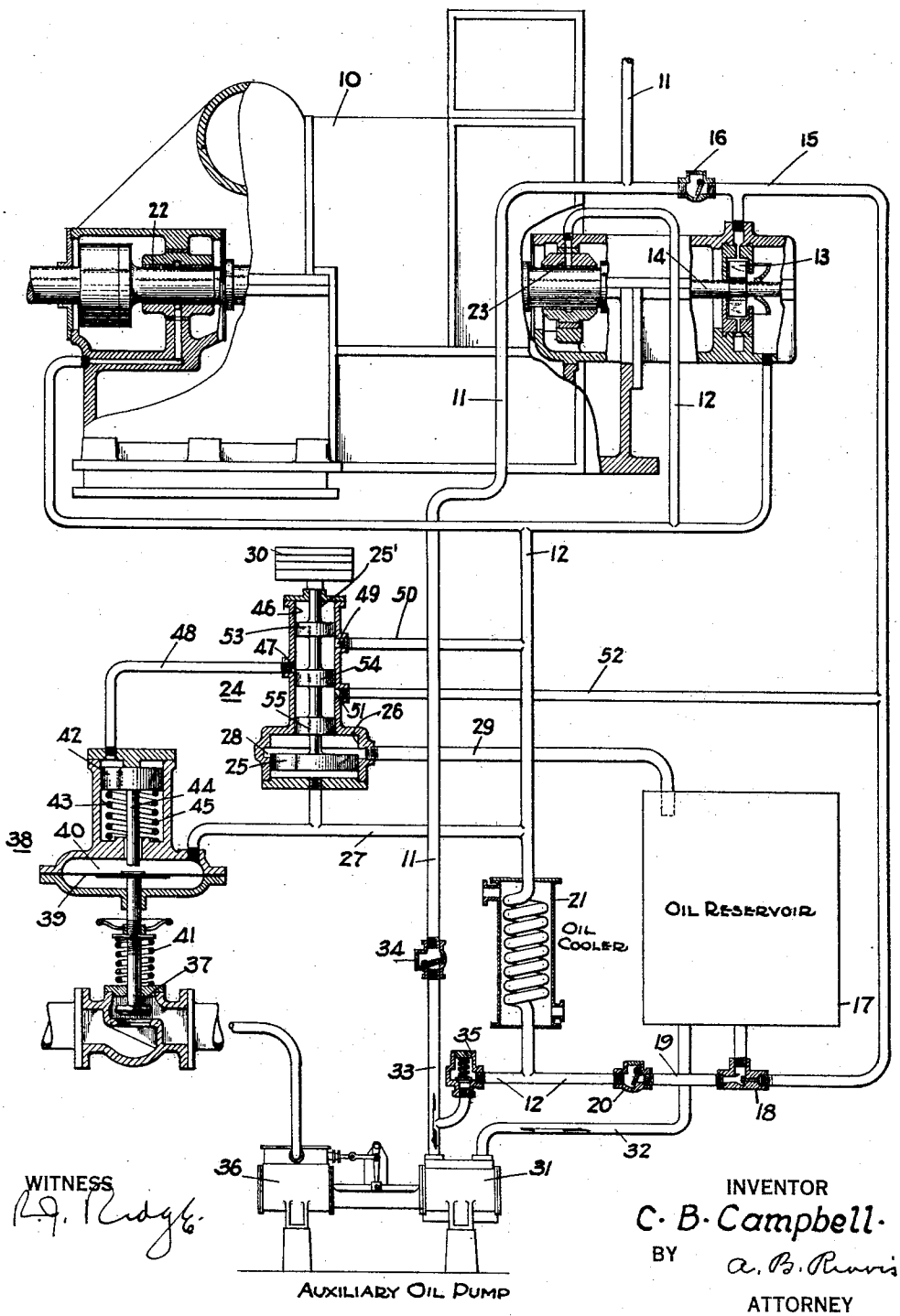
Dec. 20, 1932. C. B. CAMPBELL 1,891,618

AUXILIARY OIL PUMP REGULATOR

Filed Aug. 28, 1930



WITNESS

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Patented Dec. 20, 1932 1,891,618

UNITED STATES PATENT OFFICE

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AUXILIARY OIL PUMP REGULATOR

Application filed August 28, 1930. Serial No. 478,538.

My invention relates to a regulating mechanism, more particularly to a regulating mechanism for a valve which is completely shut a substantial portion of the time but which regulates flow of fluid in response to a variable operating condition at other times, and it has for its object to provide an improved mechanism of the character set forth.

A more particular object is to provide a mechanism adapted to regulate a valve in a simple manner and which holds the valve tightly on its seat with a large excess force when the valve is to be shut.

The fluid pressure system commonly provided for a turbine or similar prime mover, providing fluid pressure for lubricating and for operating relays, etc., is usually supplied with fluid pressure by a pump driven directly by the turbine. This arrangement requires an auxiliary pump for use in starting and stopping the turbine, the auxiliary pump also serving as an emergency pump upon failure of the main pump. The auxiliary pump is shut down, however, as long as the main pump provides sufficient fluid pressure.

Considerable difficulty has been experienced in obtaining a tight closing of the admission valve while the auxiliary pump is shut down. This is due to the fact that the pressure provided by the main pump is but a few pounds per square inch above the pressure at which the regulator moves the valve to closed position, and hence it exerts only a small excess closing force above the force of the regulator spring. While the valve is brought substantially to closed position, it is not held on its seat tightly enough to avoid leakage. The leakage has a wire-drawing or cutting action on the valve and seat, so that the leakage gradually increases and after a time causes continual operation of the auxiliary pump.

In accordance with my invention, I employ the usual direct-acting pressure regulator for regulating the admission valve of the auxiliary oil pump when the latter is required to operate. In addition, I employ a pressure-actuated piston for applying sufficient excess closing force on the admission valve to hold the same tightly shut when the main pump supplies ample fluid pressure.

In its broader aspects, the invention is not limited to an auxiliary oil pump, but is applicable to a regulating mechanism for any valve which is to be shut as long as a given value of some fluid pressure is maintained.

The above and other objects are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawing, and forming a part of this application, in which:

The single figure is a diagrammatic view of a turbine and a fluid pressure system therefor.

Referring now to the drawing more in detail, I show an elastic fluid turbine 10, having a fluid pressure system to which my novel regulating mechanism is applied. The fluid pressure system preferably employs lubricating oil, and includes a relatively high-pressure portion 11 supplying fluid pressure for operation of relays, etc., and a low-pressure portion 12 for supplying fluid at a lower pressure for such purposes as lubrication.

A main pump 13 is mounted on the turbine shaft 14 and delivers fluid to a conduit 15 at a relatively high pressure, for example, 70 lbs. per sq. in. From the conduit 15, the fluid pressure flows through a check valve 16 to the high-pressure portion 11.

The fluid pressure system further includes a reservoir 17 and an ejector 18. High-pressure fluid is supplied from the conduit 15 to the ejector 18, in which it entrains fluid flowing by gravity from the reservoir 17. The ejector delivers the fluid at a relatively low pressure, for example, 7 lbs. per sq. in., through a conduit 19 and a check valve 20 to the low-pressure portion 12. The fluid then flows through the low-pressure portion, including an oil cooler 21 interposed therein, to the turbine bearings 22 and 23 and to the inlet of the main pump 13.

The low-pressure portion 12 includes a relief valve 24 for returning to the reservoir 17 the amount of low-pressure fluid in excess of that required; the capacity of the system, when the pump 13 is operating, being in

excess of normal requirements in order to assure an adequate supply of lubricating fluid. The relief valve 24 includes a piston 25 disposed in a cylinder 26. The lower end of the cylinder 26 communicates with the low pressure portion through a conduit 27. Somewhat above the lower end, the cylinder is formed with an annular recess 28, which communicates with the reservoir 17 through a conduit 29.

The piston 25 is biased downwardly by a force balancing the force of the fluid pressure on the lower side of the piston at the value desired to be maintained in the low-pressure portion 12, for example, 7 lbs. per square inch. This force is preferably provided by the weight of the piston 25, a stem 25′ formed integrally therewith, and a group of weights 30 carried by the stem 25′. As the supply of fluid under pressure exceeds that required to maintain the desired pressure in the low-pressure portion, the piston 25 is raised and uncovers the recess 28, permitting the excess amount of fluid to return through the recess 28 and the conduit 29 to the reservoir 17, and maintaining the desired pressure on the fluid in the low-pressure portion.

An auxiliary pump 31, supplied with fluid from the reservoir 17 through a conduit 32, delivers fluid through a conduit 33 and a check valve 34 to the high-pressure portion 11, and through the conduit 33 and a pressure-relief valve 35, to the low-pressure portion 12. The relief valve 35 is set at a pressure below that provided by the main pump 13 when the turbine is at normal speed, for example 45 lbs. per sq. inch. The relief valve 35 maintains the pressure of 45 lbs. per sq. inch in the high-pressure portion while the auxiliary pump is supplying fluid pressure thereto. The fluid above that necessary to maintain such pressure is conveyed to the low-pressure portion 12, in which a pressure of about 5 lbs. per sq. in. is to be maintained when the auxiliary pump is supplying the fluid pressure.

The auxiliary pump 31 is driven by a steam engine 36, provided with an admission valve 37 for controlling the admission of motive fluid thereto. The admission valve is actuated by a regulating device 38 in response to the pressure in the low-pressure portion 12.

The regulating device 38 includes a diaphragm 39 connected directly to the stem of the valve 37 and a chamber 40 on the upper side of the diaphragm 39. The pressure in the low-pressure portion 12 is communicated through the conduit 27 to the chamber 40, in which it biases the diaphragm 39 in valve-closing direction. A spring 41, acting on the stem of the valve 37, opposes the fluid pressure and provides a position of the valve 37 corresponding to the pressure acting on the diaphragm 39.

This much of the regulating device 38 constitutes an ordinary pressure regulator. Upon increase in pressure in the chamber 40, an increased deflection of the spring 41 is effected, providing decreased valve opening. Upon decrease in pressure, the deflection of the spring 41 is decreased, providing increased valve opening.

The regulating device 38 is further provided with a pressure-actuated piston 42 disposed in a cylinder 43. The piston 42 carries a plunger 44 adapted to abut the stem of the valve 37. The piston 42 is normally held at the uppermost position by a light spring 45.

The application of motivating-fluid pressure to the piston 42 is controlled in response to an excess supply of fluid in the low-pressure portion 12, and preferably by the relief valve 24. The latter further includes a cylinder 46 having a port 47 communicating with the upper end of the cylinder 43 through a conduit 48. Above the port 47, the cylinder 46 is formed with a port 49 communicating with the low-pressure portion 12 through a conduit 50, and below the port 47, the cylinder 46 is provided with a port 51 communicating with the conduit 15 through a conduit 52. The piston stem 25′ forms piston portions 53, 54 and 55, the piston portion 54 serving to place the port 47 in communication with the port 49 or the port 51.

The operation of the above-described apparatus is as follows:

In normal operation of the turbine 10, fluid pressure is supplied to the system solely by the pump 13, which supplies high-pressure fluid directly to the high-pressure portion 11 and which provides low-pressure fluid to the low-pressure portion 12 by means of the ejector 18, as described.

During such time, the auxiliary pump 24 should be shut down and the valve should be closed and effective to prevent the leakage of any steam thereby.

The pressure in the low-pressure portion is but a few pounds above that required to fully deflect the spring 41. In the example of fluid pressures assumed, this pressure is 7 pounds per sq. inch, while a pressure of 5 pounds per sq. inch is required to provide full spring deflection, so that an excess force of only two pounds per sq. inch is effective to hold the valve against its seat.

Additional closing force is applied to the valve 37 by the piston 42. The piston portion 54 is held in raised position by the piston 25, placing the ports 47 and 51 in communication in order to admit fluid pressure developed by the pump 13 through the conduits 15, 52 and 48 to the cylinder 43, in which it acts on the piston 42. As the fluid pressure developed by the pump 13 is relatively high, a large additional valve-closing force is readily obtained. For example,

with a three-inch diameter of the piston 42, a force of about 500 lbs. is provided.

When the speed of the turbine decreases, the pressure developed by the pump 13 decreases accordingly. The first effect thereof on the low-pressure portion is to reduce the excess supply of fluid, and when there is no longer an excess supply, the piston 25 drops to lowermost position, cutting off all escape of fluid through the recess 28. At the same time, the piston portion 54 cuts off the high-pressure fluid from the piston 42 and places the same in communication with the low-pressure fluid. Since the pressure in the chamber 40 is communicated to the lower end of the cylinder 43, the fluid pressures acting on the piston 42 are balanced, and the piston is moved to and supported at its uppermost position by the spring 45.

The valve 37 is now under full control of the normal regulator, and as soon as the pressure drops within the regulating range, the valve 37 is opened to admit motive fluid to the engine 36.

The auxiliary pump 31 then supplies fluid pressure to the system. The pump 31 supplies fluid to the high-pressure portion to maintain a pressure of 45 lbs. per sq. inch, and the remainder is passed by the relief valve 35 to the low-pressure portion 12. As the pressure in the low-pressure portion controls the operation of the auxiliary pump, the latter will operate to supply sufficient fluid to maintain the pressure in the low-pressure portion and to insure a supply of lubricating fluid to the bearings.

When the auxiliary pump is operating, the check valve 16 prevents the escape of fluid to the pump 13 through the conduit 15, and the check valve 20 prevents the escape of fluid to the reservoir 17 through the conduit 19 and the ejector 18. When the main pump 13 is supplying the fluid pressure, the check valve 34 prevents the escape of fluid to the auxiliary pump, and the relief valve 35 serves as a check valve to prevent the escape of fluid from the low-pressure portion.

From the above description it will be seen that I have provided a regulating mechanism which actuates the valve in the normal manner when it is regulating, and which applies a large excess closing force to prevent leakage when the valve is shut.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In a regulating mechanism for controlling a valve in response to a variable force, the combination of an element subjected to the variable force and directly connected to the valve, a spring biasing said element in opposition to said variable force, and means for applying additional force to the valve to hold the same tightly closed in response to a value of said variable force acting on said element which causes the same to move to valve closed position.

2. In a regulating mechanism for controlling an operated member in response to a variable fluid pressure, the combination of a pressure-responsive element subjected to the variable fluid pressure and acting directly on the operated member to regulate the same, a pressure-actuated member adapted to act on the operated member to hold the same at one end of its travel, and means responsive to a value of said variable fluid pressure outside of the regulating range for applying motivating fluid pressure to said pressure-actuated member for actuating the same.

3. The combination with a prime mover, an admission valve for the prime mover, and a pump driven by the prime mover and providing fluid pressure in an enclosed space, of a regulating mechanism for the admission valve comprising pressure-responsive means including an element responsive to the fluid pressure in said space and directly actuating the admission valve to regulate the same, and means responsive to a given value of said fluid pressure for applying additional fluid pressure to the pressure-responsive means in order to hold the admission valve tightly on its seat.

4. The combination with a prime mover, an admission valve for the prime mover, and a pump driven by the prime mover and providing fluid pressure in an enclosed space, of a regulating mechanism for the admission valve comprising pressure-responsive means including an element responsive to the fluid pressure in said space and directly actuating the admission valve to regulate the same, and means responsive to a given value of said fluid pressure above the pressure at which the pressure-responsive element completely closes the admission valve for applying additional fluid pressure to the pressure-responsive means in order to hold the admission valve tightly on its seat.

5. The combination with a prime mover, an admission valve for the prime mover, and a pump driven by the prime mover and providing a fluid pressure in an enclosed space, of a regulating mechanism for the admission valve comprising an element responsive to the fluid pressure in said space and acting directly on the admission valve to regulate the same, a pressure-actuated member adapted to hold the valve tightly closed, and means responsive to a predetermined value of said fluid pressure for applying motivating fluid pressure to the pressure-actuated member for render-

ing the same effective to hold the valve tightly closed.

6. The combination with a fluid pressure system comprising means providing a supply of fluid to the system, an auxiliary pump for supplying fluid to the system, a prime mover for the auxiliary pump and an admission valve for the prime mover, of means for regulating said admission valve comprising an element responsive to deficiency in the supply of fluid provided by the first-mentioned means for directly actuating the admission valve to regulate the same, a pressure-actuated member adapted to act on the admission valve to hold the same tightly on its seat, and means responsive to an excess supply of fluid for applying motivating fluid pressure to said pressure-actuated member to hold the same tightly on its seat.

7. The combination with a fluid pressure system comprising means normally providing fluid pressure to the system, an auxiliary pump for supplying fluid pressure to the system when the first-mentioned means is not fully operative, a prime mover for the auxiliary pump, and an admission valve for the prime mover, of a regulating mechanism for the valve including an element responsive to a fluid pressure in the system and acting directly on the valve to regulate the same, a pressure-actuated member adapted to hold the valve tightly closed, and means responsive to a value of said fluid pressure above the regulating range of the pressure-responsive element for applying motivating fluid pressure to the pressure-actuated member for rendering the same effective to hold the valve closed.

In testimony whereof, I have hereunto subscribed my name this 26th day of August, 1930.

CLARENCE B. CAMPBELL.