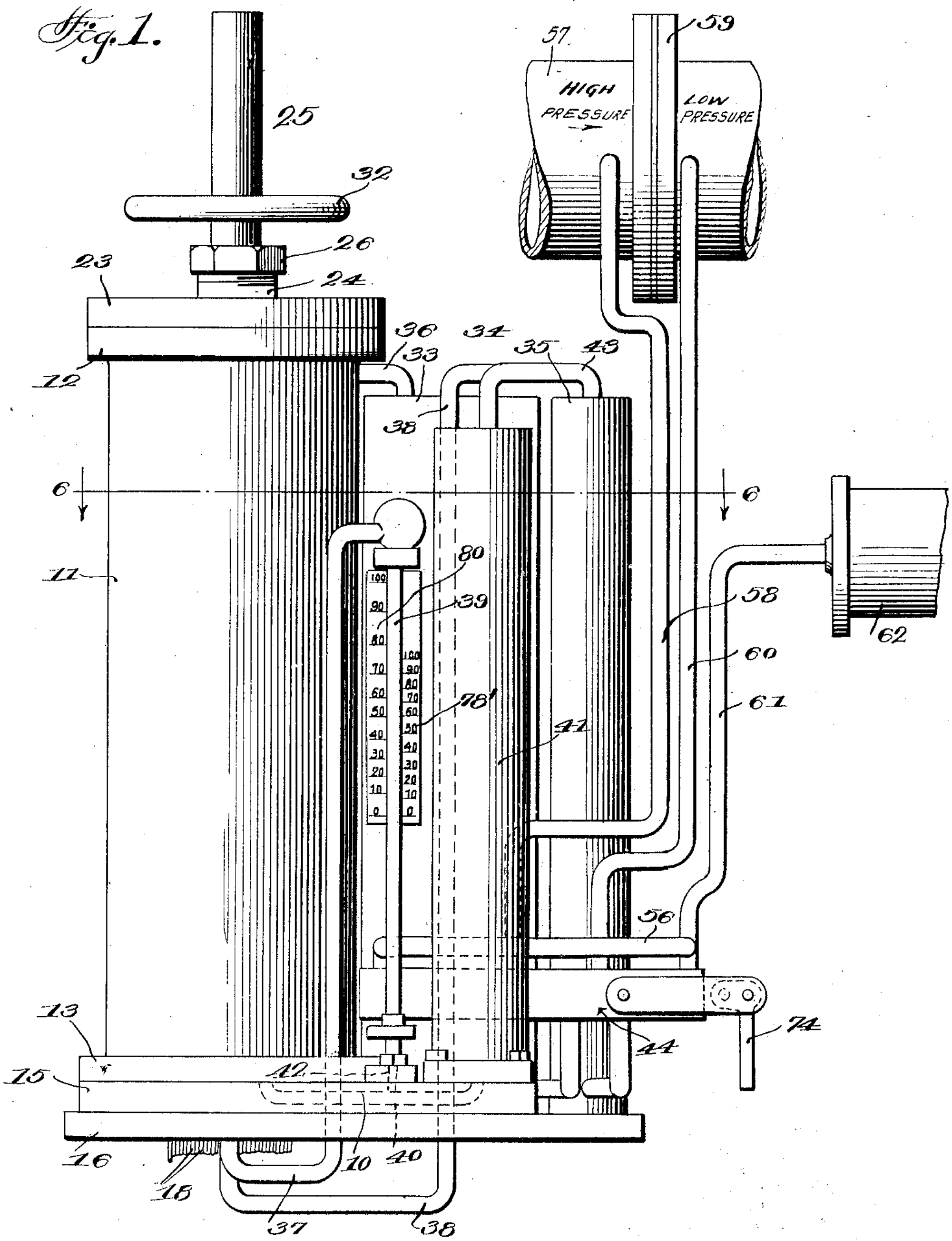
March 29, 1932.   T. W. DELANEY   1,851,896

CONTROL FOR ELECTRIC MOTORS

Filed May 5, 1931   4 Sheets-Sheet 1

Fig. 1.



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CONTROL FOR ELECTRIC MOTORS

Filed May 5, 1931 4 Sheets-Sheet 2

Fig. 2.

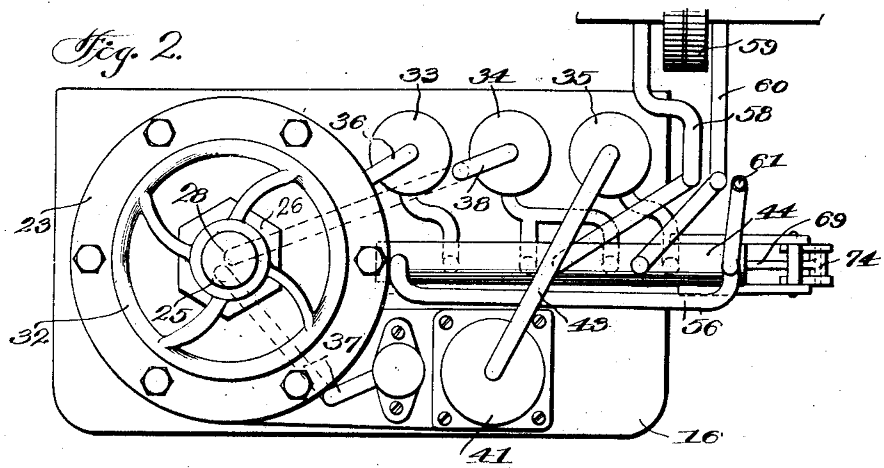
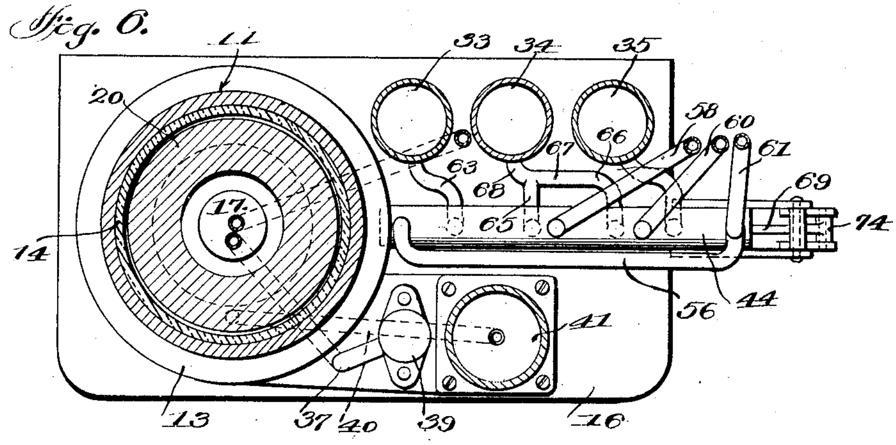


Fig. 6.



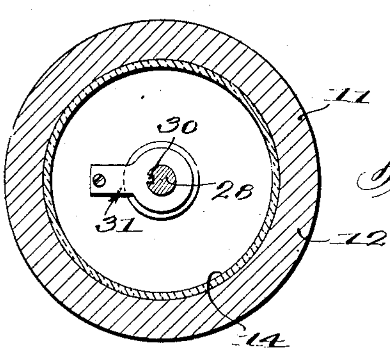


Fig. 7.

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CONTROL FOR ELECTRIC MOTORS

Filed May 5, 1931 4 Sheets-Sheet 3

Fig. 3.

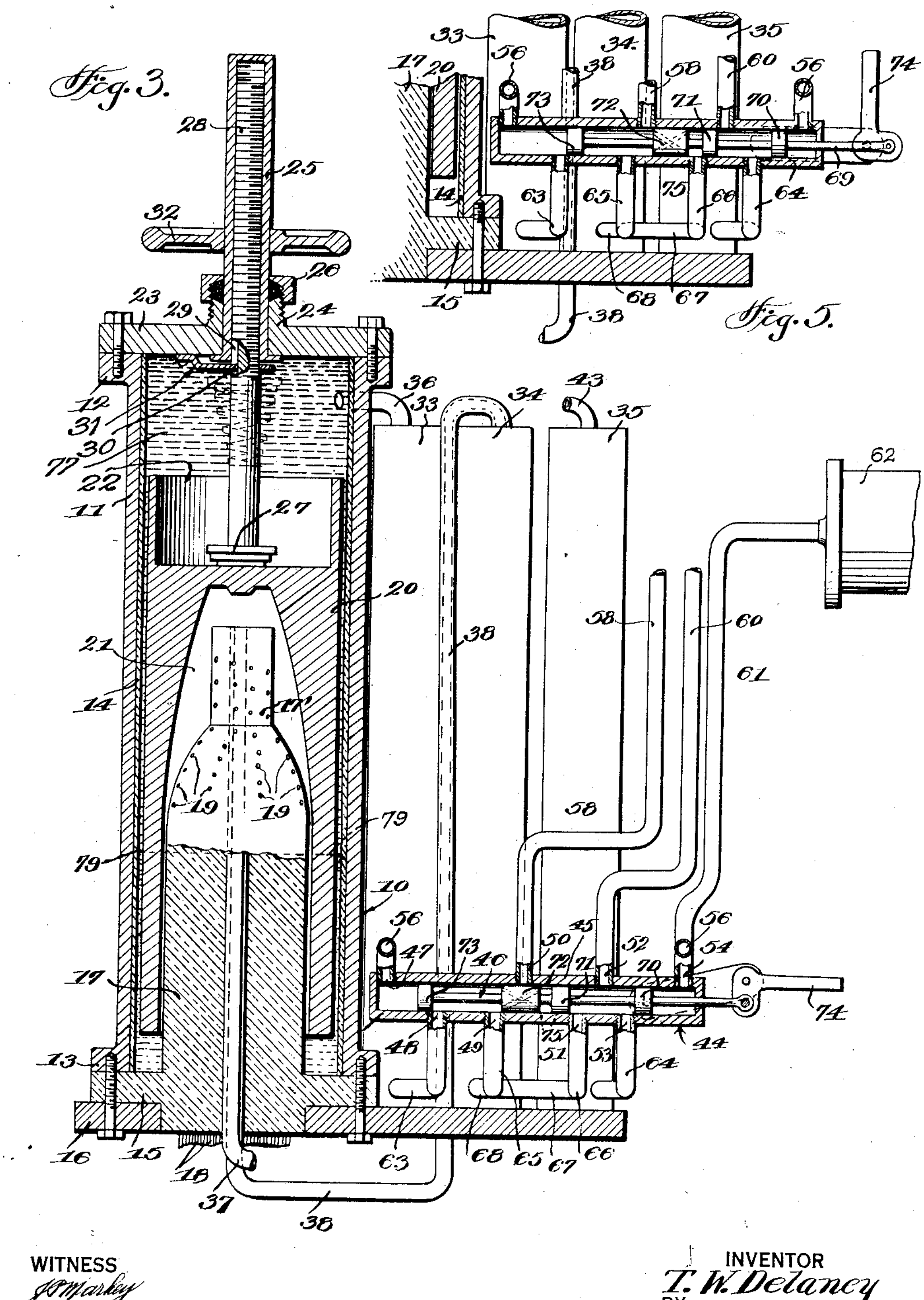

Fig. 5.

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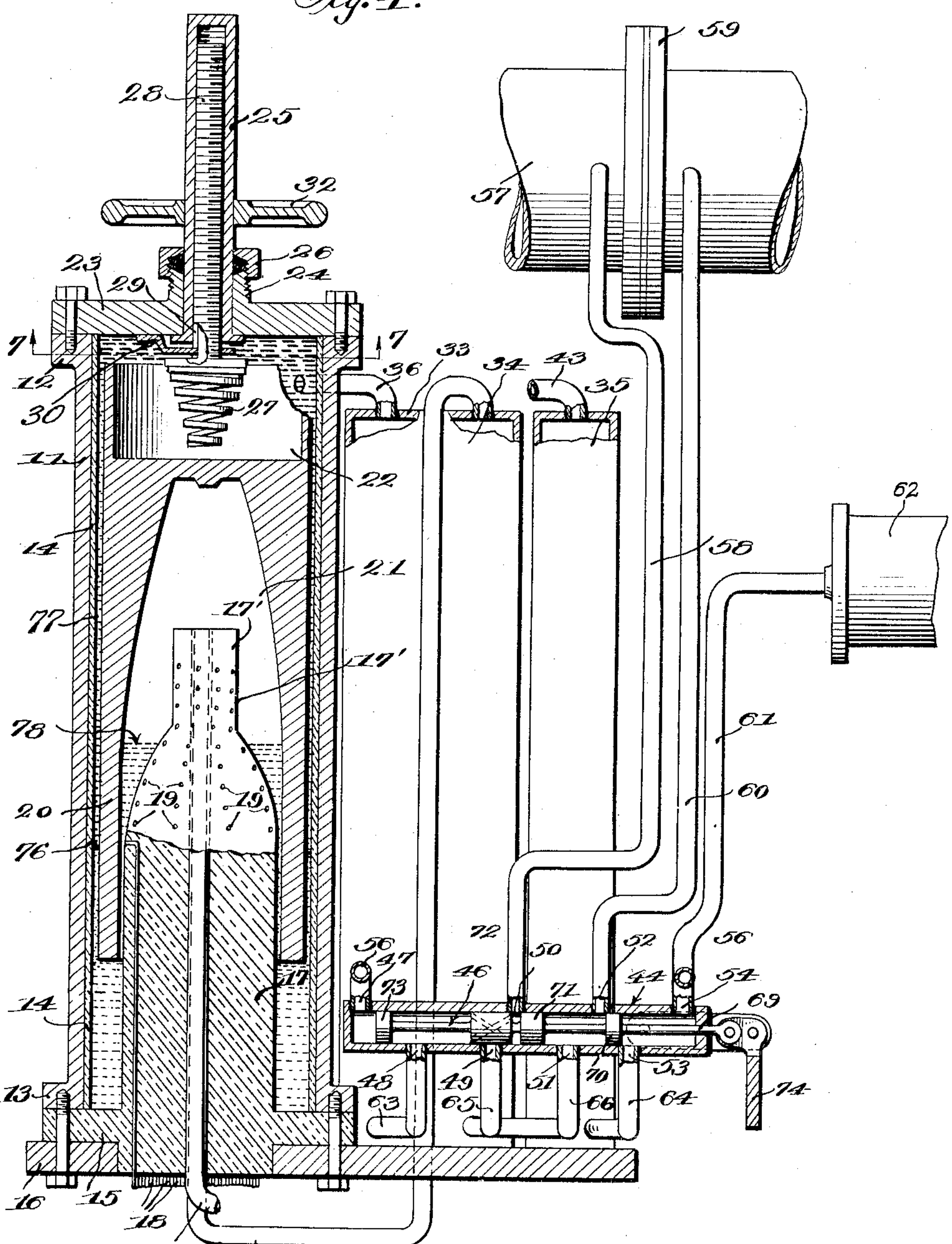
CONTROL FOR ELECTRIC MOTORS

Filed May 5, 1931 4 Sheets-Sheet 4

Fig. 4.



WITNESS

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Patented Mar. 29, 1932 | 1,851,896

UNITED STATES PATENT OFFICE

THOMAS W. DELANEY, OF ST. PAUL, MINNESOTA

CONTROL FOR ELECTRIC MOTORS

Application filed May 5, 1931. Serial No. 535,258.

My invention relates to a control for electric motors employed in regulating furnaces under steam boilers, whereby the boilers will be positively controlled by the rate of flow of steam from the boilers at varying loads, and may be employed in connection with apparatus as disclosed in my pending application, filed October 12, 1929, Serial No. 399,379; and application filed October 16, 1930, Serial No. 489,221.

It is an object of the invention to provide a control unit which is highly responsive to the varying pressures of steam developed in a boiler.

It is a further object of the invention to provide a control wherein an adjustable valve is employed for operation of a boiler under a fixed or varying load.

It is a still further object of the invention to provide a control unit wherein a double column of mercury is so associated with the steam pressure of a boiler that the rise and fall in the level of the mercury will be directly proportional to the rate of flow of steam from the boiler.

Other objects relating to details of construction, combination and arrangement of parts will hereinafter appear in the detailed description and accompanying drawings wherein:

Figure 1 is a side elevation of my control unit;

Figure 2 is a top plan view thereof;

Figure 3 is a vertical sectional view thereof, illustrating the valve in position for equalizing pressures when adjusting for operation on a fixed load;

Figure 4 is a similar view illustrating the valve in position for normal operation;

Figure 5 is a detail sectional view of the valve illustrating its position for operation on fixed load;

Figure 6 is a cross section on the line 6—6 of Figure 1;

Figure 7 is a cross section on the line 7—7 of Figure 4.

In carrying out my invention I provide a control unit generally indicated by the reference character 10 which in the present instance comprises a tube member 11 having upper and lower flanges 12 and 13. The tube 11 is interiorly lined as at 14 with a material of high electrical resistance, the lower end of the tube 11 being closed by a base 15, which may be bolted to the flange 12 and mounting plate 16, as shown. Formed integrally with the base 15, there is a contact support 17, this support being of a length to extend upwardly into the tube above the medial portion thereof, and as shown the upper part is reduced as at 17′.

A plurality of contact wires 18 are supported within the support 17, in spaced longitudinal relation, their upper ends being extended at right angles through the support to present exposed contacts, as indicated at 19. The wires 18 are of varying lengths, thus presenting contacts throughout the upper portion of the support 17, for a purpose which will presently appear.

A float 20 is disposed within the tube 11 and is of elongated form, centrally recessed as at 21 to accommodate the support 17. The upper portion of the float is cupped as at 22.

The tube 11 is closed at its upper end by a cap 23 which is bolted to the flange 12. The cap is centrally bored to provide a bearing 24 for an interiorly threaded sleeve 25. The bearing 24 is provided with a packing gland 26 to effectively seal the sleeve within the cap 23.

In order to limit the upward movement of the float 20, I provide a helical spring buffer 27, which is shown in the present instance, as mounted upon a rod 28 exteriorly threaded and engaged in the sleeve 25. The rod 28 has a longitudinal slot 29 within which a tongue 30 of a retainer 31 is received, permitting vertical movement of the rod 28 and its associated buffer spring 27. The retainer 31 is illustrated as mounted upon the underside of the cap 23.

The sleeve 25 has a hand wheel 32 fixed thereto, and by this means, it will be readily seen that rotation of the hand-wheel will raise or lower the buffer 27 to the full line or dotted line positions shown in Figure 3, or to positions intermediate thereof.

The mounting plate 16 is of a size to support the tube 11 at one end thereof and also provides a mounting for oil reservoirs 33, 34 and 35. The reservoirs 33, 34 and 35 are illustrated as elongated cylindrical, vertically disposed tubes, having closed ends suitably apertured and tapped for reception of conduits as will now be described.

The reservoir 33 is provided with a conduit 36 which is in communication with the upper portion of the tube 11 so as to permit passage of a fluid, such as oil, into the tube 11.

The electrode support 17 has a pair of vertically extending bores within which respective pipes 37 and 38 are mounted, each of these pipes opening upon the upper end of the support 17, and therefore any fluid discharged from these pipes will tend to raise the float 20, as will be readily understood. The pipe 37 is connected to the upper end of the gauge glass 39 (see Fig. 1), and the pipe 38 is in communication with the upper end of the reservoir 34. The base 15 of the electrode support 17 has a bore 40 communicating with the interior of the tube 11 and a mercury reservoir 41 which is also carried by the base 15. A port 42 establishes communication between the bore 40 and the gauge 39, as most clearly shown in Figure 1. The reservoirs 35 and 41 are placed in communication with each other, at their upper ends, by the pipe 43.

For controlling the passage of fluid between the several reservoirs and the tube 11, I provide a manually operable valve, generally indicated by the reference character 44. This valve in the present instance comprises a cylindrical casing 45 in which there is slidably arranged a piston valve 46.

The casing 45 of the valve is provided with a plurality of ports 47 to 54 inclusive, each of which establishes communication with the control unit 10, as will now be set forth. The ports 47, 50, 52 and 54 are formed upon one side of the casing, while the ports 48, 49, 51 and 53 are formed upon the side diametrically opposite thereto. The ports 47 and 54 which it will be noted, are located at the extreme ends of the casing 45 are connected by a manifold or pipe 56; the port 50 is connected to a steam pipe 57 by pipe 58 which is connected to the steam pipe upon the high pressure side of an orifice plate 59; the port 52 is connected to low pressure side of the steam pipe by conduit 60. A conduit 61 is connected with the port 54 and manifold 56 to a constant pressure drum 62. The drum 62 is, of course, connected with the furnace boiler (not shown) so that whatever pressure exists in the furnace boiler will also exist in the drum 62.

The ports 48 and 53 are connected to the reservoirs 33 and 35 respectively, by conduits 63 and 64, the conduits entering the reservoirs at their lower ends. The ports 49 and 51 are connected by respective branch pipes 65 and 66 of a manifold 67 which in turn is connected to the bottom portion of the reservoir 34 by the conduit portion 68, as clearly shown in Figure 6.

Attention is now directed particularly to Figures 3 and 5 of the drawings for a full and clear understanding of the construction and operation of the valve. The valve 46 is of the piston type, including a rod 69 upon which there is secured pistons 70, 71, 72 and 73 which are simultaneously operable upon manipulation of the lever 74. The lever 74 has three operating positions, namely, a vertical position for operating under a fixed load; a horizontal position to effect equalized pressures in the various reservoirs; and a downwardly extended position (see Figure 1) for normal operation. The pistons 70—73 are spaced longitudinally upon the rod, the piston 70 is positioned between the ports 53 and 54; the piston 71 between the ports 51 and 52; the piston 72 between the ports 49, 50 and 51, and the piston 73 between the ports 48 and 49. It will thus be apparent that the ports 48 to 54 may be variously controlled to produce the different functions of the unit, as will be set forth in detail hereinafter.

It will also be noted that the piston 72 is provided with diagonal ports 75 leading from one end of the piston to the other end thereof, permitting passage of pressure to opposite ends of the piston.

In use, the cylindrical tube 11 is partially filled with mercury, the remainder of the tube being filled with a fluid such as oil, and indicated at 77. The reservoirs 33, 34, and 35 also contain fluid such as oil, and the tube 41 contains mercury, the fluid of each tube being transferable to and from the tube 11, upon manipulation of the valve 46 to effect a raising or lowering of the float 20.

Considering the operation of the device with the parts positioned as shown in Figures 1 and 4, the control valve 46 is set for normal operation. Pressure from the high pressure side of the orifice plate 59 is delivered to the valve casing 44 by pipe 58 and discharges between the pistons 71 and 72. The pressure exists from between the piston by way of the diagonal ports 75 through the pipe 63 into the lower portion of the reservoir 33. Such pressure will be communicated to the oil in the reservoir 33 forcing oil outwardly through the pipe 36 into the tube 11 above the float 20. Since the tube 11 is already filled with oil and mercury, any additional fluid forced into the tube 11 from above the float, will force the float 20 downwardly, causing the mercury at the lower end of the tube to rise in the recess 21 of the float. The low pressure side of the orifice plate 59 is connected to the valve casing 44 by the conduit 60 in advance of the piston 70 and discharges thereinto. From the valve casing 44 the low pressure is conducted to the reservoir 34 through conduit 66, and by reason of the conduit 38 low pressure is effective upon the under side of the float 20. The constant pressure drum 62 is also connected to the valve casing 44 by conduit 61. From the valve the constant pressure is conducted to the reservoir 35 by conduit 64. Communication is formed between the upper portion of the reservoir 35 and the reservoir 41, by conduit 43. The reservoir 41 is open to the tube 11 by virtue of the bore 40, and also to the gauge 39.

We will assume that the flow of steam to be one-half of a maximum required. The float 20 will be depressed by the higher pressure thereabove, causing the level of mercury to be raised and at the same time cause some of the mercury to be displaced into the central recess 21. This action will cause the mercury to rise to a point at about that indicated by the reference character 78 within the recess 21 and drop to a point 76 between the float 20 and tube 11. As the height of the mercury varies, it will be apparent that a greater or lesser number of contacts 19 will be effected by the mercury, and since these contacts are associated with the conductors 18 which in turn are operatively connected with the motor for operating furnace control devices, the boiler pressure may be readily controlled thereby. In the present instance, any increase in rate of flow will cause an increase of difference in pressure above the float, causing a further depression thereof, thereby causing rate of combustion to increase through controlling means associated with the electrical conductors 18. A decrease in rate of flow will have an opposite effect. In the event that the boiler pressure should rise above that in the constant pressure drum, mercury will be displaced from the tube 11 to the reservoir 41, thus effecting a decrease in the rate of combustion of the furnace. A lowering of the boiler pressure will have an opposite effect.

From the foregoing it will be apparent that any change in pressure or rate of flow through the steam pipe 57 will cause a motor associated with apparatus to operate furnace controls to adjust themselves to meet new conditions.

The gauge glass 39 being connected at its bottom with the mercury column in tube 11 through ports 40 and 42 and at its top by conduit 37 opening into the recess 21, the height of mercury in the glass of gauge 39 will be the same as that in the contact chamber 21. The gauge 39 may include a scale graduated from zero to full load to indicate what portion of load is being carried.

When it is desired to operate a boiler on fixed load, the control valve handle 74 is placed in horizontal position, which places the valve 46 in the position shown in Figure 3. With the valve in this position the reservoirs 33, 34, 35 and 41 will be in communication with each other and with the low pressure side of the orifice plate 59, causing the mercury to equalize in all reservoirs and in the tube 11 to a point indicated by the line 79—79 (see Fig. 3). The hand wheel 32 is now turned so as to force rod 28 to compress spring 27 against float 20 to displace a portion of the mercury until it reaches a mark on the left hand scale 80 corresponding to the desired load. Handle 74 of the valve is then swung upwardly, moving the valve to the position shown in Figure 5.

The portion of the tube 11 above float 20 is thus placed in communication with the constant pressure drum 62 through the conduit 36, reservoir 33, conduit 63, the valve casing 44, manifold 56 and conduit 61. The portion of the tube 11 under the float 20 is connected with the high pressure side of orifice through conduit 38, reservoir 34, conduit 65, valve casing 44 and conduit 58. The reservoir 41 is connected through conduit 43, reservoir 35, conduit 64, valve casing 44 and conduit 60 with the low pressure side of the orifice plate 59. Mercury will now be displaced from the tube 11 into the reservoir 41 due to lower pressure in the latter. Assuming that the pressure is normal and rate of flow that for which the float is adjusted, the mercury should have its top surface level with graduations on right hand scale 78′ of the indicating glass corresponding to the desired load. As the float 20 is now balanced between the tension of the spring 27 and constant pressure on top and the buoyant action of the mercury and boiler pressure below, any change in boiler pressure will cause float to raise or lower. If the pressure rises, the float 20 will accordingly rise, causing a lowering of the mercury level, by which action suitable dampers or the like will be operated to reduce the rate of combustion of a furnace. A drop in pressure will have the opposite effect.

Should rate of flow increase over that desired, the resulting lower pressure in chamber 41 will cause mercury to flow into it from the other reservoirs, and thus decreasing rate of combustion.

A decrease in steam flow will in consequence increase rate of combustion. It should be noted that when operating a boiler on fixed load, the dominant factor in determining height of the mercury in contact chamber is the relation between the boiler pressure and constant pressure, and the rate of flow relation is the correcting factor. When operating on normal floating control, however, the flow of steam is controlling factor and pressure relation the corrective one.

It should be understood that deviations met in practical application from theoretical law, may be encountered, but in all cases the differences in pressures are proportional to the square of velocity, and can by successive changes in contour of the float and contact element be allowed for giving a height of mercury in contact chamber above zero position, proportional directly to the rate of flow at all points throughout its range.

I claim:

1. In combination a steam main subject to changes of steam pressure therein, a constant fluid pressure, connections between the steam main and constant fluid pressure, including pressure tanks filled with fluid, a contact chamber associated therewith and adapted to receive fluid from said tanks, a float in said contact chamber movable with the level of fluid in said contact chamber, and electrical control circuits operable upon movement of said float.

2. In combination a steam main subject to changes of steam pressure therein, a constant fluid pressure, connections between the steam main and constant fluid pressure, including pressure tanks filled with fluid, a contact chamber associated therewith and adapted to receive fluid from said tanks, a float in said contact chamber movable with the level of fluid in said contact chamber, electrical control circuits operable upon movement of said float, and a manually operable valve between said steam main, pressure tanks, and contact chamber whereby to control movement of fluid into said contact chamber.

3. In combination a steam main subject to changes of steam pressure therein, a constant fluid pressure, connections between the steam main and constant fluid pressure, including a plurality of pressure tanks filled with fluids, a chamber having mercury therein, a float in said chamber, a conduit establishing communication between one of said pressure tanks and said chamber and discharging above said float, a conduit establishing communication with another of said pressure tanks and said chamber and discharging beneath said float, electrical control circuits in said chamber controlled by change of level of mercury in said chamber through movements of said float, and a manually operable valve associated with said steam main, constant pressure and pressure tanks for controlling movements of said float.

4. In combination a steam main subject to changes of steam pressure therein, a constant fluid pressure, connections between the steam main and constant fluid pressure, including a plurality of pressure tanks filled with fluids, a chamber having mercury therein, a contact support in said chamber having a plurality of electrical contacts, a hollow float in said chamber and disposed loosely over said support and defining a compartment for passage of mercury thereinto, a conduit establishing communication between one of said pressure tanks and said chamber and discharging above said float, a conduit establishing communication with another of said pressure tanks and said chamber and discharging into the compartment of said float, and a manually operable valve associated with said steam main, constant pressure and pressure tanks for controlling movements of said float to vary the level of said mercury.

5. In combination a steam main subject to changes of steam pressure therein, a constant fluid pressure, pressure tanks connected to said steam main and constant fluid pressure, a control unit associated with said pressure tanks and comprising a container having mercury therein, a hollow float in said container, and conduits between said pressure tanks and said control unit discharging above and below said float whereby to elevate or depress the float upon variations of fluid pressure.

6. In combination a steam main subject to changes of steam pressure therein, a constant fluid pressure, pressure tanks connected to said steam main and constant fluid pressure, a control unit associated with said pressure tanks and comprising a container having mercury therein, a plurality of vertically spaced electrical contacts in said chamber, a hollow float in said container and disposed over said contacts, conduits between said pressure tanks and said control unit discharging above and below said float whereby to elevate or depress the float upon variations of fluid pressure, and means carried by said control unit operable to hold said float in a depressed position.

7. In combination a steam main subject to changes of steam pressure therein, a constant fluid pressure, pressure tanks connected to said steam main and constant fluid pressure, a control unit associated with said pressure tanks and comprising a container having mercury therein, a plurality of vertically spaced electrical contacts in said chamber, a hollow float in said container and disposed over said contacts, conduits between said pressure tanks and said control unit discharging above and below said float whereby to elevate or depress the float upon variations of fluid pressure, and means carried by said control unit operable to hold said float in a depressed position, said means including a reciprocable screw threaded shaft, a buffer spring carried upon the lower end thereof and adapted to engage said float and an internally threaded sleeve engaged upon said threaded shaft, and means for rotating said sleeve.

8. In a motor control for furnaces or the like comprising in combination, a steam conduit having an orifice plate providing high and low pressure sides, a closed chamber, electrical contact members variously disposed therein, a contact fluid in said chamber, a float supported in said fluid and conduits in communication with said chamber and said high and low pressure sides of said steam conduit whereby to raise or lower said contact fluid in proportion to the rate of flow of steam through said main.

THOMAS W. DELANEY.