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C. C. CONWAY III, ET AL

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PRESSURE RESPONSIVE ACTUATOR

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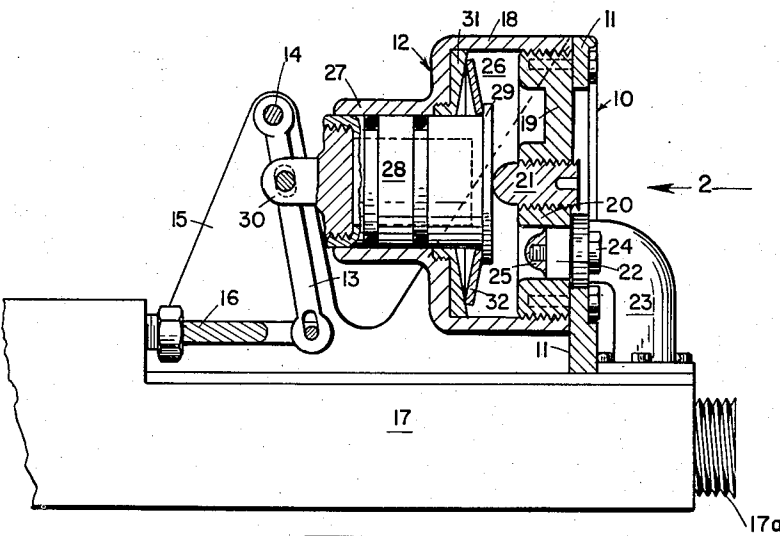


Fig 1

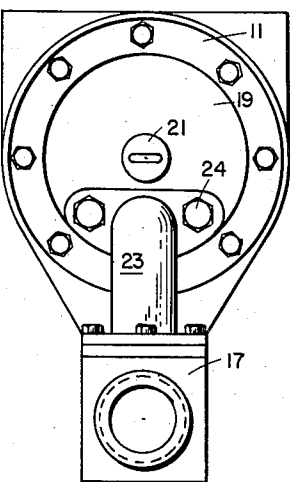


Fig 2

INVENTOR.
CARLE C. CONWAY III
NELS E. NYLIN

BY
D. Gordon Rogers
ATTORNEY

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PRESSURE RESPONSIVE ACTUATOR

Carle C. Conway III, Glendora, and Nels E. Nylin, Folsom, Calif., assignors to Aerojet-General Corporation, Azusa, Calif., a corporation of Ohio

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8 Claims. (Cl. 121—38)

This invention relates to pressure responsive actuators and particularly to actuators operated by hydraulic pressure.

In many hydraulic actuator applications it is required that the actuator should exert a force as rapidly as possible after a pressure responsive device controlling the actuator has responded to a critical pressure.

Actuator devices as most commonly used are operated by a solenoid and electrical circuits including a pressure responsive switch. If any material force is required to be exerted directly by the actuator, the use of solenoids of considerable size and therefore of considerable weight, is necessary.

It is an object of this invention to provide a simple hydro-mechanical device by which a hydraulic actuator is brought into operation when a predetermined pressure is reached in the hydraulic line, and which will return to initial position when the pressure is later reduced below a predetermined value, the actuator being used to directly operate a part.

It is a further object of the invention to provide a device, as above described, which may be assembled to meet different requirements of the pressure, travel of the operated part, and the like, with a minimum change of parts and little loss of time.

Another object of the invention is to provide a snap action hydraulic actuator of small size but capable of exerting considerably more force than electrical means of comparable weight.

Still another object of the invention is to provide a hydraulic actuator as a small compact unit which may be readily incorporated with any mechanism it is to operate, and may be supplied with pressure fluid from any source which may be readily connected to the actuator.

With these and other objects in view, the invention comprises an actuator having a casing provided with a cylinder and coaxially arranged pressure receiving chamber in communication with a pressure line, a piston in said cylinder and means effective to restrain the piston from movement until a predetermined pressure in said chamber is exceeded, the piston thereafter being projected by the hydraulic pressure without substantial hindrance from said means.

The invention further comprises an actuator as above set forth in which said means are effective to withdraw said piston to initial position when the pressure in said cylinder falls below a predetermined value subsequent to the projection of said piston.

Further objects and features of the invention will hereinafter appear from the following specification read with reference to the accompanying illustrative drawings.

In the drawings:

Fig. 1 is a side elevation of a valve operating unit incorporating a device arranged according to the invention which is shown in section;

Fig. 2 is an end elevation of the parts shown in Fig. 1 looking in the direction of the arrow (2) in that figure.

Referring now to Fig. 1, the numeral 10 indicates a

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bracket providing a seat 11 on which the novel actuating device generally indicated at 12 is mounted, and which operates a lever arm 13 pivoted at 14 between upstanding arms 15 forming a part of bracket 10. Lever arm 13 operates the stem 16 of the valve controlling flow through a valve housing 17 to which bracket 10 is secured.

The actuating device comprises a casing 18 mounted on a base plate 19 at one end, the base plate being secured to seat 11 of the bracket. The base plate is provided with a central boss 20 which is threaded to receive the pressure adjustment screw 21 and is provided with a port 22 for pressure fluid conducted thereto by an elbow 23 connected to the valve housing 17. Cap screws 24 are shown securing the elbow to threaded interior boss 25 cast with the base plate and also screwed into the body of the housing. Casing 18 is formed to provide a cylindrical chamber 26 and a cylinder 27 coaxially therewith. An operating piston 28 working in cylinder 27 is provided with a peripheral flange 29 which may be in the form of an end plate of greater diameter than the piston, and with a projecting lug 30 for attachment to the part to be operated. A shoulder is provided around the forward end of the cylindrical chamber 26 in the form of a stop ring 31. A coned disc spring 32 is arranged with its outer periphery abutting the shoulder of the stop ring 31 and with its inner periphery bearing against the peripheral flange 29 of the piston, which is restrained in the deactuating direction by the adjusting screw 21.

Operation

The actuator shown by way of illustration is designed to operate in a hydraulic system at a predetermined pressure and in either an automatic or assisted reset manner by proper selection of the coned disc spring 32, which may be determined from the known equations for this type of spring.

In the embodiment of the invention illustrated it was required to provide an actuator which would operate at a pressure of about 300 lbs. per square inch, to give the piston 28 and lug 30 a predetermined forward movement, and to snap into initial position when the pressure dropped below 200 lbs. per square inch, the movement of the piston being amplified by the lever connection of the lug 30 and swinging arm 13 to give the stem 16 of the valve the required stroke.

The provision of a stop ring 31 rather than of a shoulder machined around the forward wall of cylinder 18 enables cone disc springs of different characteristics to be fitted as well as to permit adjustment of the stroke of the piston 28 to the particular associated mechanism to be actuated by the substitution of an appropriate stop ring.

Before connecting the piston 28 to the part to be actuated, the adjustment screw 21 is turned down until spring 32 snaps forward and is then slacked back to obtain a preset load which insures full forward movement of the piston when the load exceeds the preset load. This procedure obviates any gradual initial movement of the part operated which is very undesirable. The design of the device insures that once the preset activating pressure is exceeded, full pressure of the operating fluid with negligible resistance from the coned disc spring is applied to the piston with consequent rapid actuation of the part operated. Said part then remains in the actuated position until the operating pressure falls below that at which the coned disc spring will snap back to initial position.

In the operation of the mechanism, fluid under pressure enters the valve housing 17 through a coupling 17a from a source of fluid under pressure (not shown); and ordinarily the pressurized fluid will flow past the valve mechanism (not shown in detail) to the left in Fig. 1. Part of the fluid supplied to housing 17 will flow through

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conduit 23 into chamber 26; and when this pressure reaches the value required to overcome the resistance of the cone spring 32, the cone spring will snap suddenly to the left; and the sudden motion of piston 28 will move bar 17 to the left. Since bar 16 is attached to the operating mechanism of the valve in housing 17, the valve can thus be shut off to prevent further flow of fluid through housing 17.

Inasmuch as the details such as how to produce this shut off of the fluid flow are no part of the present invention, it is not shown in the drawings. Such shut off valves are well known in the art and can be readily attached to the operating arm 16.

It will be recognized that since the adjusting screw 21 is preadjusted to pressurize conical spring 32 almost to its yielding point, a small amount of additional pressure from the fluid entering chamber 26 is sufficient to snap the spring suddenly and produces the desired sudden and quick acting motion of operating arm 16.

It should be noted that coned disc springs may be designed to provide a snap action while capable of carrying a predetermined load without material deflection until the load is exceeded and thereafter to suddenly cease to oppose resistance but regain their initial configuration on the load being released.

While a preferred embodiment of the invention given by way of illustration has been specifically described and shown, it is to be understood that various changes and modifications may be made by those skilled in the art without departing from the scope of the invention as defined by the appended claims.

We claim:

1. An actuator comprising: a cylindrical casing providing a cylinder at one end and walls of a pressure fluid chamber of greater diameter than said cylinder at the opposite end; an end plate closing said chamber and having a port therein for putting said chamber in communication with a source of fluid under pressure; a piston mounted in said cylinder; a radially projecting flange around the inner end of said piston; and a coned disc spring having its outer perimeter bearing against the forward end of the fluid chamber and its inner perimeter bearing against said radially projecting flange of the piston.

2. An actuator comprising: a cylindrical casing providing a cylinder at one end and walls of a pressure fluid chamber of greater diameter than said cylinder at the opposite end; an end plate closing said chamber and having a port therein for putting said chamber in communication with a source of fluid under pressure; a piston mounted in said cylinder; a radially projecting flange around the inner end of said piston; a coned disc spring having its outer perimeter bearing against the forward end of the fluid chamber and its inner perimeter bearing against said radially projecting flange of the piston; and means to preload said coned disc spring to near its operating point.

3. An actuator as set forth in claim 2 and in which said preloading means comprises an adjusting screw threaded into a threaded hole in said end plate, said screw being adjustable from outside the casing and bearing against the center of said piston.

4. An actuator comprising: a cylindrical casing providing a cylinder at one end and walls of a pressure fluid chamber of greater diameter than said cylinder at the opposite end; an end plate closing said chamber and having a port therein for putting said chamber in communication with a source of fluid under pressure; a piston mounted in said cylinder; a radially projecting flange around the inner end of said piston; a shoulder around

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the inner periphery of said fluid chamber at the forward end thereof; and a coned disc spring having its outer perimeter bearing against said shoulder and its inner perimeter bearing against said radially projecting flange of the piston.

5. An actuator comprising: a cylindrical casing providing a cylinder at one end and walls of a pressure fluid chamber of greater diameter than said cylinder at the opposite end; an end plate closing said chamber and having a port therein for putting said chamber in communication with a source of fluid under pressure; a piston mounted in said cylinder; a radially projecting flange around the inner end of said piston; a stop ring secured to the front wall of the pressure fluid chamber, said stop ring providing a shoulder around the inner periphery of said fluid chamber at the forward end thereof; and a coned disc spring having its outer perimeter bearing against said shoulder and its inner perimeter bearing against said radially projecting flange of the piston.

6. An actuator operated by fluid pressure and comprising: a cylinder and a pressure-receiving chamber arranged in communication with one another; a piston in said cylinder and resilient means attached to the piston offering a substantial degree of restraint against said piston until a predetermined pressure in said chamber is exceeded and a much lower degree of restraint after said predetermined pressure is exceeded whereby the piston is immovable until said predetermined pressure is exceeded, and then is readily projected without substantial hindrance after said predetermined pressure is exceeded, said means being effective to withdraw said piston to its initial position when the pressure in said chamber falls below a predetermined value lower than said predetermined pressure subsequent to the projection of said piston.

7. An actuator operable by fluid pressure and comprising: a cylinder and a pressure-receiving chamber arranged in communication with one another; a piston in said cylinder reciprocable in a forward and a reverse direction; and resilient means attached to the piston offering a substantial degree of restraint against movement of the piston in the forward direction until a predetermined pressure in said chamber is exceeded, and a substantially lower degree of restraint after said predetermined pressure is exceeded, whereby the piston is immovable in the forward direction until such predetermined pressure is exceeded, after which the piston moves without substantial hindrance in the forward direction and when the pressure in the chamber drops substantially below said predetermined pressure, the piston moves in the reverse direction.

8. An actuator operable by fluid pressure and comprising: a cylinder; a piston reciprocable in a forward and in a reverse direction in said cylinder; means for applying pressure to the side of said piston which tends to move it in the forward direction; and resilient means attached to the piston offering a substantial degree of restraint against movement of the piston in the forward direction until a predetermined pressure is exceeded, and a substantially lower degree of restraint after said predetermined pressure is exceeded, whereby the piston is immovable in the forward direction until such predetermined pressure is exceeded, after which the piston moves without substantial hindrance in the forward direction, and when the pressure drops substantially below said predetermined pressure, the piston moves in the reverse direction.

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