Aug. 20, 1935.

E. L. MAYO

2,012,067

AUTOMATICALLY CONTROLLED HEATING SYSTEM

Filed June 9, 1932

3 Sheets-Sheet 1

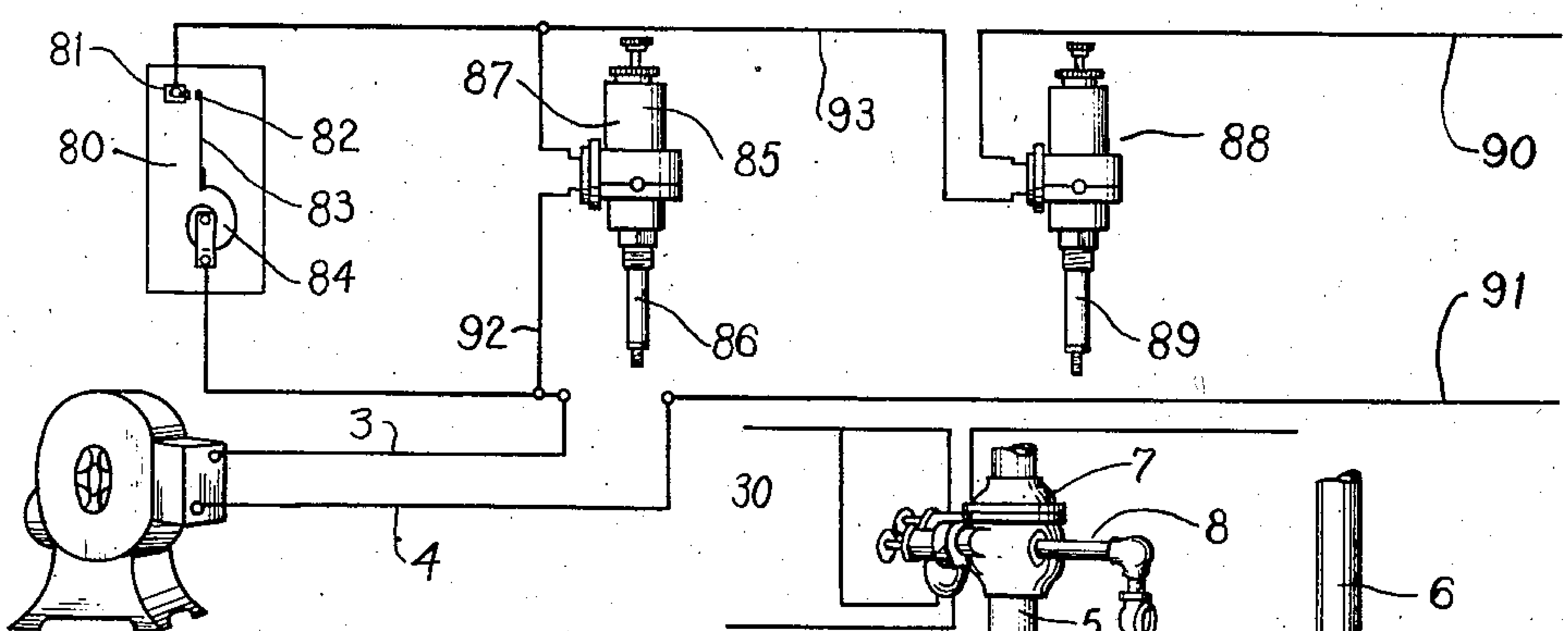

Fig 2

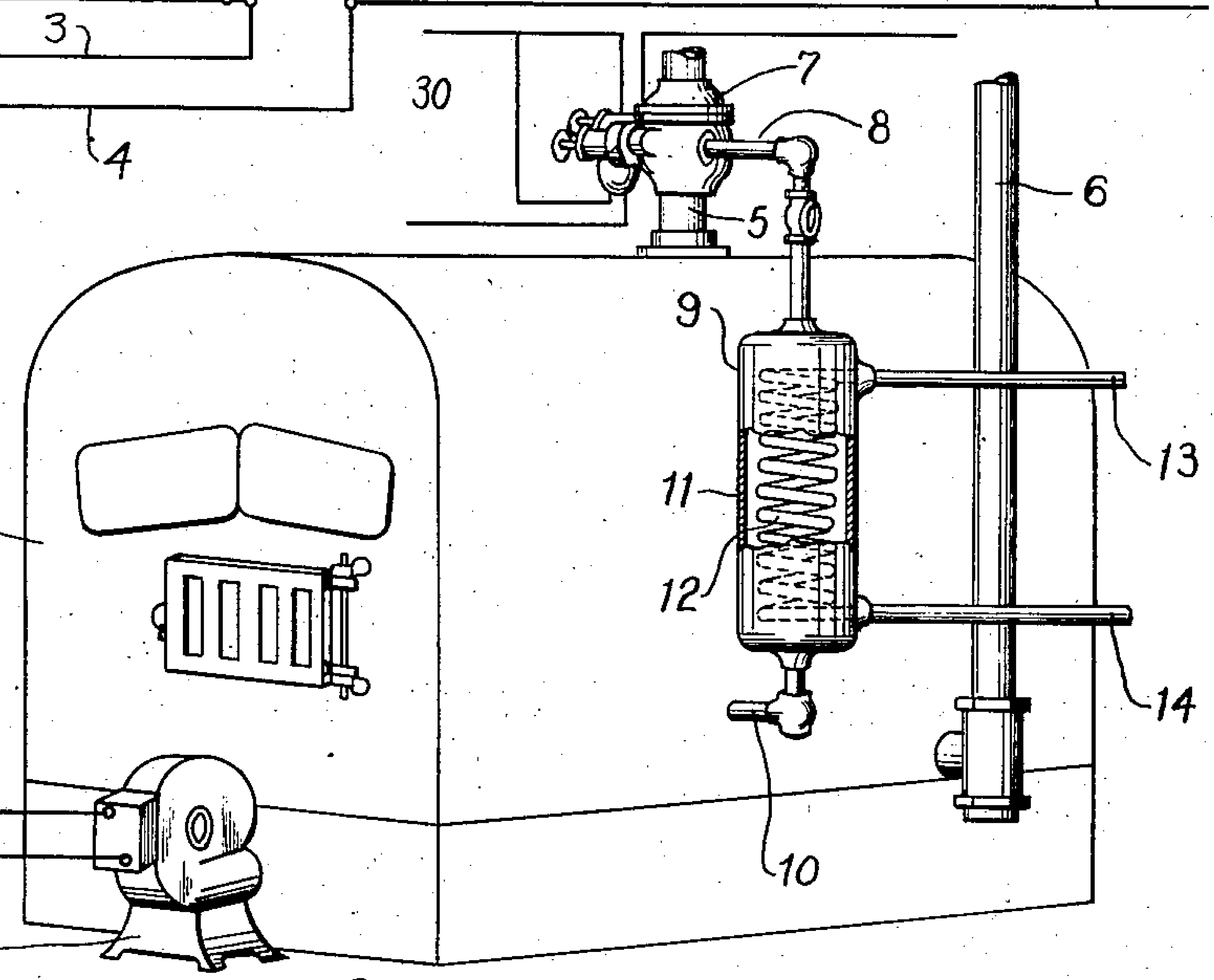

Fig 1

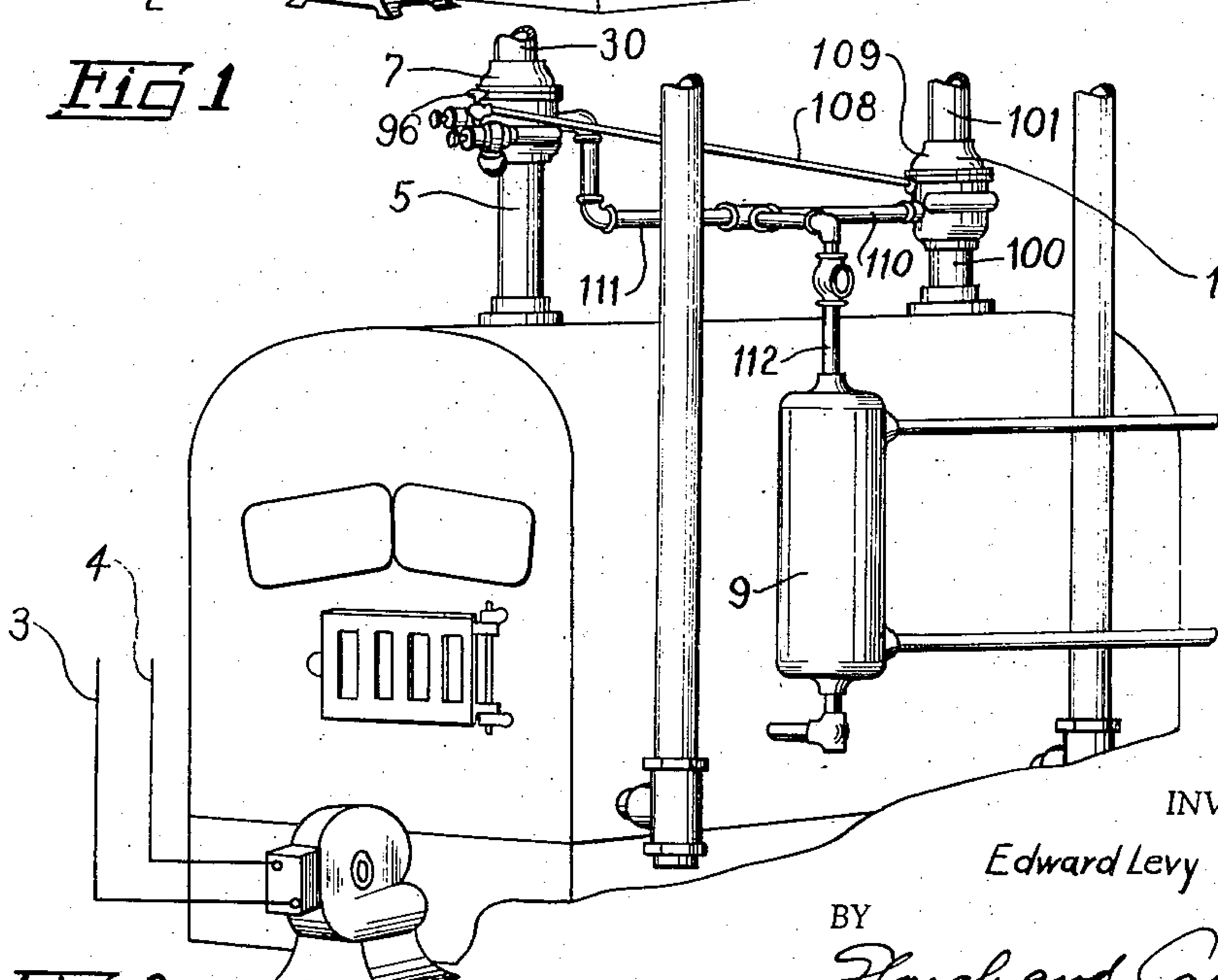

Fig 3

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AUTOMATICALLY CONTROLLED HEATING SYSTEM

Filed June 9, 1932 3 Sheets-Sheet 2

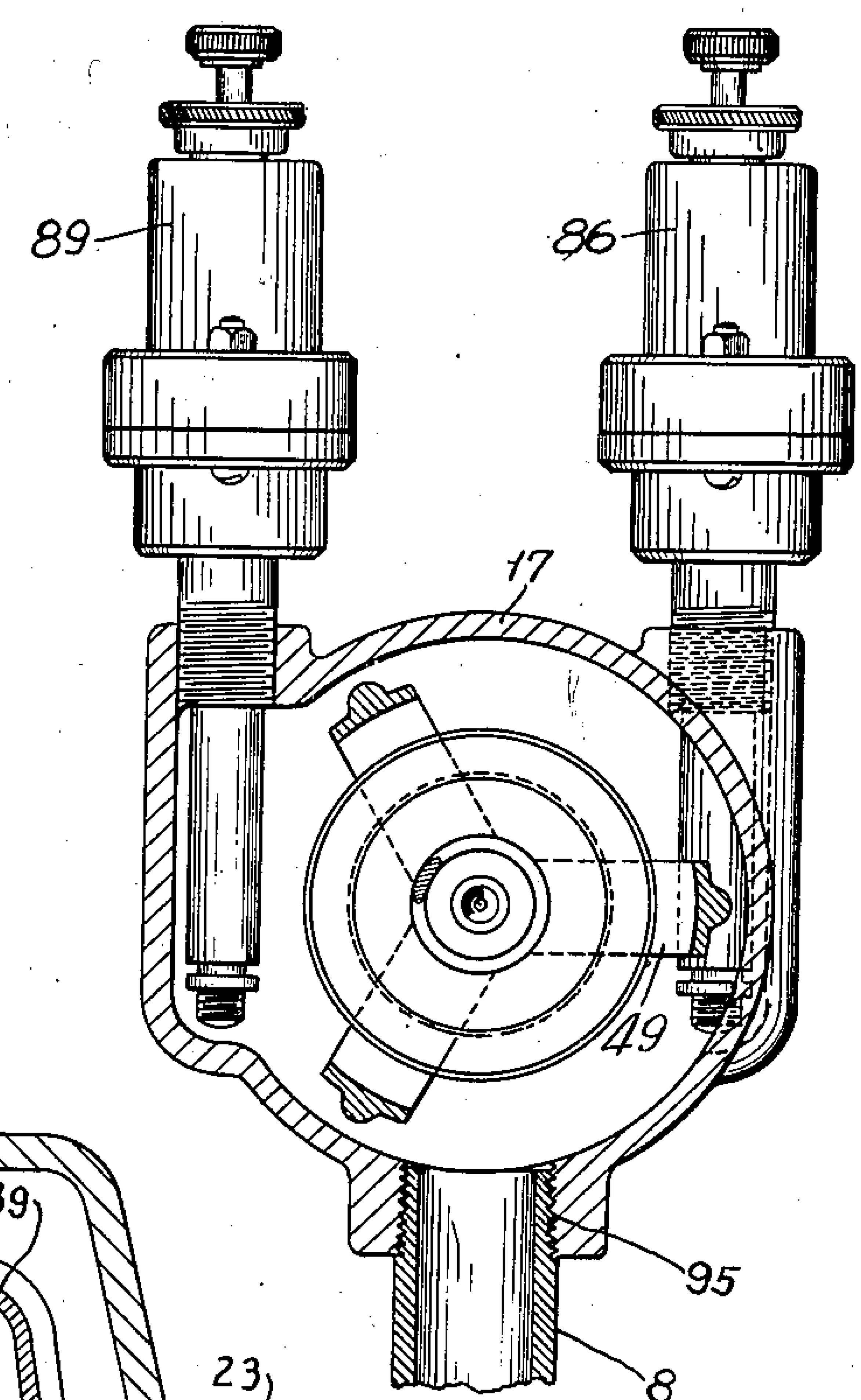

Fig 5

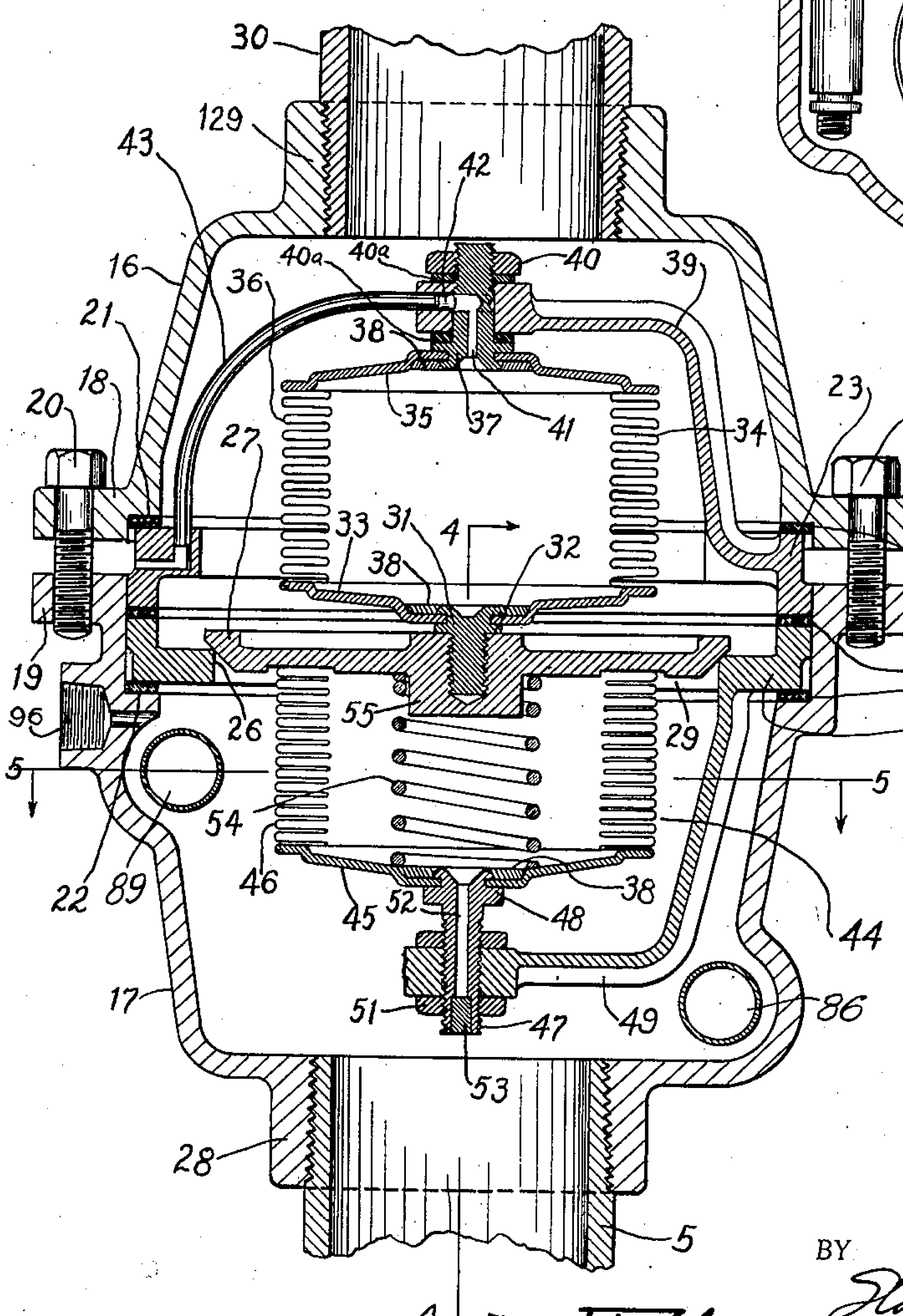

Fig 4

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Aug. 20, 1935. E. L. MAYO **2,012,067**

AUTOMATICALLY CONTROLLED HEATING SYSTEM

Filed June 9, 1932 3 Sheets-Sheet 3

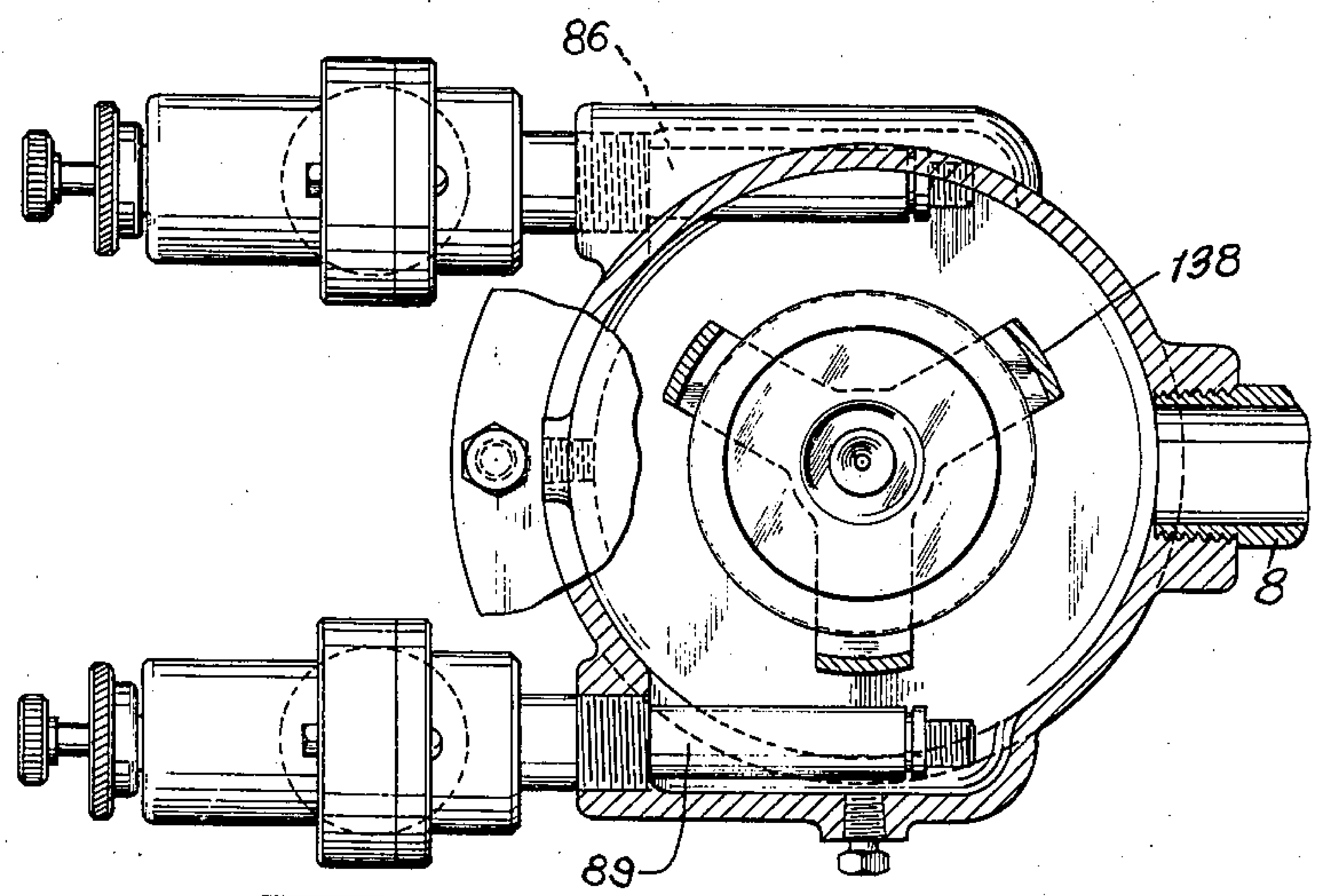

FIG 8

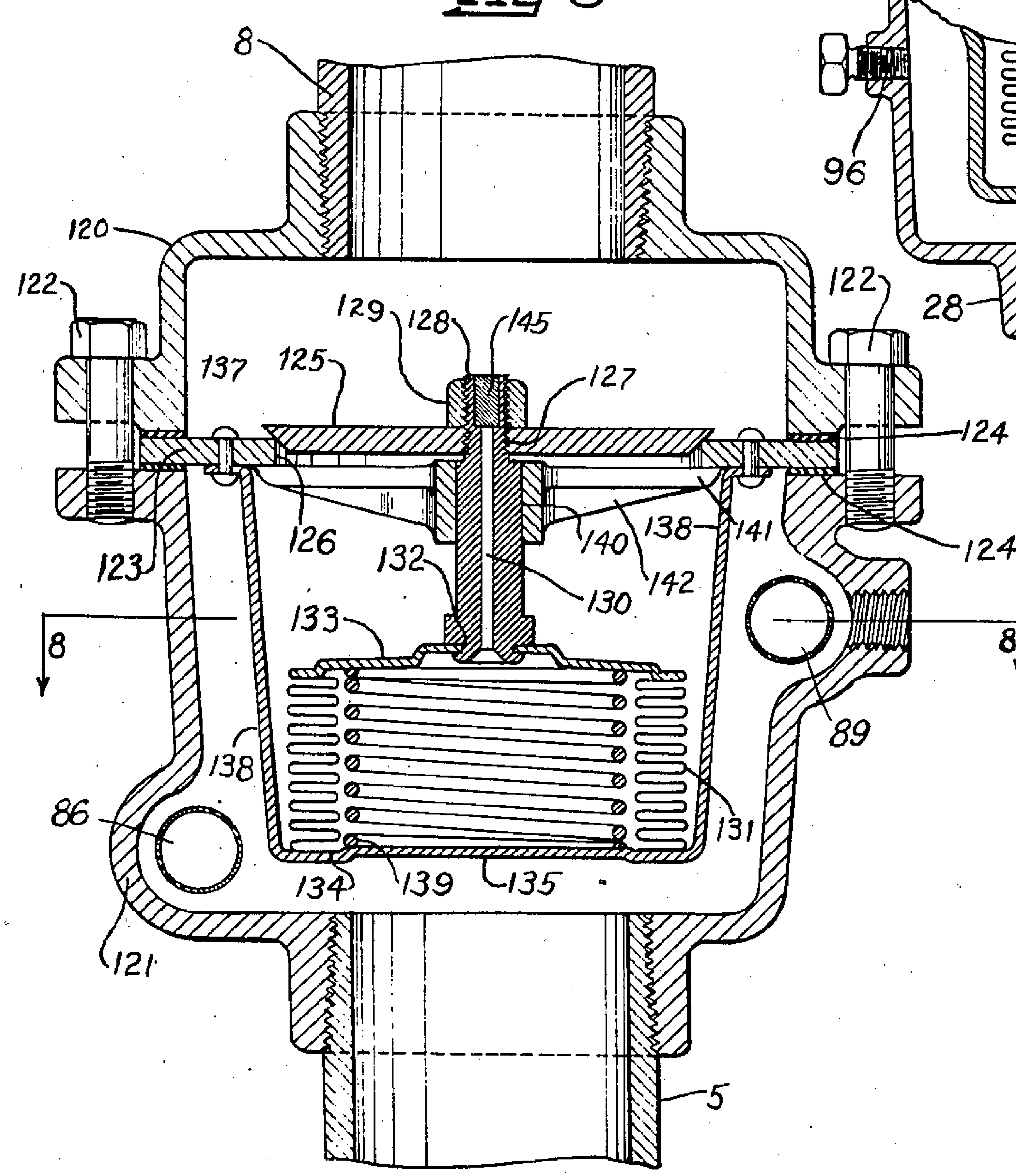

FIG 7

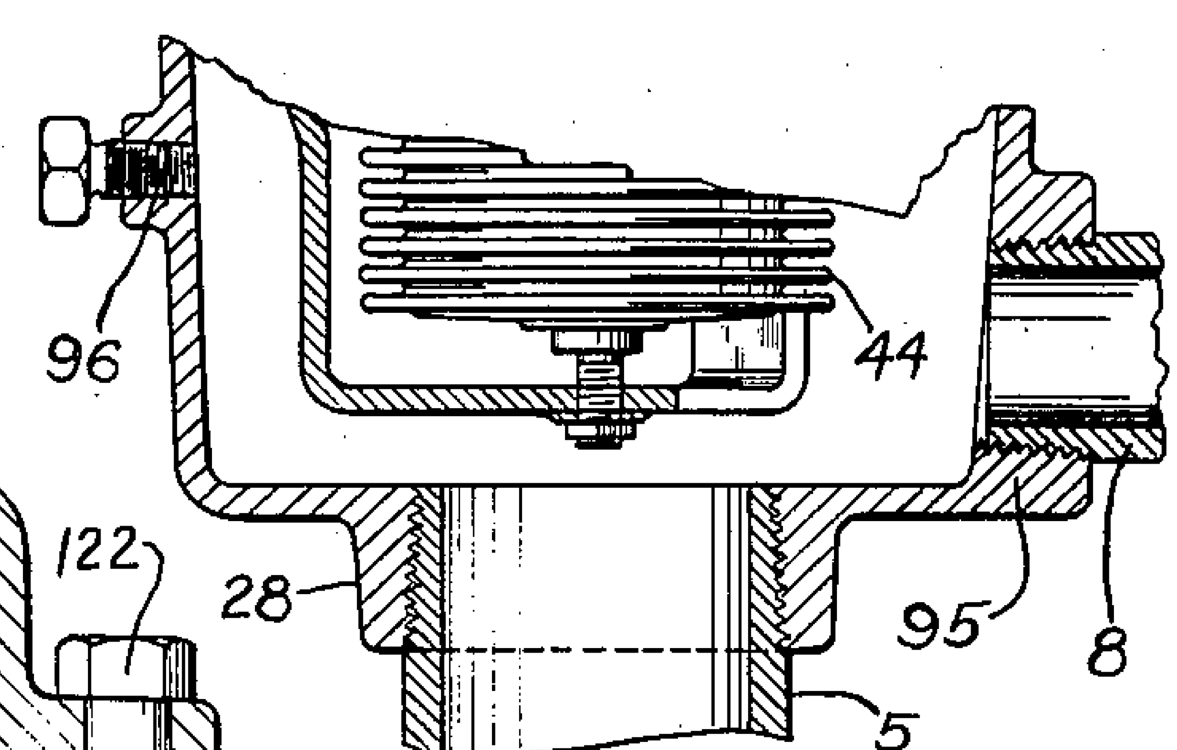

FIG 6

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Patented Aug. 20, 1935

2,012,067

UNITED STATES PATENT OFFICE

2,012,067

AUTOMATICALLY CONTROLLED HEATING SYSTEM

Edward Levy Mayo, Cleveland, Ohio, assignor to The Bishop & Babcock Mfg. Company, Cleveland, Ohio, a corporation of Ohio

Application June 9, 1932, Serial No. 616,275

32 Claims. (Cl. 236—9)

This invention relates to automatically controlled heating systems and particularly to such heating systems as are employed to heat the interior of buildings.

My invention has particular advantages when applied to heating systems in which steam or circulating hot water is employed as a heating medium and in which heat is supplied to the water or steam by an automatic electrically controlled fuel burning apparatus.

In connection with hot water or steam heating systems, it is desirable to provide a constant supply of hot water for use at faucets, such as faucets in bathrooms, lavatories, etc., and to maintain the same at a desirable temperature above a predetermined minimum temperature, irrespective of the heat demands upon the system for heating the rooms of the building.

Thus, for example, in winter hot water is wanted at the faucets and heat is also wanted in the rooms in the room heating radiators, whereas in summer hot water is wanted only at the faucet; and in spring and autumn, besides hot water at the faucet, heat may be wanted intermittently or occasionally in the radiators.

Heretofore, various relatively simple and economical apparatus and control means therefor have been proposed for providing hot water for faucets or domestic purposes in conjunction with a radiator heating system where the system has been a steam system or a vacuum vapor system. However, where hot water has been used as the heating medium, the first cost of suitable control devices and the installation has rendered such systems prohibitively expensive for providing heat both for the radiators and for faucet hot water purposes.

With the increasing popularity of hot water heat, there has been an increasing demand for apparatus and controls therefor for furnishing hot faucet water and which would not be prohibitive in cost. It is becoming more and more general practice, following the advent of automatic fuel fed boilers such as oil, gas, and stoker-fed boilers, to heat the boiler summer and winter, and to employ an indirect water heater in conjunction with the boiler and suitable controls therefor, to provide the hot water for faucet or domestic purposes.

It is therefore an object of this invention to provide a hot water heating system automatically controlled to provide hot water for faucet purposes at all times, winter and summer, at a substantially constant temperature, and automatically supply hot water to the room heating radiators only when necessary to maintain the rooms at a predetermined temperature.

Another object is to provide such a system in which the temperature of the faucet water may be automatically thermostatically controlled in an improved manner.

Another object is to provide such a system in which the supply of hot water to the radiators may be controlled in an improved manner responsive to temperature changes of the rooms to be heated.

Another object is to provide a hot water heating system in which the fuel supplying apparatus for a water heating boiler may be controlled automatically in a manner to maintain a supply of hot water in the boiler at all times, sufficient to heat a supply of faucet water and to maintain the same at a desired temperature and which supply of hot boiler water may automatically be admitted to the room heating radiators and circulated therein upon a thermostatic demand for higher temperature in the rooms to be heated.

Another object is to provide in connection with a water boiler and heat supplying apparatus therefor and indirect heating means for heating a supply of faucet water, improved means for controlling the supply of fuel to the boiler.

Another object is to provide a hot water heating system automatically controlled to provide hot water for faucet purposes at all times at a substantially constant temperature, and automatically supply hot water to the room heating radiator when necessary to maintain the room at a predetermined temperature, which is uninfluenced by variations in the head of water maintained in the system.

Another object is to provide in connection with an automatically controlled hot water heating system adapted to provide hot water for faucet purposes and for room heating radiators, a means of maintaining the rooms at a predetermined temperature which will maintain a supply of hot water to the radiators irrespective of breakage or derangement of the normal operation of the system.

Other objects of my invention will be apparent to those skilled in the art to which my invention appertains.

My invention is fully disclosed in the following description taken in connection with the accompanying drawings in which,

Fig. 1 is a view illustrating a form of my invention applied to the boiler of a heating system of a type having a single circulating riser and return pipe and having an electrically actuated and controlled fuel supply apparatus;

Fig. 2 is a diagram illustrating one form of an electric control circuit which I may employ in connection with the boiler and fuel supplying apparatus of Fig. 1;

Fig. 3 is a fragmentary view similar to a part of Fig. 1 but illustrating my invention applied to a boiler system of the type having two circulating risers and return pipes;

Fig. 4 is an elevational sectional view of a thermostatically operated valve device which I may employ having hydraulic pressure balanced features;

Fig. 5 is a horizontal sectional view taken from the plane 5—5 of Fig. 4;

Fig. 6 is a fragmentary view to a smaller scale of a part of Fig. 4 taken from the plane 4—4 of Fig. 4;

Fig. 7 is a view similar to Fig. 4 showing a modified form of thermostatically operated valve device which I may employ; and

Fig. 8 is a horizontal sectional view taken from plane 8—8 of Fig. 7.

Referring to the drawings, I have shown at 1 a boiler and at 2, generally, a part of an automatic fuel supplying apparatus for heating the boiler. The part 2 is shown generally in the form of a blower for supplying air for combustion purposes within the boiler and the other operative parts of the fuel supplying apparatus are not shown, being concealed within the base of the boiler. The part 2 therefore, may represent a fuel supplying apparatus of any type suitable to automatically supply fuel to the boiler such for example, as an oil burner, gas burner, coal stoker, coal blower, etc., and inasmuch as all such apparatus is well known in this art, it is believed unnecessary to describe the same in detail.

The control of such automatic firing apparatus is commonly effected by an electric circuit leading thereto and which in Fig. 1, is illustrated by the circuit wires 3 and 4. In other words, electric current flowing over the wires 3 and 4 to the apparatus 2 will cause the same to supply fuel to the boiler and heat the same in any of the several well known types of apparatus and modes of operation thereof.

However, I contemplate that the control of the boiler firing apparatus may be effected by other means than an electric circuit such as controlling a gravity operated oil burner or a burner controlled by throttling of the fuel supply wherein the burner is continuously operated and a temperature responsive bellows or the like effects the throttling action.

The boiler 1 is of a type suitable to supply hot water to room heating radiators and therefore has leading upwardly from the top of the boiler a riser 5 through which hot water in the boiler may circulate to heat radiators; and the circulating water from the radiators may flow back to the boiler by a return pipe 6 in a well known manner.

Immediately above the boiler and in the line of the riser 5, I provide a thermostatically operated valve device shown generally at 7, the construction and operation of which will presently be described.

Leading from the riser 5, is a conduit 8 communicating with an indirect water heater 9 from which a return conduit 10 leads back to the boiler. The indirect water heater 9 may be of any suitable or known construction.

One such known indirect water heater comprises a shell 11, through which a coil 12 extends communicating with the conduits 8 and 10. Hot water from the boiler therefore may circulate through the coil 12. Water in the shell 11 surrounding the coil 12 will therefore be heated and by means of conduits 13 and 14 connected to a hot water supply tank may heat the water in the tank, the water circulating through the conduits 12 and 14 and shell 11 and storing up hot water in the supply tank in a well known manner.

I contemplate that various types of thermostatic valve devices other than those hereinafter described may be employed in connection with this system, one such valve device being described and illustrated (Figs. 6 and 7) in a copending application of William J. McGoldrick, Serial No. 616,344, filed June 9, 1932, for Theromstatic valves.

The thermostatic valve device 7 is shown separately in Figs. 4 and 5. An upper housing 16 and a lower housing 17 generally of cup shape having flanges 18 and 19 at their open ends, are rigidly bolted together by bolts 20 projected through perforations in the flanges; the housings being recessed to provide circular shoulders 21 and 22 in housings 16 and 17 respectively. Partitions 23 and 24 are clamped between the flanges and are sealed therewith by a plurality of sealing rings 25 disposed intermediate the partitions and also seating upon the shoulders 21 and 22.

A valve seat constituting a portion of the peripheral edge of a large perforation 29 in the partition 24 has a coooperating valve 27 whereby the flow through the perforation or valve port 26 may be controlled.

The lower housing 17 communicates with the riser 5, an interiorly screw-threaded boss 28 being provided in the bottom wall of the housing 17 to receive the threaded end of the riser 5. Hot water in the riser 5 may therefore flow into the housing 17, and when the valve 27 is in the open position, may flow through the port 26 upwardly through the housing 16 and out through an interiorly threaded boss 129 which communicates with a continuation 30 of the riser 5.

Substantially at the center of the circular valve 27, it is axially threaded and a stud 31 is threaded thereinto, having a circular flange 32 adjacent the upper end thereof.

A circular head 33 of a pressure bellows 34 is apertured substantially centrally thereof and is rigidly secured to the stud 31 preferably by flanging over portions of the stud above the flange 32 to form a tongue and groove connection therebetween. The pressure bellows 34 comprises besides the head 33 an axially opposite head 35, the two heads being connected by a metal corrugated bellows wall 36. The head 35 is rigidly secured to a flanged threaded stud 37 in a manner previously described. The head joints are preferably soldered as indicated at 38 to ensure that the studs 31 and 37 will be in fluid tight relation with the pressure bellows 34.

The bellows 34 is rigidly secured to a bracket 39 integral with partition 23 through a nut 40 which threadedly engages an end of stud 37 projected through an aperture provided in the bracket. Sealing washers 40a—40a are preferably provided to ensure that the stud 37 will be in air tight relation with bracket 39.

The stud 37 is provided with a longitudinal recess 41 adapted to communicate with a laterally extending aperture 42 provided in bracket 39 and within which an end of a tube 43 is sealingly secured. The opposite end of the tube 43 is sealingly secured within an aperture provided therefor in the base portion of partition 23 whereby it will be in communication with the atmosphere and thus maintain the interior of bellows 34 at atmospheric pressure at all times.

A thermostatic bellows generally indicated at 44 comprises a centrally apertured base 45 connected to the underside of valve 27 by a corrugated metal bellows wall 46. The underside of valve 27 is preferably annularly recessed to provide a face to which the bellows wall 46 is sealingly secured coaxial with valve 27. A threaded stud 47 is rigidly secured to the base 45 of the bellows preferably by flanging over portions of the stud extending beyond the circular flange 48 thereon to form a tongue which engages the peripheral edges of the base aperture. A sealing washer 38 is preferably provided to ensure that the bellows 44 will be in fluid tight relation with stud 47.

The stud 47 is disposed within an aperture provided therefor in a downwardly extending bracket 49 integral with partition 24 and is locked therewith by a nut 51 which threadedly engages the stud.

The stud 47 is provided with a longitudinal aperture indicated at 52 terminating in an enlarged aperture adapted to engage a plug 53 whereby the bellows 44 may be supplied with a volatile fluid which can be sealed therein by the plug 53.

A spring 54 is disposed within the thermostatic bellows 44 prior to assembly and at the lower end seats upon the base 45 and the upper end abuts the under face of valve 27. A centrally disposed generally circular boss 55 is preferably provided on the underside of valve 27 to ensure that the spring 54 will be maintained in coaxial alignment the valve 27. The function of the spring 54 will be hereinafter described.

In operation of the device of Figs. 3 and 4 when the heat demands upon the system are only for a supply of faucet hot water, the automatic fuel firing apparatus will be controlled so as to heat the water in the boiler only to a maximum temperature of say 160° in a manner to be more fully described. Thermostatic bellows 44 is constructed and adjusted so that up to a temperature 160° the valve 27 will be maintained on its seat to close the port 29 therethrough; and the hot water therefore will circulate only through the indirect heater 9. If however, the heat demands of the system require that heat be supplied through the riser 5 to heat radiators, the automatic control of the firing apparatus will heat the water in the boiler and therefore in the casing 17 to a temperature above 160°, and thereupon the bellows device 44 will expand axially and open the valves 27 and the hot water from the boiler will at once begin to circulate, upwardly through the housing portion 16 and out through the riser 30 and thence to the radiators to supply heat thereto.

The bellows device 34 is uninfluenced by temperature, its interior being at all times at atmospheric pressure and its function is to balance the effect of hydraulic heads upon the bellows device 44. Since the riser 30 may lead to radiators of considerable variation in height above the boiler even in private residences, hydraulic pressure in the housing 17 and therefore on the bellows 44 may be considerable and will tend to counteract the expansion of the bellows thermostatically. The bellows 34, however, is subjected to the same hydraulic pressure and any tendency to collapse is counter balanced by the tendency of the bellows 44 to collapse, the bellows 34 exerting an upward thrust on the base 33 and the bellows 34 exerting a downward thrust on the valve 27 and both the base and the valve being rigidly secured together.

The spring 54 together with the expansion of the volatile filling of bellows 34 exert sufficient pressure axially and upwardly at a temperature of substantially 160° to lift the valve 27 from the seat and permit the circulation of hot water through the ports. However, it is necessary to ensure that if the volatile filling within the bellows should escape for any reason and thereby lessen the pressure within the bellows, that the valve 27 will be opened to provide a supply of heated water to the radiators. Otherwise, the valve would not open regardless of the temperature of the water within the housing 17 and irrespective of the temperature of the rooms. The spring 54 acts as a positive means for forcing the valve 27 to an open position if the volatile filling should escape from the bellows 44, thus providing a safety feature preventing undue lowering of the temperature in the room and consequent danger to health and equipment. The pressure within bellows 44 if leakage should occur, will obviously eventually become equal to the hydraulic pressure exteriorly thereof in the housing 17 which will be exerting an upward thrust on valve 27 in addition to the spring.

If the pressure bellows 34 should leak it would mean that the bellows would fully or partially fill with water which would replace all or a portion of the air within the bellows and would be subjected only to atmospheric pressure. Therefore as the valve 27 was raised upwardly it would force water from the bellows through the tube 43 against atmospheric pressure. It will thus be seen that the construction of the device is such that irrespective of a leak in either the thermostatic bellows or the pressure bellows that the valve will be forced open at substantially the desired temperature.

The control of the boiler to maintain temperature of the water therein at or below a maximum temperature of say 160° when water for the indirect heater of the faucet water supply tank only is needed, and to raise the temperature of the water in the boiler to effect opening of the thermostatic valve and to circulate same through the heating radiators when a need for heat arises in the rooms to be heated, will now be described.

Referring to Fig. 2 I have shown generally at 80 a room thermostat comprising a stationary contact 81, and a movable contact 82 the latter being carried by the movable arm 83 which is connected to a thermostatic element 84. Upon changes of surrounding room temperature, the thermostatic element 84 will effect a movement of the contact 82 to engage the contact 81 or to disengage the same in a well known manner.

Generally at 85 I have illustrated a thermostat of the so-called immersion type that is to say, a thermostatic device having a generally tubular element 86 adapted to be inserted or immersed into a fluid, in the case under consideration, hot water, the temperature of which is to actuate the device. Within a housing 87, an electric switch is provided adapted to have its contacts closed when the temperature of the water on the element 86 falls to a predetermined value and vice versa.

At 88 is indicated another thermostatic device of the immersion type which may be identical with or similar to the device 85.

An electric circuit is provided adapted to be connected to a source of current by mains 90 and 91. Current from the main 91 may flow through the contact of the thermostat 88 and thence by wires 92 and 93, respectively through the thermostats 80 and 85 in parallel with each other; and the current may then flow by wires 3 and 4 to the apparatus 2 and to the other supply main 90.

The thermostat 80 is situated in a room to which heat is to be supplied. The thermostat 85 has its immersion element 86, as shown generally in Figs. 3 and 4 disposed in the housing portion 17 adjacent the thermostatic bellows 40 and the thermostatic device 88 has its immersion element 89 disposed in the same housing portion, and thus both thermostats are subjected to the temperature of water in the said housing portion.

The thermostat 85 is adjusted so that it will operate to open its contacts when the water temperature on its element 86 reaches 160°. The thermostatic device 88 however, is adjusted so that it will open its contacts at some suitable temperature above 160° for example 170°, a 10 degree differential being preferred as thus indicated.

In the operation of the system therefore, if as in the summertime the rooms to be heated do not demand heat, the thermostat 80 will open its contacts to shut down the fuel supplying apparatus 2 but the contacts of the thermostat 85 will remain closed and thus actuate the apparatus 2 to keep the water heated up to but not beyond 160° whereby it will supply heat to the indirect faucet water heater 9. If however, the water rises in temperature above 160°, the thermostatic device 85 will open its contacts, and the contacts of the thermostat 80 being open, the apparatus 2 will be completely shut down. If the temperature of the boiler water falls below 160° or a predetermined differential amount below 160°, the contacts of the device 85 will close and start up the apparatus 2 to restore the boiler water temperature.

Thus the device 85 will maintain the boiler water at a suitable temperature to heat the faucet water tank. If however, the room temperature should fail it will close the contacts of the device 80 and this will actuate the apparatus 2 irrespective of the thermostat 85 and even if the latter opens its contacts, fuel will continue to be supplied to increase the temperature of the boiler water beyond the 160° specified. The water will thus continue to increase in temperature until it reaches say the temperature of 170° according to which the bellows thermostat 44 is adjusted whereupon the thermostat 44 will open the valve 27 and the hot water will begin to circulate through the radiators to raise the temperature of the rooms. If the rooms are slow to heat up and the boiler temperature continues to increase or overrun the desired temperature at which, after the rooms once become warm, it may be kept warm, such temperature will operate the thermostat 88 to open its contacts and shut down the apparatus 2 irrespective of the circuit conditions in the thermostat 80.

Thus the thermostat 88 will limit the maximum temperature of the boiler water under all conditions, to a predetermined maximum and the thermostats 80 and 85 will, one or the other, keep the boiler water hot, the thermostat 85 keeping it up to but not beyond 160° and the thermostat 80 raising it above 160° whenever this is necessary to maintain room temperature; and the device of Figs. 3 and 4 will shut off the circulation of hot water to the radiators and limit the circulation to the indirect heater by closure of the valve 27 when the room thermostat does not demand heat.

The thermostatic switch devices 85 and 88 may as stated, be of any suitable construction, comprising an immersion element 86 or 89 which may be inserted into the boiler water and comprising switch contacts which will be opened when the temperature reaches predetermined adjusted values. One such suitable thermostatic switch device is illustrated in the pending application of C. W. Bondurant, filed February 12, 1931, Serial No. 515,262, for improvements in Thermostatic switches.

My invention also is not limited to the details of construction of the thermostatic flow controlling device of Figs. 4 and 5. Any known thermostatic valve construction having a thermostatic element subjected to the temperature of the boiler water and adapted to open the main flow valve when the temperature reaches a predetermined value with or without the elements which compensate for the pressure of hydraulic head in the riser may be employed.

Referring again to Figs. 4 and 5 I have indicated at 95 the connection from the housing 17 to the conduit 8 leading to the indirect water heater; and I have indicated generally therein an aperture adapted to have an air relief valve 96 inserted therein whereby any accumulation of air in the valve apparatus may be discharged to the atmosphere.

In Fig. 3 I have indicated generally the preferred arrangement when there are two water supplying risers. The riser 5, thermostatic valve device 7, and riser 30 have been reproduced as in Fig. 1. The second riser 100—102 has interposed in the line thereof a second thermostatic valve device 107 which may be identical with or similar to the device 7. A pipe 108 connects the upper housing portion 109 of the device 107 with relief valve 96 of the device 7 whereby upon operating the valve 96, both thermostatic devices may be drained of accumulated air in a well known manner.

The device 107 is not provided with any thermostatic switch devices such as 85 and 88 as is the device 7. The lower housing portions 17—17 of both the devices 7 and 107 are connected by conduits 110 and 111 to a single conduit 112 for supplying heating water to the indirect heater 9.

In this form, the control of the heat supplying device 2, is responsive to temperature conditions in the device 7. The electric circuit in connection with this form may be the same as that for the form of Fig. 1. A response of the boiler to room temperature may be controlled by a room thermostat 80; each riser may have its flow cut off independently by its respective device 7 or 107; and the minimum and maximum boiler temperatures may be controlled by thermostats 85 and 88 in association with device 7 in the riser 5.

In the modified form of my invention of Fig. 7, I show a form of thermostatic valve device which is not compensated for fluid pressure of the hydraulic head of water in the risers, such a simplified construction being adapted for a specific installation wherein the hydraulic head to which it is subjected is known and in correspondence with which it may initially be constructed and adjusted.

In this form a two part housing comprising an upper portion 120 and lower portion 121 clamped together by bolts 122 upon a partition 123 sealed to the housing portion by washers 124—124 is provided.

A valve 125 adapted to close the valve port 126 is screw-threaded as at 127 upon a stem 128 and thus may axially be adjusted along the stem and locked in adjusted position by a nut 129. The stem 128 has a duct 130 therethrough by which thermostatic fluid may be conducted initially to the interior of a collapsible bellows 131, the stem 128 being rigidly and sealedly connected as at 132 to an upper head 133 of the bellows. The lower end of the bellows is sealedly connected as at 134 to a circular head 135 supported by brackets 138—138 secured as by rivets 137 to the partition 123.

A spring 139 within the bellows 131 abuts upon the opposite head thereof and opposes the collapsing effect of hydraulic pressure on the bellows. The stem 128 is guided for vertical coaxial movement in a bore 140 provided in the head 141 supported by generally radial brackets 142 connected to or formed integrally with the partition 123.

In the operation of the form of my invention in Fig. 5, the valve 125 will be opened to permit the flow of fluid from the riser 5 to the riser portion 8 through the valve port 126 when temperature of water in the housing portion 121 rises to a predetermined value responsive to which the thermostatic bellows is adjusted. This value can be adjusted by adjusting the axial position of the valve 125 along the stem 128 as will be understood, as well as by a predetermination of the quantity of and thermal characteristics of the expansible fluid injected initially into the bellows 131 through the duct 130 and sealed therein by the plug 145.

In connection with either of the forms of the thermostatically operated valve device of Figs. 4 and 5, or Fig. 6, it will be observed that the boiler water continuously circulates through the indirect heater so that the water in the valve device is maintained at the temperature of the water in the boiler so that the thermostat of the thermostatically operated device 7 for example, is always subjected to the boiler water temperature even when the valve is closed and flow through the riser is shut off. Thus the conduit system to the indirect water heater performs an additional function to that of merely supplying heat to the heater, namely, the function of communicating to the thermostat in the riser the temperature of the water in the boiler.

In the absence of such a local circulating system, it will be understood that the water in the boiler might attain a temperature many degrees different from that in the riser when the riser valve is closed.

Water for the indirect heater may be conveyed out of the housing portion 121 by conduit 8 and the immersion elements 89 and 86 of thermostatic devices 85 and 88 may be projected into the housing portion 121 as more completely described hereinbefore in connection with the other form.

The thermostatic switch device 85 is preferably mounted substantially at or above the top plane of thermostatic bellows 44 and above the limit control thermostatic switch 88. The bellows 44 is calibrated to open the valve 27 when surrounded by water at a predetermined temperature say 160°. The thermostatic switch device 85 operates to shut down the fuel supply apparatus when the water temperature goes above a definite point as 160° and is only operative when the room thermostat is not calling for heat.

If air were trapped beneath the valve 27 and above bellows 44 a relatively higher temperature would be required to expand the bellows sufficiently to operate valve 27, say 165° due to the fact that the bellows is not surrounded by water. If the thermostatic switch device were mounted at the bottom plane of the bellows it would not permit the water to attain a temperature of above 160° and consequently when the room thermostat demanded heat and rendered device 85 inoperative, the water would have to heat to 165° before the valve 27 would open. When the device 85 is mounted as indicated it will not shut down the fuel supply apparatus until the immersion element has attained a temperature of 160° and since it is mounted at substantially the top plane of or above the bellows 44, the bellows will be subjected to 160° and consequently will operate immediately to open valve 27 upon a demand for heat from the room thermostat and will thus vent any trapped air. The air may then be vented to the atmosphere by any automatic air relief valve.

The waterstat if installed in a horizontal position is preferably supplied with an automatic air relief valve of the float type since it is essential to the proper functioning of the apparatus that a minimum level of water be maintained in the waterstat.

The waterstat may be utilized through proper adjustment to minimize the time interval or lag encountered between the time at which the room thermostat signals for heat at a predetermined minimum temperature and the time at which this temperature is attained. For instance, the room thermostat may be set to demand heat at 70° but due to the time necessary to effect this result, the temperature will go and remain below 70° for a period, thus giving rise to a condition known as cold 70. (The thermostat set at 70° yet the room is colder than the set temperature.)

This condition is aggravated in mild weather when the boiler has not been called upon to heat water for the radiators but due to a drop in temperature such heat is required. Obviously, a relatively large amount of time will be required to heat the body of water in the boiler to the desired temperature and replace the water of low temperature in the heating system.

The waterstat affords a means of maintaining heated water in the radiator system at substantially the desired temperature irrespective of the room thermostat due to the throttling action of the valve. Thus the bellows being adjusted to open valve 27 when a predetermined temperature in the housing is attained, will permit water at substantially this temperature to flow to the radiator system. This water will be replaced by water a few degrees colder causing the bellows to contract and close the valve. This continuous throttling action ensures that a supply of heated water will be maintained in the radiator system at a temperature dependent on the temperature within the waterstat. Thus, the radiator system is always maintained at substantially the desired temperature and the time interval required to bring the room to this desired temperature is reduced to a minimum.

Although I have described embodiments of my invention, I contemplate that numerous and extensive departures may be made therefrom without departing from the spirit and scope of my invention and the appended claims.

Having thus described my invention, what I claim is:—

1. In a fluid heating system, two fluid conducting circuits comprising a room heating circuit and a hot water supply circuit, a throttling valve for one circuit operatively responsive to the temperature of that circuit, and compensating means whereby the valve will operate at substantially the same temperature irrespective of fluid head.

2. In a fluid heating system, a boiler, boiler fuel supply apparatus, two fluid conducting circuits comprising a room heating circuit and a hot water supply circuit, a throttling valve for one circuit operatively responsive to the temperature at the common source, and a thermostat responsive to fluid temperature controlling the fuel supply apparatus.

3. In a fluid heating system, a boiler, boiler fuel supply apparatus, two fluid conducting circuits comprising a room heating circuit and a hot water supply circuit, a throttling valve for one circuit operatively responsive to the boiler temperature, a thermostat controlling the fuel supply apparatus responsive to fluid temperature, a second thermostat controlling the fuel supply apparatus responsive to room temperature, the fluid temperature thermostat being rendered inoperative when the room temperature falls below a predetermined value.

4. In a fluid heating system, a boiler, boiler fuel supply apparatus, two fluid conducting circuits comprising a room heating circuit and a hot water supply circuit having a common source of supply, a throttling valve for one circuit operatively responsive to the temperature at the common source, thermostatic means controlling the fuel supply apparatus responsive to fluid temperature at the common source, thermostatic means controlling the fuel supply apparatus responsive to room temperature, the fluid temperature thermostat being rendered inoperative when the room temperature is below a predetermined value, and a third thermostat limiting the fluid temperature and adapted to render the room thermostat inoperative.

5. In a heating system, in combination with a boiler and a main circulating conduit for supplying heat at a point of use, a valve controlling flow through the conduit, a thermostat for operating the valve disposed externally of the boiler and responsive to fluid temperature and a local circulating conduit for conducting boiler fluid to the thermostat to maintain it substantially at the temperature of the water in the boiler when the valve is closed, and said local circulating conduit supplying heat to a faucet water heater.

6. In a heating system, in combination with a boiler and a main circulating conduit for supplying heat at a point of use, a thermostatic valve device in the conduit line of flow comprising a valve controlling the flow and a fluid temperature responsive thermostat adapted to operate the valve, a local circuit conduit communicating with the line of flow at a point adjacent to the thermostat, and adapted to communicate temperature of fluid in the boiler to the thermostat when the valve is closed, an electrically controlled heat-supplying apparatus for the boiler, an electric circuit therefor, and a thermostatic switch controlling the circuit and responsive to temperature of fluid at the said valve thermostat when said valve is closed to maintain the temperature of the water below the valve-opening temperature of the valve thermostat.

7. In a heating system, in combination with a boiler and a main circulating conduit for supplying heat at a point of use, a thermostatic valve device in the conduit line of flow comprising a valve controlling the flow and a fluid temperature responsive thermostat adapted to operate the valve, a local circuit conduit communicating with the line of flow at a point adjacent to the thermostat, and adapted to communicate temperature of fluid in the boiler to the thermostat when the valve is closed, electrically controlled heat-supplying apparatus for the boiler, an electric circuit therefor, a thermostatic switch controlling the circuit and responsive to temperature of fluid at the said valve thermostat when said valve is closed to maintain the temperature of the water below the valve-opening temperature of the valve thermostat, and the thermostatic switch controlling the circuit and responsive to temperature below a predetermined value at the point of use to effect an increase of fluid temperature at the valve thermostat to cause the valve to open irrespective of the control of the first mentioned thermostatic switch.

8. In a heating system, comprising a water boiler and a main circulating conduit for supplying heat at a point of use, a thermostatic valve device in the conduit line of flow comprising a valve controlling the flow and a water temperature responsive thermostat adapted to operate the valve, a local circulating conduit communicating with the line of flow at a point adjacent the thermostat and adapted to communicate temperature of water in the boiler to the thermostat, an electrically controlled heat supplying apparatus for the boiler, an electric circuit therefor and a thermostatic switch controlling the circuit and responsive to temperature below a predetermined value at the point of use to effect an increase of water temperature at the valve thermostat to cause it to open the valve.

9. In a heating system, in combination with a water boiler and a main circulating conduit for supplying heat at a point of use, a thermostatic valve device in the conduit line of flow comprising a valve controlling the flow and a water temperature responsive thermostat adapted to operate the valve, a local circuit conduit communicating with the line of flow at a point adjacent to the thermostat, and adapted to communicate temperature of water in the boiler to the thermostat when the valve is closed, an electrically controlled heat supplying apparatus for the boiler, an electric circuit therefor, a thermostatic switch controlling the circuit and responsive to temperature of water at the said valve thermostat when said valve is closed to maintain the temperature of the water below the valve-opening temperature of the valve thermostat, a thermostatic switch controlling the circuit and responsive to temperature below a predetermined value at the point of use to effect an increase of boiler water temperature at the valve thermostat to cause it to open the valve irrespective of the control by the first said thermostat, and a thermostatic switch controlling the circuit responsive to temperature at the valve thermostat to maintain the water temperature below a predetermined maximum irrespective of the control by the second said thermostat at the point of use.

10. The method of controlling the circulation of fluid in a fluid heating system comprising a boiler and an electrically actuated boiler heating apparatus therefor which includes shutting off the circulation by a thermostatically operated valve at the boiler responsive to fluid temperature, maintaining a local circulation of boiler

fluid and heating the valve thermostat thereby, maintaining said local circulation at a predetermined minimum temperature by a thermostatic electric switch responsive to said fluid temperature and controlling the boiler heating apparatus, controlling the boiler heating apparatus by a room temperature responsive thermostatic switch to increase the temperature at the valve thermostat to open the valve when the room temperature falls to a predetermined value independently of the control by the first thermostat and controlling the boiler heating apparatus by a third thermostat responsive to boiler water temperature to prevent a rise thereof above a predetermined value independently of the room thermostatic control.

11. A heating system substantially as described in claim 4, characterized by the throttling value comprising a contractible and expansible bellows subjected to head of fluid pressure in the room circuit and in which means is provided to compensate for the bellows collapsing tendency of the fluid pressure.

12. A heating system substantially as described in claim 4, characterized by the throttling value comprising a bellows of the contractible and expansible type, a second bellows to compensate for the bellows collapsing tendency of the fluid head, and wherein means are provided to open the valve at substantially the desired temperature irrespective of derangement of either bellows.

13. In a heating system, a boiler, a fluid circulating conduit connected to the boiler to supply heat at a point of use, a valve in the conduit disposed externally of the boiler, a thermostat of the expansible and contractible sealed chamber type containing thermally expansible fluid adapted to open and close the valve at predetermined fluid temperatures, a local circulating conduit for conducting fluid of boiler temperature to the thermostat, and means to open the valve upon loss of seal of the thermostatic chamber.

14. In a heating system, a boiler, a fluid circulating conduit connected to the boiler to supply heat at a point of use, a valve in the conduit disposed externally of the boiler, a thermostat of the expansible and contractible sealed chamber type containing thermally expansible fluid adapted to open and close the valve at predetermined fluid temperatures, a local circulating conduit for conducting fluid of boiler temperatures to the thermostat, and means constantly acting tending to open the valve and operable upon loss of seal of the thermostatic chamber.

15. A heating system as described in claim 13 and in which the thermostat is of the bellows type and the means to open the valve is a spring.

16. A heating system as described in claim 13 and in which the thermostat is of the bellows type and a spring is disposed within the bellows reacting upon the valve to open it upon the occurrence of a loss of seal of the bellows.

17. A heating system as described in claim 13 and in which the chamber type thermostat is subjected to the pressure of liquid head in the circuit, and a second expansible and contractible chamber, subjected to the pressure of liquid head in the circuit, opposes the tendency of the first-named chamber to collapse under the head of pressure.

18. A heating system as described in claim 13 and in which the thermostatic chamber is subjected to the pressure of liquid head in the circuit, and a second expansible and contractible chamber communicating interiorly with the atmosphere is subjected to the pressure of liquid in the circuit and opposes the tendency of the first-named chamber to collapse under the pressure of the liquid head.

19. A heating system as described in claim 13 and in which the chamber type thermostat is subjected to the pressure of liquid head in the circuit and a second expansible and contractible chamber, subjected to the pressure of liquid head in the circuit, opposes the tendency of the first-named chamber to collapse under the head of pressure and the means to open the valve upon loss of seal is a spring acting upon the valve in the same direction as the thermostatic chamber.

20. In a thermostatic valve device, a housing adapted to be connected in the line of flow of a conduit, a valve in the housing controlling flow therethrough, a thermostatic bellows in the housing containing thermally expansible fluid and having a movable wall connected to the valve to move it to open position upon thermal expansion of the bellows, a second bellows having a movable wall connected to the first-named movable wall and communicating interiorly with the atmosphere externally of the housing, both said bellows being subjected to the pressure of fluid head in the conduit, and means exerting resilient force in the valve opening direction only and constantly acting in that direction tending to move the valve to open position and operable to open it upon failure of seal of the thermostatic bellows.

21. A thermostatic valve device as described in claim 20 and in which means is provided to simultaneously adjust the force of the constantly acting means and the valve opening force exerted by the thermostatic bellows.

22. In a heating system, a boiler, a fluid circulating conduit connected to the boiler to supply heat at a point of use, a valve in the conduit disposed externally of the boiler, a thermostat adapted to open and close the valve at predetermined fluid temperatures, a local circulating conduit for conducting fluid of boiler temperature to the thermostat, and means to open the valve upon failure of the thermostat.

23. In a heating system, a boiler, a fluid circulating conduit connected to the boiler to supply heat at a point of use, a valve in the conduit disposed externally of the boiler, a thermostat adapted to open and close the valve at predetermined fluid temperatures, a local circulating conduit for conducting fluid of boiler temperature to the thermostat, means to open the valve upon failure of the thermostat, and means constantly acting and tending to open the valve and operable upon failure of the thermostat.

24. In a combined hot water supply and heating system, a water boiler, means for heating said boiler, a domestic water supply tank, a heat exchange unit in circuit with said boiler for indirectly heating the water in said supply tank, thermostatic means in said circuit for controlling the heat supplied to said boiler for regulating the temperature of the water flowing through said exchange unit, a house heating system also in circuit with said boiler, thermostatic means in said house for increasing the heat supplied to said boiler when the room temperature falls below normal, and thermostatic means responsive to the boiler temperature for controlling the flow of hot water in said house heating circuit.

25. In a combined hot water supply and heating system, a water boiler, means for heating said boiler, a domestic water supply tank, a heat exchange unit in circuit with said boiler for indirectly heating the water in said supply tank, thermostatic means in said circuit for controlling the heat supplied to said boiler for regulating the temperature of the water flowing through said exchange unit, a house heating system also in circuit with said boiler, and thermostatic means responsive to the boiler temperature for controlling the flow of hot water in said house heating circuit.

26. In a combined hot water supply and room heating system, a water boiler, means for heating said boiler, a heat exchanger for a hot water supply system in circuit with said boiler, means responsive to the temperature of the water in said heat exchanger circuit for controlling the supply of heat to said boiler, a room heating system in a separate circuit with said boiler, means responsive to the room temperature for independently controlling the supply of heat to said boiler, and a thermostatically controlled valve in said room heating circuit responsive to the boiler temperature for connecting said room heating circuit to said boiler when said boiler temperature exceeds a predetermined point.

27. In an automatically controlled room heating and domestic hot water supply system, a water boiler, means for heating said boiler, a room heating system in circuit with said boiler, a heat exchanger for a hot water supply system also in circuit with said boiler, thermostatic means responsive to the temperature in said heat exchanger circuit for controlling the supply of heat to said boiler, a room thermostat adapted to increase said heat supply when the room temperature falls below normal, a thermostatically controlled valve in said heating system circuit adapted to open and permit hot water to circulate in said room heating system when the temperature in said boiler exceeds a predetermined point.

28. In a combined hot water supply and room heating system, a water boiler, means for heating said boiler, a heat exchanger for a hot water supply system in circuit with said boiler, means responsive to the temperature of the water in said heat exchanger circuit for controlling the supply of heat to said boiler, a room heating system in a separate circuit with said boiler, and adjustable valve means responsive to the boiler temperature for opening said room heating circuit when said boiler temperature exceeds a predetermined point.

29. In a heating system, in combination with a boiler, a boiler circulating conduit for supplying heat at a point of use, a housing in the conduit line, a thermostatic valve in the housing for controlling flow therein responsive directly to changes of fluid temperature in the housing and constructed to substantially close and stop flow through the conduit upon attainment of a predetermined lower fluid temperature in the housing, a boiler fuel supplying apparatus for heating fluid in the boiler above normal temperature, a thermostat of the immersion type having an immersion element projected into fluid in the housing and controlling the apparatus to control the supply of fuel to the boiler responsive to changes of temperature of the fluid in the housing to maintain the fluid at a temperature above normal but below the valve opening temperature of the thermostat.

30. In a thermostatic valve device, a housing adapted to be connected in the line of flow of a conduit, a valve in the housing controlling flow therethrough, a thermostatic bellows in the housing containing thermally expansible fluid and having a movable wall connected to the valve to move it to open position upon thermal expansion of the bellows, and means exerting resilient force on the valve in the opening direction and constantly acting in that direction to move the valve to open position and operable to open it upon failure of seal of the thermostatic bellows, and means to simultaneously and commensurably adjust the force of the constantly acting means and the valve opening force exerted by the thermostatic bellows.

31. A fluid heating system controlling mechanism adapted for inclusion in a heating system comprising an electrically controlled fluid heater, a main heating fluid circulating conduit leading to room heating radiators of the system, and an indirectly heated water circulating conduit for providing a source of hot water supply, said mechanism comprising a valve device disposed in the line of flow of the main conduit, thermostatic means adapted to control fluid flow through the valve device and main conduit responsive to the temperature of fluid passing through the valve, and thermostatic switch means associated with the valve device and controlling the fluid heater to maintain a predetermined minimum temperature in the indirectly heated conduit and to render said heater inoperative at a predetermined maximum temperature of fluid passing from the heater to the valve device.

32. A fluid heating controlling mechanism comprising an electrically controlled fluid heater, a main heating fluid circulating conduit leading to room heating radiators of the system, and an indirectly heated water circulating conduit providing a source of hot water supply, said mechanism comprising a valve device disposed in the line of flow of the main conduit and provided with an outlet for supplying heated water to the indirect heater, thermostatic means adapted to control fluid flow through the valve device and main conduit responsive to the temperature of fluid passing through the valve, and thermostatic switch means responsive to the temperature of water in the fluid heater for controlling the fluid heater to maintain a predetermined minimum temperature in the indirectly heated conduit and to reduce the heating effect of the fluid heater at a predetermined maximum temperature of fluid passing from the heater to the valve device.

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