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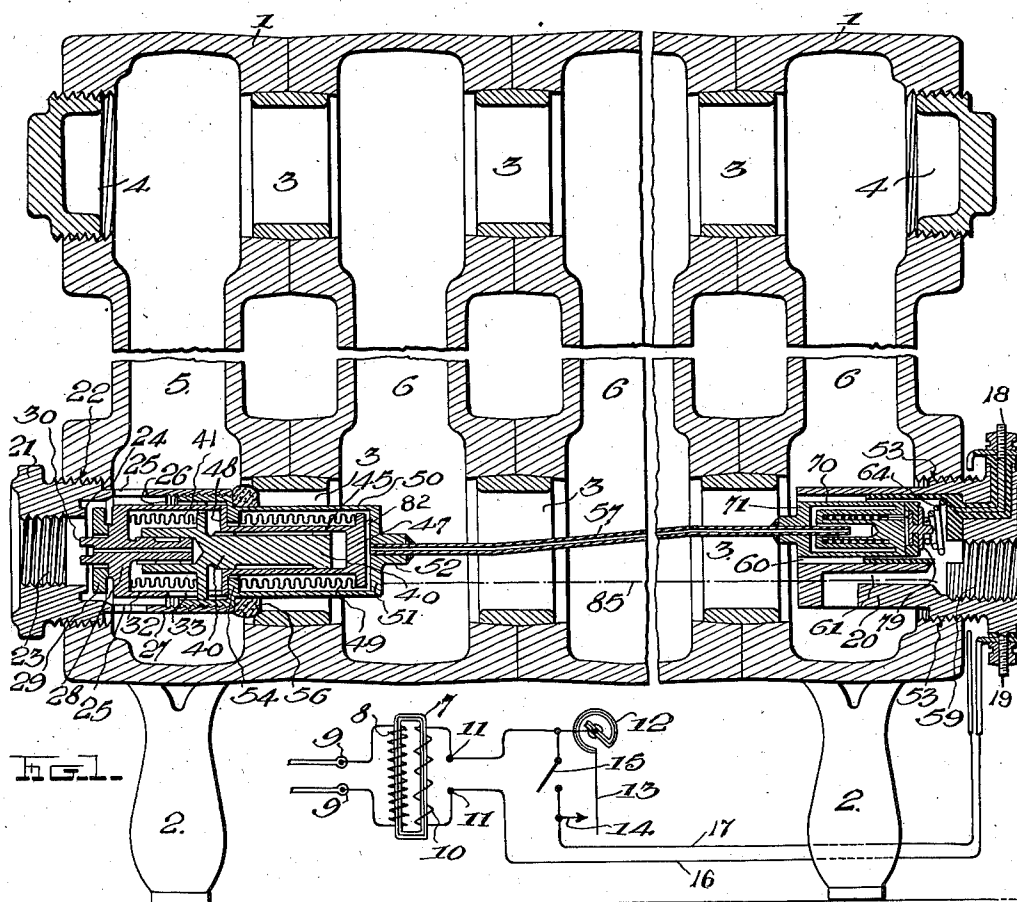
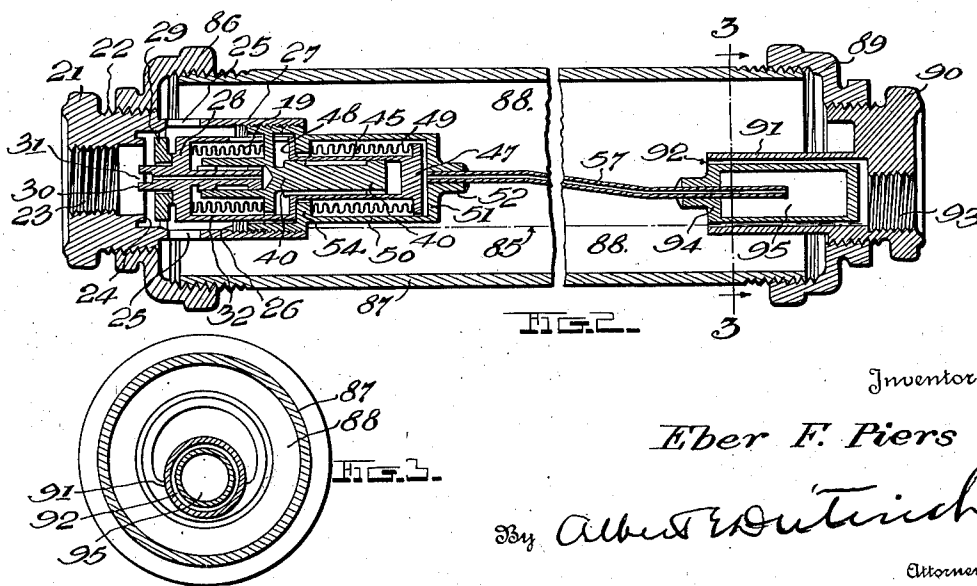
E. F. PIERS

2,058,104

AUTOMATIC RADIATOR CONTROL

Filed Oct. 6, 1933

3 Sheets-Sheet 1



Inventor

Eber F. Piers

By *Albert R. Dutrich*

Attorney

Oct. 20, 1936.

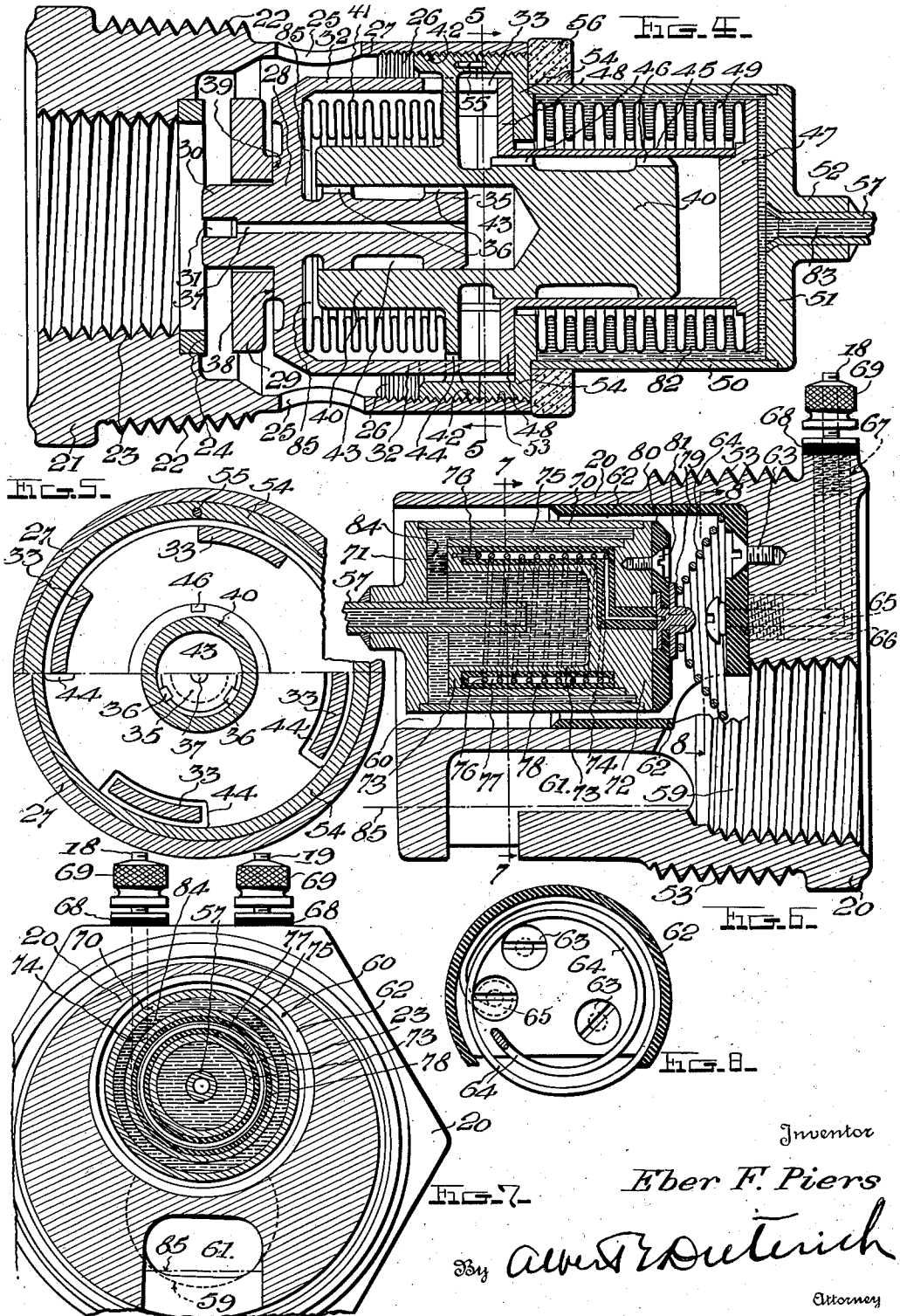
E. F. PIERS

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3 Sheets-Sheet 2



Inventor

Eber F. Piers

By *and* *Attorney*

Attorney

Oct. 20, 1936.

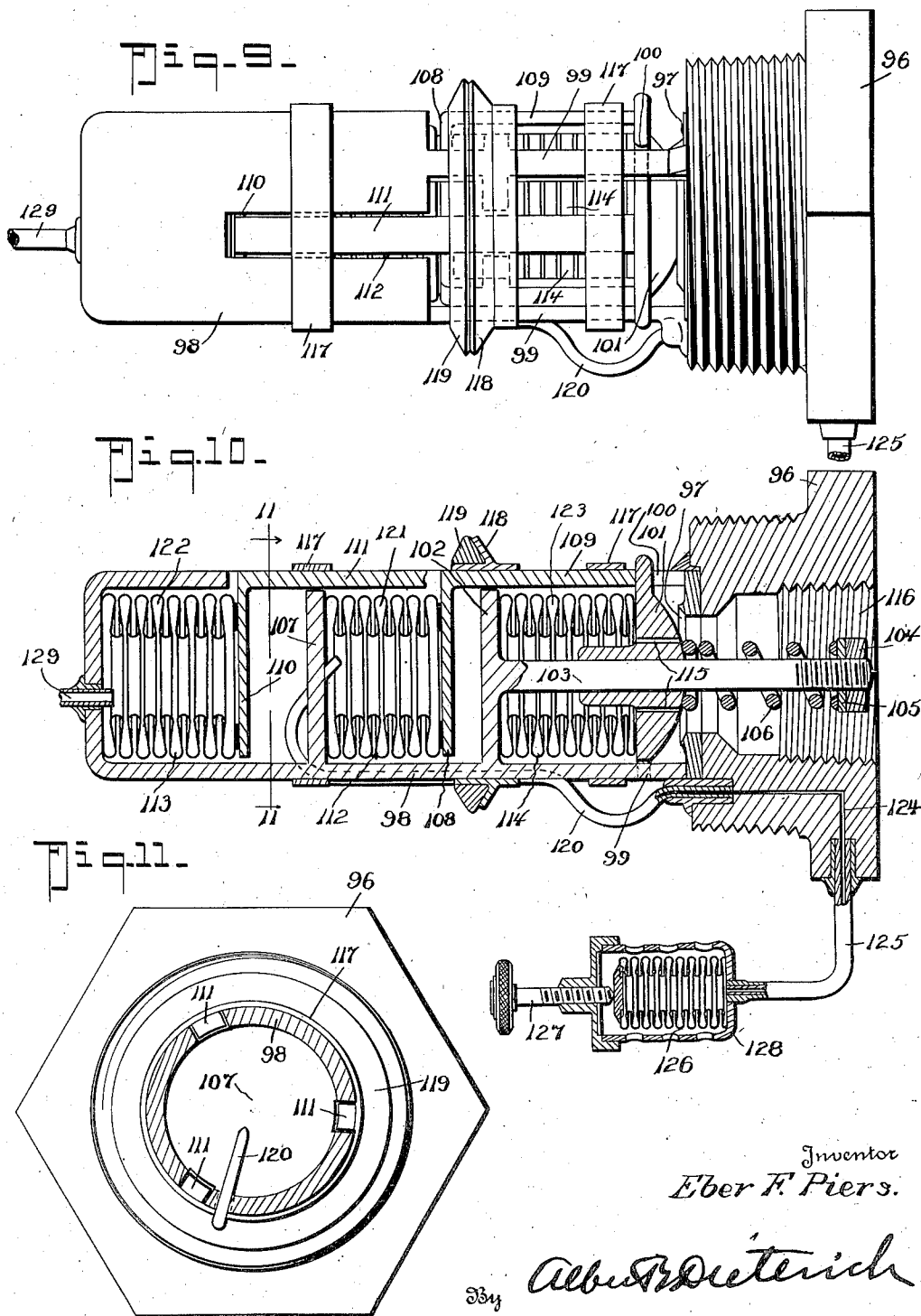
E. F. PIERS

2,058,104

AUTOMATIC RADIATOR CONTROL

Filed Oct. 6, 1933

3 Sheets-Sheet 3



Inventor
Eber F. Piers.

By *Albert Dietrich*
Attorney

UNITED STATES PATENT OFFICE

2,058,104

AUTOMATIC RADIATOR CONTROL

Eber F. Piers, Ogden, Utah

Application October 6, 1933, Serial No. 692,538

9 Claims. (Cl. 236—37)

The invention relates to certain new and useful improvements in the automatic control of prime surface heating radiator units, and the efficient utilization of the heat contained in the heating medium supplied to the radiating units.

The primary object of the invention is to provide full automatic control of any heating medium of a gaseous fluid nature, that is condensable at normal temperatures, such as steam (hereinafter called steam) supplied to any heat radiating unit (hereinafter called the radiator) whose prime surface is used to heat a surrounding fluid (hereinafter called air).

Further it is an object to utilize as the governing factors, first, the steam after it has passed through the radiator and the products of the thermal transfer from the steam to the radiator within said radiator, that are discharged or have arrived at the return or discharge opening from said radiator; second, the temperature of the air heated and circulated over the prime surface of the radiator.

A further object is to provide for a self-contained unit with all parts protected from mechanical injury; a unit that when once adjusted requires no further adjustment; a unit that precludes the necessity for or the use of any form of hand controlled valve connecting said radiator to the system of piping distributing the steam; a unit that precludes the necessity for or the use of any form of trap, air valve or check valve to prevent the passage of any uncondensed steam beyond the radiator into the return piping, and/or to purge the contained air from within said radiator; a unit that will at all times and under all conditions allow the free, unobstructed and continuous passage of contained air and condensed steam to pass from the interior of the radiator through the discharge opening into the return piping system; a unit that may be connected in-circuit with any extant two pipe steam or vapor heating system without disturbing in the least the proper operation of any or all of the units of said system; a unit that will give up or deliver, a given quantity of British thermal units per unit of prime radiating surface, regardless of the initial pressure or superheat of the supplied steam.

Other objects will in part be obvious and in part be pointed out hereinafter.

To the attainment of the aforesaid objects and ends, the invention still further resides in the novel details of combination, and arrangement of parts, construction, etc., all of which will be first fully described in the following detailed de-

scription, then be particularly pointed out in the appended claims, reference being had to the accompanying drawings, in which:—

Figure 1 is a vertical longitudinal section on the center line through the hubs or longitudinal passages of a conventional steam radiator with my invention incorporated therein.

Figure 2 is a longitudinal section of an application of a simplified form of my invention as a high or low pressure steam trap.

Figure 3 is a cross section on line 3—3 of Figure 2 looking in the direction of the arrows.

Figure 4 is an enlarged vertical longitudinal section of the construction of the valve mechanism employed as a part of my invention.

Figure 5 is a cross section on line 5—5 of Figure 4 the upper half of which looks in the direction of the upper arrow and the lower half of which looks in the direction of the lower arrow.

Figure 6 is an enlarged vertical longitudinal section of the actuating mechanism and housing for same.

Figure 7 is a cross section on the line 7—7 of Figure 6 looking in the direction of the arrows.

Figure 8 is a partial cross section of Figure 6 on the line 8—8, looking in the direction of the arrows.

Figure 9 is an elevation of another form of valve mechanism which may be employed in lieu of that shown in Figure 1.

Figure 10 is a vertical longitudinal section of the same.

Figure 11 is a cross section on the line 11—11 of Figure 10.

In the drawings, in which like numerals and letters of reference indicate like parts in all the figures, 1 represents a conventional cast iron radiator with through passages from end to end at both top and bottom hubs. However, I do not wish to confine the application to this particular pattern or style of radiator unit, as the invention is applicable to any style or pattern of direct or indirect radiating unit now extant, or other steam conveying or containing unit, as later explained.

The radiator legs are indicated by 2; the nipples connecting the upper and lower hubs by 3; the first column or section of radiator by 5, all other columns or sections by 6, and upper tapping closure plugs by 4.

In Figure 1 is indicated a source of electricity, composed of a low wattage transformer comprised of the following numbered parts; 7 represents a laminated iron core, 8 a primary winding on said core connected to the terminals 9 which terminals are fed by any alternating current sup-

ply, 10 represents a low voltage secondary winding on said core 7 supplying a low voltage current to the terminals 11. Also a simple make and break electric thermostat is indicated, comprised of the following numbered parts; 12 is a bimetal thermal spring anchored at one end to the frame of the thermostat and carrying a blade 13 on the other end. Said blade carries a contact point thereon that engages the contact point 14 when a rising temperature expands the thermal spring 12 and moves the blade 13 up to the contact point 14. 15 represents a manually operated switch, in multiple with said thermostat, to close the thermostat circuit at will. 16 and 17 indicate conductors connecting the thermostat, switch and transformer terminals 11 to the terminals 18 and 19 in bushing 20 of my invention. I do not claim invention on the transformer, thermostat and switch, but have indicated these items to better illustrate the principle. A direct current supply, such as an accumulator, dynamo, or primary cells, may be used in place of the transformer indicated.

Referring now particularly to Figures 4 and 5 of the drawings, it will be observed that 21 is a hexagon lipped bushing that is adapted by the standard pipe thread 22 to screw into the inlet or supply aperture of the radiator 1. This bushing is internally threaded with a standard pipe thread at 23 for the reception of the steam supply pipe of the heating system, the said opening 23 constituting the steam inlet. Carried by and within the bushing 21 is a valve seat 24 composed of a hard corrosion resisting metal such as stainless steel. Said bushing 21 is provided with an extended shell 27 in which six ports 25 are placed, equally spaced about its girth. Said extended shell of bushing 21 is internally threaded at 26 for a sufficient distance to allow the parts 40 and 54 to be accommodated with ample adjusting thread.

Mounted to float within the shell of bushing 21, is the valve head 28 which carries the valve disc 29 on the cylindrical boss 30. The boss 30 is provided with a screw driver slot 31, for adjustment of the valve opening. The valve head 28 is provided with an enclosing shell 32, which shell is segmented at the rear end into four prongs 33, which prongs abut the flanged face 48. The valve head 28 is guided in the chamber 43 by the guide post 35. Three sets of relief slots or channels 36 in the girth of the guide post 35 are provided. A port 37 connects and maintains communication from 23 to 43 and through 36 to 85. The valve disc 29 is loosely carried on the boss 30 and is provided with a concentric shoulder 38 that abuts the concentric shoulder 39 on valve head 28. Valve head 28 is flexibly connected as shown to the adjustable guide member 40, by the corrugated metal bellows 41.

The guide member 40 is threaded on its outer circumference at 42 which threads engage the threads 26 in the shell 27 of the member 21. The bore 43 of 40 forms a guide for the guide post 35 of valve head 28. Slots or apertures 44 are provided in 40 to allow the four prongs 33 of the valve head 28 to freely move back and forth therein. The rear portion of the adjustable guide 40 forms a guide post for the cylinder 45, in which guide post are three sets of slots or channels 46 in the girths of the annular guides thereon.

The cylindrical shell 45 is provided with a closing head 47 at the rear end and an extended circular flange 48 at the other end, the face of said

flange 48 abutting the ends of the prongs 33 of valve head 28. The head 47 is flexibly or movably connected to 54 by the bellows 49. The cylindrical shell 45 is guided in its movement, upon the guide post of the adjustable guide member 40.

The cylindrical enclosing shell 50 is provided with a closing head 51 at the rear end, the boss 52 of which accommodates the connection of the tubing 57. The extended annular flange 54 is threaded on its circumference at 53 which threads engage the threads 26 of the shell 27. In the edge of the flange 54 is the fixed pin 55 which engages a hole in the edge of the flange of the adjustable guide member 40. The inside flange of 54 provides an attachment for the bellows 49 and also a stop for the rearward motion of the extended front flange 48 of shell 45.

The member 56 is a porous packing ring to engage the radiator nipple 3 between sections 5 and 6 of the radiator 1.

The bellows 41 and 49 are secured to the members 28, 40, 54 and 47 by soldering, brazing, welding or any other suitable method that will effect a gas and liquid tight connection. Tubing 57 is secured in boss 52 in a similar manner and joints between members 50 and 51, 50 and 54, and 45 and 47 are likewise made. Valve seat 24 is a press fit into 21, or other suitable steam tight fastening method.

Referring now to Figures 6, 7 and 8 of the drawings, it will be observed that 20 is a hexagon bushing that is adapted by the standard pipe threads 53 to screw into the outlet, return or discharge opening or aperture, of the radiator 1. This bushing is internally threaded, eccentrically, with a standard pipe thread at 59 for the accommodation of the connection to the return piping of the heating system, the said opening 59 constituting the outlet of the radiator. The bushing 20 is provided with an eccentrically placed chamber 60 and a port 61, both of which open into the outlet opening 59. The port 61 opens to the bottom of the bushing 20 at its inlet end, and is provided with a vertical passage as well as a horizontal passage. Secured in the end of the chamber 60 is a dielectric cup 62, secured to the bushing 20 by the countersunk screws 63. Said cup 62 is cut away, as shown, at the bottom of the closed end, to allow a free passage between chamber 60 and opening 59. The insulating cup 62 has the conical bronze spring 64 secured therein by the screw 65. Screw 65 is threaded into the head of the cup 62, securing the spring 64 and extending through the insulating bushing 66 to be engaged by the terminal screw 18, insulating bushing 66 being threaded into and secured by 20. The terminal screw 18 is threaded into the insulating bushing 67 which in turn is threaded into and secured by 20. The terminal screw 18 engages and makes an electrical contact with the extended end of the screw 65. The insulating washer 68 and the binding nut 69 are threaded onto the terminal screw 18. The terminal screw 19 makes electrical contact with the bushing 20 and is secured thereto. An insulating washer 68 and a binding nut 69 are threaded onto the terminal screw 19.

Removably placed within the chamber 60 is the actuating mechanism made up of the following components: A circular shell 70 and the ends 71 and 72 enclose the chamber 75; the end 71 receives and has fastened therein the tube 57 which tube extends about half way into the cham-

ber 75; the end 72 has an internal extended concentric shell 73 which forms a spool upon which is wound the resistance wire 76 in the space 77, which wire is insulated from the adjacent members by the dielectric 78. The space 77 is sealed from the chamber 75 by the cylindrical shell 74. One end of the resistance wire 76 is electrically and mechanically fastened to the spool 73, the other end passing through the insulating bushings 78, secured in the head 72, and electrically and mechanically connected to the contact button 79. The dielectric disc or plate 80 is secured to the head 72 by the countersunk screws 81 and supports the contact button 79, which button is riveted or suitably fastened to said insulating plate 80. The contact button 79 engages the small coiled end of the conical spring 64, thereby making an electrical contact therewith. The joints between members 57 and 71; 71 and 70; 70 and 72; 72 and 74; and between 74 and 73 are soldered, brazed, welded or so suitably made as to render them liquid or gas tight under pressure.

The chamber 75, Figure 6, communicates with the chamber 82, Figure 4, through the bore 83 of the tubing 57; all included spaces and chambers are totally filled with two liquids at normal temperature and atmospheric pressure, and the said spaces and chambers hermetically sealed. The first liquid fills all of the chamber 82, the interior 83 of the tubing 57 and about 70% of the included volume of the chamber 75. The first liquid has the following characteristics: Low vapor tension pressure; low coefficient of expansion; high boiling point; liquid at normal temperatures; high specific gravity; and practical insolubility in the second liquid. The first liquid may be glycerine. The second liquid fills the approximately 30% of the space in chamber 75, unoccupied by the first liquid. The second liquid has the following characteristics: High vapor tension pressure; rising rapidly between 60° C. and 150° C.; high coefficient of expansion; liquid at normal temperatures; lower specific gravity than the first liquid, and practical insolubility in the first liquid. The second liquid may be acetone. The above named liquids are suitable, but I do not wish to be confined to the use of the ones mentioned as there are many substances and combinations of substances that may be used to accomplish my purpose and I wish, on occasion, to enjoy the use of any that are suitable for the use specified. 84, Figures 6 and 7, denotes the approximate plane of separation between the first liquid and the second liquid, due to the difference in their specific gravities and their antipathies for each other. The actuating assembly of Figure 6 may be rotated end for end or concentrically without the possibility of displacing any of the first liquid from the tube 57 or the chamber 82, due to the positioning of the end of the tube 57 in the chamber 75, the end of said tube being always immersed in the first liquid.

So far as described, the manner in which the foregoing embodiment of my invention operates is as follows:

Steam, as above described, being delivered at any pressure through piping connected to the opening 23 in the bushing 21, enters the bushing, passes through the open valve between the seat 24 and the disc 29, and thence out of the bushing 21 by way of the ports 25 into the first column or section of the radiator 1. The valve is kept open by the light spring action of the bellows 41.

The steam upon entering the radiator is confined to the first section 5 of radiator 1, by the porous packing 56, which packing has the characteristic of retarding the passage of steam but allowing the water of condensation to filter through. Following the path of least resistance, aided by its natural tendency to rise, the steam flows up through the tubes 5 of said radiator, to the top hubs and through the nipples 3 to all other sections or columns of said radiator, and by this method the steam is evenly distributed throughout the top of the radiator first.

As more steam enters, the spaces 6 will be filled from the top downward, thereby displacing the heavier air therein contained, in a proper and efficient manner. As the steam displaces the air from the interior, 5 and 6 of the radiator 1, the air is freely passed through the annular passage 60; that is formed between the shells 20, 62 and 70, and from thence it passes out of the discharge opening 59 into the return piping connected thereto, there being no restriction whatever to its free and unobstructed egress.

Simultaneously with the displacement of the air, as just described, the steam comes into contact with the interior surfaces of the radiator and by convection gives up its latent heat of evaporation and condenses into the liquid form (water), which condensate is soon at a lower temperature than the steam. Said condensate falls to the bottom of the radiator 1 where it collects until a sufficient amount is accumulated to raise the level of same in the bottom of the radiator until it freely flows through the port 61, in the bushing 20, and thence through the discharge opening 59 into the return piping. The condensate can never attain a higher level than that indicated by broken line 85, in Figures 1, 2, 6 and 7. In the maintenance of the level 85 by the condensate, the port or passage 61 is effectually sealed against the passage through same of steam or air, thereby forcing all air to leave the radiator via the annular passage 60, surrounding the shell 70 of the actuating mechanism. Steam, in order to pass out of the radiator would have to follow the last described course of the air.

When sufficient steam has entered the radiator 1 to expel all of the contained air and overcome the existing rate of condensation, said steam will enter the annular passage 60, where it will come into contact with the shell 70 of the actuating mechanism. Upon said contact with shell 70 (as with contact with any cooler surface), the steam will give up its latent heat of evaporation to said shell 70, which heat will be transferred through the shell 70 and from there to the liquids, hereinbefore described, therein contained in the chamber 75. Both liquids will absorb said heat but no physical change of any particular consequence will take place in the first liquid. The second liquid, upon the absorption of said heat, will, by its expansion and increase of its vapor tension pressure, according to its physical characteristics, create a pressure within the chamber 75 and force a portion of the first liquid through the passage 83, in the tube 57, into the chamber 82, where the increased volume of the first liquid will exert a pressure upon the outer folds of the bellows 49. This external pressure upon the bellows 49 will contract same and move the head 47, together with the shell 45, forward, being guided in said movement by the guide member 40. The face of 48, the extended flange of shell 45, being in abutment with the prongs 33 of the valve head 28, the entire assembly of the valve head 28

will move forward in a like amount to the movement of the assembly 45, which will make the valve disc 29 approach the valve seat 24, thereby restricting the quantity of steam being admitted to the radiator 1, in relative proportion to the amount of heat being absorbed in the chamber 75 by the second liquid. As the valve head assembly 28 moves forward, it is guided in collimation by the guide post 35 in the guide chamber 43 of the adjustable guide member 40, also the bellows 41 are extended, overcoming their slight spring action tending to hold the valve open.

The above described restricting or shutting down of the steam supply entering the radiator will therefore be to a sufficient degree to prevent a further quantity of steam from entering the annular passage 60, and further, a state of balance between the new supply of steam and the existing rate of condensation will be established, preventing any loss of uncondensed steam into the return piping, through the discharge opening 59. Air and condensate are allowed to freely pass out of the radiator at all times, under any and all conditions of operation, as a free and unrestricted opening is constantly maintained between the interior of the radiator and the return piping system.

Anyone skilled in the art will appreciate that the last above described operation takes place almost instantaneously. A very small amount of energy on the part of the second liquid is required to operate the valve, as there is only the almost negligible friction of the parts and the slight spring action of the syphons 41 and 49 to overcome. Varying initial pressures of the steam supply has no effect on the operation, as the steam pressure of the supply is always free to enter the interior 85 of the bellows 41, through the port 37, the chamber 43, and the slots or channels 36, of the guide post 35. The effective area of the bellows 41 being the same as that of the opening in the valve seat 24, an absolutely balanced condition of the valve is always maintained regardless of the pressure of the supplied steam or any condition of vacua within the radiator 1.

The primary terminals 9 of the transformer (7, 8 and 10) are connected to any alternating current source of supply, such as a lighting or power circuit. The low voltage terminals 11 of said transformer are connected through the conductors 16 and 17 to the binding posts 18 and 19 of my invention with a simple make and break thermostat in series with said connection. A hand operated switch 15 is connected in multiple with the said thermostat for the purpose of shutting the radiator entirely off, as occasion demands, regardless of temperature conditions; said thermostat may be adjusted to any predetermined operating temperature. When the air being heated by the radiator 1 reaches or attains the desired temperature or degree to which the thermostat is set, the blade 13 makes contact with the point 14, completing the low voltage circuit of the secondary of said transformer, allowing a small current to flow through the conductor 17 into the binding post terminal 18 in bushing 20. This current is conveyed through the terminal 18 to and through screw 65, to and through spring 64, to and through contact button 79 into the high resistance heating wire 76, coiled in the chamber 77, through said resistance wire into spool 73, thence through spool 73, head 72, shell 70, tubing 57, head 51, shell 50, 54, 21, thence into radiator 1, from radiator into bushing 20 and into terminal binding post 19,

thence through the conductor 16 to the transformer. When the current flows as above described, the resistance wire 76 heats. Due to the heating element 76, with its enclosing casing, being fully immersed in the first and second liquids, the greater part of the heat generated by the heating element 76 is rapidly absorbed by the liquids named and the same action takes place as above described as when steam comes in contact with the shell 70, with the following difference in results: The closing action of the valve disc 29 towards the valve seat 24 does not diminish the heat supply being applied to the second liquid on account of the continuing supply of heat applied thereto, furnished by the heating element 76. Therefore the valve disc 29 continues to approach the seat 24 until the outer edge of said disc is in perfect contact all around with said seat. This perfect seating is made possible and positive by the articulated mounting of disc 29 on the boss or post 30. When the disc 29 has seated against the valve seat 24 a higher unit pressure contact is made between 38 and 39, thereby sealing the radiator against the further entrance of steam as long as the thermostat, or the hand operated switch 15 maintains a circuit through the heating element 76 from the low voltage secondary 10 of said transformer. When the steam supply is shut off, as above described, the radiator cools down to the temperature of the surrounding air, but the heated second liquid continues, through the means described, to hold the valve shut until the air, being heated by said radiator, cools down sufficiently to allow said thermostat to open the circuit supplying the heating element 76. Upon the breaking of said circuit, the heating element 76 cools and the liquids contained in the chamber 75 slowly lose their heat, thereby lessening the pressure within said chamber which in turn allows the bellows 49 to expand, thereby allowing the valve disc 29 to recede from the seat 24 in proportion to the amount of heat dissipated by the second liquid. Said opening of the valve allows a new supply of steam to enter the radiator and, as hereinbefore described, establishes a state of balance between the steam supply being admitted, the existing rate of condensation, and the temperature of the air being heated by the said radiator, both controls functioning as required and hereinabove described.

It must be remembered, in the foregoing described operations, that the steam is constantly giving up its latent heat of evaporation within the radiator and condensing into its liquid form and, therefore, the restricting of the opening of, or closing of, the valve admitting steam will have an almost instantaneous effect upon the contents of the radiator and especially the steam that has entered the passage 60. There is naturally a condition of partial vacuum within parts of the radiator varying with the amount of steam being admitted and the rate of condensation. When the actuating mechanism has caused the valve to close and the steam supply is shut off, there is immediately a condition of vacua set up within the radiator, which will draw cooler vapors, and if air is present back through the return opening 59, thereby cooling the actuating mechanism, and (provided the heating element circuit is open), through the action hereinbefore described, the valve will again be opened and steam admitted in quantity sufficient to displace said cooler vapor or air from the radiator. The vacuum in the radiator materially assists the in-

gress of the steam supply, the effect being to promote the rapid circulation of the steam and the highest possible efficiency of the radiating unit. Due to the cooling of the condensate discharged into the return piping system, a state of natural vacua of varying degree is established in the return piping.

The fact that the return or discharge opening of the radiator is always wide open to the return line, precludes the possibility of ever having more than an atmosphere of pressure on the interior of the radiator, regardless of the pressure of the steam being supplied to same. It therefore follows that the radiator will have an exact and given rate of heat emission under all operating conditions, while steam is being admitted to same, and also the trap formed by the passage or port 61 in the condensation present will positively prevent steam from leaving said radiator through said port 61. A sufficient pressure cannot be built up in the radiator to displace said water seal in said trap of said port 61.

It is apparent from the above that under any condition of operation or environment, a radiator embodying my invention will utilize and admit to the radiator only a nicely balanced quantity of steam and then only in sufficient amount to just occupy and fill all space within the radiator, and, due to my invention and the functioning of its parts, no excess of steam (that would pass out of the radiator into the return piping) is admitted into the radiator, and also such steam supply is only sufficiently admitted to maintain the desired predetermined temperature of the space to be heated by said radiator, thereby obtaining the highest possible efficiency of the radiating unit.

Another embodiment and application of my invention is illustrated in Figures 2 and 3, and is constructed as follows:—The bushing 21 and all its attendant mechanism is exactly as illustrated in Figure 4, except that the porous packing 56 is omitted as being unnecessary in this embodiment. All parts function as hereinbefore described for the parts of Figure 4. The bushing 21 screws into a reducer 86, which reducer forms the end of a casing 87 enclosing a chamber 88. Another reducer 89 forms the other end of the chamber 88. The bushing 90 screws into the reducer 89, which bushing has an extended shell 91, forming the chamber 92. Said bushing is eccentrically tapped with a standard pipe thread at 93 and forms the outlet or discharge opening of the trap, and which outlet 93 is connected to the return piping of the system. The actuating mechanism 94 encloses a chamber 95 and is connected to the tubing 57, which tubing extends about half way into said chamber 95. Actuating mechanism 94 is loosely and removably accommodated in the chamber 92 of the shell 91. The chamber 95, the tubing 57 and the chamber 82 are completely filled with the two liquids, hermetically sealed within, all as described in the first embodiment of my invention. The actuating mechanism 94 in this particular embodiment does not contain the electrical heating element contained in the first embodiment of my invention.

The primary purpose of this embodiment of my invention, illustrated by Figures 2 and 3, is to provide an efficient high or low pressure steam trap for passing into the return system all air and condensed steam, as it accumulates, from any pipe line, main, steam containing or condensing device, cooker, heater, steam jacket, etc., without passing any steam beyond the outlet

opening 93 into the return piping system. The inlet 23 is connected to the device or apparatus that it is wished to free of air and condensation.

The device functions in a similar manner to the first embodiment as hereinabove first described (omitting the air temperature control from said description). It is thought that anyone skilled in the art may readily comprehend and understand its functions and operation from the drawings referred to (Figures 2 and 3), and the description of the functions of the first embodiment of my invention; therefore I deem it unnecessary to describe in detail the operation of this embodiment of my invention.

It is to be noted that the chamber 92 is eccentrically placed in the bushing 90 (Figures 2 and 3) and anything passing from the interior 88 is forced to pass out into the return piping through the annular passage 92 and make intimate contact with the actuating mechanism, 94.

By unscrewing the bushing 21 the entire mechanism may be readily removed from the radiator 1, or the casing 87, leaving only the bushing assembly 20 in the radiator 1, or the bushing 90 in the casing 87, as the case may be. This feature of removal facilitates the inspection of parts, the renewal of the valve disc 29, cleaning, replacement, or salvaging the device for further use upon the discarding of the radiator. It is to be noted that the removal of the mechanism does not disturb or necessitate the disconnection of the electrical control wiring.

The screw-driver slot 31 in the boss 30 allows the valve opening to be adjusted without the removal of the mechanism from the radiator or container. Rotating the valve head 28 by the screw-driver slot 31 retracts or advances the valve disc 29 away from or towards the valve seat 24, and said rotation of said valve head 28 rotates the guide member 40 through the bellows 41, which member 40 causes the complete assembly of 54, 50, 51, 49, 47, 45, 57 and complete actuating assembly (shown in Figure 6) to rotate in a like manner and amount, through the action of the driving pin 55 between 40 and 54. It will be seen, therefore, that all parts are kept in perfect alignment, collimation and juxtaposition, regardless of the setting or changing of the valve opening.

The conical spring 64 automatically compensates for any valve adjustment, thermal expansion and contraction of the tube 57, varying lengths in the manufacture of the mechanism and varying lengths of radiators; always maintaining an adequate electrical contact with the heating element 76 through the contact button 79.

The thermostat 12, etc., may be placed at any advantageous location that will properly register the temperature of the space being heated by the radiator.

The other embodiment of my invention, which is illustrated in Figures 9, 10 and 11, is constructed as follows: The bushing 96 carries the valve seat 97 and a valve mechanism cage 98; the cage 98 has parts cut away, to leave arms 99 that lie in radial slots 100 in the valve head and serve as guides to prevent rotation of the valve 101 as it moves toward and from its seat.

102 is a stationary head having a stationary guide stem 103 on which is threaded an adjusting nut 104 and on which is located a washer 105 and a compression spring 106, the spring abutting the washer 105 and the valve head 101, thereby tending to unseat the valve.

107 is another stationary head in the valve cage

98. 108 is a movable head with thrust arms 109 that engage the valve 101, and 110 is another movable head with thrust arms 111 to engage the valve 101.

112 and 113 are flexible metal diaphragms, the former being located between the heads 107 and 108 and the latter being located between the head 110 and the closed end of the valve cage 98. These flexible metal diaphragms 112—113 are soldered, welded, or otherwise suitably secured to their respective heads and enclose chambers 121 and 122 respectively.

114 is another flexible metal diaphragm, enclosing chambers 123, one end of which diaphragm is suitably secured to the stationary head 102 and the other is secured to the valve 101, the valve having small ports 115 for the passage of steam from the inlet opening 116 of the bushing 96 into the chamber of the diaphragm 114 so as to maintain a balanced pressure on the valve 101.

117 designates bands fixed to the valve mechanism cage 98 to serve as guides for the arms 109 and 111.

118 is a retaining ring for holding the packing 119 in place so that when the unit is inserted in the radiator communication may be cut off between the first and second radiator sections at the bottom hub and nipple.

120 is the tube which effects communication between the interior 121 of the bellows 112 and the port 124 in the bushing 96; the port communicates with one end of the small bore tube 125; the other end of which communicates with the interior of a flexible metal diaphragm 126 located within the casing 128 and adapted to cooperate for adjustment purposes with an adjusting screw 127 that is threaded into the cap of the body casing 128 and engages one end of the diaphragm 126, as best shown in Figure 10.

The small bore tubing 129 takes the place of tubing 57 when the mechanism of Figures 9—10—11 is used in lieu of that shown at the left in Figures 1 and 2. An actuating mechanism like 94 is used with the mechanism of Figures 9, 10 and 11.

The embodiment of my invention just described operates as follows:—Air temperature changes affecting the member 126 are imparted to the bellows 112 and through the arms 109 thereof movement is imparted to the valve 101 correspondingly. Also the temperature variations of the member 94 cause a response in the bellows 113 with consequent movement of its arms 111 imparted to the valve 101. It is thought that a more detailed description of the operation of this embodiment of the invention will not be necessary in this application.

From the foregoing description, taken in connection with the accompanying drawings, it is thought that the complete construction, operation, novelty, use and advantages of my invention will be clear to those skilled in the art to which it relates.

What I claim is:

1. An integral controlling mechanism of the character described consisting of a balanced valve with thermal means of actuation, insertable into a condenser, a radiating unit, said thermal means being only responsive to the arrival of heating medium at the outlet of said radiating unit and to independent heating means applied thereto responsive to the temperature of the medium being heated.

2. In combination with a radiator comprising a plurality of vertical sections having ducts com-

municating between the sections at the top and at the bottom, and having an inlet for heating medium and an outlet; a valve mechanism unit insertable through the inlet into the lower duct between the first and second vertical sections, means cooperative with said valve mechanism unit to close off the heating medium passage through said lower duct between the first and second sections of the radiator, said valve mechanism unit including a valve to control the admission of the heating medium, and two independent valve moving devices, means effective by the temperature of the heating medium at the said outlet for actuating the other of said valve moving devices.

3. In combination with a radiator having an inlet and an outlet; a valve mechanism insertable in said inlet, comprised of an articulated balanced valve, an expansible fluid operated bellows to vary the opening of said valve from open to closed positions, means for supporting and guiding said members, and means for adjusting and setting said valve opening; an actuating mechanism unit insertable in the outlet opening of said radiator comprised of an expansible liquid container in communication with said valve operating bellows, said liquid in said container being actuated by the heat of the heating medium that is admitted to said radiator through said valve mechanism, when said heating medium arrives at and comes in contact with said expansible liquid container, thereby throttling said entrance of said heating medium into said radiator, means controlled by the temperature of the medium being heated by said radiator to apply an independent source of heat to the said expansible liquid in the said liquid container, thereby independently closing and opening said valve as the temperature rises and falls in the medium being heated by said radiator; and means for producing said heat.

4. In combination with a radiator comprising a plurality of vertical sections having longitudinal ducts between sections at top and bottom, having an inlet for heating medium, and an outlet; a valve mechanism unit insertable through the inlet into the lower duct between the first and second vertical sections, said valve mechanism including a bushing insertable into the radiator inlet, a cage and a valve seat carried by the bushing, a valve within the cage cooperating with said seat, a floating guided valve head carrying an articulated valve disc, said valve head engaging a flange of a metal diaphragm secured to said cage and said flange, means affected by the temperature of the heating medium arriving at the radiator outlet to contract said metal diaphragm, and thermostatic means affected by the temperature changes in the surrounding medium being heated by said radiator for actuating said means for contracting said metal diaphragm.

5. In combination with a radiator comprising a plurality of vertical sections having ducts communicating between sections at the top and the bottom, and having an inlet for the heating medium and an outlet for the products of the thermal transfer; a valve mechanism unit insertable through the inlet into the lower duct between the first and second sections, means cooperative with said valve mechanism unit to close off the passage of the heating medium through said lower duct between the first and second vertical sections of said radiator, said valve mechanism including a valve to control the admission of the heating medium and a valve moving device,

means effective by the temperature of the heating medium when it reaches the said outlet for actuating the said valve moving device, and independent means controlled by the temperature of the medium being heated by said radiator to actuate the said valve moving device.

6. In combination with a radiating unit having a plurality of vertical sections having ducts communicating between the sections at the top and at the bottom, and having an inlet for the heating medium, and an outlet; a valve mechanism unit insertable into and having means for blocking off said duct between the first and second sections, said valve mechanism unit including a bushing insertable into said radiator inlet, a cage carried by said bushing, said bushing and cage having a passage for the heating medium, controlled by a valve and a valve seat, an expansible fluid actuated means within said cage for operating said valve, a thermal "bulb" located adjacent the radiator outlet and connected with said expansible fluid means and affected by the temperature of the heating medium when in contact therewith for controlling the action of said expansible fluid actuated means; and a thermal unit located in and controlled by the temperature of the surrounding medium being heated by said radiator, and means for independently actuating said thermal "bulb" by the function of said thermal unit.

7. In combination with a radiator comprising a plurality of vertical sections having ducts communicating between the sections at the top and at the bottom, and having an inlet for heating medium and an outlet; a valve mechanism unit insertable through the inlet into the lower duct between the first and second vertical sections, said valve mechanism unit including a bushing insertable into the radiator inlet, a cage carried by the bushing, said bushing and cage having a passage for the heating medium controlled by a valve and a valve seat, two expansible fluid actuated means within said cage for separately operating said valve, a thermal "bulb" located adjacent the radiator outlet and connected with one of said expansible fluid means and affected by the temperature of heating medium when in contact therewith for controlling the action of

one of said expansible fluid actuated means, and a thermal "bulb" located in the surrounding medium being heated and connected with the other of said fluid actuated means for controlling the action of the same.

8. In mechanism for automatically controlling a radiator which has an inlet for the heating medium and a discharge outlet; a valve unit insertable in the inlet, said valve including a balanced valve and a bellows for operating the valve to control the admission of the heating medium, thermal means located adjacent the discharge outlet and affected by the temperature of the heating medium arriving at the said thermal means adjacent the discharge opening to actuate said bellows, other means affected by temperature changes in the medium being heated for actuating said thermal means; said thermal means which is adjacent the outlet of the radiator comprising a bushing insertable into the outlet of said radiator, a housing carried by the bushing within the radiator, a chamber located within the housing and spaced from the same, and a duct connecting said chamber and said bellows, and a separate trapped duct through said housing into the discharge opening.

9. A radiator having an inlet for the heating medium and having an outlet combined with a valve unit for controlling the admission of heating medium, means for sustaining said valve unit within the radiator adjacent the inlet, a valve controlling unit, means located at the outlet of the heater for receiving said controlling unit, a duct connecting said controlling unit with said valve unit whereby said controlling unit is supported by said valve unit and susceptible of being removed from the radiator with said valve unit as a single structure, said controlling unit having provisions actuated by the temperature changes for actuating the valve of said valve unit in accordance with the temperature change within the radiator, said controlling unit including an electric heating device and a thermostat controlled electric circuit cooperatively connected with said electric heating device, with the thermostat located in the medium to be heated for the purposes described.

EBER F. PIERS.