May 8, 1934. F. C. CHADBORN 1,957,629

TEMPERATURE REGULATOR

Filed June 1, 1931 3 Sheets-Sheet 1

Fig. 1.

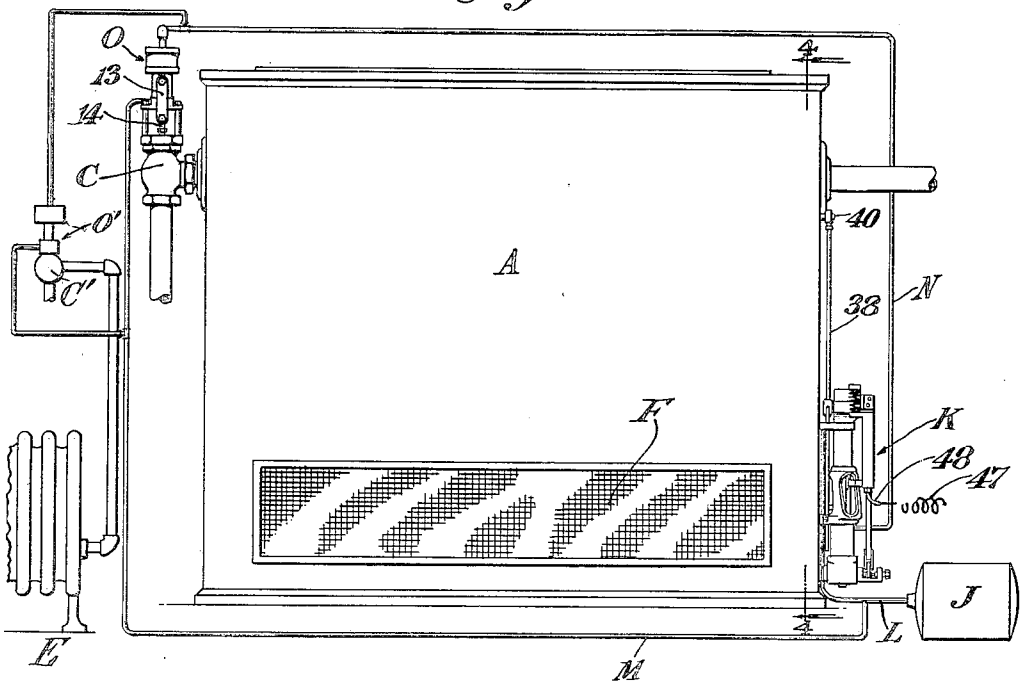


Fig. 2.

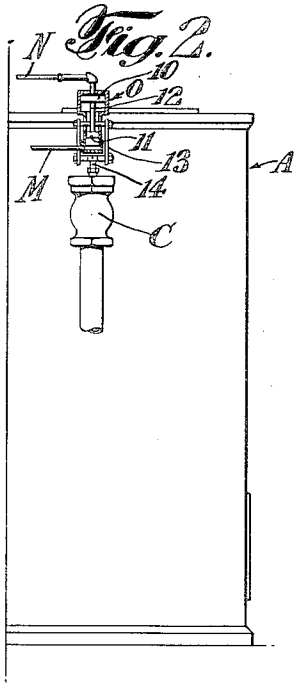


Fig. 3.

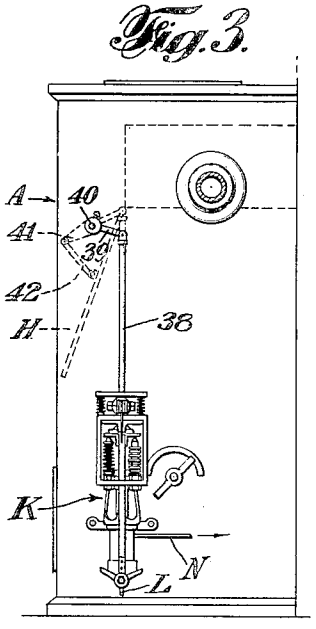
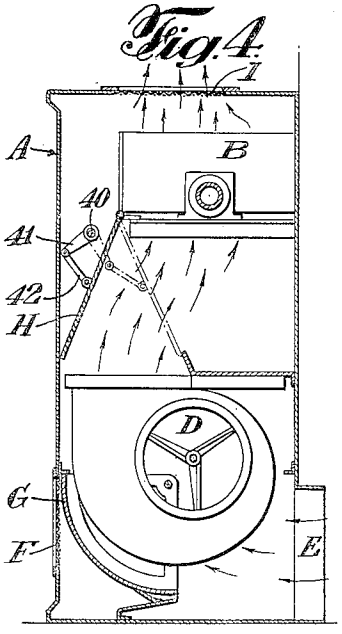


Fig. 4.



INVENTOR
Fred C. Chadborn
BY
Ward, Crosby & Neal
ATTORNEYS

May 8, 1934. F. C. CHADBORN 1,957,629

TEMPERATURE REGULATOR

Filed June 1, 1931 3 Sheets-Sheet 2

Fig. 5.

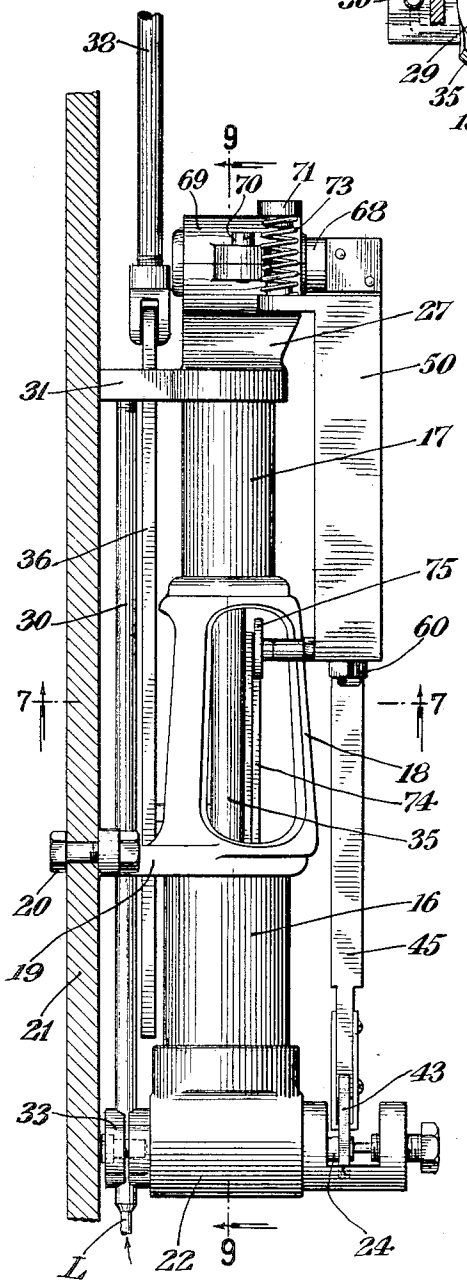


Fig. 7.

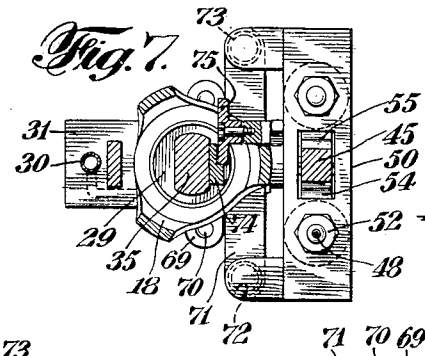
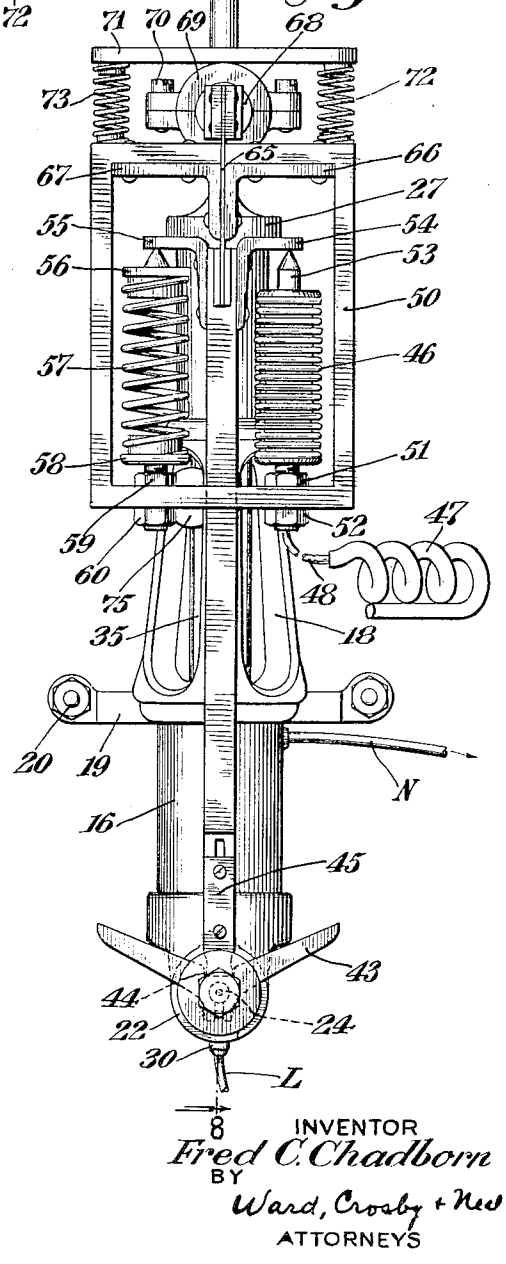


Fig. 6.



INVENTOR
Fred C. Chadborn
BY
Ward, Crosby & Nes
ATTORNEYS

May 8, 1934. F. C. CHADBORN 1,957,629

TEMPERATURE REGULATOR

Filed June 1, 1931 3 Sheets-Sheet 3

Fig. 12.

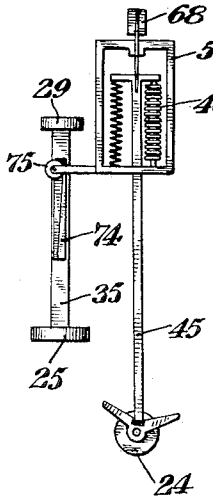


Fig. 11.

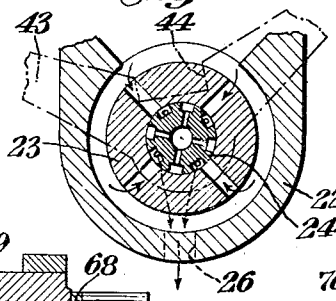


Fig. 10.

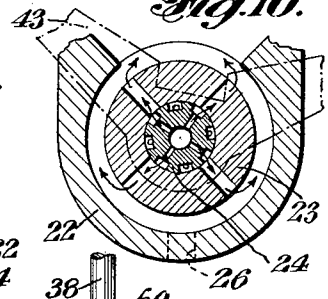


Fig. 8.

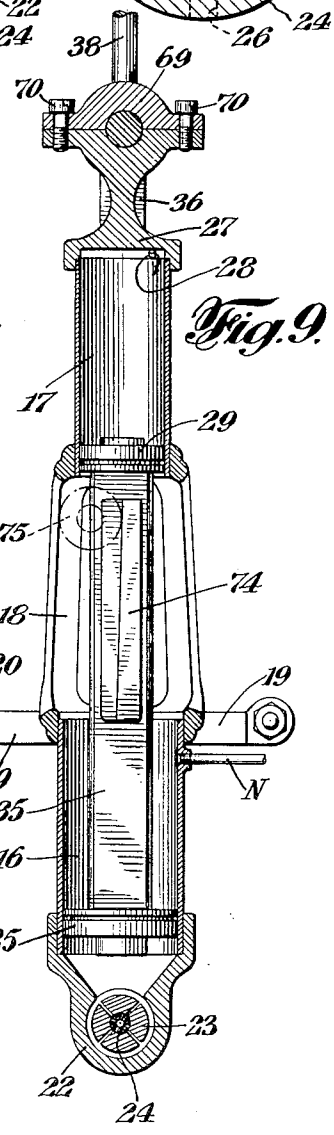
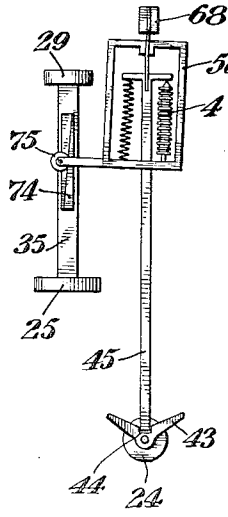


Fig. 9.

Fig. 13.



INVENTOR
Fred C. Chadborn
BY
Ward, Crosby & Neal
ATTORNEYS

Patented May 8, 1934 1,957,629

UNITED STATES PATENT OFFICE

1,957,629

TEMPERATURE REGULATOR

Frederic C. Chadborn, Newburgh, N. Y.

Application June 1, 1931, Serial No. 541,148

5 Claims. (Cl. 236—38)

This invention relates to a temperature regulator.

Among the objects of this invention are improved means for controlling the temperature of rooms or the like, which is of simple construction, may be readily adjusted, and is not only extremely sensitive to small changes in temperature but also very powerful in its operation.

Another object of this invention is the provision of a temperature regulator, including means for completely shutting off the heat supply upon rise of temperature beyond an arbitrary point for which the device is set.

Another object of the invention is the provision of means for shutting off the heat supply to a heating cabinet at the same time that the intake air to the radiator unit in the cabinet is cut off.

Other objects of this invention will appear from the following description taken in connection with the drawings which show one use to which the invention may be put, and in which

Fig. 1 shows the invention applied to a heating cabinet shown in front elevation;

Fig. 2 is a view of the left end of the cabinet as shown in Fig. 1;

Fig. 3 is a view of the right end of the cabinet as shown in Fig. 1;

Fig. 4 is a vertical section showing the interior parts of the cabinet;

Fig. 5 is a left side elevation of the temperature regulator;

Fig. 6 is a front elevation of the temperature regulator;

Fig. 7 is a section taken substantially on the line 7—7 of Fig. 5;

Fig. 8 is a vertical sectional view taken substantially on the line 8—8 of Fig. 6;

Fig. 9 is a vertical sectional view taken substantially on the line 9—9 of Fig. 5;

Fig. 10 is a cross section of the triple valve in position to establish communication between a source of pressure and the larger cylinder of the temperature regulator;

Fig. 11 shows the triple valve in position to exhaust the larger cylinder;

Fig. 12 shows the temperature regulator holding the triple valve in the position shown in Fig. 10 to admit air under pressure to the larger cylinder; and

Fig. 13 shows the temperature regulator in the position in which it holds the triple valve between ports to prevent admission of air to, or exhaust from, the larger cylinder.

The invention will be described with reference to one specific use which I have disclosed in Figs. 1, 2, 3 and 4, in which combination the regulator I have shown is controlled by changes of pressure in a fluid produced by temperature changes, though it is to be understood that these changes in pressure might be such as various changes of steam pressure, gas, etc.

Fig. 1 shows a cabinet A of usual and well-known construction, and in which is housed a heating unit B, Fig. 4, which may comprise radiation means of any suitable form into which steam is admitted through a valve C, Figs. 1 and 2. In the bottom of the cabinet is a blower fan D which may be driven by any suitable means and which may draw air from the exterior of the room through an intake E or from the room in which the radiator cabinet is located through a grid F, depending upon the position of the member G, as is well known.

The air from the fan D is delivered upwardly, usually a portion of the air being forced through the radiator B and another portion of the air being forced up past the radiator B, the relative volumes of air passing through and outside of the radiator B, being controlled by a swinging vane H which is adapted to occupy different positions under control of my temperature regulator. When the vane H is in the position indicated by dotted lines none of the air delivered by the fan D passes through the radiator B so that all of the air issuing out of the radiator grid I will be either air at room temperature or air at outside temperature.

As shown in Fig. 1, the steam valve C may be mounted on the left hand end of the cabinet and the temperature regulator control K may be mounted on the right hand end of the cabinet. A tank J or any suitable well-known equivalent means, such as an electric motor and pump, may be used for supplying compressed air, or any other fluid, to the cylinders of the temperature regulator through a pipe L and a pipe M and to the smaller cylinder of the air motor O for tending to hold the steam valve C normally open. Under certain conditions, as when it is necessary to shut off the heat supply entirely, air or fluid may pass from the pipe L through the pipe N to the larger cylinder of the air motor O operating the steam valve C. As shown in Fig. 2, the air motor O consists of a large cylinder and a small cylinder in which operate large and small pistons 10 and 11 mounted on a common piston rod 12 connected by any suitable link connection 13, as shown, with the stem 14 of the movable valve element of the valve C, as is obvious. The pressure

is constantly acting through the pipe M upon the smaller piston 11 to urge the valve into open position. As will be shown later, when no further heat supply is necessary, air pressure through the pipe N operating on the larger piston 10 will move the valve stem 14 downwardly and close the valve C.

The temperature regulator will be described with reference to Figs. 5 to 13. The regulator comprises a large cylinder 16, a small cylinder 17, suitably connected together as in by an open supporting frame work 18 on which is formed or secured a bracket 19 provided with a pair of eyes through which pass bolts 20 securing the temperature regulator to the wall 21, Fig. 5. The lower end of the larger cylinder 16 is closed by means of a cap 22 which houses a seat 23 of a triple valve 24 which is constructed to admit air in one position under pressure from the pipe L in the space behind the larger piston 25 in the larger cylinder 16, and to exhaust air from said space in another position through the exhaust port 26, and in still another position to prevent admission to or exhaust of air from the space behind the piston 25. The specific construction of the valve is not claimed in this application but forms the subject matter of another of my applications, Serial No. 317,660, filed November 6, 1928, in view of which a detailed description will be omitted from this application.

The upper end of the smaller cylinder 17 is preferably closed by a cap 27 which is provided with a port 28 communicating with a space behind the piston 29, said port being in communication with the pipe L by means of a tube 30 which is threaded into an extension 31 on the cap 27, and which is clamped over a port 32 in the cap 22 by means of a clamp 33, so as to open into the port 32, as is shown more clearly in Fig. 8. The tube 30 is connected to the pipe L in any suitable manner. By means of this connection the space behind the piston 29 is always in communication with the source of pressure J. The extension 31 on the cap 27 may bear against the wall 21 to steady the device, as shown in Fig. 5.

The pistons 29 and 25 are preferably carried on a piston rod 35 adapted to drive an operating slide 36 by means of a screw bolt 37. The operating slide is slidably mounted in the bracket 19 and in the extension 31, and at its upper end pivotally carries a connecting rod 38 pivotally connected to an arm 39, Fig. 3, on the outside of the cabinet on a rock shaft 40 which carries an arm 41 connected by a link 42 to the vane H. When pistons are in lowermost position, vane or damper H will be pressed against the inside front wall of cabinet, and all of the air brought into the cabinet by the fan, will be forced to go through the radiator. When the pistons are in the uppermost position, the vane H will have been moved into the dotted line position shown in Fig. 4 in which none of the air delivered by the fan D passes through the radiator unit so that the fan will merely act as a ventilating system when the air is drawn through the intake E, or merely as a circulating system when the air is drawn through the grid F.

In the uppermost position of the pistons, the larger piston 25 rises above the open end of the pipe N so that air passes from the larger cylinder 16 to the pipe N. Then if the triple valve 24 is still in position to admit air into the larger cylinder the air pressure from the tank or pump J will be communicated to the larger piston 10 in the air motor O operating the valve C, thus causing the valve C to close and to shut off steam to the radiator B. As will be shown later, this condition will be maintained until there is a fall in temperature in the room.

The end of the triple valve 24 carries an operating member 43 by which it is operated, comprising two arms, as shown, and a notch 44 located between the arms into which extends a valve operating arm 45 having a wide possible free swing, the construction being such that when the operating arm 45 is in the position shown in Fig. 6 the valve is closed against admission to or exhaust of air from the larger cylinder 16. When the operating arm 45 moves to the right, Fig. 6, into the position shown in Fig. 12, it moves the valve into the position shown in Fig. 10 in which communication is established between the pipe L and the space in the cylinder 16 behind the piston 25, causing the pistons 25 and 29 to rise. When the operating rod 45 is moved to the left of its central neutral position, it moves the valve into the position shown in Fig. 11 in which air in the larger cylinder 16 may exhaust through the port 26, the movement of the pistons in a downward direction being effected by the constant pressure through the pipe 30 on the smaller piston 29. The movement of the pistons in an upward direction when air is admitted behind the larger piston 25 is, of course, due to the fact that the pistons are of unequal area.

The position of the rod 45 is controlled by means of a thermostatic member shown as a bellows device 46, the pressure in which is controlled by a fluid in a temperature coil or bulb 47, Fig. 1, which is preferably made to contain a fairly large volume of fluid and which is coiled, as shown, so as to be sensitive to small temperature changes. I prefer to use thin wall tubing for the temperature coil or bulb 47 and to connect this bulb to the bellows by a relatively thick walled tubing 48 of very small bore, and I also prefer to make the bellows 46 of small capacity so that the amount of fluid in the bellows 46 and the tubing 48 is comparatively small as compared with the amount of fluid in the coil 47. By means of this construction the bellows will expand or contract substantially, in accordance with slight changes in temperature which affect ordinary sensitive thermometers.

The bellows 46 is mounted in a frame 50 by means of a threaded stud and nuts 51 and 52, by means of which it may be adjusted to be effective at any temperature desired. The upper end of the bellows carries a conically ended stud or bearing member 53 which bears against an L-shaped member 54 connected to one side of the upper end of the operating arm 45, to the other side of which is connected an L-shaped member 55 against which bears the conical end of a spring seat 56 on which is seated a spring 57, the other end of which is provided with an adjustable seat 58 made adjustable by a threaded stud and nuts 59 and 60. This is for securing the proper thrust against the bellows.

The operating arm 45 is supported on a blade spring 65 which is secured thereto by rivets passing through the L-shaped members 54 and 55 and the operating arm 45, as shown. This blade spring 65 preferably passes through a slit in the frame 50 and is secured to the frame by a rivet passing through L-shaped members 66 and 67 which are riveted to the frame, as shown. The upper end of the operating arm or rod 45 is suitably spaced from the L-shaped members 66 and

67 so that the blade spring 65 may act as a pivotal connection between the operating arm or rod 45 and the frame 50.

The upper end of the blade spring 65 extends into a saw cut in a cylindrical member 68 to which it is connected by rivets, as shown. The frame 50 is preferably spaced a short distance below the cylindrical member 68 so that the blade spring constitutes the pivotal connection between the frame 50 and the cylindrical member 68 and eliminates all lost motion. The cylindrical member 68 is supported in the cap 27 of the smaller cylinder 17 and may be clamped in position by a clamp 69 and screw bolts 70. The clamp 69 carries a bar 71 on which are seated a tension spring 72 and a compression spring 73 which operate to hold the frame 50 in position against a cam 75, described below. By means of the construction described, the cylindrical member 68 may be adjusted angularly to move the valve into position between ports and then the member 68 is clamped in such position by means of the clamp 69 and the screw bolts 70. These adjustments are made for the approximate temperature at which the temperature regulator will function to control the desired temperature. Further and finer adjustments of the device will be made by means of the nuts 51 and 52 which will position the bellows to swing the rod 45 into a position to control the temperature desired.

Provision is made to slow up heating after the temperature has begun to rise, and similarly slow up cooling as shown more particularly in Figs. 5, 7, 12 and 13, the piston rod 35 carries a cam-shaped member 74 which operates on a roller 75 carried by the frame member 50 so that as the pistons move upwardly, due to the expansion of the bellows 46, which moves the operating arm 45 to the right to establish a communication between the larger cylinder and the source of fluid pressure J, the cam 75 will function to counteract the movement of the operating arm 45 caused by the expansion of the bellows 46, by moving the frame 50 to the left into neutral position, as shown in Figs. 6 and 13. Any rise in the temperature causes the bellows to expand and move the operating arm 45 to the right, as shown in Fig. 12, thus establishing communication between the source of fluid pressure and the lower cylinder which causes the pistons to rise and to move the vane H, Fig. 4, toward the position shown by dotted lines so that a smaller volume of air will thereafter pass through the heating unit B.

By means of the construction shown and just described, the movement of the pistons when the temperature in the room has risen to a predetermined amount will be a slow movement corresponding to that of an ordinary thermometer. As the pistons move upwardly they cause the vane H, Fig. 4, to move toward the right so that a smaller volume of air will be heated to prevent a rise of temperature in the room. If the temperature still continues to rise the pistons will continue to move upwardly and move the vane H farther from the full line position and finally into the dotted line position, and when the vane H is in such position the larger piston 25 will have been moved up above the open end of the pipe N. This allows the air under pressure coming from the source of pressure J through the pipe L, and coming through the valve 23, which is controlled by the bellows to establish communication between the pipe L and the larger cylinder 16, then coming through the larger cylinder, to pass through the pipe N into the space behind the larger piston 10 of the air motor O. This causes the valve C to close and so shut off the steam supply from the radiator B. In this position of the mechanism, when the source of steam is shut off from the radiator B, none of the air delivered by the fan D passes over the radiator B, so that if the fan sucks in air from the room the ensuing temperature of the room will depend upon other radiation, and if the fan sucks in air from the intake E the ensuing temperature of the room will depend upon the temperature of the intake air delivered to the room.

If there is a fall in temperature, after the mechanism is in the condition just stated, the bellows 46 will contract first to close the triple valve and then to move the triple valve into the position shown in Fig. 11 to exhaust air from the larger cylinder 16. As the pistons move downwardly they move the vane H from the dotted line position shown in Fig. 4 to the left to cause some of the air from the fan D to pass through the radiator B, and at the same time the larger piston 25 moves clear of the pipe N and vents the air behind the larger piston 10 of the air motor O through the pipe N to the atmosphere causing the valve C to be opened to admit steam to the radiator. As the pistons move downwardly, the frame 50 will be rocked by the springs 72 and 73 under control of the cam 74 which tends to move the operating arm 45 to the right to close or partially close the triple valve. Later, when the room is at proper temperature, the control over the operating arm 45 and the triple valve by the cam 74 and the bellows 46 is such that the valve will occupy the position shown in Figs. 10 and 12, in which air is admitted behind the larger piston 25 causing the pistons to rise and to move the vane toward the dotted line position shown in Fig. 4 to cause a smaller amount of air to pass through the radiator coils in the radiator unit B, Fig. 4, to cut down the temperature of the air delivered through the radiator grid I to prevent further rise in the temperature of the room.

As indicated diagrammatically in Fig. 1, branch pipes may lead off from the pipes M and N to control the operation of an air motor O' to control a steam valve C' which controls the admission of steam to an additional radiator E placed anywhere in the room in which the cabinet A is placed. It is obvious, of course, that the valves of other radiators may be operated from the central control in the same manner.

While in Fig. 1 I have shown the source of compressed air J and the temperature regulator control K located outside of the cabinet, it is to be understood of course that all of these could be located within the cabinet A and related to each other in such a way as to save considerable piping, which arrangement I have contemplated.

The fluid under pressure in the tank J may be air or any equivalent fluid, as is of course obvious. It is also to be understood that the heat supply to the cabinet may be other than steam heat, and that the unit B may readily be replaced by a heating coil or any suitable heating device.

While the invention has been described specifically as to the details of construction of the temperature regulator and as to one specific use, it is to be understood that the claims are not to be limited by the words of description employed except as such limitations are made necessary by the prior art.

What I claim is:

1. The combination of a pair of cylinders of unequal diameters, pistons operating therein, an operative connection between said pistons, temperature control means for controlling the admission and exhaust of fluid into and out of the larger cylinder, a fluid pressure controlled heat supply control valve operating means, and a conduit pipe connecting the forward end of said larger cylinder to said operating means, said connection with said cylinder being made at a point to normally vent said operating means and to communicate with said cylinder as said piston moves into its extreme forward position upon an increase of temperature.

2. In a thermostatic device an operating arm, a main frame, a shiftable frame, a bendable member supporting the shiftable frame on the main frame, a spring device tending to turn the shiftable frame on its bendable member, an adjustable support for the bendable member on the main frame, a thermostatic device in the shiftable frame, an arm against which the thermostatic device bears to turn the arm, a bendable member carried in the shiftable frame and supporting the arm, a spring in the shiftable frame holding the arm against the thermostatic device, and means for finely adjusting the thermostatic device in its frame.

3. In a heating and ventilating system the combination with a heating element across which ventilating air is adapted to pass, of a device for dividing the ventilating air so that part of the air passes across the heating element to be heated thereby and part passes clear of it, a connection for operating the device, a thermostat, a swinging arm moved in union with the thermostat, a power driven device for driving the connection, and a valve for controlling the power driven device and operated by the swinging arm over a small part of its possible swing so that the arm may have a wide idle swing.

4. In a thermostatic device the combination with a main support, of a swinging support, a bendable mounting on the main support for the swinging support, a thermally expanding member in the swinging support, a swinging arm driven by the expanding member, a bendable mounting for the arm on which it swings on the swinging support, a spring bearing against the support and holding the arm against the member, a power-controlling valve operated by the arm, a travelling member adapted to be driven by the power, a cam moving with the travelling member, a follower for the cam connected to the swinging support to swing its support and the member, and a spring urging the follower against the cam.

5. In a thermostatic device an operating arm, a shiftable frame, a main frame, a bendable member uniting the arm to the shiftable frame so that the arm swings without lost motion, a bendable member uniting the shiftable frame to the main frame so that the shiftable frame swings without lost motion, a bellows device between the arm and the frame to swing the arm, and a spring in the shiftable frame adapted to hold the arm against the bellows device.

FREDERIC C. CHADBORN.