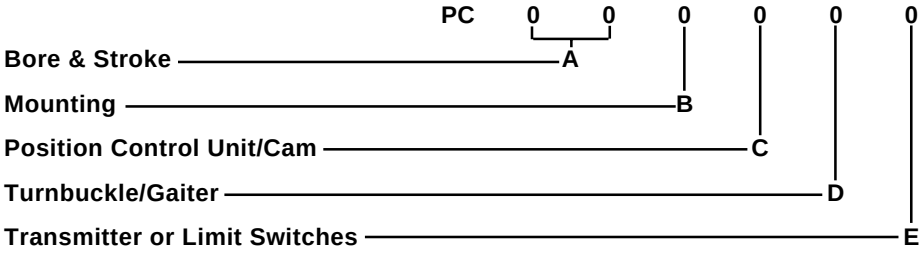
4.5.2 Logarithmic Cam (Concave or Convex)

The procedure for changing the direction of operations for a power cylinder with a logarithmic cam is similar to that given above (Section 4.51) for the power cylinder with a linear cam if the direction of operation of the process regulating unit (valve, damper etc.) with relation to the control pressure signal remains the same.

If however the direction of operation is reversed with relation to the control pressure signal, replace the original cam with the alternative cam supplied i.e. a convex cam to replace convex and vice versa. Apart from this the procedure as given in Section 4.51) remains the same.

Fig. 6 gives the cam arrangements for the various control signal/ regulating unit operation configurations.

Ordering Code



A Bore & Stroke

11 3in Bore x 6in Stroke
12 3in Bore x 12in Stroke
21 $5^1/_2$in Bore x 6in Stroke
22 $5^1/_2$in Bore x 12in Stroke
23 $5^1/_2$in Bore x 24in Stroke
32 7in Bore x 12in Stroke
33 7in Bore x 24in Stroke
43 10in Bore x 24in Stroke
44 10in Bore x 36in Stroke

B Mounting

1 For End Mounting
2 For Trunnion Mounting
9 Special

C Position Control Unit/Cam

0 Without
1 With PCU and Convex Cam
2 With PCU and Concave Cam
3 With PCU and Linear Cam
9 With PCU and Special Cam

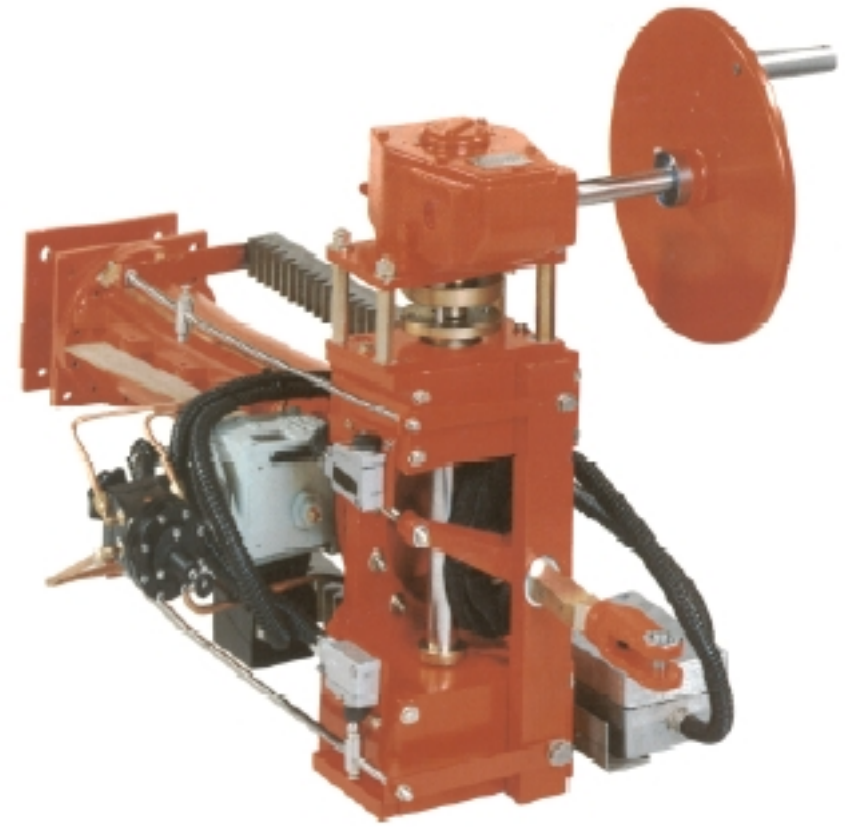
D Turnbuckle/Gaiter

0 Without
1 With Turnbuckle
2 With Gaiter
3 With Turnbuckle and Gaiter

E Transmitter or Limit Switches

0 Without
1 With Transmitter**
2 With one Limit Switch**
3 With 2 Limit Switches**

** Position Control Unit must be fitted



Kent Power Cylinder shown fitted with optional automatic air fail lock and de-clutchable handwheel manual overide facility

The Company's policy is one of continuous product improvement and the right is reserved to modify the information contained herein without notice.

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