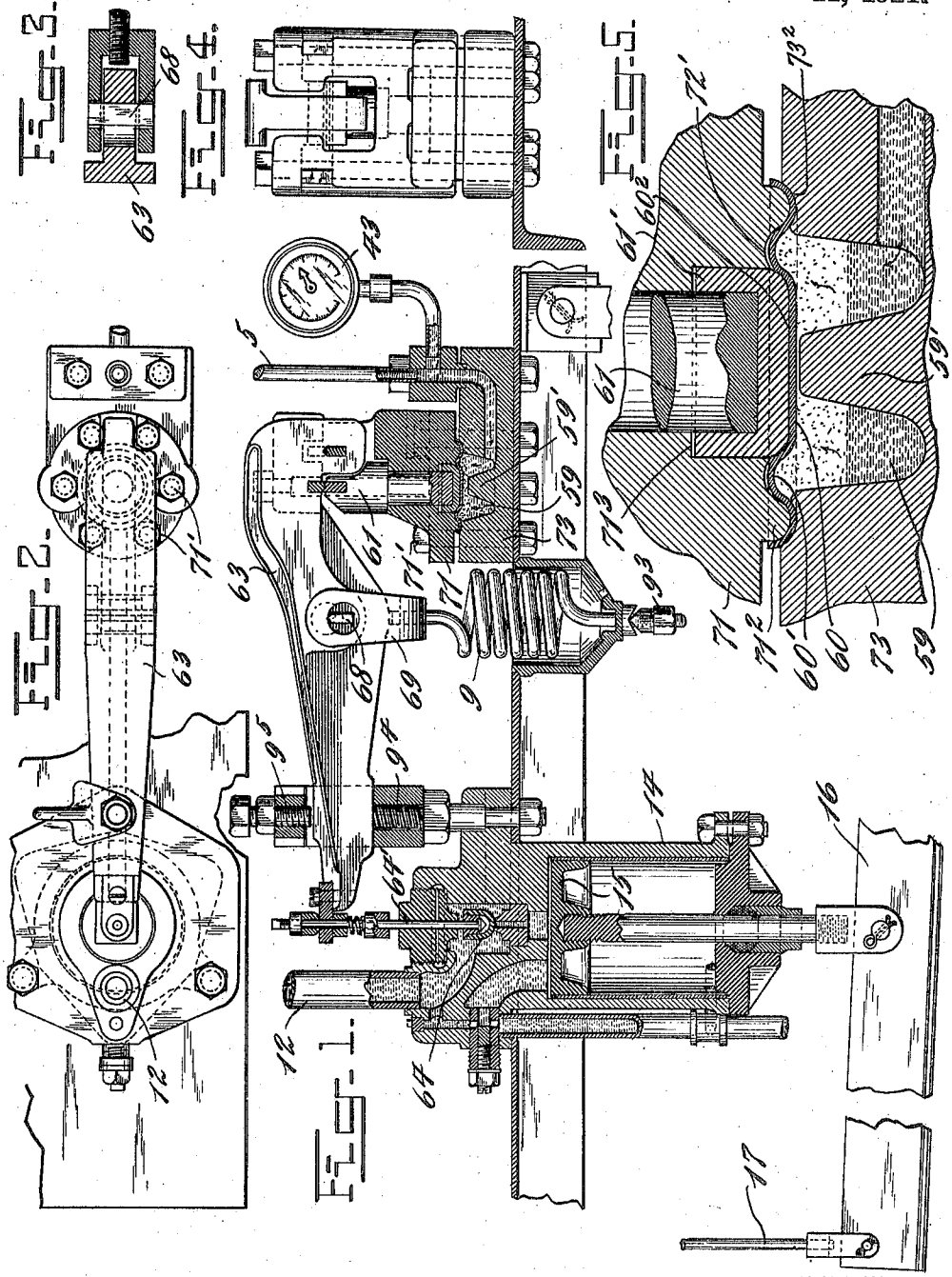
D. S. JACOBUS.

FLUID PRESSURE OPERATING DEVICE.

APPLICATION FILED OCT. 16, 1918.

1,393,446.

Patented Oct. 11, 1921.



INVENTOR.

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UNITED STATES PATENT OFFICE.

DAVID S. JACOBUS, OF JERSEY CITY, NEW JERSEY, ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

FLUID-PRESSURE OPERATING DEVICE.

1,393,446. Specification of Letters Patent. Patented Oct. 11, 1921.

Application filed October 16, 1918. Serial No. 258,430.

To all whom it may concern:

Be it known that I, DAVID S. JACOBUS, a citizen of the United States, residing in Jersey City, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Fluid-Pressure Operating Devices, of which the following is a specification.

My invention relates to a fluid pressure-operated device, and it has for its object the improvement in a device of this character. More particularly, my invention relates to a device of this character comprising a diaphragm of such form that only a part thereof changes its form during movement of the diaphragm.

My invention is particularly useful where the diaphragm is called upon to perform mechanical work, and in the embodiment here shown it is used in connection with a superheat limiting device as disclosed in my prior application Serial No. 136,832 which was filed in the United States Patent Office December 14, 1916. It will be understood, however, that while I have illustrated my invention in connection with a superheat limiting device, it may be used in other places where a device of this character is desired.

My invention will best be understood by reference to the accompanying drawings in which Figure 1 is a side view, partly in section, of a diaphragm-operated device embodying my invention and the parts associated therewith; Fig. 2 is a plan view; Fig. 3 is a sectional view through the arm which is operated by the diaphragm; Fig. 4 is an end view of Fig. 1 and Fig. 5 is a sectional view on an enlarged scale of the diaphragm and the parts immediately associated therewith.

Referring now to the drawings, the member within which the diaphragm is disposed comprises two sections, an upper section 71 and a lower section or plate 73 provided with a chamber 59 to which fluid under pressure may be admitted through a pipe 5. In my prior application above referred to, this pipe is connected to a closed tube filled with or containing a volatile liquid, the tube being subjected to the influence of superheated steam, the pressure within the tube and therefore in the pipe and the chamber 59 varying with the termperature of the superheated steam, the temperature of which is to be controlled. Inasmuch as the details of construction by which the variation in pressure in the pipe 5 is brought about constitute no part of my present invention, they have been omitted for the sake of simplicity. The diaphragm 60 is disposed between the two members 71 and 73 at the upper part of the chamber 59. In order to form a water tight joint between the members 71 and 73 and the diaphragm 60, the member 71 is formed with a projection 71^2 and the diaphragm is firmly held between said projection and a corresponding depression 73^2 in the base member 73. The diaphragm 60 is formed with a distorted portion to which the change of form of the diaphragm is confined during its operation. In the form of my invention here illustrated the diaphragm is provided with a central depression 60^2 which is surrounded by a corrugation 60′, in the form here shown an annular corrugation, the upper side of which is convex in form so that the fluid pressure acts on the lower or concave surface thereof and tends to produce a tensile stress in the metal of this portion of the diaphragm, a clearance 72′ being provided in the member 71 above the corrugation to provide for the desired movement of the diaphragm. Resting upon the depressed central portion of the diaphragm is a strut or post 61 which bears against a knife edge carried by a lever 63 pivoted at a point at the right of the knife edge. The lever 63 is normally held in its lower position by a tension spring 9 which may be adjusted by a nut 9^3 to hold the lever 63 firmly against a stop 9^4, and to provide the requisite resistance to the upward movement of the strut 61, the upward movement of the lever being limited by a stop 9^5 located above the stop 9^4 and on the opposite side of the lever thereof. The spring 9 is connected to a yoke member 69 provided with an opening in which is received a knife edge 68 secured to the lever 63. To the free end of the lever 63 is attached a spindle 64′ which, when the end of the lever 63 is raised, lifts a valve 64 from its seat and admits fluid under pressure from a supply pipe 12 to the upper side of a piston 15 in a cylinder 14, the piston stem being connected to a lever 16 to the end of which is attached a link or rod 17 which in

turn operates a controlling mechanism for varying the temperature of the superheated steam in response to the temperature thereof. I have deemed it unnecessary further to describe the parts associated with the power cylinder and its piston, as the same constitute no part of my present invention. These parts are fully described in my prior application to which reference may be made for these details.

Preferably the strut 61, instead of being directly seated in the depression in the diaphragm 60, is seated in a cup 61′ which is in turn seated in the central depression of the diaphragm, the upper edge of the cup 61′ engaging a shoulder 71^3 formed within the member 71 to limit the upward movement thereof. The downward movement of the diaphragm is limited by a stop 59′ which projects upwardly within the central portion of the chamber 59. There is a clearance provided between the projection 59′ and the diaphragm, under normal operation, as indicated in Fig. 5. During the normal operation, the movement of the diaphragm 60 is limited by the stops 9^4 and 9^5, the function of the stop 59′ being to prevent distortion and injury of the diaphragm in case the stops 9^4 and 9^5 are improperly adjusted. Since the stops 9^4 and 9^5 limit the movement of the lever 63 and since the movement of the lever at these stops is greater than the movement of the diaphragm, these stops form accurate means of limiting the motion of the diaphragm.

From the above description it will be apparent that the form of the diaphragm 60 is such that the part which changes its form on a movement of the diaphragm has a convex surface so that the fluid pressure acts on the concave side and tends to produce a tensile stress in the metal of the diaphragm. This form of diaphragm is of a much stronger construction than a flat diaphragm or one with a number of annular corrugations. The shape of the diaphragm is in fact a close approximation to that which a ductile diaphragm originally flat would assume when subjected to sufficient pressure to distort it and thereby cause the molecules of the material in the diaphragm to adjust themselves in a way to equalize the stress between the molecules. The special form of diaphragm makes it possible to construct it of a minimum thickness, thereby securing a maximum sensitiveness; the form in combination with the small amount of movement given the diaphragm also makes it possible to construct the diaphragm of tempered steel, which, in turn, makes it possible to employ a diaphragm in which the stresses will not exceed the elastic limit of the material. A defect that has been found to exist in diaphragms of the sort is that there is a "lag" when the diaphragm returns to its position in balancing a given fluid pressure; for example, if the apparatus and diaphragm is adjusted so that 500 pounds per square inch fluid pressure would cause the diaphragm 60 to rise 0.015 inch above the stop 59′, and the pressure of 600 pounds per square inch would cause it to rise 0.026 inch above the stop, the height of the diaphragm above the stop on lowering the pressure to 500 pounds per square inch after subjecting it to 600 pounds per square inch might be 0.016 inch, or there would be a "lag" of 0.001 inch. By employing a tempered steel diaphragm of the special form described the "lag" may be reduced to an inappreciable or negligible quantity.

What I claim and desire to secure by Letters Patent of the United States is:—

1. A fluid pressure operated device, comprising a member provided with a chamber to which fluid under pressure is admitted, a metal diaphragm sealed against the wall of said chamber, said diaphragm being formed with a central depression on the side opposite the fluid, the depression being surrounded by a corrugation presenting a concave surface to the fluid, a controlling mechanism, a strut seated in said depression and connected to said controlling mechanism, and stops for limiting the movement of said diaphragm in both directions to a narrow range thereby keeping the stresses set up in the diaphragm within the elastic limit of the diaphragm material.

2. A fluid pressure operated device, comprising a member provided with a chamber to which fluid under pressure is admitted, a metal diaphragm sealed against the wall of said chamber, said diaphragm being formed with a central depression on the side opposite the fluid, the depression being surrounded by a corrugation presenting a concave surface to the fluid, a clearance being provided in the member above the corrugation, a controlling mechanism, a strut seated in said depression and connected to said controlling mechanism, and stops for limiting the movement of said diaphragm in both directions to a narrow range thereby keeping the stresses set up in the diaphragm within the elastic limit of the diaphragm material.

3. A fluid pressure operated device, comprising a member provided with a chamber to which fluid under pressure is admitted, a metal diaphragm sealed against the wall of said chamber, said diaphragm being formed with a central depression on the side opposite the fluid, the depression being surrounded by a corrugation presenting a concave surface to the fluid, a controlling mechanism, a strut seated in said depres-

sion and connected to said controlling mechanism, the strut comprising a cup seated in said depression and acting as a stop for the diaphragm in one direction of movement, a stop for limiting the movement of said diaphragm in the other direction, the stops limiting the movement of the diaphragm to a narrow range thereby keeping the stresses set up in the diaphragm within the elastic limit of the diaphragm material.

4. A fluid pressure operated device, comprising a member provided with a chamber to which fluid under pressure is admitted, a metal diaphragm sealed against the wall of said chamber, said diaphragm being formed with a central depression on the side opposite the fluid, the depression being surrounded by a corrugation presenting a concave surface to the fluid, a controlling mechanism, a strut seated in said depression and connected to said controlling member, stops for limiting the movement of said member in both directions, and stops for limiting the movement of said diaphragm in both directions to a narrow range.

5. A fluid pressure operated device, comprising a member provided with a chamber to which fluid under pressure is admitted, a metal diaphragm sealed against the wall of said chamber, said diaphragm being formed with a central depression on the side opposite the fluid, the depression being surrounded by a corrugation presenting a concave surface to the fluid, a controlling mechanism, a strut seated in said depression and connected to said controlling mechanism, stops for limiting the movement of said mechanism in both directions, and stops for limiting the movement of said diaphragm in both directions to a narrow range, the stops for the controlling mechanism being arranged normally to limit the movement of the diaphragm to a value below that allowed by the diaphragm stops.

6. Fluid pressure operated device, comprising a member provided with a chamber to which fluid under pressure is admitted, a metal diaphragm sealed against the wall of said chamber, said diaphragm being formed with a central depression on the side opposite the fluid, the depression being surrounded by a corrugation presenting a concave surface to the fluid, a controlling mechanism, a strut comprising a cup-shaped member seated in said depression and forming a stop for said diaphragm in one direction of movement, said strut being connected to said controlling mechanism, a stop for limiting the movement of said diaphragm in the opposite direction, stops for limiting the movement of said controlling mechanism in both directions, the stops for the controlling mechanism being arranged normally to limit the movement of the diaphragm to a value below that allowed by the diaphragm stops.

7. A fluid pressure operated device, comprising a member provided with a chamber to which fluid under pressure is admitted, a metal diaphragm sealed against the wall of said chamber, said diaphragm being formed with a depression around its perimeter and adjacent its edge with the concave side toward said chamber, an operating member connected to said diaphragm, and stops to limit the movement of said diaphragm in both directions to a narrow range thereby keeping the stresses set up in the diaphragm within the elastic limit of the diaphragm material.

8. A fluid pressure operated device, comprising a member provided with a chamber to which fluid under pressure is admitted, a metal diaphragm sealed against the wall of said chamber, said diaphragm being formed with a depression around its perimeter and adjacent its edge with the concave side toward said chamber, said depression being given an initial shape approximately that which would be assumed by a ductile flat diaphragm when held at its center and edges and subjected to sufficient fluid pressure to distort its unsupported surface, an operating member connected to said diaphragm and stops to limit the movement of said diaphragm in both directions to a narrow range thereby keeping the stresses set up in the diaphragm within the elastic limit of the diaphragm material.

In testimony whereof I have hereunto signed my name in the presence of two subscribing witnesses.

DAVID S. JACOBUS.

Witnesses:
EDITH CAMP,
ETTA K. KRIETE.