(No Model.) 2 Sheets—Sheet 1.

C. B. BOSWORTH.

DEVICE FOR SUPPLYING FEED WATER TO BOILERS.

No. 441,740. Patented Dec. 2, 1890.

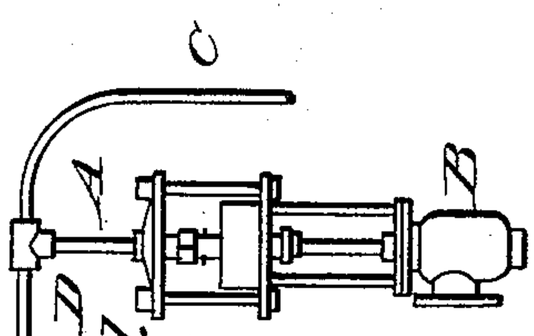

Fig. 1.

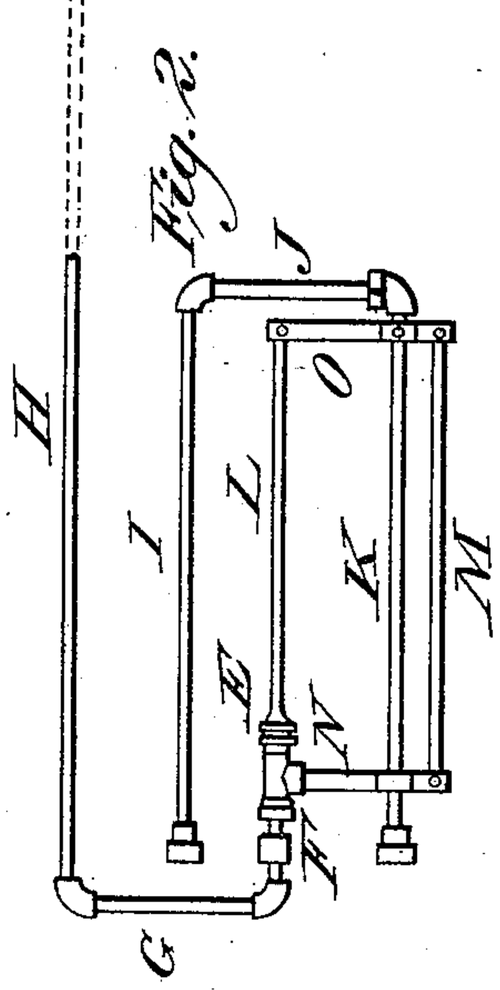

Fig. 2.

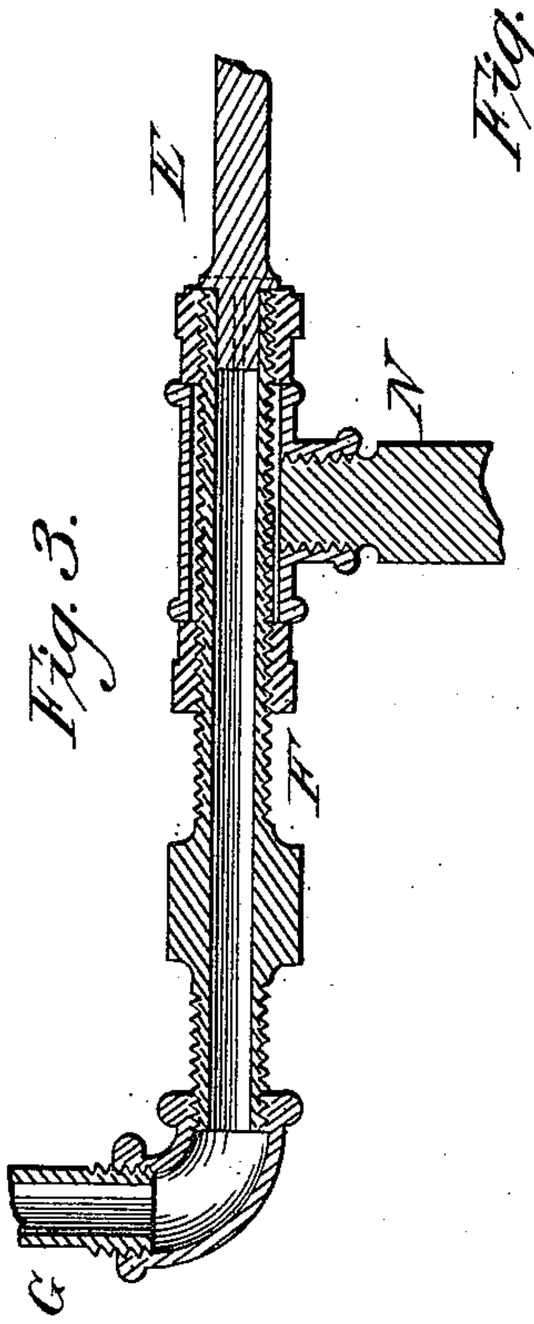

Fig. 3.

Fig. 5.

Fig. 4.

Witnesses:
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(No Model.) 2 Sheets—Sheet 2.

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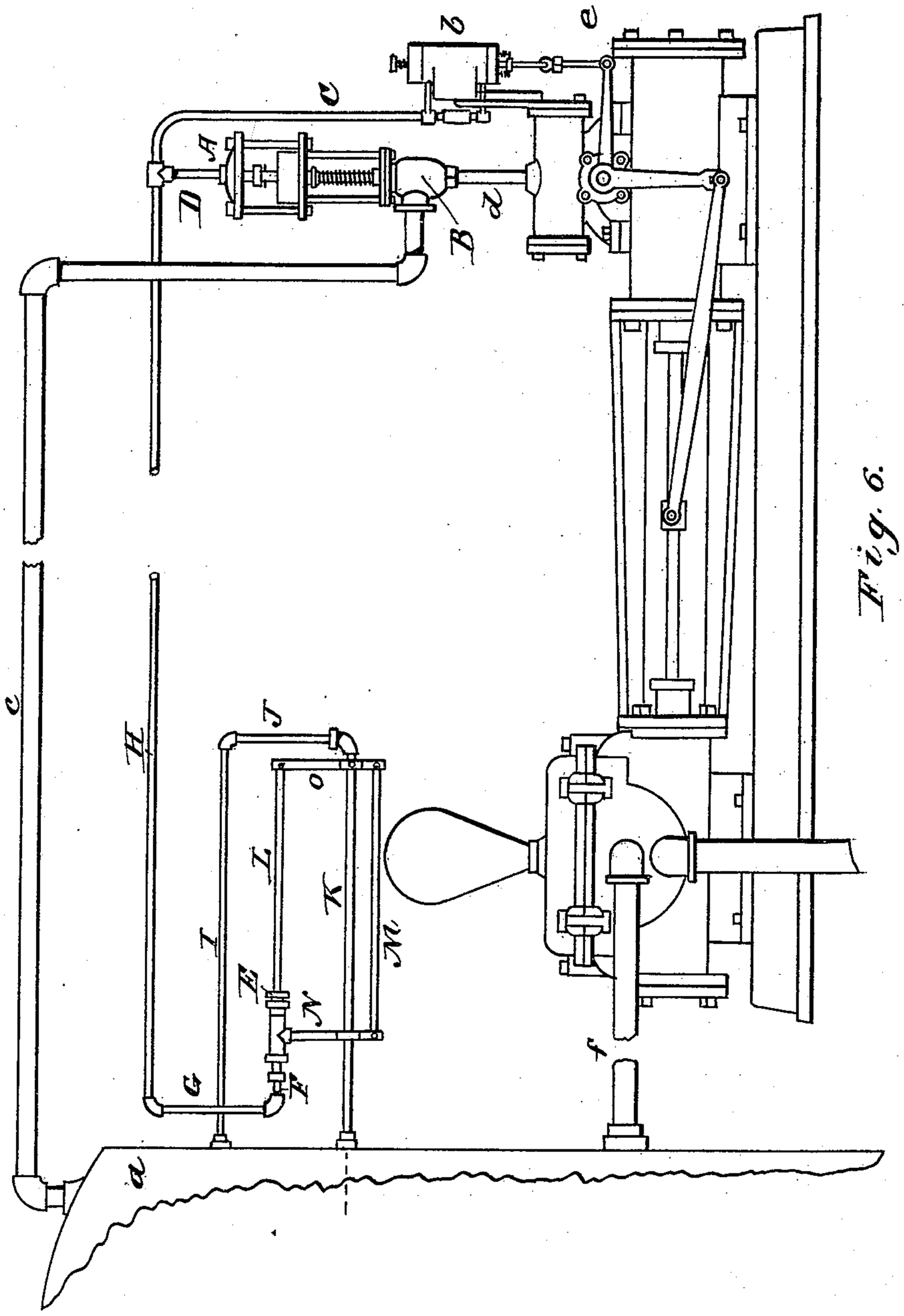

Fig. 6.

WITNESSES

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CHARLES B. BOSWORTH, OF EVERETT, ASSIGNOR TO THE CROSBY STEAM GAGE AND VALVE COMPANY, OF BOSTON, MASSACHUSETTS.

DEVICE FOR SUPPLYING FEED-WATER TO BOILERS.

SPECIFICATION forming part of Letters Patent No. 441,740, dated December 2, 1890.

Application filed October 21, 1889. Serial No. 327,748. (No model.)

To all whom it may concern:

Be it known that I, CHARLES B. BOSWORTH, a citizen of the United States, residing at Everett, county of Middlesex, and State of Massachusetts, have invented certain new and useful Devices for Automatically Supplying Feed-Water to Steam-Boilers, of which the following is a specification, reference being had to the accompanying drawings, and to letters of reference marked thereon.

This invention is an improvement in the application of the device shown and described in Letters Patent No. 333,817, granted to me the 5th day of January, 1886, for an improvement in governors, and relates to the automatic control of the action of steam-pumps when used to supply water to steam-boilers, so that the water within the boiler shall be maintained at any desired height without regard to the pressure therein or the weight of water evaporated. In the device described in the said Letters Patent I located the valve for regulating the pressure of the air from the air-pump as it flowed into the air-chamber of the governor at the top of said chamber. I now locate this air-valve at the steam-boiler to be supplied by the steam-pump at the end of a pipe connected with the air-pump and with the air-chamber; and my invention consists in part of the means provided for automatically controlling such air-valve, and thereby regulating the action of the steam-pump.

Figure 1 represents in elevation the diaphragm air-pressure chamber in connection with the throttle-valve of the steam-pump. Fig. 2 represents in elevation a system of pipes to be connected with a steam-boiler having an air-valve regulated thermostatically by the rise and fall of the water within the boiler. Fig. 3 represents in sectional elevation the air-valve and a part of its connecting-pipe, full size. Fig. 4 represents in longitudinal vertical section a modified arrangement of the thermostatic device employed at Fig. 2, full size. Fig. 5 represents a transverse vertical section through the expansion-tube shown in Fig. 4. Fig. 6 shows in combination all the elements of construction referred to in the foregoing figures.

Now, referring to the drawings in detail—

Figure 1 represents, in elevation the diaphragm air-pressure chamber A in its connection with the throttle-valve B of the steam-pump and the pipe C to convey the compressed air from the air-pump *b* into the chamber A by means of the pipe D, fully shown and described in Fig. 1 of the drawings of the Letters Patent No. 333,817, before referred to.

Fig. 2 represents in elevation a rectangular frame-work of tubes to be attached to the steam-boiler, so that the steam and water of the boiler shall enter within said tubes and by their expansion and contraction cause the air-valve E, attached thereto, to open or close, as may be required. This rectangular frame-work of pipes, beginning at the air-valve E, Fig. 2, is connected with the air-pressure chamber A, Fig. 1, by means of air-pipe F G H D and with the air-pump by air-pipe F G H C. The tubes I, J, and K are of brass, and the connecting-rods L and M are of iron. The rigid arm N and lever O are of solid brass.

Fig. 3 in sectional elevation represents (full size) the air-valve E, air-valve pipe F, and a part of the vertical air-conveying pipe G.

Fig. 4 in longitudinal vertical section represents (full size) a modified arrangement of the expansion-tube, from which equally good results may be obtained, while the device is at once more compact and more easy of construction and application. In this arrangement the expansion-tube P, having its outer end closed, is screwed into the bored socket Q, the end of which at R is screwed into the steam-boiler at a proper water-level. Within the expansion-tube P the smaller steam-circulating tube S, of a little less than half the diameter of the former, is brazed to the upper part of the socket, both ends being left open and one end projecting within the boiler, as shown. To the bottom of this expansion-tube P, which is of brass or other suitable metal, is brazed the bar or strip of iron T, which, being of unequal expansion with brass, produces, under the influence of changing temperatures, upward and downward deflections of the free end of the tube, by means of which the air-

valve U is operated. The expansion-tube P and the air-valve regulating screw V are inclosed within the cylindrical case W, and the air-pipe leading to the governor is shown at X.

Fig. 5 is a transverse vertical section through *a b*, Fig. 4, showing the application of the iron bar T to the expansion-tube P and the relative position therein of the small tube S.

The attachment and mode of operation of the several devices are as follows, and will be explained with reference to Fig. 6: The motion for the air-pump is derived from any convenient reciprocating or other moving part of the steam-pump, by which it is duly operated. The rectangular frame-work of tubes, to which is attached the air-valve E, may be connected to the boiler by attaching the end of the upper tube I at a point above the highest water-level and by attaching the end of the lower tube K to the middle water-gage connection. In this way steam will always be present in the upper tube and water in the lower tube, if it is desired to maintain the water in the boiler to this height. In this condition there will be a different degree of expansion of the two tubes, the upper one being of a greater degree than the lower one, owing to a difference of temperature. The upper tube will remain substantially constant both as to temperature and expansion, while the lower one will be modified by the constantly-diminishing temperature by radiation of the heat from the water confined in the tube. When the water in the boiler falls below the lower tube, then the water in the latter flows into the boiler, and being replaced by steam the tube expands rapidly under the greater temperature. Now when the water in the boiler is above and fills the lower tube K the air-valve E is closed, and the air forced by the air-pump into the pipe to which it is attached acts also upon the piston or diaphragm A in the air-chamber of the governor, and compressing the spring of the governor duly closes the throttle-valve B of the steam-pump. If the water falls below the lower tube K and steam flows into it, then the tube, expanding under the increased temperature, opens the air-valve E by means of the iron rod L and the lever O, pivoted on the expansion-pipe K, and iron rod M, as shown. The vertical bar N is solid and wholly without movement either in the pipe F or K. The air-valve E having been opened, as described, the air from the air-pump flows outward through it, and the spring of the governor being thereby released draws the steam throttle-valve upward, duly opening it for the admission of steam to the pump and setting it in motion. As the pump fills the boiler and also the lower tube, the lowering temperature of the inflowing water contracts the latter, and thereby closes the air-valve. By this means, as shown, the air from the air-pump then acts upon the piston or diaphragm of the governor, giving motion to the steam-pump.

At Fig. 6 is shown in elevation my feed-water-regulating device as connected with the steam-boiler *a* by pipes I and K, and with the air-chamber A by pipes G H D, and with the air-pump *b* by pipes G H C. Steam is conveyed from the boiler to the steam-pump throttle-valve B by pipe *c*, and through stand-pipe *d* into the valve-chest of the pump. The air-pump is operated by lever *e*, mounted on the steam-pump rock-shaft. From the pump the feed-water passes through pipe *f* into the boiler.

Instead of using the rectangular frame-work of tubes shown at Fig. 2 for actuating the air-valve, I sometimes employ the modification shown at Figs. 4 and 5, where its arrangement and operation are explained and will be readily understood.

Having thus fully described the construction and operation of my automatic boiler-feeding device, what I claim as of my own invention, and desire to secure by Letters Patent, is—

1. In combination with a steam-pump for feeding the steam-boiler with water, an air-pump attached thereto and operated thereby, and an air-chamber having therein a diaphragm or piston to receive the compressed air therefrom, located over the throttle-valve of the steam-pump and connected therewith by a rod operated by the said diaphragm or piston, and an expansion-tube located at the steam-boiler and connected at its ends with the interior thereof, the lower end at a proper water-level, so that any longitudinal movement of this branch of the expansion-tube arising from change of temperature within it, as from its alternate occupancy by steam or by water, is transmitted so as to operate upon the air-escape valve situated at the boiler end of the air-pipe, connected at its other end with the air-chamber and air-pump, through the action of which the air-pressure in the connecting-pipes and air-chamber is maintained and the throttle-valve of the steam-pump duly regulated, substantially as herein set forth.

2. The combination, with the steam-boiler, of the tubular thermostat opening into the boiler at its inner end and closed at its outer end, and having the tube S and valve U, all arranged substantially as set forth.

CHARLES B. BOSWORTH.

Witnesses:
JOSHUA H. MILLETT,
WM. BURNETT.