Sept. 3, 1935. H. SANDVOSS 2,013,480

TEMPERATURE REGULATOR

Filed June 29, 1934 3 Sheets-Sheet 1

Fig. 1.

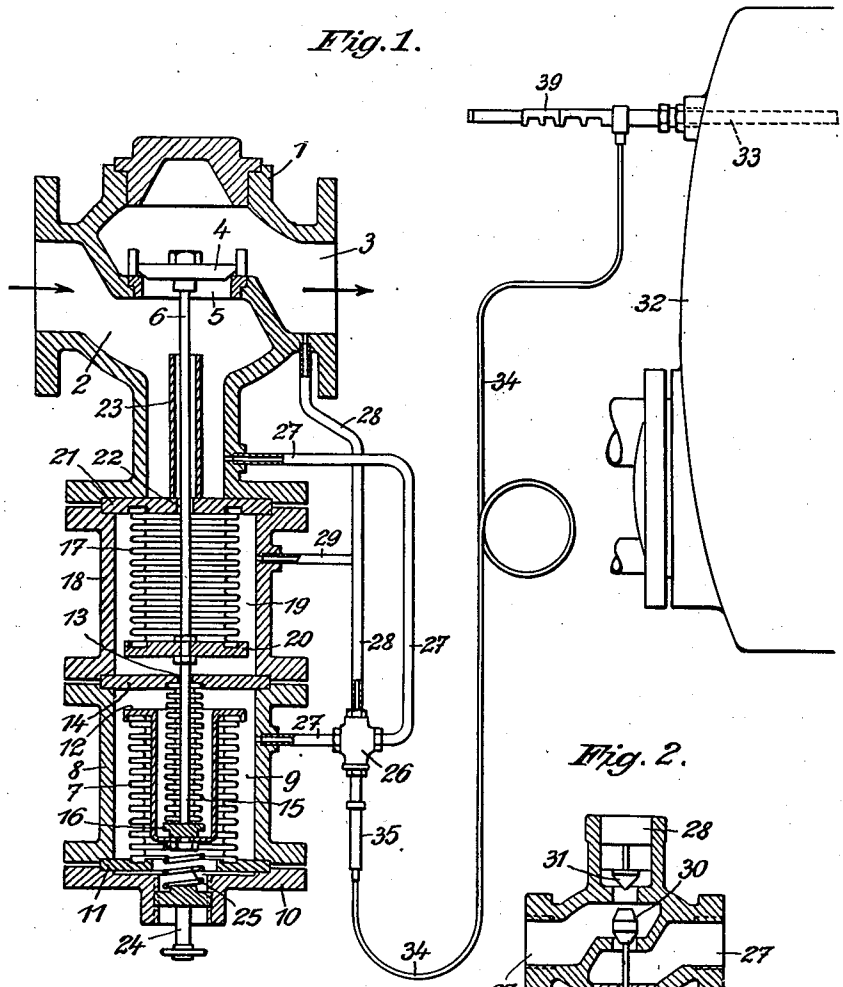
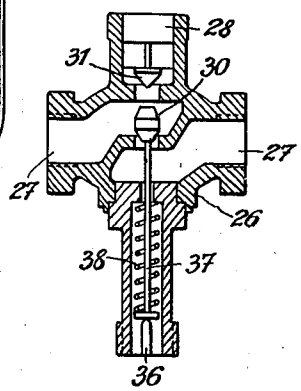


Fig. 2.



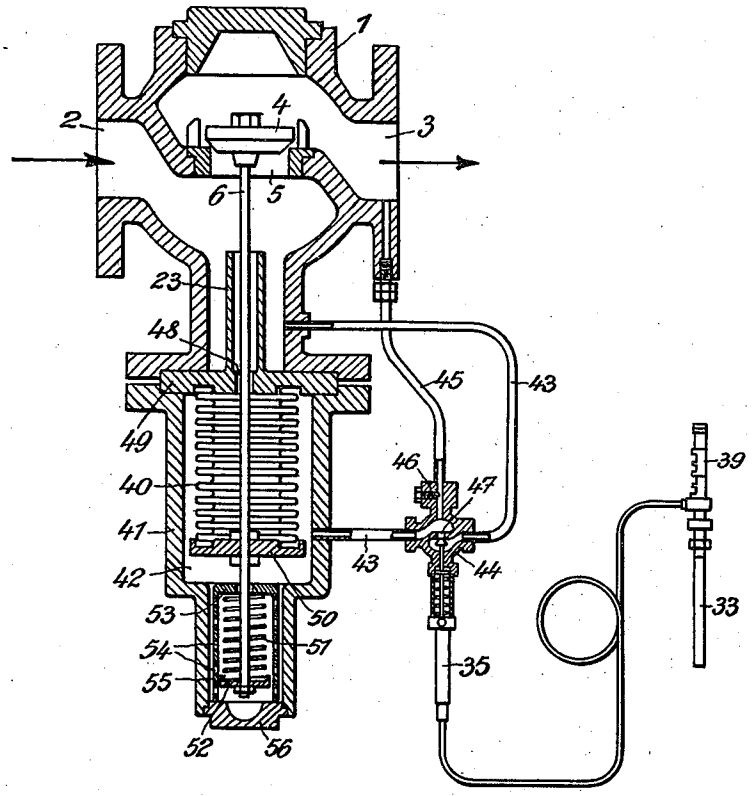
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Fig. 3.



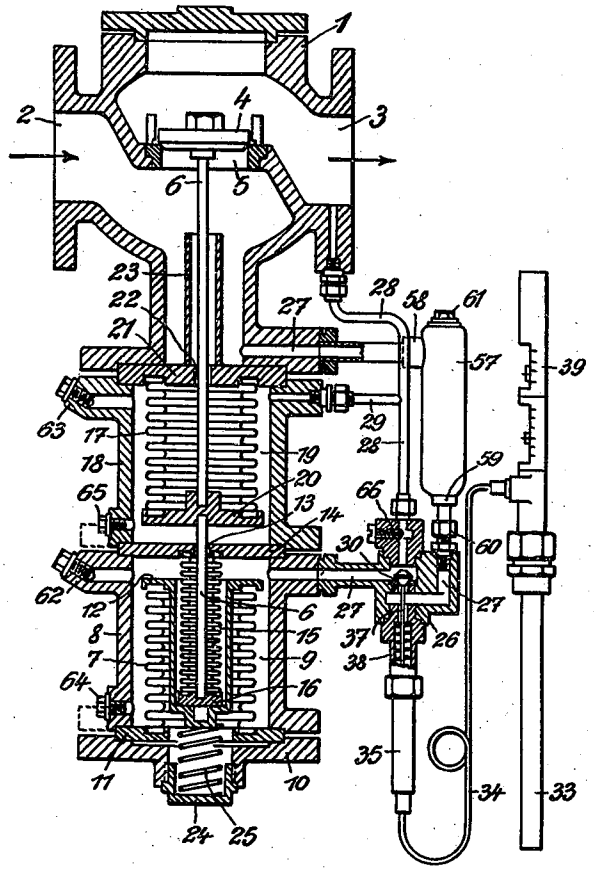
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TEMPERATURE REGULATOR

Filed June 29, 1934 3 Sheets-Sheet 3

Fig. 4.



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UNITED STATES PATENT OFFICE

2,013,480

TEMPERATURE REGULATOR

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Application June 29, 1934, Serial No. 733,135
In Germany July 24, 1933

11 Claims. (Cl. 236—80)

This invention relates to a temperature regulator for steam plants, such as steam-heated warm water and other boilers or similar apparatus, in which the main valve regulating the supply of steam is controlled by a thermostatically actuated auxiliary valve adapted to connect the steam piping with a bellows member operating the closure of the main valve.

The main feature of the invention is that the impulse space of the bellows member is connected with the ante-chamber of the main valve in such a way that the accumulating water of condensation fills the impulse space and the connecting piping leading to the auxiliary valve and the ante-chamber or inlet side of the main valve and indirectly transmits the steam pressure through the auxiliary valve to the operating bellows.

In this way, while making use of the unavoidable condensate, direct and harmful contact of the working steam with the operating bellows or expansion tube and the auxiliary valve is effectively prevented, as the water of condensation acts as interposed pressure transmitting medium and bars direct access of the steam to these members. The water surrounding the latter functions in a highly favorable manner as cooling medium whereby not only the life of the apparatus but also the operating accuracy thereof are increased.

The impulse space with the auxiliary valve is preferably disposed below the main valve and the connecting pipings lead upwardly like risers.

Furthermore, the connecting piping leading from the impulse space to the auxiliary valve and into the main steam piping may advantageously be provided with a separate compensating vessel, in which the water level can always be balanced during successive valve motions so as to keep always sufficient water available for the transmission of pressure and for closing. The compensating vessel and the various spaces of the temperature regulator may further be fitted with closable filling connections for filling these spaces and pipings with water when the outfit is started. During operation, constant refilling of the impulse space, compensating vessel and other spaces with water is insured by condensation.

Other features of the invention will be explained below in the specification.

By way of example, several embodiments of the invention are illustrated in the accompanying drawings, in which Figure 1 is a cross section of a temperature regulator according to the invention in connection with a steam-heated boiler; Fig. 2, a cross section on an enlarged scale of an auxiliary valve; Fig. 3, a cross section of a simplified constructional embodiment of the invention; and Fig. 4, a cross section of a temperature regulator with a compensating vessel.

Referring to the drawings, and first to Fig. 1, 1 is the main valve for regulating the steam supply and has an antechamber or inlet or inlet side 2 which can be separated from the outlet side 3 of the valve 1 by a valve cone 4 cooperating with the valve passage 5. The arrows indicate the direction of flow of the steam.

The valve cone 4 is connected by a rod 6 with an operating bellows 7 which consists preferably of a metal expansion tube. The operating bellows 7 is arranged in an impulse space 9 surrounded by a casing 8. The lower end of the bellows 7 is secured tightly to a bottom plate 11 disposed between the casing 8 and its bottom closure 10. The upper free end of the operating bellows 7 is tightly shut off by an inwardly curved plate 12 acted upon by the valve rod 6 which passes with slight clearance through a bore 13 of a cover 14 closing the casing 8. To pack the bore 13 an expansion tube 15 is tightly secured with its upper end to the cover 14 and with its lower end, inserted in the inwardly curved plate 12 of the operating bellows 7, to a lower closure 16 which is firmly connected with the plate 12.

Between the main valve 1 and the impulse space 9 an expansion tube or bellows 17 is arranged in a space 19 enclosed by a casing 18, as shown in Fig. 1. The bellows 17 is provided at its lower end with a tightly closing bottom plate 20 which is firmly connected with the valve rod 6. The upper end of the bellows 17 is tightly secured to a cover 21 having a bore 22 for the valve rod 6 which passes therethrough with slight clearance. The internal width of the expansion tube 17 corresponds to that of the valve passage 5, so that the valve cone 4 is fully balanced against pressure variations by the expansion tube 17. The cover 21 is provided with a tubular attachment 23 to prevent the passage of impurities into the expansion tube 17.

To increase the elasticity of the expansion tubes 7, 15 and 17, a compression spring 25 adjustable by a spindle 24 may be built into the bottom 10. The compression spring 25 may be dispensed with if the elasticity of the expansion tubes 7, 15 and 17 suffices for counteracting the pressure developing in the impulse space 9.

The main valve 1 is actuated by the pressure

of the steam flowing through it, connection being either established between the steam piping and the impulse space 9 of the bellows 7 by means of an auxiliary valve 26 or interrupted. The impulse space 9 of the operating bellows 7 is connected with the inlet side 2 of the main valve 1 in such a way that the accumulating water of condensation fills the space 9 and its connecting piping leading to the auxiliary valve 26 and the inlet side of the valve 2.

For this purpose the impulse space 9 and the auxiliary valve 26 are arranged below the main valve 1, and the connecting piping 27 leading from the space 9 to the auxiliary valve 26 ascends and opens into the lower portion of the inlet side 2, which serves as a collector 67.

To permit the water of condensation to be forced into the impulse space 9 when the auxiliary valve 26 is open to flow off after the closing of the valve 26, the impulse space 9 is connected by a second ascending piping 28 with the outlet side 3 of the main valve 1. The ascending piping 28 communicates further, by means of the compensating piping 29, with the space 19 of the casing 18, in which the balancing bellows 17 is located.

As shown in Fig. 2, the auxiliary valve 26 is preferably provided with a double seat cone 30 which closes the ascending piping 28 when it opens the connecting piping 27 and, vice versa, opens the ascending piping 28 when closing the connecting piping 27. According to Fig. 2, the ascending piping 28 contains a closing member which may consist of a freely movable check valve 31.

The auxiliary valve 26 may be connected with a thermostat 33 built into a boiler 32 and being or relatively small size by a capillary tube 34 which transmits the motions of the thermostat 33 to an operating member 35. The operating member 35 acts with its rod 36 on the valve rod 37 of the double seat cone 30, which is spring-loaded by the spring 38.

The temperature regulator as described functions as follows:

Assume that the main valve 1 is open and the heating steam flows through the main valve 1 into the boiler 32. When the temperature of the water contained in the boiler 32 rises beyond the normal limit, say, one-half degree, the liquid within the thermostat 33 fitted with an adjusting scale 39, in the capillary tube 34 and the operating member 35 will expand. The operating member 35, by means of its rod 36, will then advance the rod 37 of the auxiliary valve 26 against the action of the spring 38, so that the double seat cone 30 opens the connecting piping 27 and closes the ascending piping 28. The steam pressure prevailing in the inlet side 2 of the main valve 1 will then act indirectly by means of the water contained in the connecting piping 27 and the impulse space 9 upon the plate 12 of the operating bellows 7 arranged in the impulse space 9 whereby the bellows 7 will be compressed. The plate 12 moves down and pulls down the valve rod 6 with the valve cone 4 of the main valve 1, so that the cone 4 will close the valve passage 5 and thus interrupt the supply of steam to the boiler 32. The main valve 1 remains closed while the water in the boiler 32 can cool down again to its normal temperature.

If the temperature of the water falls below normal owing to the shutting off of the steam supply, the liquid in the thermostat 33 will contract and the spring 38 of the auxiliary valve 26 then pulls the double seat cone 30 back to its lower seat. This means that the connecting piping 27 is shut off while the ascending piping 28 will be opened by the double seat cone 30. However, the check valve 31 disposed above the cone 30 will still keep the ascending piping 28 closed until the pressure in the outlet side 3 of the main valve 1 will drop considerably, whereupon the check valve 31 will be aspirated and the ascending piping 28 opened. The overpressure prevailing in the impulse space 9 will then cause the excess water to flow from the impulse space 9 through the auxiliary valve 26 into the ascending piping 28. Owing to the drop in pressure in the impulse space 9, the operating bellows 7 will be expanded again by its own elasticity as well as by that of the other expansion tubes and the compression spring 25, and the plate 12 will then lift the valve cone 4 from its seat by means of the rod 6. The passage 5 of the main valve 1 will thus be opened again, so that steam can flow into the boiler 32 to bring the temperature of the water up to normal. While the operating bellows 7 expands, the balancing bellows 17 will contract. On account of the equalization pipe 29, the spaces 9 and 19 can supplement each other in a favorable manner, as the water flowing off through the ascending piping 28 during expansion of the operating bellows 7 will be drawn by the contracting balancing bellows 17 into the space 19, so that the space 19 and the ascending piping 28 will always be filled with water. When the valve cone 4 closes the valve passage 5 and when a higher pressure is present in the valve outlet 3, this pressure could maintain the valve cone 4 securely on its seat. By means of the compensating pipe 29 this is avoided since the pressure in the valve outlet 3 then operates through the pipe 28 and pipe 29 from underneath on the bottom 20 of the expansion tube 17 and equals for this reason the pressure operating on the top of the valve cone 4.

The processes described are continually repeated as soon as the temperature in the boiler 32 rises or drops. At uniform brisk operation the double seat cone 30 of the auxiliary valve 26 can equalize itself and keep open the pipings 27 and 28 to the same or a different extent, the valve cone 4 of the main valve 1 remaining in a certain intermediate position. As the thermostat 33, 34, 35 has to actuate only the relatively small auxiliary valve 26, the apparatus operates easily and overloading of, and damage to, the thermostat are prevented. For this reason the same type of thermostat can be used for main valves of different sizes. The main valve 1 is always tightly closed by steam pressure, and the water serving as pressure transmitting medium effectively prevents destruction of, and damage to, the expansion tubes and the small auxiliary valve by the steam.

Fig. 3 shows a considerably simplified construction of the temperature regulator. The main valve 1 is similar to that shown in Fig. 1, but the operating and relieving bellows are combined into a single bellows 40 which is arranged in an impulse space 42 enclosed by the casing 41. Similarly as in Fig. 1, this impulse space 42 communicates through a piping 43 and an auxiliary valve 44 with the inlet side 2 and also, through a piping 45 and a closing member, with the outlet side 3 of the main valve 1. The closing member is a throttle 46 whose adjustable closing body may be more or less screwed into the passage section of the piping 45. The valve cone 47 of the auxiliary

valve 44, which opens or closes the piping 43, is, as in Fig. 1, controlled by the thermostat 33 by means of its operating member 35.

The impulse bellows 40, which in its capacity as relieving bellows communicates with its inner space with the outer space 2 through the bore 48 in the cover plate 49, which accommodates the valve rod 6, is tightly shut off below by a bottom plate 50 firmly connected with the valve rod 6. In the lower portion of the casing 41 a spring 51 is arranged whose lower end is supported by a spring collar screwed to the valve rod 6 and whose upper end rests on the cup-shaped member 53 of a pipe member 55 having passages 54 and being secured to the casing 41 by a screw plug 56.

The temperature regulator as described above with reference to Fig. 3 operates as follows:

When the temperature drops, the valve cone 47 of the auxiliary valve 44 will be drawn down from its seat by the operating member 35 of the thermostat 33, so that the auxiliary valve 44 is opened and the piping 43 also. The pressure in the inlet side 2, by means of the water contained in the piping 43 and the impulse space 42, causes compression of the impulse bellows 40 and lifts the bottom 50 with the valve rod 6 and the valve cone 4 against the action of the spring 51 which tends to draw the valve cone 4 to its seat. The main valve 1 is thus opened and steam can flow through the latter to the places to be heated until the temperature at the thermostat has again reached its normal height.

If the temperature at the thermostat 33 rises again, say, one-half degree, the valve cone 47 of the auxiliary valve 44 will be pressed again against its seat and thus the admission of the control pressure from the inlet side 2 to the impulse space 42 is stopped. The overpressure in the impulse space 42 will then cause the escape of excess water through the piping 45 to the outlet side 3 of the main valve 1, the speed of this escape being regulated by the position of the throttle member 46. Pressure in the impulse space 42 will thus drop and the spring 51 draw the cone 4 of the main valve 1 to its seat, so that the passage 5 is throttled or shut off completely.

On account of its simple construction, this regulator operates very accurately and is highly sensitive. It also costs less to manufacture.

The temperature regulator shown in Fig. 4 is, in its main parts, similar to the regulator shown in Fig. 1, though a special equalizing and collecting vessel 57 for water of condensation is interposed between the inlet side 2 of the main valve 1 and the auxiliary valve 26 or the impulse space 9. This equalization vessel 57 may for instance consist of an oblong hollow body whose upper and lower connections 58 and 59 are joined on both sides to the connecting piping 27, and a screwed joint 60 may be used for connecting.

Such an equalization vessel may also be interposed if necessary in the ascending piping 28 or at some other suitable point.

The upper end of the equalization vessel 57 is preferably provided with a filling connection 61 closable by a screw or the like for filling the vessel with water, e. g., before starting the apparatus.

For the same purpose, it is advisable to fit the impulse space 9 and the space 19 with closable filling connections 62 and 63. These two spaces may further be provided with discharge connections 64 and 65 to facilitate the cleaning of these spaces.

The auxiliary valve 26 is essentially of the same type as the one described in connection with Fig. 1 except that the check valve built into the ascending piping 28 is replaced by a throttle screw 66 arranged preferably in the valve body of the auxiliary valve 26 and adjustable according to the size of the apparatus and the working speed desired.

The two bellows 7 and 17 and the two spaces 9 and 19 may of course be united to form a single bellows in a single space, as shown in Fig. 3, in which case the equalization vessel is disposed accordingly. At any rate, the spaces must always be arranged so that they are filled with water of condensation.

The mode of action of the temperature regulator according to Fig. 4 is as follows:

Assuming that the spaces 9 and 19 and the equalization vessel 57 are filled with water. When the auxiliary valve 26 is then opened, the working steam in the inlet side 2 will press the water out of the equalization vessel 57 into the impulse space 9 whereby the main valve 1 will be closed. The equalization vessel 57 can preferably take up at least the amount of water required for displacing the operating bellows in the impulse space, so that the steam can advance in the vessel 57 up to water level at the highest.

When the auxiliary valve 26 closes again, the water can escape from the impulse space 9 through the throttle member 66 into the ascending piping 28, so that the main valve 1 will be opened. As the relieving bellows 17 will contract during this opening motion, at least a portion of the water flowing through the ascending piping 28 will be drawn into the space 19 through the equalizing piping 29, so that this space, too, will always be filled with water. Owing to continual condensation, the equalization vessel 37 will have become filled with water again in the meantime. Water of condensation can collect also in the lower part of the inlet side 2, and after reopening of the auxiliary valve 26 the process described will be repeated.

I claim:—

1. A temperature regulator for steam plants, comprising a main valve including an inlet side and an outlet side, a valve cone and a rod connected thereto, and a water condensate collector below and in communication with the inlet side of the valve; a casing forming an impulse space; an operating bellows in the impulse space and cooperating with the valve rod; and a thermostatically actuated auxiliary valve for controlling the main valve in pipe communication with the impulse space, the condensate collector and the outlet side of the main valve, the water of condensation collecting in the collector being adapted to fill up the impulse space and the auxiliary valve to overcome the pressure of the steam in the inlet space acting on the operating bellows.

2. A temperature regulator for steam plants, comprising a main valve including an inlet side and a water condensate collector below and in communication with the inlet side of the valve; a casing forming an impulse space; an operating bellows in the impulse space; and a thermostatically actuated auxiliary valve for controlling the main valve in pipe communication with the impulse space and the condensate collector, the water of condensation collecting in the collector being adapted to fill up the impulse space and the auxiliary valve to overcome the pressure of the steam in the inlet side acting on the operating bellows.

3. A temperature regulator according to claim

2, in which a movable check valve is provided in the auxiliary valve and is in communication with the pipe leading to the outlet side of the main valve.

4. A temperature regulator for steam plants, comprising a main valve having inlet and outlet sides, a thermostatically actuated auxiliary valve for controlling the main valve, an operating bellows actuating and arranged below the main valve and having an impulse space, said impulse space being in pipe communication with the auxiliary valve and the latter with the outlet side of the main valve and the piping leading through a closing member to the inlet side of the main valve, said impulse space and piping when filled with accumulating water of condensation being adapted to indirectly transmit steam pressure through the auxiliary valve to the operating bellows, and an equalization vessel for the water of condensation interposed in the connecting piping leading from the impulse space to the outlet side of the main valve.

5. A temperature regulator for steam plants, comprising a main valve having an inlet side, a thermostatically actuated auxiliary valve for controlling the main valve, an operating bellows actuating and arranged below the main valve and having an impulse space, said impulse space being in pipe communication with the auxiliary valve, an equalization vessel in communication with the inlet side of the main valve and in pipe communication with the auxiliary valve, said vessel, piping and impulse space when filled with accumulating water of condensation being adapted to indirectly transmit steam pressure through the auxiliary valve to the operating bellows, and a closable filling connection fitted to the equalization vessel.

6. A temperature regulator for steam plants, comprising a main valve having an inlet side, a thermostatically actuated auxiliary valve for controlling the main valve, an operating bellows actuating and arranged below the main valve and having an impulse space, said impulse space being in pipe communication with the auxiliary valve, an equalization vessel provided with a filling connection into the inlet side of the main valve, said vessel, piping and impulse space when filled with accumulating water of condensation being adapted to indirectly transmit steam pressure through the auxiliary valve to the operating bellows, and a closable filling and discharging connection fitted to the impulse space of the operating bellows.

7. A temperature regulator for steam plants, comprising a main valve having inlet and outlet sides, a thermostatically actuated auxiliary valve for controlling the main valve, an operating bellows actuating the main valve and arranged below the main valve and having an impulse space, said impulse space being in pipe communication with the auxiliary valve and with the inlet side of the main valve, a check valve adjacent the auxiliary valve and in pipe communication with the outlet side of the main valve, said impulse space and its pipe connections when filled with accumulating water of condensation being adapted indirectly to transmit steam pressure through the auxiliary valve to the operating bellows, and a double seat cone for the auxiliary valve adapted to open the connecting piping leading into the inlet side of the main valve when closing the connecting piping leading into the outlet side of the main valve and to close the connecting piping leading into the inlet side of the main valve when opening the connecting piping leading into the outlet side of the main valve.

8. A temperature regulator for steam plants, comprising a main valve having inlet and outlet sides, a thermostatically actuated auxiliary valve for controlling the main valve, an operating bellows actuating the main valve and arranged below the main valve and having an impulse space, said impulse space being in pipe communication with the auxiliary valve and with the inlet side of the main valve, an adjustable throttle member adjacent the auxiliary valve and in pipe communication with the outlet side of the main valve, said impulse space and its pipe connections when filled with accumulating water of condensation being adapted indirectly to transmit steam pressure through the auxiliary valve to the operating bellows, and the inside of said operating bellows being in communication with the inlet side of the main valve to balance the valve cone of the main valve against pressure variations on the inlet side.

9. A temperature regulator for steam plants, comprising a main valve having inlet and outlet sides, a thermostatically actuated auxiliary valve for controlling the main valve, an operating bellows actuating the main valve and arranged below the main valve and having an impulse space, the inner space of said operating bellows being in communication with the inlet side of the main valve and said impulse space, and said impulse space being in pipe communication with the auxiliary valve and the inlet side of the main valve, an adjustable throttle screw in the pipe communication and also in pipe communication with the outlet side of the main valve, said impulse space and piping when filled with accumulating water of condensation being adapted to indirectly transmit steam pressure through the auxiliary valve to the operating bellows, and an equalization vessel for the water of condensation interposed in the connecting piping leading from the impulse space to the inlet side of the main valve.

10. A temperature regulator for steam plants, comprising a main valve having inlet and outlet sides, a thermostatically actuated auxiliary valve for controlling the main valve, an operating bellows actuating the main valve and arranged below the main valve and having an impulse space, said impulse space being in pipe communication with the auxiliary valve and with the inlet side of the main valve, a throttle member in pipe communication with the outlet side of the main valve, said impulse space and its pipe connections when filled with accumulating water of condensation being adapted indirectly to transmit steam pressure through the auxiliary valve to the operating bellows, a bellows between the inlet side of the main valve and the impulse space for balancing the valve cone of the main valve against pressure variations on the inlet side, a packing bellows for sealing a space relative to the impulse space and in which the second-mentioned bellows is arranged, and an equalizing piping for connecting the last-mentioned space with the piping leading from the impulse space through the throttle member into the outlet side of the main valve.

11. A temperature regulator for steam plants, comprising a main valve having inlet and outlet sides, a thermostatically actuated auxiliary valve for controlling the main valve, an operating bellows actuating the main valve and arranged below the main valve and having an impulse space, said impulse space being in pipe communication

with the auxiliary valve and with the inlet side of the main valve, an adjustable throttle member in pipe communication with the outlet side of the main valve, said impulse space and its pipe connections when filled with accumulating water of condensation being adapted indirectly to transmit steam pressure through the auxiliary valve to the operating bellows, a bellows between the main valve and the impulse space for balancing the cone of the main valve against pressure variations on the inlet side, a packing bellows for sealing a space relative to the impulse space and in which the second-mentioned bellows is arranged, an equalizing piping in communication with the second-mentioned bellows and with the piping leading from the impulse space through the throttle member into the outlet side of the main valve, an equalization vessel fitted with a closable filling connection provided in the connecting piping leading from the impulse space through the auxiliary valve into the inlet side of the main valve.

HERMANN SANDVOSS.