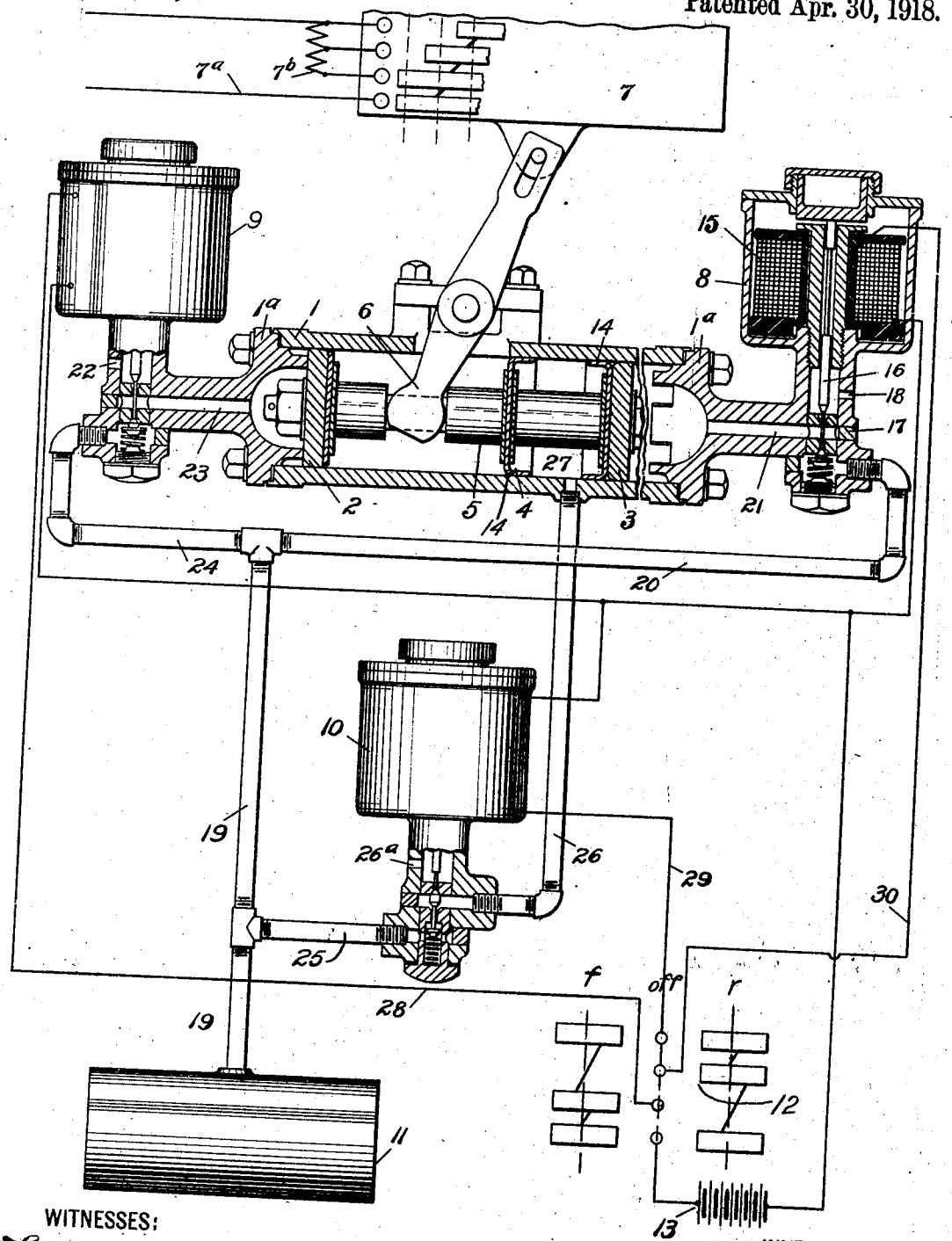
F. G. MOARD.

CONTROL APPARATUS.

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1,264,422.

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WITNESSES:

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CONTROL APPARATUS.

1,264,422. Specification of Letters Patent. Patented Apr. 30, 1918.

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To all whom it may concern:

Be it known that I, FERDINAND G. MOARD, a citizen of the United States, and a resident of Turtle Creek, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Control Apparatus, of which the following is a specification.

My invention relates to control apparatus, and it has special reference to means for controlling the operation of a movable member, such as a controller for electric circuits or the like.

The object of my invention is to provide a device of the above-indicated character, the movement of which may be readily and quickly arrested at any desired point, and wherein no tendency to "overshooting" any predetermined position is encountered, which tendency is found in some prior types of control apparatus of the class above indicated.

According to my invention, I provide a plurality of pistons which operate in a suitable cylinder and are operatively connected to an electrical controller or other member to be actuated, in combination with means for admitting fluid-pressure to each end of the cylinder to move the member to be actuated in the one or the other direction, and independent means for admitting fluid pressure between one of the end pistons and an intermediate piston for causing the piston washers or rings to immediately frictionally lock the pistons in position. Thus, a prompt arrest of movement of the member, at any desired point, may be secured.

In the accompanying drawing, the single figure is a view, partially in section and partially in elevation, of a control apparatus constructed in accordance with my invention, combined with an electrical system, which is shown diagrammatically, for governing the operation of the structure shown.

Referring to the drawing, the apparatus here illustrated comprises a suitable incasing member or operating cylinder 1 which is provided with end caps 1^a; a pair of pistons 2 and 3 which are located near the respective ends of the cylinder 1, and an intermediate piston 4, all of the pistons being mounted on a common rod or stem 5; a suitable lever 6 for operatively connecting the piston to a device 7 to be actuated, which device is shown in the drawing as a conventional electrical controller that is developed into a single plane and is adapted to control an electrical circuit 7^a which includes a resistor 7^b; a pair of magnet valves 8 and 9 that are associated with the respective ends of the cylinder 1; a third magnet valve 10 of slightly different construction; a source of fluid pressure 11 for supplying fluid pressure to the several magnet valves, a master controller 12 for governing the electrical operation of the magnet valves and adapted to assume a position *f*, in one direction, a position *r*, in the opposite direction, and an intermediate "off" position; and a source of electrical energy 13 that is suitably associated with the controller 12.

The pistons 3 and 4 are respectively provided, on their adjacent faces, with flexible washers or piston rings 14 which have relatively large bearing surfaces within the cylinder 1, for a purpose to be hereinafter specified.

The magnet valve 8 is of a familiar type and comprises essentially a magnet coil 15 which is adapted, when energized, to actuate a magnet core member 16 for operating a suitable valve member 17.

When the valve is closed, as shown in the drawing, communication is established from the corresponding end of the cylinder 1 to the atmosphere through an inlet or port 18; and, when the valve is energized, fluid pressure is admitted from the source 11 through pipes 19 and 20 to an inlet passage 21 within the corresponding end cap 1^a. The magnet valve 9 is of similar construction, being provided with an outlet port 22 and an inlet passage 23 to which fluid-pressure is admitted from the pipes 19 and 24 when the valve is energized. The valves 8 and 9 will hereinafter be referred to as "standard" valves.

The magnet valve 10 is normally deënergized and open to admit fluid-pressure from the source 11 through pipes 25 and 26 to the chamber 27 between the pistons 3 and 4, thereby causing the washers 14 to tightly grip the inside walls of the cylinder 1. Upon the energization of the coil, fluid pressure is exhausted from the chamber 27 through pipe 26 and outlet port 26^a. The valve 10 will hereinafter be spoken of as an "inverted" valve.

The operation of my apparatus may be described as follows: Assuming the master

controller to be moved to its position *f*, a circuit is established from the source of energy 13 through the master controller and conductors 28 and 29 to the coils of the magnet valves 9 and 10, respectively, whereby fluid pressure is admitted to the corresponding end of the cylinder 1 through the inlet 23 and is exhausted from the chamber 27 to actuate the pistons to the right and to gradually exclude sections of the resistor 7^b from the circuit 7^a, by the operation of the member 7 to its various operative positions. In order to arrest the movement of the member 7 at any desired point, the controller 12 is returned to its "off" position to deënergize the magnet valves 9 and 10, whereupon, fluid pressure is admitted to the chamber 27 to cause the frictional engagement of the washers 14 with the inside walls of the cylinder 1 and immediate stopping of the movement of the piston. The member 7 may thus be operated to one extreme position, or it may be held in any predetermined position as long as desired. To return the member 7 to its initial position, which is shown on the drawing, the controller 12 is thrown to its position *r*, thereby causing the energization of the inverted valve magnet 10 through the conductor 29 and of the standard valve magnet 8 through the conductor 30. Fluid pressure is thus admitted to the opposite end of the cylinder 1 and is exhausted from the chamber 27 to cause a movement of the pistons and the member 7 to the initial position. Such movement may, of course, be arrested at any point by the actuation of the master controller 12 to its "off" position.

I do not wish to be restricted to the specific structural details or arrangement of parts herein set forth for illustrative purposes, as many modifications thereof may be made within the spirit and scope of my invention; and I desire that only such limitations shall be imposed as are indicated in the appended claims.

I claim as my invention:

1. A fluid-actuator comprising a plurality of pistons, a cylinder in which the pistons operate, means for controlling the fluid pressure in each end of the cylinder to produce a movement of the pistons in the one or the other direction, and means for controlling the fluid pressure between the pistons to retard said movement.

2. A fluid-actuator comprising a plurality of pistons, a cylinder in which the pistons operate, means for unbalancing the fluid pressures in the ends of the cylinder to produce a movement of the pistons in the one or the other direction, and means for admitting operating fluid between the pistons to arrest said movement.

3. A fluid-actuator comprising a plurality of pistons, a cylinder in which the pistons operate, valves for controlling the admission of fluid pressure to the respective ends of the cylinder to produce a movement of the pistons in the one or the other direction, and a valve for controlling the admission of fluid pressure between the pistons to arrest said movement.

4. A fluid-actuator comprising a plurality of pistons, a cylinder in which the pistons operate, valves for controlling the admission of fluid pressure to the respective ends of the cylinder, another valve for controlling the admission of fluid pressure between the pistons, one of said valves being normally open and the others being normally closed, and means for actuating either end valve and the intermediate valve to produce a predetermined movement of the pistons and for permitting said valves to return to their initial positions to hold said pistons in a predetermined position.

5. A fluid-actuator comprising a plurality of pistons, a cylinder in which the pistons operate, electromagnetically actuated valves for controlling the admission of fluid pressure to the respective ends of the cylinder, and another valve for controlling the admission of fluid pressure between the pistons, one of said valves being closed when its actuating magnet is energized and the others being open when their actuating magnets are energized.

6. A fluid-actuator comprising a plurality of pistons, a cylinder in which the pistons operate, magnet-actuated valves for controlling the supply of fluid pressure to the respective ends of the cylinder, another magnet-actuated valve for controlling the supply of fluid pressure between the pistons, and a switching device for governing the operation of all of said valves.

7. A fluid-actuator comprising a plurality of pistons, a cylinder in which the pistons operate, normally closed magnet-actuated valves for controlling the supply of fluid pressure to the respective ends of the cylinder, a normally open magnet-actuated valve for controlling the supply of fluid pressure between the pistons, and control means for governing the operation of all of said valves.

8. The combination with a switching device, of a fluid-actuator comprising a plurality of pistons, a cylinder in which the pistons operate, normally closed magnet-actuated valves energized through said switching device to admit fluid pressure to the respective ends of the cylinder for producing movement of the pistons in the one or the other direction, and another magnet-actuated valve energized when the switching device is closed to exclude fluid pressure from between the pistons and deënergized at other times to admit fluid pressure between the pistons to arrest said movement.

9. A fluid-actuator comprising a piston, a

cylinder in which the piston operates, means for controlling the fluid-pressure in each end of the cylinder to produce a movement of the piston in the one or the other direction, and auxiliary means secured to the piston and selectively operated for locking the same in any predetermined position.

10. A fluid-actuator comprising a piston, a cylinder in which the piston operates, means for controlling the fluid-pressure in each end of the cylinder to produce a movement of the piston in the one or the other direction, and auxiliary fluid-pressure controlled means rigidly secured to the piston for locking it in any predetermined position.

11. A fluid-actuator comprising a piston, a cylinder in which the piston operates, means for controlling the fluid-pressure in each end of the cylinder to produce a movement of the piston in the one or the other direction, an auxiliary chamber in the cylinder, and means for controlling the fluid pressure in said chamber to lock the piston in any predetermined position.

12. A fluid actuator comprising a plurality of pistons, a cylinder in which the pistons operate, means for controlling the fluid-pressure in each end of the cylinder to produce a movement of the pistons in the one or the other direction, an auxiliary chamber intermediate the pistons, and means for controlling the fluid pressure in said chamber to lock the pistons in any predetermined position.

13. A fluid actuator comprising a plurality of associated pistons, a cylinder in which the pistons operate, means for controlling the fluid pressure in each end of the cylinder to produce a movement of the pistons in the one or the other direction, another piston disposed intermediate the first-named pistons and associated therewith, and means for admitting fluid pressure between said intermediate piston and one of the other pistons to lock the associated pistons in any predetermined position.

14. A fluid-actuator comprising a pair of pistons, a cylinder in which the pistons operate, electro-magnetically actuated valves for controlling the fluid pressure in each end of the cylinder to produce a movement of the pistons in the one or the other direction, an intermediate piston disposed near one of the first named pistons and movable therewith, and a third electromagnetically actuated valve for admitting fluid pressure between said intermediate piston and the nearer of the first-named pistons to lock the pistons in any predetermined position.

15. A fluid-actuator comprising a pair of pistons, a cylinder in which the pistons operate, normally closed electromagnetically-actuated valves for controlling the pressure in each end of the cylinder to produce a movement of the pistons in the one or the other direction, an intermediate piston disposed near one of the first-named pistons and movable therewith, and a normally open valve electromagnetically actuated to exclude fluid pressure from the chamber included between said intermediate piston and the nearer of the first-named pistons during said movement and adapted, upon deënergization, to admit fluid pressure into said chamber to lock the pistons in any predetermined position.

16. A fluid-actuator, comprising a piston, a cylinder in which the piston operates, means for controlling the fluid-pressure in each end of the cylinder to produce a movement in the one or the other direction, and means for causing a frictional arresting of the piston in any predetermined position.

17. A fluid-actuator comprising a piston, a cylinder in which the piston operates, means for controlling the fluid pressure in each end of the cylinder to produce a movement in the one or the other direction, and fluid-pressure controlling means for causing a frictional engagement of the piston within the cylinder to arrest said movement.

18. A fluid-actuated means comprising a plurality of pistons, a cylinder in which the pistons operate, means for controlling the fluid pressure on the outer side of each piston to produce a movement in the one or the other direction, and auxiliary means for causing a frictional engagement of the inner side of one of said pistons within the cylinder for arresting said movement under predetermined conditions.

19. A fluid-actuated means comprising a plurality of pistons, a cylinder in which the pistons operate, means for controlling the fluid pressure on the outer side of each piston to produce a movement in the one or the other direction, another piston disposed intermediate the first-named pistons, and means for causing a frictional engagement of said intermediate piston and another piston within the cylinder to arrest said movement.

20. A fluid-actuated means comprising a plurality of pistons, a cylinder in which the pistons operate, means for controlling the fluid pressure on the outer side of each piston to produce a movement in the one or the other direction, an intermediate piston disposed near one of the first named pistons and movable therewith, and auxiliary means for admitting fluid pressure between said intermediate piston and the nearer of the first-named pistons to cause a frictional locking of the two pistons within the cylinder, whereby said pistons are held in any predetermined position.

21. A fluid-actuated means comprising a pair of pistons, a cylinder in which the pistons operate, normally closed electromagnetically actuated valves for controlling the

pressure in each end of the cylinder to produce a movement of the member in the one or the other direction, an intermediate piston disposed near one of the first named pistons and movable therewith, and a normally open valve electromagnetically actuated to exclude fluid pressure from the chamber included between said intermediate piston and the nearer of the first-named pistons during said movement and adapted, upon deënergization, to admit fluid pressure into said chamber to cause a frictional locking of the two pistons within the cylinder, whereby the pistons are held in any predetermined position.

22. The combination with a cylinder, of a piston rod, a main piston mounted upon and adapted to actuate the said rod, and an auxiliary piston mounted upon the said rod and adapted to lock the same in place under predetermined operating conditions.

23. The combination with a fluid-receiving cylinder and a plurality of associated pistons disposed therein, of means for admitting relatively high-pressure operating fluid within the chamber formed by said cylinder and said pistons to prevent movement of said pistons.

24. The combination with a fluid-receiving cylinder and a plurality of associated pistons disposed therein, of cupped washers associated with the pistons and projecting inwardly, the one toward the other, and means for establishing a relatively high pressure within the chamber formed by said cylinder and said pistons to force said washers into intimate engagement with the inner surface of said cylinder and prevent movement of the pistons.

25. The combination with a fluid-receiving cylinder and a plurality of associated pistons disposed therein, of means for admitting operating fluid to said cylinder to effect movements of said pistons and controllable means for increasing the normal friction between said pistons and said cylinder to prevent movements thereof.

26. The combination with a fluid-receiving cylinder and a plurality of associated pistons disposed therein, of a plurality of valves severally disposed at the respective ends and at an intermediate point of said cylinder for governing the admission and release of operating fluid.

27. The combination with a fluid-receiving cylinder and a plurality of associated pistons disposed therein, of a plurality of valves severally disposed at the respective ends and at an intermediate point of said cylinder for governing the admission and release of operating fluid, the end valves only being of like construction.

In testimony whereof, I have hereunto subscribed my name this 30th day of July, 1914.

FERDINAND G. MOARD.

Witnesses:
CECILE D. BILBY,
B. B. HINES.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."