

Dec. 8, 1925.

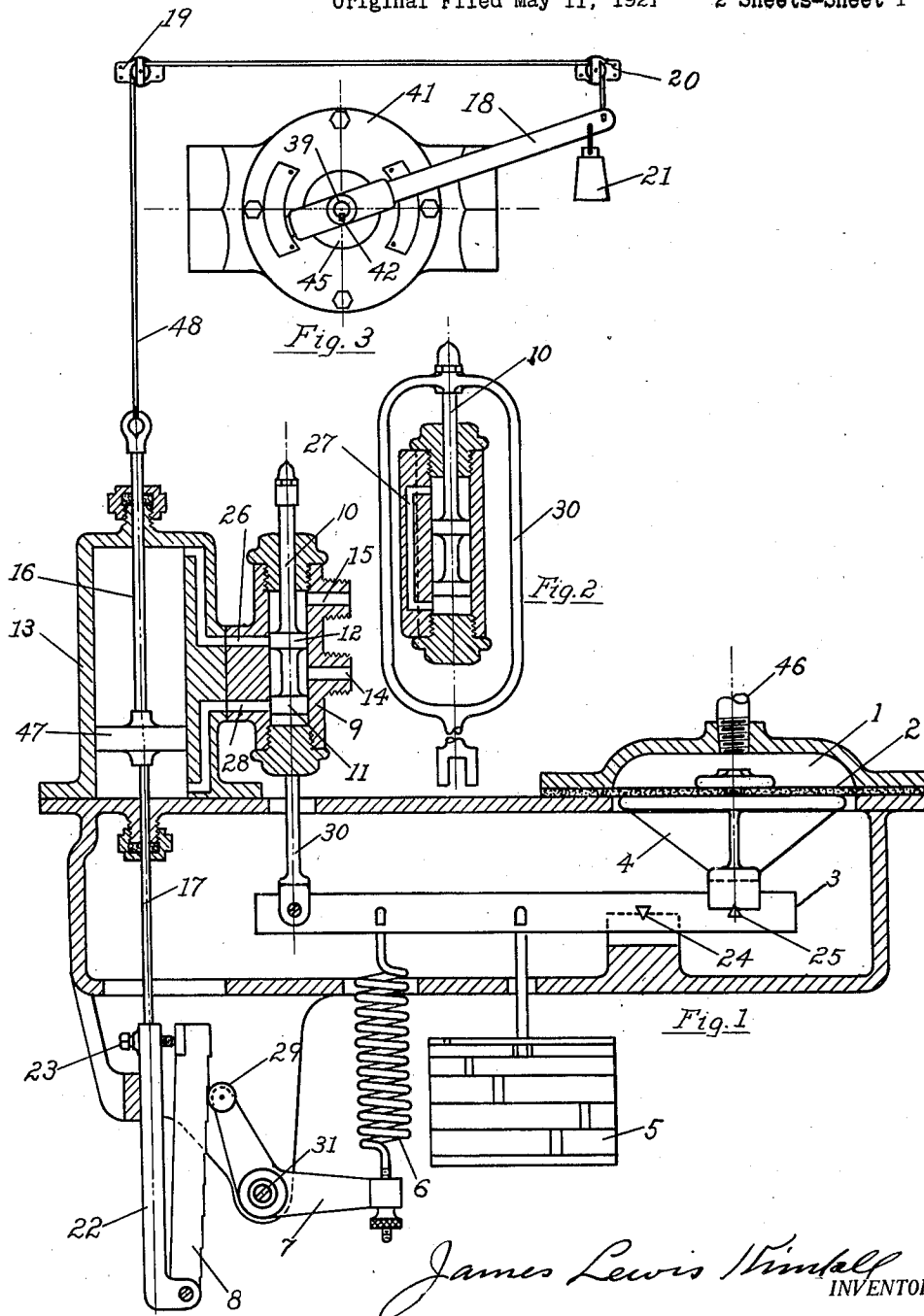
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PRESSURE CONTROL APPARATUS

Original Filed May 11, 1921

2 Sheets-Sheet 1



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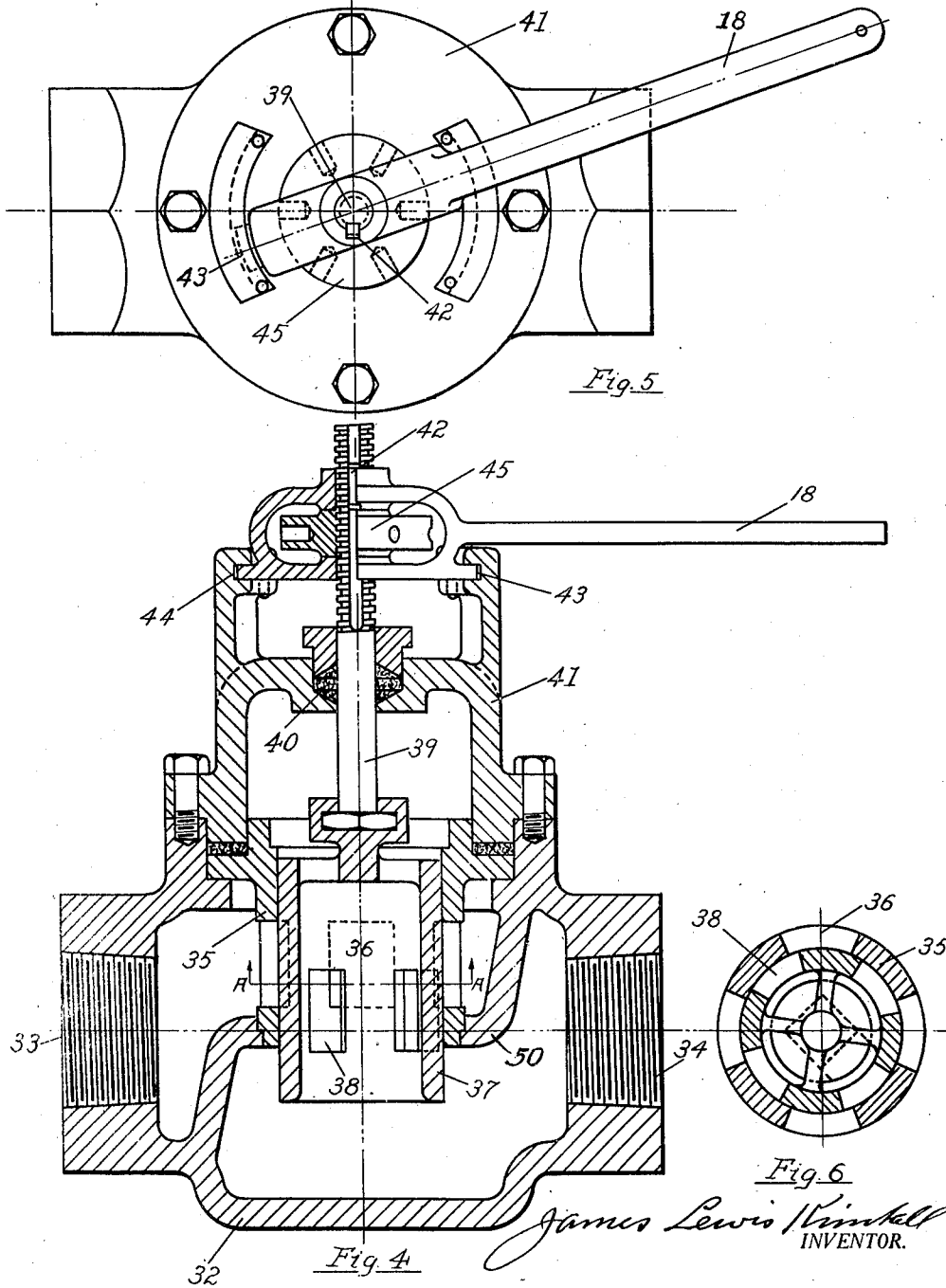
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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE.

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PRESSURE-CONTROL APPARATUS.

Application filed May 11, 1921, Serial No. 468,684. Renewed May 13, 1925.

To all whom it may concern:

Be it known that I, JAMES LEWIS KIMBALL, a citizen of the United States, residing at Salem, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Pressure-Control Apparatus, of which the following is a specification.

My invention relates to pressure-control apparatus in which a fluid-pressure valve is operated by a motor, said motor being associated with a controlling valve and a pressure device.

One of the objects of my invention is to effect a novel combination of elements in pressure-regulating apparatus, whereby a fluid-pressure motor can be made to operate a fluid-pressure valve without hunting action, and to arrange certain novel adjusting means whereby this result may be secured.

Another object of my invention is to provide pressure-controlling apparatus of the above class having a novel step-compensating arrangement, whereby the variations in pressure acting on the pressure device will be in relation to the pressure-counteracting force for all stages of the motor travel.

A further object of my invention is to provide means for adjusting said compensator to effect a stopping of the motor at each compensating point.

A still further object of my invention is to provide a fluid-pressure valve which will be balanced to all degrees of pressure, having an actuating member for closing off more or less of the port openings in one direction, and to have an adjustable means associated with said actuating member, whereby the valve can be adjusted to close off more or less of the port openings in another direction, independently of the actuating member, and to provide means for holding the adjustable means in rigid engagement with the actuating member.

The several objects enumerated in the above statement of invention are more or less dependent upon each other and mutually contribute to produce the desired results, as will be hereinafter fully set forth.

Referring to the drawings, Figure (1) represents a sectional elevation of a motor and pressure device.

Figure (2) represents a cross section of the controlling valve for the motor.

Figure (3) represents an exterior view of the fluid-pressure valve.

Figure (4) represents a vertical section of the fluid-pressure valve.

Figure (5) represents an end elevation, the same as shown in Figure (3).

Figure (6) represents a sectional plan view of the valve and cage, taken at line (A—A) of Fig. (4), looking in the direction of the arrows.

Similar numerals refer to like parts in the several figures.

A preferred embodiment of a pressure device is shown in Figure (1), in which (1) is the pressure chamber, (2) a diaphragm, (3) the scale beam, and (4) a pressure cap. An intermediate portion of the scale beam being fulcrumed at (24) and an end of the scale beam being fulcrumed to the pressure cap at (25), it will be seen that the variations of pressure in the pressure chamber will give a rocking movement to the other end of the scale beam. The said other end of the scale beam is connected by means of a yoke (30) to the motor-valve stem (10). The motor valve has a valve casing (9) with inlet for pressure (14) and exhaust (15). Delivery ports (26) and (28) lead to the top and bottom of the motor cylinder (13). Valve spindle (10) has cylindrical portions (11) and (12) and is shown in a neutral position and so arranged as to control the admission and exhaust of fluid pressure to and from the motor cylinder. The motor cylinder (13) has a piston (47) with a piston rod (16) extending through a stuffing box at the top of the cylinder and is connected to the fluid-pressure, valve-actuating lever (18) by means of flexible cord (48), extending over sheaves (19) and (20).

In the apparatus so far set forth, the elements shown are not claimed as new. My invention relates in part to compensating means for applying a varying counteracting force to the pressure device, which I will now describe:—

Connected with the under side of piston (47) is piston rod (17) which carries at its lower end a bracket (22) and hinged member (8). Said hinged member has a plurality of steps which constitute compensating points for the motor travel.

A bell crank (7) is pivoted at (31) and is provided at one end with a roll (29) which engages the steps on the compensating

member. One end of a tension spring (6) is connected to the other end of the bell crank and the opposite end of the spring is attached to the scale beam (3). The object of this construction is to vary the counter-acting force of the pressure device at each compensating point of the motor travel sufficiently to return the motor valve to its neutral position and bring the piston (47) to rest to await a further variation of pressure on the pressure device.

The objection to the ordinary controller of this class is that the movement of its fluid pressure motor is not sufficiently well compensated, resulting in a movement in excess of the requirements and producing hunting action. Therefore, the advantage of having definite cut-off points at which the motor piston will be brought to rest, will be apparent.

The primary object of my invention being to prevent hunting action of the apparatus, it will be seen that a stopping of the piston (47) at each compensating point, would not, in itself, wholly effect this result, as a unit of movement of the fluid pressure valve might effect too great a change in pressure, which would result in a reverse movement of the piston. It will be seen from the above that a motor controller cannot be brought into step with a fluid-pressure valve in which its maximum port opening is excessively large for the requirements.

For the above reason, it is not only necessary to employ a pressure device in which the motor controller will be compensated to permit a predetermined, graduated, step-by-step movement, but, if satisfactory results are to be obtained, some means must further be employed to limit the effective area through the fluid-pressure valve, so that a unit of movement of the motor will not effect too sudden a change in the pressure acting on the pressure device, and for this reason I have devised novel means for adjusting the fluid-pressure valve independently of its actuating means, which I will now describe.

Referring to Figure (4), I show a standard valve casing (32) having an inlet opening (33) an outlet opening (34) and a partition wall 50 between the inlet and outlet openings having a port. An interiorly disposed valve cage (35), the lower end of which is mounted in the port has a plurality of circumferentially disposed ports (36). The cage is open at its upper end and is closed by a bonnet 41. A valve tube (37) is slidably and rotatably mounted in the valve cage (35) and has circumferentially disposed ports (38), each arranged to register more or less with one of the ports (36) in the valve cage (35). A valve stem (39) is rigidly connected with

the valve tube (37) and extends through a stuffing box (40) in valve bonnet (41). An actuating lever (18) is rigidly secured to the upper end of the valve stem by a key (42), which permits the valve (37) to be rotated by the actuating lever (18). The lever is rotatably mounted on the bonnet (41). To this end, the bonnet has a projection having guide ways (43) concentric with the valve spindle and arranged to receive an extension of the yoke of the actuating lever. An adjusting nut (45) is threadably mounted on the valve stem and is secured against lateral motion by being held in the yoked end of the actuating lever. Screw nut (45) may be rotatably adjusted to slidably adjust the valve stem (39) to slidably close off more or less of the port openings registering between the valve (37) and valve cage (35), or the actuating lever may be moved through a given arc to rotate the stem and the valve (37) to vary the amount of port area registering between the valve cage (35) and the valve (37) in accordance with the fluid pressure demand. When the valve tube wears out, the bonnet may be removed and a new valve tube may be substituted.

It will be noted that the inlet ports (36) in the valve cage being arranged diametrically opposite one another in an annular chamber between the inlet opening (33) and the partition wall (50), places the valve (37) in a balanced condition as to pressure and this balanced condition is maintained throughout its entire opening and closing movement. Referring now more particularly to Figures (1), (2) and (3), I shall now describe the operation of the apparatus as a whole.

The fluid-pressure valve is connected to pressure chamber (1) at (46) and exerts a predetermined force on flexible diaphragm (2), which force is counteracted in part by weights (5) and in part by spring (6). It will be seen that an increase in pressure in excess of the counteracting means will force diaphragm (2) downward, raising the end of the scale beam to which the yoke (30) is attached and raising the valve stem (10), thereby opening the port (26) and allowing fluid under pressure to enter the top of the motor cylinder (13) and forcing the piston (47) downward and closing off the fluid-pressure valve sufficiently to compensate for the increase in pressure, it being understood that the bottom end of the cylinder (13) is now open to exhaust through passage (28) and passage (27) to exhaust connection (15). This downward movement of the piston (47) causes bell-crank roll (29) to engage a higher step on compensating member (8), thereby exerting an increased tension on spring (6). The proper amount of compensating force

to be applied at each compensating point would be whatever was necessary to return the motor valve to its neutral position and bring the motor piston to rest, and for this reason adjustable means is provided at (23) for varying the angularity of member (8) to effect a greater or less counteracting force between compensating points.

My invention has for one of its objects means whereby the fluid-pressure valve may be adjusted to limit the effective area through the valve ports, independent of the motor-adjustment means. The proper amount of adjustment to be made would be whatever demand, under varying conditions of fluid pressure, was necessary to effect a balance between the pressure and its counteracting force at each compensating or stopping point for the motor. Assuming the apparatus has been properly adjusted to meet the special condition under which it is operating, and that a decrease in pressure takes place in pressure chamber (1) due to an increased demand on the fluid pressure valve, then it will be seen that the counter-acting force will momentarily overcome the pressure on the diaphragm and valve spindle (10) will be moved downward, opening port (28) to pressure and port (26) to exhaust, thereby forcing the piston upward, causing the roll (29) to engage a lower step on member (8) and decreasing the tension on spring (6) and again returning the pilot valve to neutral position. The apparatus will again have assumed a balanced condition with the fluid-pressure valve slightly wider open to compensate for the increased demand.

It will be understood by those skilled in the art, that apparatus as above described may be used for a large variety of purposes, but in every case the variations of pressure acting on the pressure device are corrected by the movement of the motor in opening or closing the fluid-pressure valve, as the case may require.

In Figure. (3) I show a counter-weight (21) for operating the valve in one direction, although the actuating lever (18) could be connected direct to the piston rod (16) and equally satisfactory results obtained. Likewise piston rod (17) which, actuates the step compensator, is shown extending through a stuffing box at the bottom of the motor cylinder. This rod could be connected with the top end of piston rod (16), which would give the desired motion to the compensating device, and in other ways the parts could be variously arranged and organized without departing from the scope of the claims.

From the foregoing description, it will be apparent that I have devised a novel and useful means for adjustment in pressure control apparatus and the same has been

found in practice to give reliable and satisfactory results under all conditions of service.

What I claim as my invention and desire to secure by Letters Patent, is:—

1. In a fluid-pressure system, the combination with a fluid-pressure device controlled by the pressure in the system, a valve controlled by the fluid-pressure device, a motor controlled by the valve, and an adjustable compensator controlled by the motor for counteracting the action of the fluid-pressure device, of a rotatable balanced fluid-pressure valve automatically adjustable by the motor for controlling the pressure in the system, and means for manually adjusting the fluid-pressure valve to cause the variations in the pressure of the system transmitted to the fluid-pressure device to bear a predetermined relation to the counter action controlled by the compensator for all stages of motor travel.

2. In pressure-control apparatus, the combination of a fluid-pressure valve, with a motor controller, and a pressure device, a controlling valve for said motor, a graduated step compensator associated with said motor, having a plurality of compensating points arranged to apply a varying counteracting force to said pressure device, and means for adjusting said fluid-pressure valve independently of its actuating means, whereby the variations in pressure acting on the pressure device will be in relation to the pressure-counteracting force at each compensating point.

3. In pressure-control apparatus, the combination of a fluid pressure valve, with a motor controller, and a pressure device, a controlling valve for said motor, a graduated step compensator associated with said motor, having a plurality of compensating points, arranged to apply a varying counteracting force to said pressure device, and means for adjusting said compensator to effect a stopping of said motor at each compensating point, and means for adjusting said fluid-pressure valve independently of its actuating means, whereby the variations in pressure acting on the pressure device will be in relation to the pressure-counteracting force for all stages of motor travel.

4. In pressure-control apparatus, the combination of a fluid-pressure valve, with a motor controller, and a pressure device, a controlling valve for said motor, an adjustable step compensator for said motor, an actuating member for closing off said fluid pressure valve in one direction, and adjustable means, supported by said actuating member, whereby the valve can be more or less closed off in another direction, independently of the actuating member.

5. In a fluid-pressure system, the combination with a fluid-pressure device con-

trolled by the pressure in the system, a valve controlled by the fluid-pressure device, and a motor controlled by the valve, of a fluid-pressure valve for controlling the pressure in the system, the fluid-pressure valve having an inlet opening, an outlet opening, a partition wall between the inlet and the outlet openings, and oppositely disposed ports between the inlet opening and the partition wall the degree of opening of which in one direction only is automatically controlled by the motor, and means for manually adjusting the degree of opening of the ports in another direction.

6. In a fluid-pressure system, the combination with a motor controlled by the pressure in the system, of a fluid-pressure valve for controlling the pressure in the system having an inlet opening, an outlet opening, a partition wall between the inlet and the outlet openings having a port, an interiorly disposed cage in the port adapted to obstruct the flow of fluid under pressure from the inlet opening to the outlet opening, the cage being provided with a plurality of circumferentially spaced oppositely disposed ports between the inlet opening and the partition wall, and a valve tube having a plurality of corresponding circumferentially spaced ports each adapted to register with one of the cage ports, and means for manually adjusting the degree of registry of the registering ports in one direction, the valve tube being controlled by the motor to adjust the degree of registry to the registering ports in another direction only.

7. In a fluid-pressure system, the combination with a motor controlled by the pressure in the system, of a fluid-pressure valve for controlling the pressure in the system having an inlet opening, an outlet opening, a partition wall between the inlet and the outlet openings having a port, an interiorly disposed cage in the port adapted to obstruct the flow of fluid under pressure from the inlet opening to the outlet opening, the cage being provided with a plurality of circumferentially spaced oppositely disposed ports between the inlet opening and the partition wall, and a valve tube having a plurality of corresponding circumferentially spaced ports each adapted to register with one of the cage ports, and means for manually adjusting the degree of registry of the registering ports, the valve tube being automatically rotatable only by the motor to adjust the degree of registry of the registering ports.

8. A fluid-pressure valve having, in combination, a valve casing having an inlet opening, an outlet opening, a partition wall between the inlet and the outlet openings having a port, an interiorly disposed cage in the port adapted to obstruct the flow of fluid under pressure from the inlet opening

to the outlet opening, the cage being provided with a plurality of circumferentially oppositely disposed ports between the inlet opening and the partition wall, a valve tube having a plurality of corresponding circumferentially spaced ports each adapted to register with one of the cage ports, means for manually adjusting the degree of registry of the registering ports in one direction, and means for automatically adjusting the degree of registry of the registering ports in another direction only.

9. A fluid-pressure valve having, in combination, a valve casing having an inlet opening, an outlet opening, a partition wall between the inlet and the outlet openings having a port, and an interiorly disposed, cylindrical case in the port adapted to obstruct the flow of fluid under pressure from the inlet opening to the outlet opening, the cage being provided with a plurality of circumferentially oppositely disposed ports between the inlet opening and the partition wall, a cylindrical valve tube slidably and rotatably adjustable with respect to the cage having a plurality of corresponding circumferentially spaced ports each adapted to register with one of the cage ports, means for manually adjusting the cage and the tube relatively in one of the said two directions of adjustment to adjust the initial degree of registry of the registering ports, and means for automatically adjusting the cage and the tube relatively in the other only of the said two directions of adjustment to adjust the degree of registry of the registering ports under predetermined conditions.

10. A fluid-pressure valve having, in combination, a valve casing having an inlet opening, an outlet opening, and an interiorly disposed, cylindrical cage adapted to obstruct the flow of fluid under pressure from the inlet opening to the outlet opening, the cage being provided with a plurality of circumferentially disposed ports, a cylindrical valve tube slidably and rotatably adjustable with respect to the cage having a plurality of corresponding circumferentially spaced ports each adapted to register with one of the cage ports, the valve tube having a threaded stem, a nut threaded upon the stem for manually slidably adjusting the valve tube to adjust the initial degree of registry of the registering ports, and an actuator for automatically rotating the valve tube to adjust the degree of registry of the registering ports under predetermined conditions.

11. A fluid-pressure valve having, in combination, a valve casing having an inlet opening, an outlet opening, and a partition wall between the inlet and the outlet openings and having a port, an interiorly disposed open cage mounted in the port, a

valve bonnet closing the cage having a stuffing box, the cage being provided with a plurality of circumferentially disposed ports, a valve tube having a plurality of circumferentially disposed ports, each adapted to register with one of the cage ports, a valve stem connected to the tube extending through the stuffing box, and an actuating lever rotatably mounted on the valve bonnet and connected to the said stem to rotate the valve tube to vary the flow of fluid under pressure from the inlet opening to the outlet opening, the valve being slidable with respect to the stem to permit manually adjusting the degree of registry of the registering ports.

12. A fluid-pressure valve having, in combination, a valve casing having an inlet opening and an outlet opening, an interiorly disposed open cage, a valve bonnet closing the cage having a stuffing box, the cage being provided with a plurality of circumferentially disposed ports, a valve tube having a plurality of circumferentially disposed ports each adapted to register with one of the cage ports, a valve stem connected to the tube extending through the stuffing box, an actuating lever, the bonnet having guide ways for the lever concentric with the said stem, and an adjusting nut threadably mounted on the valve stem and supported by the actuating lever.

13. In combination, a pressure device, a motor, two elements having a relative neutral position in which they are ineffective and a relative effective position in which they control the operation of the motor, means controlled by the pressure device for effecting the relative actuation of the elements to the relative effective position, an adjustable compensator controlled by the motor for counteracting the actions of the fluid-pressure device and for relatively returning the elements to the relative neutral position, a rotatable balanced-fluid-pressure valve automatically adjustable by the motor for controlling the pressure upon the pressure device and means for manually adjusting the fluid-pressure valve to cause the variations in pressure upon the pressure device

to bear a predetermined relation to the counter action controlled by the compensator for all stages of motor travel.

14. In a fluid-pressure system, the combination with a fluid-pressure device controlled by the pressure in the system, a motor, two elements having a relative neutral position in which they are ineffective and a relative effective position in which they control the operation of the motor, means controlled by the fluid-pressure device for effecting the relative actuation of the elements to the relative effective position, and an adjustable compensator controlled by the motor for counteracting the action of the fluid-pressure device and for relatively returning the elements to the relative neutral position, of a rotatable balanced-fluid-pressure valve automatically adjustable by the motor for controlling the pressure in the system, and means for manually adjusting the fluid-pressure valve to cause the variations in the pressure of the system transmitted to the fluid-pressure device to bear a predetermined relation to the counter action controlled by the compensator for all stages of motor travel.

15. In combination, a pressure device, a motor, two elements having a relative neutral position in which they are ineffective and a relative effective position in which they control the operation of the motor, means controlled by the pressure device for effecting the relative actuation of the elements to the relative effective position, a fluid-pressure valve for controlling the pressure upon the pressure device having an inlet opening, an outlet opening, a partition wall between the inlet and the outlet openings, and oppositely disposed ports between the inlet opening and the partition wall the degree of opening of which in one direction only is automatically controlled by the motor, and means for manually adjusting the degree of opening of the ports in another direction.

In testimony whereof I have affixed my signature.

JAMES LEWIS KIMBALL.