ADJUSTABLE PRE-SET PRESSURE ACTUATED MECHANICAL PRIME MOVER

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ADJUSTABLE PRE-SET PRESSURE ACTUATED MECHANICAL PRIME MOVER
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ABSTRACT OF THE DISCLOSURE
The disclosure involves a snap acting mechanical prime mover which is actuated by a pre-set fluid pressure and can be adjusted to be actuated by any desired pre-set pressure within the range of the prime mover. The prime mover actuator will move outwardly and return when the actuating pressure reaches a pre-set level, even though the actuating pressure is maintained. Upon release of the actuating pressure the prime mover resets for another cycle.

BACKGROUND OF THE INVENTION
The invention is directed to a snap acting fluid pressure mechanical prime mover for operating numerous devices such as valves, electric switches, triggers, pilot members, safety devices and the like.

Description of the prior art
Prior to the present invention pressure actuated mechanical prime movers were of such a nature that movement of the device was directly related to the working pressure and the device would remain in extended position until a drop in pressure was sufficient to permit the device to retract. Such devices were not capable of providing an instant recycling snap acting device such as the present invention. Other devices utilize an over dead center mechanical means to obtain a snap action, but these too fail to provide the instant recycling snap action of the present invention.

Brief description of the drawings
FIGURE 1 is a schematic view of a control system incorporating the pre-set pressure actuated mechanical prime mover of the present invention.
FIGURE 2 is an exploded perspective view of the invention.
FIGURE 3 is an enlarged vertical cross-section of the invention showing the parts in one operative position.
FIGURE 4 is a view similar to FIGURE 3 showing the parts in another operative position.
FIGURE 5 is a view similar to FIGURES 3 and 4 with the parts in still another operative position.

Rewirings now to the drawings in detail wherein like reference characters indicate like parts throughout the several figures, the reference numeral 10 indicates generally a pre-set pressure actuated mechanical prime mover constructed in accordance with the invention.

The prime mover 10 includes a body 11 having a longitudinally extending threaded bore 12 opening inwardly from the outer end thereof. A cylindrical valve chamber 13 is formed centrally of the body 11 in communication with the bore 12 and having a diameter somewhat greater than that of the bore 12. A second threaded bore 14 opens inwardly from the inner end of the body 11 and communicates with the chamber 13. The second bore 14 has a diameter substantially greater than the diameter of the chamber 13 as can be clearly seen in FIGURES 3 through 5. The bore 12, chamber 13, and bore 14 are formed on a common axis.

An externally threaded cylinder 15 is threaded into the threaded bore 14 at one end and extends outwardly therefrom. The threaded cylinder 15 is provided with a pair of oppositely disposed elongated longitudinally extended slots 16 as can be seen in FIGURE 2.

A resilient double valve seat member 17 is molded onto a washer 18 and is positioned so as to extend into the chamber 13 in sealing engagement therewith and into the cylinder 15, also in sealing engagement therewith. The washer 18 engages the shoulder 19 between the threaded bore 14 and the chamber 13 and is clamped thereto by the inner end of the cylinder 15.

A generally flat valve 20 is positioned within the chamber 13 for reciprocal movement therein into and out of engagement with a valve seat 21 on the double valve seat member 17. The valve 20 has a dimple formed centrally thereof at 22 for reasons to be assigned. A taper coil spring 23 is positioned in the chamber 13 in engagement with the shoulder 24 at one end of the chamber 13. The opposite end of the coil spring 23 engages the valve 20 with the dimple 22 serving to center the valve 20 with the upper end of the spring 23. The lower end of the coil spring 23 has a diameter to snugly fit the wall of the chamber 13.

A cylindrical piston 25 is positioned within the cylinder 15 and is adapted to reciprocate therein. The piston 25 has an outwardly extending conical valve 26 formed centrally of the lower end thereof adapted for engagement with a depressed conical valve seat 27 formed on the double valve seat member 17. A central bore 28 is formed in the piston 25 opening through the valve 26 at the lower end thereof and terminating short of the opposite end of the piston 25. A free valve stem 29 is mounted in the bore 28 for reciprocation therein and has at its upper end a reduced diameter guide pin 30 as can be seen in FIGURES 3 through 5. A coil spring 31 is mounted in the bore 28 in engagement with the upper end thereof with its lower end engaging over the guide pin 30 to resiliently bias the valve stem 29 into engagement with the valve 20. The lower end of the valve stem 29 is centered in the recessed portion of the dimple 22 in the valve 20. The upper end of the piston 25 has a reduced diameter spring guide portion 32 to receive the lower end of a coil spring 33 positioned in the cylinder 15. A moveable spring seat 34 is in engagement with the upper end of the spring 33 and has a pair of oppositely extending ears 35 which project through the slots 16 outwardly of the cylinder 15. An adjusting nut 36 is threaded onto the externally threaded cylinder 15 and is adapted to engage the ears 35 to move the moveable spring seat 34 longitudinally of the cylinder 15 to the extent permitted by the length of the slots 16. An actuator pin 37 is integrally formed on the piston 25 and extends axially therefrom oppositely of the valve 26.

A four-way spool valve 46 is provided with a conventional reciprocating spool (not shown). Fluid under pressure is fed to the four-way spool valve through an inlet conduit 47 and depending upon the setting of the spool is fed outwardly through outlet port 48 or outlet port 49.
Exhaust ports 50 and 51 are adapted to be connected to the outlet ports 48 and 49 when the opposite outlet ports 48, 49 are connected to the source of fluid under pressure 47.

A prime mover 10 is connected to each end of the four-way spool valve 46 with its actuator 37 arranged to operate a bleed valve at each end of the four-way spool valve. The spool is moved conventionally by fluid pressure from the pressure conduit 47 in the direction of the open vent valve. A pilot pressure line 52 extends from the outlet port 48 and is pressurized simultaneously with the pressurizing of the outlet port 48 and the fluid supply line 40. A pilot pressure line 53 extends from the outlet port 49 and is pressurized simultaneously with the fluid supply line 41.

A second four-way spool valve 46 is identical in every respect to the four-way spool valve 46 having an inlet pressure conduit 47', outlet ports 48' and 49', exhaust ports 50' and 51', and a pair of prime movers 10 connected to oppose ends thereof. A fluid supply line 44 extends to the outlet port 48' and a second fluid supply line 45' extends to the outlet port 49'. A pilot pressure line 54 extends from the outlet port 48' and a pilot pressure line 55 extends from the outlet port 49'. The pilot pressure lines 52, 53, 54, and 55 each extend to a separate one of the prime movers 10 and are adapted to actuate the respective prime mover 10 when pressure in the lines 52, 53, 54 or 55 reach a pre-set point.

The operation of the control system in FIGURE 1 is a sequential operation in which the piston rod 39 is first extended, then the piston rod 43 is extended, the piston rod 43 is retracted and finally the piston rod 43 is retracted to form a cycle which is continuously repeated so long as fluid pressure is fed through the conduits 47, 47'.

In order to start the operation it is assumed that pressure is in the line 41 actuating the prime mover D which causes the spool to move toward the prime mover D shifting pressure into the fluid supply line 40 and simultaneously into the pilot pressure line 52. Pressure in the line 40 causes the piston rod 39 to be extended out of the cylinder 38. Pressure in the pilot pressure line 52 actuates the prime mover B so that pressure is fed from the conduit 47' to the fluid supply line 44 and simultaneously to the pilot pressure line 54. Pressure in the line 44 causes the piston rod 43 to be extended from the cylinder 42. Pressure in the pilot pressure line 54 actuates the prime mover C moving the spool valve spool to the left and connecting the fluid pressure from the supply conduit 47 to the fluid supply line 41 and simultaneously provides pressure in the pilot pressure line 53. Pressure in the supply line 41 causes the piston rod 39 to be retracted into the cylinder 38 while the pressure in the pilot pressure line 53 causes the prime mover A to be actuated causing the spool to move to the left connecting the fluid pressure conduit 47' to the fluid supply line 45 and the pilot pressure line 55. Pressure in the fluid supply line 45 causes the piston rod 43 to be retracted in the cylinder 42 and the pressure in the pilot pressure line 55 actuates the prime mover D to start a second cycle of operation.

Referencing now to FIGURES 3 through 5 the operation of the prime mover 10 will now be explained. The threaded bore 12 is connected to a source of fluid pressure either hydraulic or pneumatic, and with the pressure at zero the parts of the prime mover will be in the position as shown in FIGURE 3. As the pressure develops in the system the fluid flows into the valve chamber 13, around the valve 20, through a central port 56 in the double valve seat 17 and is prevented from flowing further by contact of the valve 26 with the valve seat 27. As the pressure increases to the pre-set point the piston 25 remains in its lower position with the valve 26 retracted to the seat 27. As the pressure reaches the pre-set point the fluid will lift the piston slightly off the valve seat 27 against the pressure of the spring 33, exposing the whole lower end of the piston 25 to the pressure. As soon as the whole lower end of the piston 25 is exposed to the pressure the piston 25 snaps upwardly in the cylinder 15 until the valve 20 comes in contact with the valve seat 21 sealing the fluid pressure against further passage through the central port 56. This position of the parts is illustrated in FIGURE 4. The valve 20, sealing against the valve seat 21 prevents further passage of the fluid into the cylinder 15 and the fluid already therein now bleeds past the piston 25 and the piston 25 is snapped downwardly by the spring 33 to the top position shown in FIGURE 6. As the pressure is maintained on the system the valve 20 will remain in sealed position against the valve seat 21 and all of the remaining parts of the prime mover 10 will remain in the position illustrated in FIGURE 3, resetting the parts for another cycle. The adjusting nut 36 can be moved on the cylinder 15 to increase or decrease the spring pressure brought to bear on the piston 25 so as to adjust the point in pressure at which the piston 25 will be cracked from the valve seat 27. The floating valve stem 29 and the spring 31 are capable of keeping the valve 20 spaced from the seat 21 against the pressure of the spring 23 as illustrated in FIGURE 3. However, the spring 31 is insufficient to move the valve 20 away from the seat 21 to long as pressure in the system is bearing there against.

1. A snap acting adjustable pre-set pressure actuated prime mover comprising a cylinder, a piston mounted for reciprocation in said cylinder, a valve seat at one end of said cylinder, said valve seat having a central port extending through therebetween and communicating with a source of fluid pressure, a valve on said piston engageable with said valve seat and sealing said central port against the passage of fluid, resilient means biasing said piston and said valve into sealing engagement with said valve seat to maintain said piston in engagement with said valve seat until the fluid pressure exceeds a pre-set point, said valve having an area exposed to the pressure substantially less than the cross sectional area of said piston, valve means for closing the pressure side of said central port upon movement of said piston in said cylinder away from said valve seat, and resilient means on said piston for opening said valve means upon movement of said piston in said cylinder toward said valve seat.

2. A prime mover as claimed in claim 1 wherein means are provided on said cylinder for adjusting the tension of said resilient biasing means and thereby adjusting the pressure necessary to move said piston.

3. A prime mover as claimed in claim 1 wherein means are provided on said cylinder for adjusting the tension of said resilient biasing means and thereby adjusting the pressure necessary to move said piston, and spring means supporting said valve means in balanced relation in said prime mover.

4. A prime mover as claimed in claim 1 wherein said last named resilient means includes a free valve stem resiliently mounted in said piston in engagement with said valve means and resilient means biases said valve means toward said piston maintaining said valve means in engagement with said free valve stem.

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