

H. C. MALLORY.
HEATING APPARATUS.

APPLICATION FILED FEB. 8, 1907. RENEWED JULY 26, 1910.

988,727.

Patented Apr. 4, 1911.

2 SHEETS—SHEET 1.

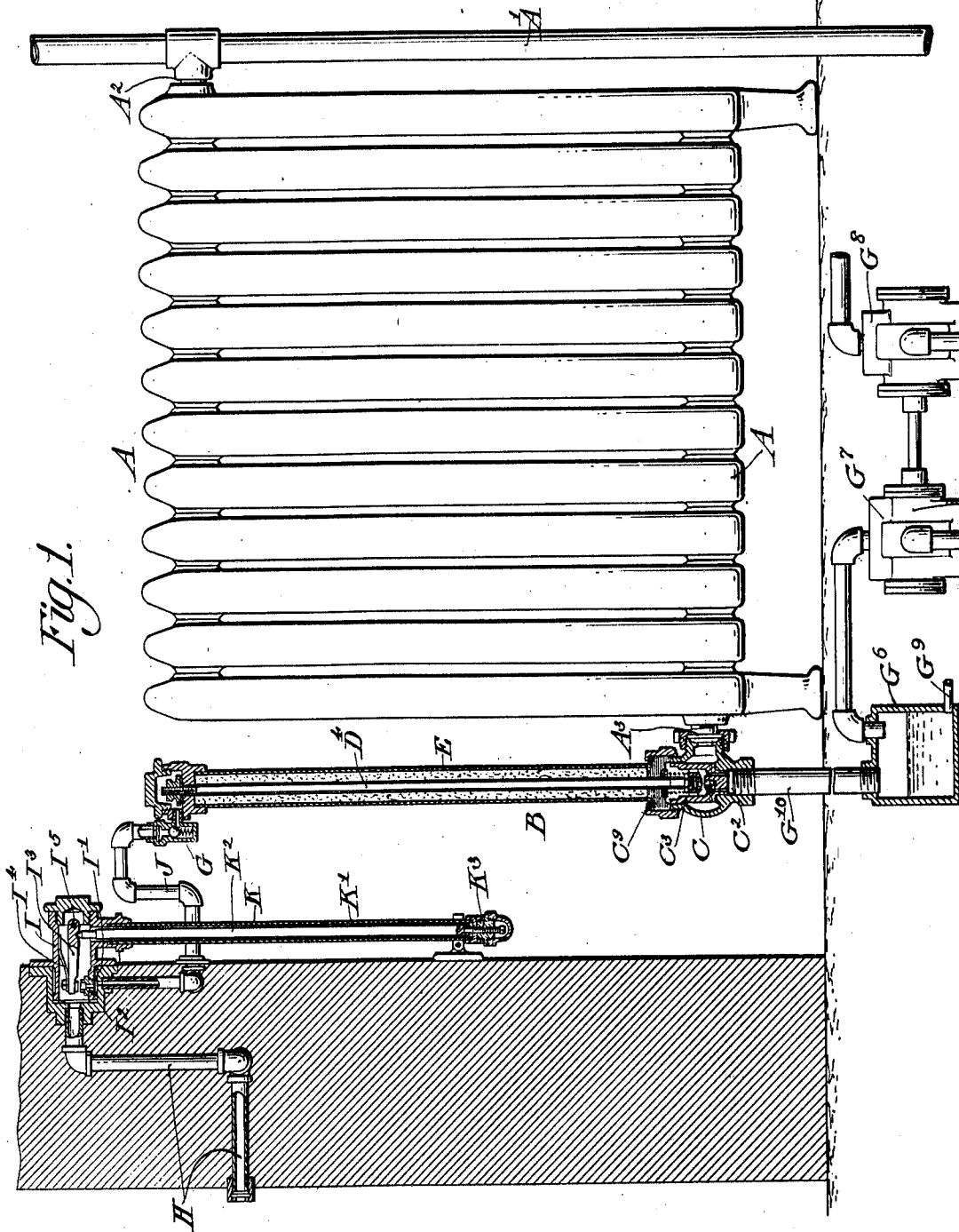


Fig. 1.

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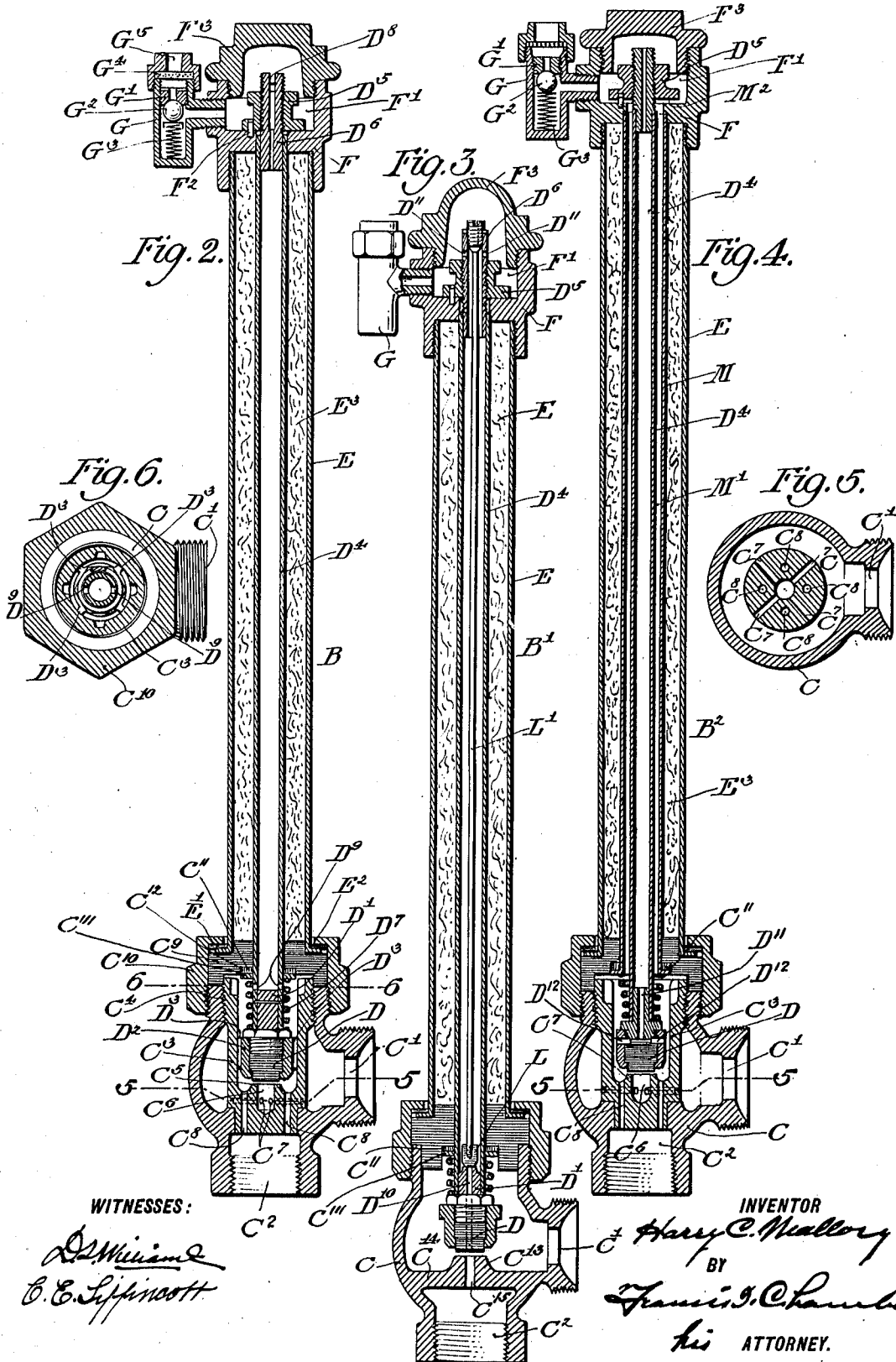
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HEATING APPARATUS.

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Specification of Letters Patent.

Patented Apr. 4, 1911.

Application filed February 8, 1907, Serial No. 356,318. Renewed July 26, 1910. Serial No. 573,844.

To all whom it may concern:

Be it known that I, HARRY C. MALLORY, a citizen of the United States of America, residing in New York, in the county of New York and State of New York, have invented a certain new and useful Improvement in Heating Apparatus, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part thereof.

My present invention relates to means for regulating the heat radiating capacity of a heating device and the primary object of my invention is to provide automatic regulating mechanism which will be simple and reliable in operation and will properly respond to the varying conditions of service.

In carrying out my invention I employ a thermostatically actuated valve for controlling the flow of the heating fluid through the radiator and I insure a proper operation of the valve by subjecting the thermostatically actuated mechanism to a wide temperature range thus insuring an amount of expansion and contraction sufficient for proper operation.

In the preferred forms of my invention I employ a radiator having a low pressure return conduit and use my regulating valve to control the escape of the heating fluid from the radiator into the escape conduit. With this form of apparatus I utilize the difference between the pressure in the escape conduit and that of the atmosphere to create a flow by the thermostatic mechanism to cool it, of a stream of relatively cold air which may be drawn from a suitable source, as the room in which the heating device is located or the external atmosphere. In order to obtain the desired wide range of temperatures acting on the thermostatic mechanism I insulate the expansible mechanism against heat derived by radiation or conduction from the radiator while allowing the mechanism to be influenced by the temperature of the heating fluid allowed to escape when the controlling valve is open.

My invention is particularly adapted for use where the heating fluid applied to the radiator is steam which escapes ordinarily in the form of water of condensation. With such an arrangement when the controlling valve stays open long enough, all the water

of condensation escapes from the radiator and then steam begins to flow through the outlet port of the radiator. Such escape of steam is, of course, undesirable and is very rapidly checked by my improved mechanism, since I arrange the mechanism so that the escaping steam very rapidly heats up the thermostatic actuating mechanism and hence closes the controlling valve. In one of the forms of my invention illustrated I have provided means for obtaining a very effective heat transferring flow of steam by the thermostatic actuating mechanism when steam escapes from the radiator. This means is not claimed herein, however, but is claimed in my copending application hereinafter referred to.

To prevent the escape of the heating fluid through the thermostatically actuated mechanism when for any reason the heating fluid may be subjected to an unusual degree of pressure tending to create a back flow through the thermostatically actuated mechanism I have provided a non-return valve which readily permits the flow of the stream of air by the thermostatically actuated mechanism but prevents a flow through the mechanism in the opposite direction.

Another feature of my invention consists in the provision of means whereby the expansion of the expansible portion of the thermostatically actuated mechanism more than sufficient to seat the controlling valve will not be attended with any injury to the expansible mechanism or the valve or its seat.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of my invention, however, and the numerous advantages possessed by it, reference may be had to the accompanying drawings and descriptive matter in which I have illustrated and described forms in which my invention may be embodied.

Of the drawings; Figure 1 is an elevation partly in section and partly diagrammatic of a heat radiator and one form of thermostatic controlling mechanism therefor which may be employed. Fig. 2 is a sectional elevation on a larger scale than Fig. 1 of the

main thermostatic controlling valve shown in Fig. 1. Figs. 3 and 4 are views similar to Fig. 2 but each showing a form differing in some respects from the others. Fig. 5 is a horizontal section taken on the line 5—5 of Figs. 2 or 4 and Fig. 6 is a horizontal section taken on the line 6—6 of Fig. 2.

In the drawings, and referring first to the construction shown in Figs. 1, 2, 5 and 6, A represents the radiator or heating device which may be of any form suitable for use with hot water or steam as the heating fluid. The heating fluid is supplied to the radiator at the top by means of the supply pipe or conduit A¹ through the coupling A² and escapes from the lower end through the coupling A³ which leads to the lower end of the thermostatically actuated valve mechanism B, which controls the escape of the fluid from the radiator. This mechanism consists of a valve casing C having an inlet port C¹ connected to the coupling A³ and an outlet port C². A tubular valve seat member C³ which is closed at its lower end except for the hereinafter described ports C⁷ and C⁸, and which is threaded externally at its upper end is screwed into a threaded opening C⁴ formed in the upper end of the valve casing. The lower end of the member C³ fits tightly against the wall of the casing C immediately above the outlet port C². From the bottom wall of the valve seat member rises a boss C⁵ having a recess C⁶ formed in its upper side. Ports C⁷ extend through the wall of the member C³ from the inlet side of the valve casing to the recess C⁶ and ports C⁸ pass through the end wall of the valve seat member outside the boss C⁵ to the outlet side of the valve casing.

Connection between the inlet and outlet sides of the valve casing is controlled by a valve D adapted to seat on the upper end of the boss C⁵ and close the mouth of the recess C⁶. The valve D is connected with the lower end of a long tube or hollow rod D⁴ formed of some material as copper or brass having a relatively high coefficient of thermal expansion, and the seating of the valve D is controlled by the expansion and contraction of the rod D⁴. In the form shown the valve D is secured to the end of a short stem D¹ by a screw cap D² having guide-ribs which engage the inner wall of the valve seat member. The upper end of the stem D¹ is secured in the lower end of the long tube or hollow rod D⁴ formed of some material as copper or brass, having a relatively high coefficient of thermal expansion. The upper end of the rod D⁴ is supported by means of a nut D⁵ screwed on the threaded upper end of the rod D⁴ or rather of a hollow extension, D⁶, of the rod, the nut resting on a support formed by the bottom wall of a recess F¹ formed in a cap member F, which is supported by the upper end of

a tube E, which surrounds the much smaller tube D⁴ and the lower end of which is supported on the valve casing C. As shown the upper end of the valve casing C is closed by a bushing C⁹ provided with a central aperture through which the rod D⁴ passes. A washer C¹¹ of suitable yielding material forming a packing to prevent the passage of moisture along the rod D⁴ through the bushing C⁹ is placed in a recess C¹² surrounding the rod D⁴. The lower end of the tube E which is outwardly flanged at E¹ rests upon the upper side of the bushing C⁹. The bushing C⁹ and the shell E are secured firmly to the valve casing C by a screw cap C¹⁰. In order to limit the transfer of heat from the valve casing C to the expanding member D⁴ directly and through the tube E the bushing C⁹ is preferably made of some material having poor heat conductivity while at the same time having a sufficient mechanical strength for the purpose such as from some compressed fiber compound. For this reason also a washer E² which may be of the same material as the bushing C⁹ is interposed between the flanged end E¹ of the tube E and the upper end of the cap C¹⁰. With the arrangement described the thermostatic mechanism is connected to and supported by the valve casing, but the members C⁹ and E² unite to form a heat insulating barrier holding the valve casing and the shell of the thermostatic mechanism out of direct contact with each other, and thereby perform a highly useful function by limiting the transfer of heat by conduction from the valve casing to the thermostatic mechanism. To still further shield the expanding member D⁴ from the heat derived from the tube E as through radiation from the radiator, the space E³ between the tubes may be filled by a packing or jacket of material such as magnesia having poor heat conductivity, though filling this space with a jacket of dead air forms an effective protection for the tube D⁴.

When the rod D⁴ warms up and expands, the valve D is moved against its seat and closes communication between the inlet and outlet sides of the valve casing C, but when the rod D⁴ cools, the valve D is lifted off of the seat, opening communication between the inlet and outlet sides of the casing. The position of the valve D at any instant depends on the temperature of the rod D⁴, and the valve D acts therefore as a throttling valve in distinction from a valve which is either wide open or shut tight.

Buckling of the tube D⁴ or injury of the valve or valve seat by expansion of the tube in excess of that required to seat the valve is prevented by allowing the nut D⁵ to lift off its seat after the hollow tube D⁴ expands enough to move the valve D onto its seat. A spring D⁷ extending between the

cap D² and a washer C¹¹¹ bearing against the washer C¹¹ supplementing the action of gravity tends at all times to hold the nut D⁵ against its seat. The effective length of the rod D⁴ can be varied by turning the extension D⁶ in the nut D⁵. To facilitate this adjustment, a kerf D⁸ is formed in the upper end of the extension D⁶ and the nut is prevented from rotation by a guide-pin F² carried by the cap member F.

The upper end of the recess or chamber F¹ is closed by a screw cap member F³. The tubular member D⁴ is cooled by a power actuated stream of air drawn from the chamber or recess F¹ through the tube and discharged at its lower end into the valve seat member through lateral ports D⁹.

In the radiator of Fig. 1, the outlet side C² controlling the valve casing is connected to an escape pipe or return conduit G¹⁰, in which a vacuum or pressure below that of the atmosphere is maintained by connecting it to the reservoir G⁶ which is connected to the exhauster G⁷ operated by the engine G⁸, the cold water or water of condensation from the radiator being drawn out of the reservoir G⁶ through a pipe G⁹. In this form of my invention the stream of air through the tube D⁴ is caused to flow into the pipe G¹⁰ by the difference in the pressure in the pipe G¹⁰ and that of the external atmosphere.

In the valve shown in Fig. 2 air enters the chamber F¹ through a valve casing G having a valve seat G¹ and a non-return ball valve G² urged against the valve seat by a spring G³ light enough to yield and allow the air to enter the valve casing on a very slight excess of the pressure outside the valve seat over that in the chamber F¹ but which causes the valve to rapidly seat itself and prevent the escape from the casing of steam or water which might otherwise occur in case of an undue rise of pressure of the heating fluid. A gauze washer G⁴ is placed in the inlet port G⁵ of the valve casing G to prevent the entrance of dirt into the valve casing.

The air drawn into the chamber F¹ through the valve casing G may come from various sources depending on the character of regulation desired or the means available. For instance, it may be drawn directly from the room heated by the radiator. In many cases, however, I prefer to draw it from the external atmosphere as shown in Fig. 1 where H represents piping embedded in the apartment wall and leading from the external atmosphere to the inlet port of a valve casing I, the outlet port I¹ of which is connected by piping J to the inlet port of the valve casing G. With this arrangement the air drawn through the member D⁴ is of the temperature of the external atmosphere and hence the cooler the external

atmosphere and consequently the more heat necessary from the radiator, the greater the contraction of the member D⁴ produced by the stream of air blowing through it.

In many cases regulation of the flow of the stream of air through the pipe D⁴ is desirable and this is obtained with the construction shown in Fig. 1 by the valve I³ pivoted at I⁵ and controlling the port I² between the pipes H and J. A spring I⁴ constantly urges the valve I toward its seat but the valve I is moved off its seat when necessary by the pilot thermostat K, responsive to room temperature, the outer tubular member K¹ of which having a relatively high thermal coefficient of expansion, contracts when the room temperature falls and consequently causes the valve to be lifted from its seat through the rod K² having a relatively low coefficient of thermal expansion. The members K¹ and K² are adjustably connected together by means including an adjusting screw K³ at their lower ends.

The thermostatically actuated valve B¹ of Fig. 3 differs from that of Fig. 2 in the fact that the separate valve seat member G³ is dispensed with, the valve D seating on the upper end of the boss C¹³ rising from the partition C¹⁴ separating the inlet and outlet sides of the valve casing. A port C¹⁵ passes through the boss connecting the inlet and outlet sides of the casing when the valve is off its seat. In this valve a port D¹⁰ passing axially through the stem D¹ and valve D takes the place of the lateral ports D⁹ of Fig. 2. The port D¹⁰ is controlled by a valve L carried by a rod L¹ having a relatively low coefficient of thermal expansion, the upper end of which is enlarged and threaded to be adjusted into the upper end of the extension D⁶ which is internally threaded for the purpose. Air is drawn from the chamber F¹ into the tube D⁴ through lateral ports D¹¹. The rod L¹ is so adjusted that the valve L engages its seat and closes the thoroughfare through the tube D⁴ when the valve D moves off its seat, thus preventing the passage of air through the pipe D⁴ when the valve D is open and also preventing the passage of steam from the valve casing into the tube D⁴ which may tend to cause the valve D to close too soon.

To some extent the valve L takes the place of the pilot valve I shown in Fig. 1 and the valve of Fig. 3 is primarily intended for operation without any external pilot valve, though it may be used in the place of the valve B of Fig. 1.

The valve B² of Fig. 4 differs from that of Fig. 2 principally in the fact that the tube D⁴ is surrounded by a tubular shell M secured at its upper end to the cap F, with the space M¹ between the tubes D⁴ and M open at its lower end to the interior of the

valve seat member C³ and at its upper end through grooves M² formed in the under side of the nut D⁵ to the chamber or recess F¹. This arrangement is particularly adapted for application to a steam radiator in which the valve D controls the escape of the water of condensation from the radiator in the normal operation. When the conditions of service are such that the valve D remains open until steam enters the valve seat member C³, an up and down gravity circulation of the steam through the interior of the tube D⁴ and the space M¹ is obtained, which causes the member D⁴ to very rapidly expand and bring the valve D back on to its seat to prevent further escape of steam from the radiator. In this form of my invention ports D¹¹ and D¹² connect the interiors of tube D⁴ and the valve seat member C³.

No claim is made herein to the features of construction and arrangement shown in Fig. 4 whereby steam issuing from the radiator outlet is caused to circulate in a definite manner along the thermostatic mechanism to cause the latter to close the control valve, as this part of the invention disclosed herein is claimed in my co-pending application, Serial No. 380,995, filed June 27, 1907.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a thermostatic valve mechanism the combination with a valve casing of a valve, a thermostatic valve actuating mechanism, and a barrier of non-metallic heat insulating material all connected together with said barrier holding said casing and actuating mechanism out of direct contact and thereby thermally insulating said mechanism from said valve casing.

2. In a thermostatic valve mechanism the combination with a valve casing of a valve, a thermostatic valve actuating mechanism comprising an expanding member and a casing member, and a barrier of non-metallic heat insulating material, the valve casing, said casing member and said barrier being all connected together with said barrier holding said valve casing and casing member out of direct contact with each other and thereby thermally insulating the latter from the valve casing.

3. In a thermostatic valve mechanism, the combination with a valve casing provided with a tubular portion, a valve, a thermostatic valve actuating mechanism comprising an expanding member and a casing formed at one end with a flange, a cup member threaded to said tubular portion and provided with a portion taking over said flange and washers of non-metallic heat insulating material interposed, between the valve casing and the said flange and between the latter and the said cup member.

4. In combination a heat radiating device and regulating mechanism therefor, including a valve casing having a port, a valve for said port and thermostatically actuated mechanism for the valve comprising an expanding member and a casing, the latter being supported by, but thermally insulated from said valve casing.

5. In combination, a heat radiating device and controlling mechanism therefor, including a metallic valve casing having a port, a valve controlling said port, a thermally expansible rod having one end extending into said casing and connected with said valve, a metallic tube surrounding the portion of said rod exterior to said casing and having the outer end of said rod connected to and supported by it, and means connecting said tube to, but maintaining it out of direct contact with, the valve casing, said tube being separated from said rod by a space whereby the rod is shielded against heat from the heat radiating device.

6. In combination, a heat radiating device and controlling mechanism therefor, including a metallic valve casing having a port, a valve for said port, a thermally expansible rod extending into said casing and connected with said valve, a bushing formed of material having poor heat conductivity surrounding the rod and insulating it from the casing, a tubular member surrounding the external portion of said rod and having the outer end of the rod connected to it, said tubular member having an outwardly extending flange at one end which engages said bushing, a metallic cap member C¹⁰ securing the bushing and tubular member to the valve casing, and a washer E² formed of material having poor heat conductivity inserted between the flanged end of the tubular member and the cap member whereby the tubular member is maintained out of metallic contact with the valve casing to diminish the transfer of heat from the valve casing to said expansible rod.

7. In combination a heat radiator and a controlling valve mechanism therefor, said mechanism including a part having a valve seated port, a valve for controlling said port, a thermally expansible member controlling the seating of said valve and a support for said member, and means connecting said member to said support arranged to permit said member to move in its support upon an expansion of the expansible member occurring after the valve has seated itself.

8. In combination a heat radiator and a controlling valve therefor, said mechanism including a valve casing having a port, a valve controlling said port, a thermally expansible rod one end of which is connected with said valve, a support, and means connecting the other end of said rod remote

from that connected with the valve to said support arranged to accommodate an expansion of the rod occurring after the valve is seated on its port by permitting movement of the rod relative to the support.

said expansible member opens said valve and its expansion closes it, said means connecting said tubular member and rod comprising a support carried by the tubular member having an aperture through which the rod extends and a nut threaded on the outer end of said rod and normally resting against said support and a spring acting on the rod to normally hold the nut against the support.

9. In combination a heat radiator and a controlling valve mechanism therefor, said mechanism including a member having a port, a valve controlling said port, a thermally expansible rod one end of which is connected with said valve and by the expansion of which rod the valve is seated, a support for the opposite end of said rod and means for connecting said opposite end to said support to prevent movement of said opposite end in a direction to carry the valve into the closed position, but permitting a movement of said other end in the opposite direction.

13. In combination a heat radiator and means controlling the flow of heating fluid through said radiator including a valve casing having a port, a valve controlling said port, a thermally expansible device for actuating said valve, expanded by the heat of the fluid passing through said port and cooled by a stream of fluid thermal agent flowing by said device, means for causing said stream to flow and means for insulating said device from heat radiated or conducted away from said radiator.

10. In combination a heat radiator and a controlling valve mechanism therefor, said mechanism including a member having a port, a valve controlling said port, an expansible rod one end of which is connected with said valve, and having its other end threaded, a support having an aperture through which the rod passes, a nut carried by said threaded end of the rod and engaging said support to prevent movement of that end of the rod in direction to move the valve on to its seat, but permitting a movement of the rod in the opposite direction and yielding means tending to hold the nut against the support.

14. In combination, a heat radiating device, a low pressure escape conduit and mechanism controlling the flow of the heating fluid through said device, including a valve casing having its inlet side connected to the heating device and its outlet side connected to the escape conduit, a valve controlling communication between said inlet and outlet sides, a tubular member connected at one end to, but thermally insulated from, said casing, a hollow rod of material having a relatively high co-efficient of thermal expansion located within said tubular member and having one end secured to the outer end of said tubular member and the other end extending into said casing and connected with said valve, the interior of said rod being open at its outer end to a source of air and at its inner end to the outlet side of said valve casing, whereby a thoroughfare for a stream of air is provided in said rod, and a valve automatically actuated by the contraction of said rod to close said thoroughfare.

11. In combination a radiator, a source of heating fluid, a return conduit leading away from the radiator, a valve controlling the flow of the heating fluid through the radiator, thermostatic actuating mechanism for said valve, including a chamber or passage connecting a source of supply of a fluid thermal agent for acting on said thermostatic actuating mechanism to said return conduit, and a non-return valve automatically opening to permit a flow of fluid through said chamber away from said source, and closing to prevent a flow of fluid through said chamber toward said source.

15. In combination, a heat radiating device, a low pressure escape conduit and mechanism controlling the flow of the heating fluid through said device, including a valve casing having an inlet side connected to the heating device and an outlet side connected to the escape conduit, a valve controlling communication between said inlet and outlet sides, a tubular member having one end connected to the valve casing, a chambered end member connected to the other end of the tubular member, a hollow rod, of a material having a relatively high co-efficient of expansion, located within said tubular member and extending between the chamber in said end member and said valve casing with its bore forming a thoroughfare between the chamber in said end member and the outlet side of said valve casing,

12. In combination, a heat radiating device, a low pressure escape conduit, and mechanism controlling the flow of the heating fluid through said heating device, including a valve casing having an inlet side connected to the heating device and an outlet side connected to the escape conduit, a valve controlling communication between said inlet and outlet sides, a tubular member having one end connected to, but thermally insulated from said valve casing, a rod of material having a relatively high coefficient of thermal expansion located within said tubular member, and having its outer end connected to the outer end of said tubular member, and its inner end connected with said valve, whereby the contraction of

means connecting said valve with the corresponding end of said hollow rod, said chamber having a port leading to its interior from a source of a fluid thermal agent under
5 pressure greater than that normally in the escape conduit, and a non-return valve controlling said port and permitting a flow to

said chamber from said source, but preventing a flow in the opposite direction.

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Witnesses:

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