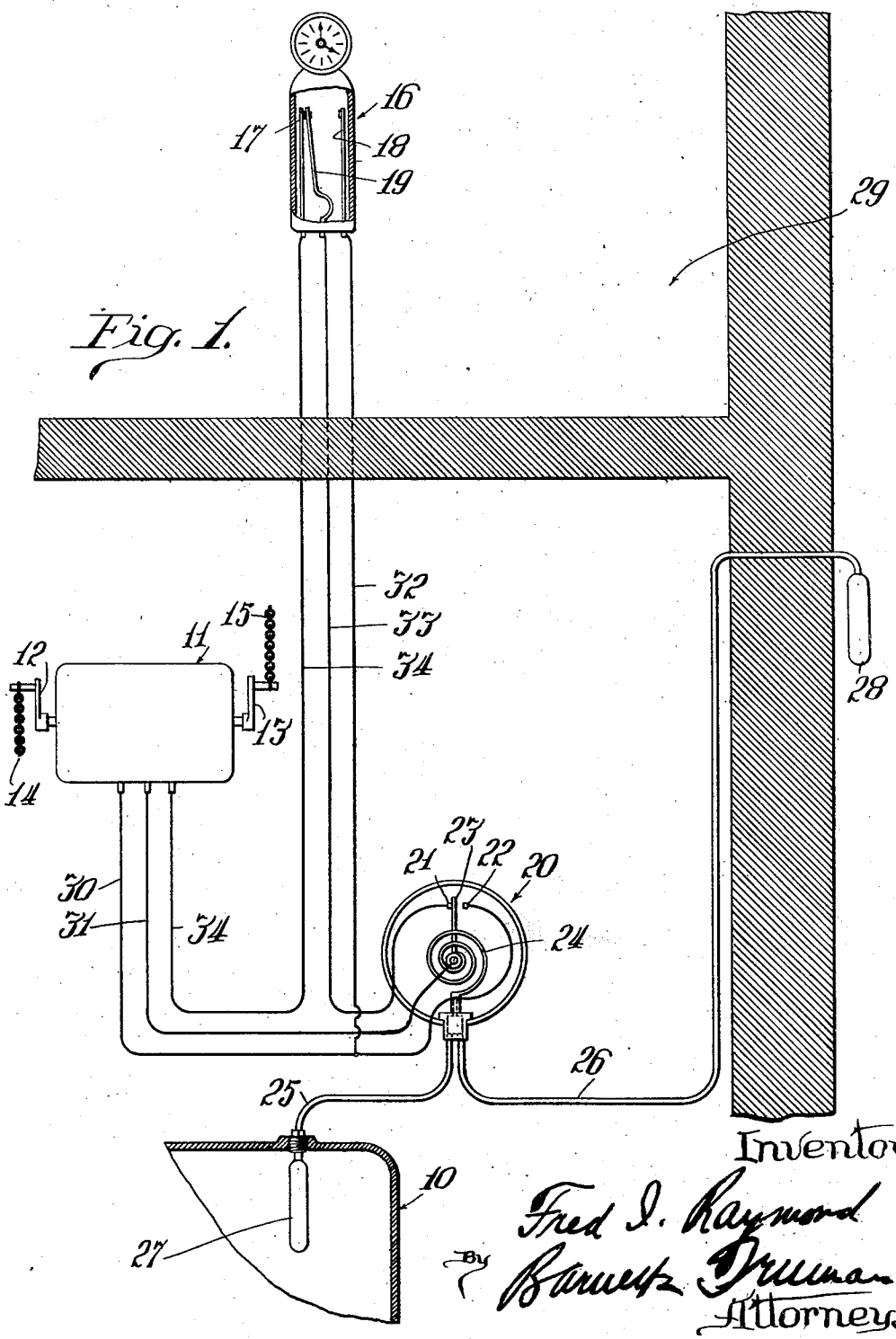
Dec. 16, 1930. F. I. RAYMOND 1,785,426

METHOD OF HEATING

Filed July 16, 1928 4 Sheets-Sheet 1



Inventor

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METHOD OF HEATING

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Fig. 2.

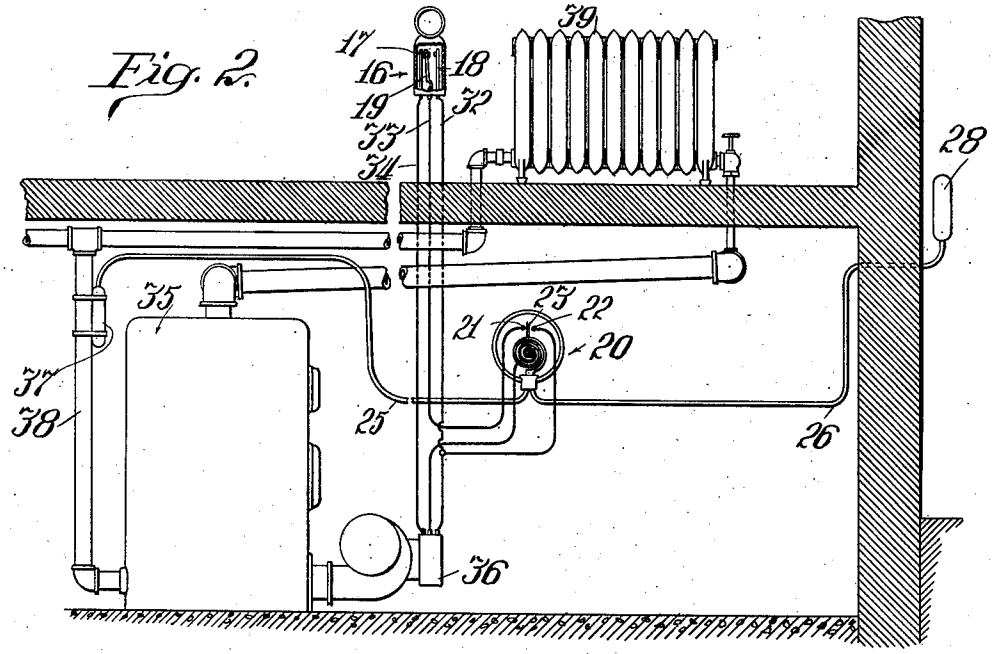


Fig. 3.

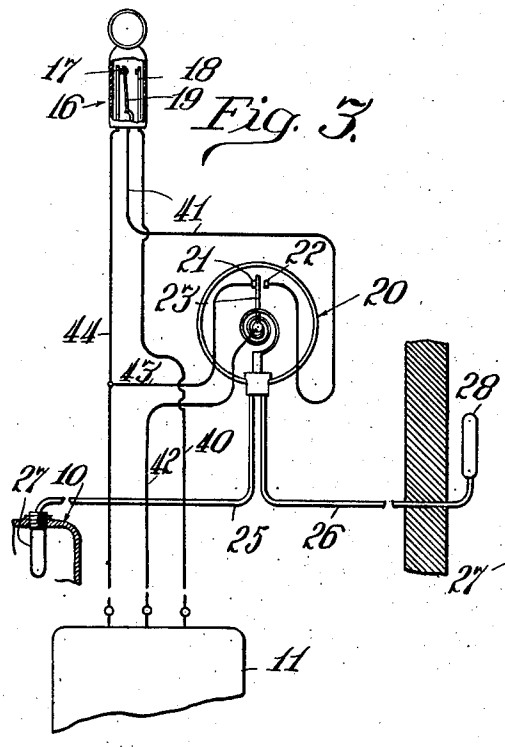
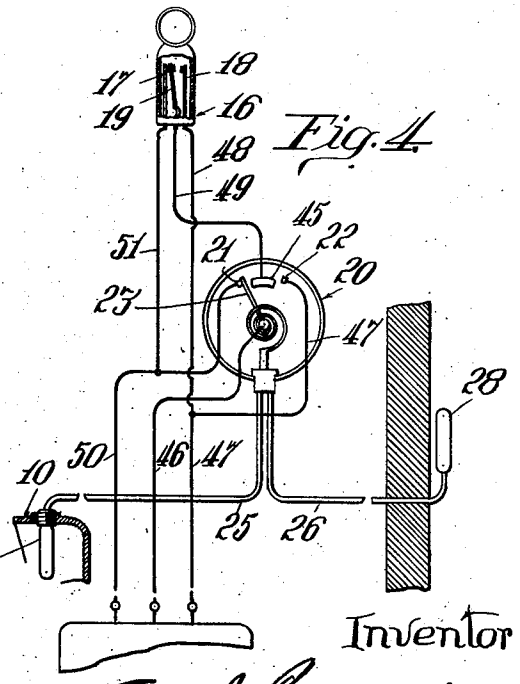


Fig. 4.



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METHOD OF HEATING

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Fig. 5.

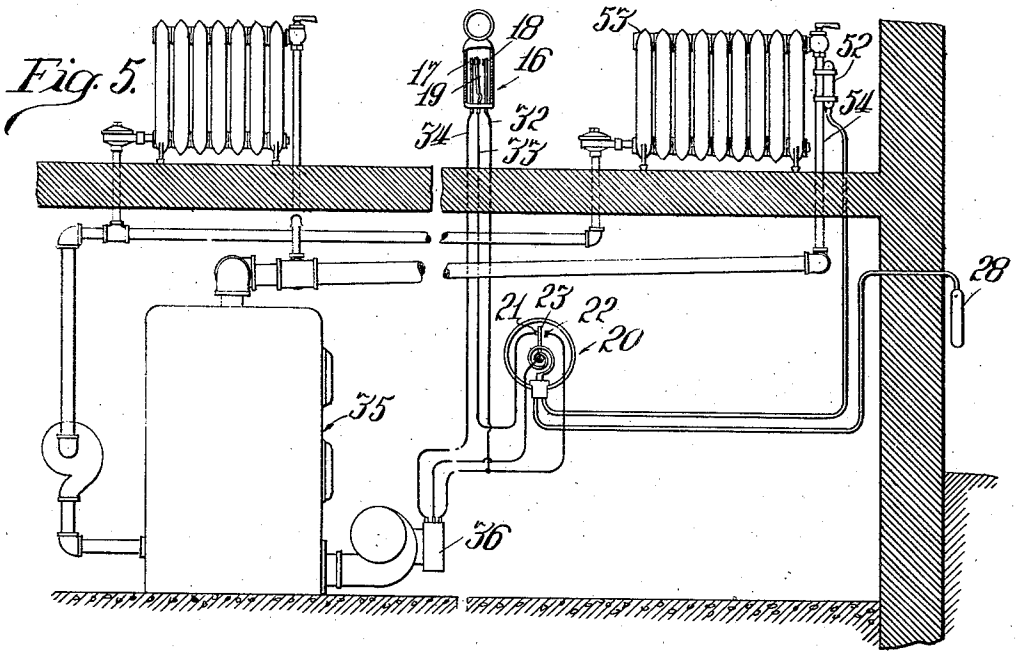
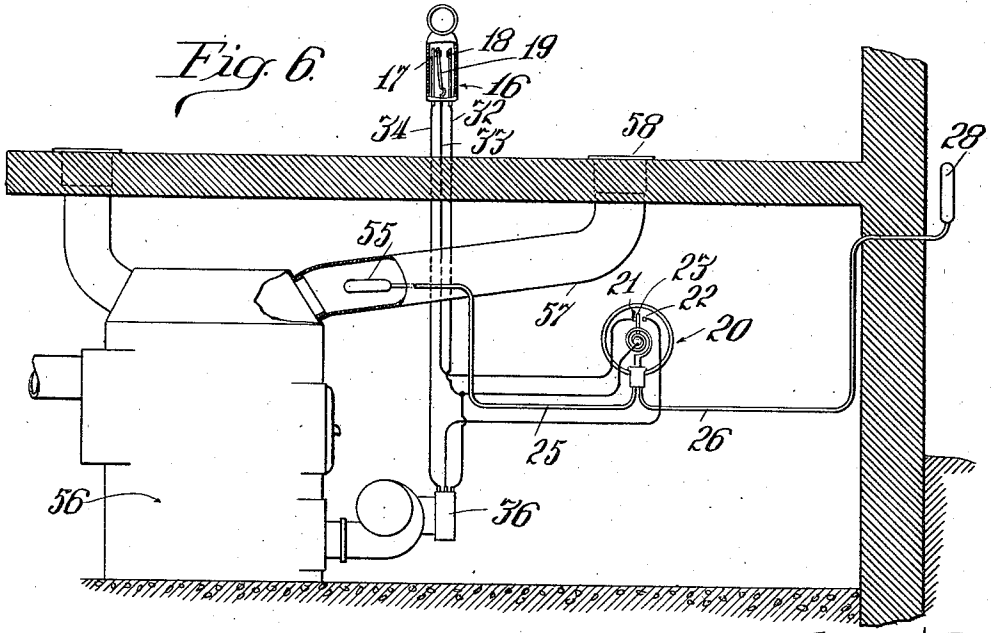


Fig. 6.



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METHOD OF HEATING

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Fig. 8.

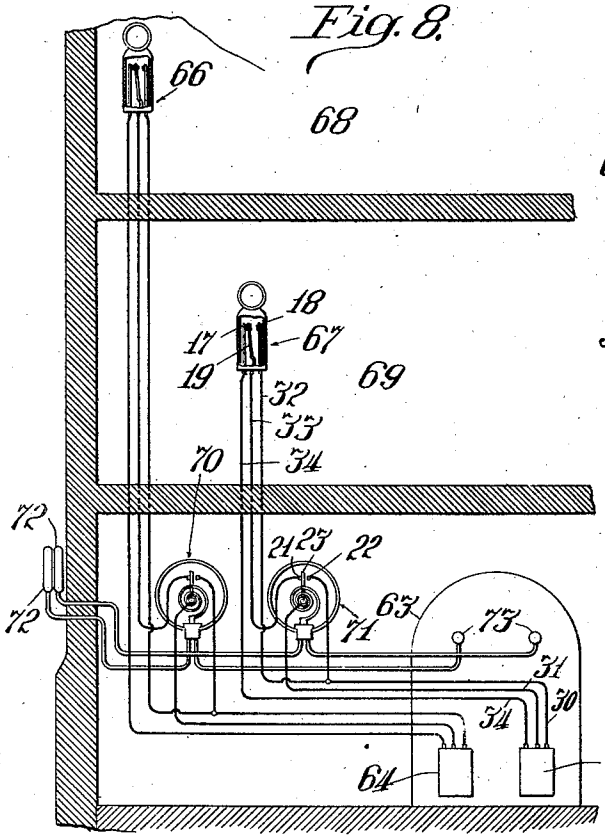


Fig. 7.

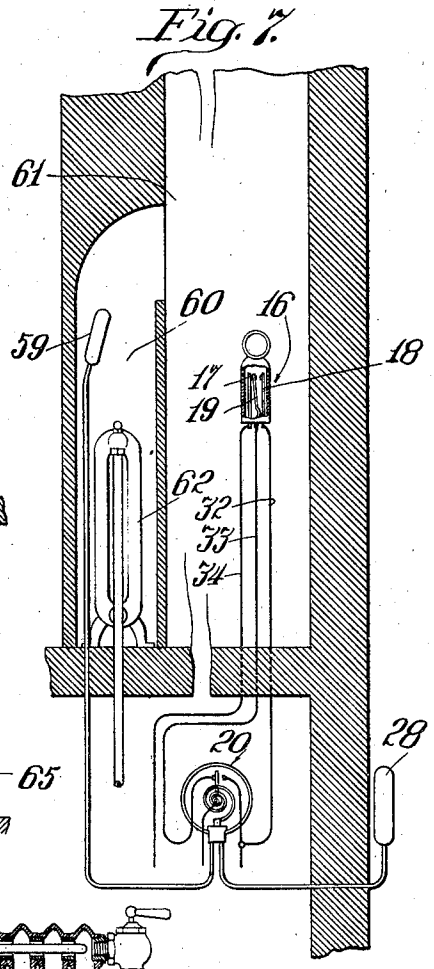
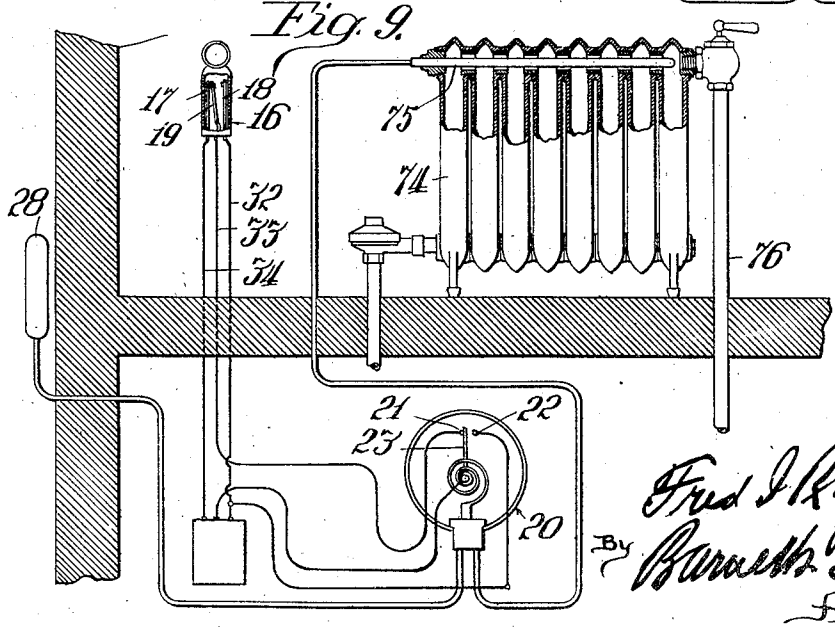


Fig. 9.



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1,785,426

UNITED STATES PATENT OFFICE

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METHOD OF HEATING

Application filed July 16, 1928. Serial No. 293,293.

This invention relates to a new and improved method of heating having for its object the maintenance of a more uniform temperature in the space to be heated and, incidentally, a reduction in the amount of fuel consumed.

The method is applicable to heating by means of hot water, hot air or steam as heating media, and can be employed either for direct or indirect systems of heating, and, in the case of steam, either with high pressure, vacuum or vapor systems. In all cases it is applicable to systems using either solid fuel, such as coal, or fluid fuels such as gas or oil.

The method involves the control of the application of heat to the space heated, in accordance with temperature changes in said space and also in accordance with temperature changes in the heating medium; and varying the temperatures at which the heating medium accelerates and retards the fire (which phrase will be used hereinafter, for brevity, in the specification and claims to mean any increase or decrease in the amount of heat generated or applied to the space heated) in accordance with changes in temperature of the outside atmosphere.

The effect of this method of control is to minimize those fluctuations in the temperature of the space heated that are inherent in any system involving retardation and acceleration of the fire by intermittent action. In any such system the response of the fire, in case of the solid fuel fire when the furnace dampers are opened and closed, will not be immediate. Another factor of lag is the stored heat in the heating medium where such medium consists of hot water or steam. There is also a lag in temperature change as between the source of radiation (radiator) or of convection currents (hot air register) and the place where the control instrument is located. In accordance with the present method these fluctuations of temperature in the space heated, both above and below the desired temperature, if not entirely eliminated, are reduced to a minimum by the maintenance of the heating medium at all times and for all weather conditions at temperatures very close to those required for keeping the temperature of the space heated at the desired level. This "cold 70" is effectively done away with, that is a condition in which despite the fact that the room thermostat indicates 70° F. the actual temperature of the room, and particularly the part of the room near the windows where it is customary to locate radiators, is below 70° F.

The correlation of the two control factors—that responsive to fluctuations in the room temperature, and that responsive to temperature fluctuations in the medium as modified by outside temperature—may take different forms according to the particular result desired. For example, (1) the fire may be accelerated only when lower critical temperatures are reached both in the space heated and in the heating medium while the fire is retarded whenever either upper critical temperature is reached. This means that the heating medium will never exceed a certain maximum, regardless of the requirements for heat of the room.

(2) In accordance with another embodiment of the method the fire will be accelerated whenever either the room temperature or the temperature of the heating medium falls below a certain point while the retardation of the fire is dependent upon both room atmosphere and heating medium being at or above determinate upper temperatures. This means that the radiators (assuming a hot water or steam system) will always be maintained at a certain fixed high temperature even though it may be at the expense of overheating the medium.

(3) These two types of control correlation may also be combined to obtain, to some extent, the advantages of both.

In any case the adjustments may be such as to give what may be termed "point control" so far as concerns the instrument responsive to changes in room temperature.

In the ordinary thermostatically controlled heating system the room thermostat functions to accelerate and retard the fire at temperatures which may be, for instance, two degrees apart. That is, the fire is accelerated when the room temperature falls, say, to 68°

Fahrenheit. The fire is not retarded until the room temperature reaches, say, 70° Fahrenheit. This will necessarily involve an accentuation of the lag as between the desired change in room temperature and the change in the setting of the control instrument. That is, assuming a straight line to represent the temperature of the heating medium required to maintain the room at the desired temperature the actual temperature curve of the heating medium will oscillate periodically above and below such line. With what has been termed "point control" involving alternate retardation and acceleration whenever room temperature varies from a single point one serious cause of lag as between the functioning of the control mechanism and the response thereto of room temperature is eliminated.

The method will be better understood from the following description of its application to the different types of heating systems and to different types of control correlation which are illustrated diagrammatically in the accompanying drawings in which:

Fig. 1 shows the invention as applied to a hot water system in which the medium is heated by a solid fuel fire having the first mentioned type of control.

Fig. 2 shows the application of the method to a water heating system but with one of the control elements in a different position.

Fig. 3 shows a system embodying the second mentioned type of control correlation.

Fig. 4 illustrates a system combining both types of control correlation.

Fig. 5 illustrates the application of the method to a vacuum or vapor steam heating system.

Fig. 6 illustrates its application to a hot air system.

Fig. 7 shows the application of the method to an indirect heating system, so-called, in which air for heating the room is caused to move past a heating device.

Fig. 8 illustrates a system in which the control is applied to a multiple oil-burning or gas-burning furnace for accelerating or retarding the fire by control of the burners singly; and

Fig. 9 illustrates an embodiment of the method in which the control is applied to the radiator of a steam or vapor system to vary the extent to which the radiator will be filled with steam.

Other applications of the method of practice are possible and it is my purpose to cover by patent all variations on the method as illustrated and hereinafter described, and all applications of the same to practice within the scope of the hereto appended claims.

Referring first to Fig. 1, 10 designates the boiler of a hot water heating system and 11 the motor or other equivalent device for controlling the fire under the boiler, the drawing illustrating the usual periodically actuated motor for a solid fuel furnace having cranks 12, 13 connected by chains 14, 15 with the ash-pit door and check draft dampers of the furnace.

16 is a room thermostat of ordinary construction. This device may have the usual manual or time adjustment for night and day operation of the fire. The thermostat is shown in a conventional manner, 17 being the low temperature contact, 18 the high temperature contact and 19 the heat sensitive circuit closing element or movable contact which vibrates between the fixed contacts 17 and 18.

The compound thermostat designated 20 (by which is intended the instrument responsive to temperature fluctuations of the heating medium modified by outside temperature) is provided with a low temperature contact 21, a high temperature contact 22 and a circuit closing element 23 which latter is oscillated by means of a spiral tubular element 24, the interior of which is connected by tubes 25, 26 with bulbs 27 and 28, the spiral tubular element, tubes and bulbs containing a fluid which expands and contracts appreciably with changes of temperature. The bulb 27 is arranged so as to respond to temperature changes of the heating medium. It is shown as submerged in the water in boiler 10. The bulb 28 is arranged so as to respond to fluctuation in the temperature of the outside atmosphere. The bulb 28 however need not be exposed directly to the outside atmosphere so long as it is so placed as to respond to the temperature changes thereof. The bulbs 27 and 28 may be equal in volumetric contents or different in volumetric contents, in any proportions, dependent upon the extent to which it is desired to have changes in outdoor temperature modify the control effected by temperature fluctuations of the heating medium.

The wiring system for the apparatus is a modification of the common three-wire system used in temperature control apparatuses.

A specific example of the operation of the system is as follows: It will be assumed that with the water of the heating system at 170° Fahrenheit the heat output of the system will be somewhat more than is necessary under any conditions to keep the house warm with an outside temperature of 0° Fahrenheit. The bulbs 27 and 28 as shown are of the same size, although this in practice will depend upon the particular heating plant with which the control system is associated. The compound thermostat 20 may be calibrated to function at a low temperature of 160° F. and at a high temperature of 170° F. With an outside temperature of zero the temperature of the water in boiler 10 will therefore have to reach 170°, or thereabouts, before this thermostat will function to slow down the fire. If the

outside temperature instead of being zero Fahrenheit is 60° Fahrenheit the boiler temperature need rise only to 110° before the fire is retarded. At 10° below zero the boiler temperature must be 180° in order to actuate the thermostat to retard the fire. Other outside temperatures will modify the operation of the compound thermostat proportionately. In the drawing the parts of control apparatus are shown in the positions they will occupy when the heating system is first started up. That is, the temperature in the room 29 in which thermostat 16 is located is at or below 70°, the temperature at which the oscillating member 19 of the thermostat 16 contacts with the low temperature contact 17. The water in the boiler is also below 120° F., let us say, assuming for the purpose of illustration an outside temperature of 50° F. If the time be early morning the oscillating member of thermostat 16 has been brought against contact 17 by the timing mechanism of the room thermostat. Under these conditions the fire is drawing. Thermostat 20 will ordinarily be first to operate. As soon as the water in the boiler reaches a temperature of 120° F. the circuit closing member 23 of thermostat 20 will be moved against the high temperature contact 22 closing a circuit through motor 11 over wires 30 and 31. The closing of this circuit actuates motor 11 to retard the fire. If in the meantime the room temperature has reached 72°, the temperature at which the oscillating member 19 is brought into contact with the high temperature contact point 18, the fire will be retarded by the room thermostat 16 acting independently of the compound thermostat 20, by the closing of a circuit comprising wires 30, 32, 33 and 31. This circuit includes the low temperature contact 21 of thermostat 20 against which, by supposition, the arm 23 of thermostat 20 lies. Ordinarily however thermostat 20 will function several times to retard and accelerate the fire before the temperature of the room 29 will have risen to a point to break the circuit at 19—17. The thermostat 20 operates to accelerate the fire when the heating medium cools to 160° F. by closing at 23—21 a circuit comprising wire 34, low temperature contact 17 of the room thermostat 16, movable contact member 19 of thermostat 16, wire 33, low temperature contact 21 of thermostat 20, movable contact member 23 of thermostat 20 and wire 31. This fire accelerating circuit includes, it will be seen, the low temperature contacts of both thermostats so that while either thermostat can retard the fire, depending upon whether the circulating water is first to heat up to its maximum critical temperature or the room temperature heats up to its maximum critical temperature, both water and room temperatures must be at or below their minimum critical temperatures in order that the fire should be accelerated. In starting up the system in the morning the water will be heated up to 120° (on the conditions assumed) several times before the room thermostat breaks the "on" circuit at 19—17. The room thermostat merely puts a check upon the compound thermostat, preventing such overheating as might occur because of the fact that the compound thermostat is adjusted to control the system for an output of heat enough in excess of actual requirements to take care of the variable factors of wind, heat from the sun, etc. In effect the control of the room thermostat 16 is a point control. Whenever the temperature in the room rises above 70° enough to move oscillating member 19 away from contact 17, the fire will be accelerated provided the circulating water is at or below the low temperature point of the compound thermostat 20. That is, the movable contact member 19 of the room thermostat does not have to move over to the high temperature contact 18 before acceleration of the fire takes place.

Because of this mode of operation, there is a close correspondence between the temperature of the heating medium and the requirement for heat of the space to be heated, and this regardless of changes of outside temperature. The fluctuations in room temperature incident to the intermittent acceleration and retardation of the fire and resulting from the delay in the response of the system to temperature changes in the space heated, are reduced to a minimum. The temperature curve of the heating medium, instead of periodically rising considerably above and then falling considerably below the straight line representing the required temperature level, closely approximates such line.

It may be stated that contact 18 of the room thermostat 16 could be eliminated. It has no function so far as the method of control is concerned. In practice the thermostat has this upper contact as a measure of safety in case the compound thermostat should fail to function.

In Fig. 2 a similar method but with some modification is applied again to a hot water heating system. The furnace 35 in this form of the invention is indicated as an oil-burning furnace. The thermostatic mechanism actuates a control device 36 for controlling the supply of fuel to the furnace. In this arrangement the bulb 37 of the compound thermostat 20, which is to be subjected to fluctuations in the temperature of the heating medium, is clamped to the return pipe 38 from the radiating system, represented by radiator 39, to the boiler of the steam generator. The wiring arrangements are the same as in Fig. 1. By associating the bulb 37 with the return pipe, the water throughout the circulating system will have to be raised to a

certain point before thermostat 20 will function to retard the fire.

In Fig. 3 the method utilizes the control correlation (2) mentioned above. In this embodiment of the invention either the room thermostat 16 or the compound thermostat 20 will function to accelerate the fire, whichever thermostat closes its circuit first; but both must close their circuits in order that the fire be retarded. The system insures a quick heating up of the room when the system is first started up, for example. It also positively eliminates "cold 70". The radiator temperature (once the system is balanced) can never fall below a determinate point. The arrangement has the disadvantage that since the control apparatus does not impose an upper temperature limit on the medium a separate safety device may be required for the boiler.

In a typical case the high temperature point of the room thermostat 16 may be 70° F. and the low temperature point 68°. The compound thermostat 20 may be set for low temperature actuation at 150° F. and high temperature actuation at 170°. These temperatures are of course merely illustrative. When the system is started up in the morning the movable contact members 19 and 23 will be against their respective low temperature contacts. Ordinarily the heating medium will heat up to the high temperature point of thermostat 20 before the room temperature has brought the movable contact member 19 against the high temperature contact 18. However the fire will not be retarded until both movable contact members are against their respective high temperature contacts. When this occurs the fire will be retarded by the closing of a circuit as follows: wire 40, high temperature contact 18 of the room thermostat 16, movable contact member 19, wire 41, high temperature contact 22 of compound thermostat 20, movable contact member 23 and wire 42. The fire will again be accelerated as soon as the heating medium cools to 150° F. or if before that time the room temperature should fall to 68° F. The circuit through the low temperature contact of the compound thermostat is as follows: wire 43, low temperature contact 21, movable contact member 23 and wire 42. The circuit through the low temperature contact of the room thermostat 16 is as follows: wire 43, wire 44; low temperature contact 17 of thermostat 16, movable contact member 19, wire 41, high temperature contact 22 of thermostat 20, movable contact member 23, and wire 42. Thus the room thermostat may bring about an acceleration of the fire even if the temperature of the medium has been previously raised to such a point as to cause thermostat 20 to bring about a retardation of the fire; that is, if the temperature of the medium in rising has reached 170° F. so that movable contact member 23 is against the high temperature contact 22, thus slowing the fire down. If the temperature of the room falls to 68° the fire will again be started up even though the heating medium is still at or above the upper critical temperature of the compound thermostat.

However, this situation will not ordinarily be presented. Once the heating system is in operation movable contact member 19 will oscillate in proximity to the high temperature contact 18, bringing about a retardation of the fire when the circuit is broken at this point and an acceleration of the fire, through operation of the compound thermostat, when the circuit is closed. In short, there will be point control but as between movable contact member 19 and the high temperature contact 18.

The system shown in Fig. 4 combines the control methods of the systems shown in Fig. 1 and Fig. 3. The compound thermostat 20 has, in addition to the low temperature contact 21 and high temperature contact 22, a contact plate 45, with which the movable contact member 23 is in contact except just before it is moved against contacts 21 or 22.

To illustrate a particular case, assume that the room thermostat 16 is set for a high temperature of 70° and a low temperature of 68° and the compound thermostat (in the case of a hot water system) for a high temperature of 170° and a low temperature of 150°. The drawing illustrates the positions of the movable contact members when the fire is first started up. Ordinarily the heating medium will heat to 170° before the room temperature reaches 70°. In that case the fire will be retarded by the closing of a circuit as follows: wire 46, movable contact member 23 and thermostat 20, high temperature contact 22, and wire 47.

However, if the room temperature reaches 70° before the heating medium is elevated to 170° the fire will be retarded by closing of a circuit as follows: wire 47, wire 48, high temperature contact 18 of the room thermostat 16, movable contact member 19, wire 49, contact plate 45, movable contact member 23 (which, except for extreme positions, will be on contact plate 45) and wire 46.

As soon as the water falls to 150° a circuit is closed, bringing about an acceleration of the fire, this circuit being as follows: wire 46, movable contact member 23 of thermostat 20, low temperature contact 21, and wire 50. Ordinarily the fluctuations of temperature between the limits for which the thermostats are set will be more rapid in the heating medium than in the space heated, so that the compound thermostat will control the system subject to the making and breaking at 19—18 of the circuit through the room thermostat. However, if on falling temperatures the room thermostat acts first it will

accelerate the fire by the closing of a circuit as follows: wire 50, wire 51, low temperature contact 17 of thermostat 16, movable contact member 19, wire 49, contact plate 45, movable contact member 23 of thermostat 20 and wire 46. The gaps between the contact plate 45 and contacts 21 and 22 of thermostat 20 provide appreciable intervals of time between the actuations in opposite senses of the control apparatus by the two thermostats. This correlation of the controls insures maintenance of room temperature at a fixed point, eliminating any possibility of "cold 70", besides insuring a quick heating up of the room when the system is started up and also puts an upper limit on the water temperature so that an additional safety device on the boiler is not required.

Fig. 5 illustrates the application of the method to control of a vacuum or vapor steam system. The thermostats and their wiring are the same as shown in Figs. 1 and 2 (although the systems of Figs. 3 or 4 might be used). The furnace is indicated as an oil burning furnace. The bulb 52 of thermostat 20, which is responsive to temperature fluctuations of the heating medium, is associated with the radiator 53, which is the most remote from boiler 35. The bulb is shown as clamped to the inlet pipe 54 to radiator 53. It might be otherwise placed so as to respond to the temperature fluctuations of the medium at approximately this place in the radiating system. The purpose is to insure the complete filling of the radiating system with steam before the compound thermostat is actuated to retard the fire and the continuous operation of the system at outside temperatures above the temperature at which the operation of the ordinary vacuum system, for example, ceases to be continuous.

The bulb 52 is preferably half the size of the outdoors bulb 28. This provides for a reduction in radiator temperature of 2° for every one degree increase in outdoors temperature. This is a customary gradient used in vacuum systems.

The system will permit the fire to operate in the morning until the room thermostat has functioned to retard the fire, or until the system is freed of air and the medium in the last radiator, the one most remote from the boiler, has reached a point at which the compound thermostat 20 will retard the fire.

Fig. 6 illustrates the application of the method to a hot air heating system. The thermostats and their wiring are the same as in Figs. 1 and 2 (although the arrangements of Figs. 3 or 4 might be substituted) but the bulb 55 of the thermostat 20 is arranged in the hot air flue of the furnace 56, 57 designating one of the hot air pipes 57 of the furnace leading to the usual register 58.

Fig. 7 illustrates the application of the method to the control of an indirect heating system. The thermostats and their wiring are shown the same as in Fig. 1. The bulb 59 of the compound thermostat 20 is arranged in the hot air duct 60 leading to the space 61 to be heated. 62 designates a steam or hot water radiator arranged to heat the air passing through duct 60.

Fig. 8 illustrates the application of the method as applied to the control of a system in which the heating medium, hot water, for example, is heated by a plurality of fluid fuel, for example, oil burners, two of such burners being shown. Each burner is controlled by the combined action of a room thermostat and a compound thermostat, the latter being set so that they function at different water temperatures. The room thermostats function preferably at the same high and low points, for example 72° and 70°. The wiring of the control apparatus for each burner may be the same as shown in Fig. 1. The furnace is designated 63 and has two burners, which, with their fuel controlling devices, are designated 64, 65. The room thermostats 66, 67 are preferably located in different rooms 68, 69. The compound thermostat 70 may be set to function at 158° F. and 168° F., for example, with an outside temperature of 0° F. The compound thermostat 71 may be set to function at 160° and 170° F. Each thermostat has an outdoors bulb 72 and a bulb 73 in the water space of the boiler 63 or elsewhere in the water system as may be desired. Under these conditions, (assuming the system as being started up) and assuming, say, an outside temperature of 50° F., thermostat 70 will retard the fire by shutting off burner 64 when the water temperature reaches 118°.

The other burner continues to operate. This burner is shut off, however, as soon as the water temperature reaches 120°. The room thermostats 66, 67 are located in different parts of the house. If the temperature in either of these rooms reaches the upper critical temperature for which the room thermostat is set, the thermostat will operate to shut off the burner which it controls. In this system the acceleration and retardation of the fire is by increments and decrements, proportioned to the maximum intensity of the fire, depending upon the number of burners individually controlled. One advantage is that if a window is opened in one of the rooms 68, 69, artificially stimulating the fire, the effect will be counteracted by action of the thermostat in the other room.

In Fig. 9 is illustrated an application of the method for the purpose of controlling the effective amount of radiating surface under steam in a steam or vacuum system. The thermostats and their wiring is shown the same as in Fig. 1. The bulb of thermostat 20, responsive to temperature fluctuations in the heating medium, is arranged to extend longitudinally through one of the radiators

designated 74, as indicated at 75. Thermostat 20 will therefore function to retard the fire when, having regard to outside temperature, the steam entering radiator 74 through pipe 76 has displaced the air and filled enough of the radiator sections so that the oscillating member 23 of thermostat 20 has been brought against the low temperature contact 21. The retardation of the fire will result in the arrest, to a greater or less extent, of further introduction of steam into the radiator, until such time as the fire is accelerated through functioning of the compound thermostat in the opposite direction. In this arrangement, therefore, the amount of radiating surface under steam depends upon the outside temperature as affecting bulb 28.

It will be obvious from the above specific embodiments of the invention that it is capable of application to practice in many different ways. The invention, therefore, is not to be considered as limited to any particular form of apparatus but resides in the method of control common to all of the typical installations chosen for illustration. The terms "acceleration" and "retardation" as applied to the fire are intended to include the turning on of a gas or oil flame and the shutting off of the same, in the case of furnaces of this type, as well as the increase or diminution of the flame as in Fig. 8.

This application is a continuation in part of my copending application, Serial No. 244,225, filed January 3, 1928.

I claim:

1. Method of heating which comprises controlling the introduction of heat to the space heated in accordance with temperature fluctuations of said space and also of the heating medium, and varying the temperatures at which the heating medium effects its control in accordance with temperature changes of the outside atmosphere.

2. Method of heating which comprises controlling the introduction of heat to the space heated in accordance with temperature fluctuations of said space and also of the heating medium, and varying the temperatures at which the heating medium effects its control inversely with respect to the rise and fall of outside temperature.

3. Method of heating which comprises controlling the introduction of heat to the space heated in response to temperature fluctuations of said space and also in response to fluctuations in the average of the temperatures of the heating medium and of the outside atmosphere.

4. Method of heating which comprises maintaining the heating medium at a temperature, by acceleration and retardation of the fire, between high and low critical temperatures whenever the space heated is below the desired temperature, which said critical temperatures are raised and lowered inversely with respect to changes in outside temperature and the average of which said critical temperatures is in excess of that required for keeping the space heated to the desired temperature, and decreasing the generation of heat whenever the temperature of said space reaches a determinable maximum.

5. Method of heating which comprises controlling the acceleration and retardation of the fire at critical low and high temperatures of the medium varied inversely with respect to changes in outside temperature, and making the control brought about at one of said critical temperatures dependent upon a determinate temperature condition in the space heated.

6. Method of heating which comprises increasing the introduction of heat to the space heated whenever the temperatures both of said space and of the heating medium, in falling, reach critical low temperatures, decreasing the application of heat to said space when the temperature of the heating medium, in rising, reaches a critical high temperature, and varying the critical temperatures at which the heating medium effects its control inversely with respect to rise and fall of outside temperatures.

7. Method of heating which comprises increasing the introduction of heat to the space heated whenever the temperatures both of the space heated and of the heating medium, in falling, reach a critical low temperature, decreasing the introduction of heat when the temperature either of the heating medium or of the space heated, in rising, reaches a critical high temperature, and varying the critical temperatures at which the heating medium effects its control inversely with respect to rise and fall of outside temperatures.

8. Method of heating which comprises increasing the introduction of heat to the space heated when the temperature of the heating medium, in falling, reaches a critical low temperature and decreasing the introduction of heat when the temperatures both of the heating medium and of the space heated, in rising, reach critical high temperatures and varying the temperatures at which the heating medium effects its control in accordance with temperature changes of the outside atmosphere.

9. Method of heating which comprises increasing the introduction of heat to the space heated when the temperature either of the heating medium or of the space heated, in falling, reaches a critical low temperature, and decreasing the introduction of heat when the temperatures, both of the heating medium and of the space heated, in rising, reach critical high temperatures, and varying the temperatures at which the heating medium effects its control in accordance with temperature changes of the outside atmosphere.

10. In a heating system the combination of a circuit making and breaking room thermostat having high and low temperature contacts and a movable contact member, and a compound circuit making and breaking thermostat subject to temperature fluctuations of the heating medium and also of the outside atmosphere and provided with high and low temperature contacts, a movable contact member and a contact intermediate the high and low temperature contacts over which the movable contact member moves but so as to be free therefrom when against the high and low temperature contacts; said high and low temperature contacts of the compound thermostat being in circuits, closed by the movable contact member of said thermostat which are independent of the room thermostat and the high and low temperature contacts of the room thermostat being in circuits, closed by the movable contact members of said thermostats which include the intermediate contact of the compound thermostat.

11. Method of heating which comprises controlling the introduction of heat to the space heated in accordance with temperature fluctuations of said space and also of the heating medium, and varying the temperatures at which the heating medium effects its control whenever any substantial changes take place in outside atmosphere temperatures and in accordance with such changes.

12. Method of heating which comprises controlling the introduction of heat to the space heated in accordance with temperature fluctuations of said space and also of the heating medium, and automatically varying the temperatures at which the heating medium effects its control in accordance with fluctuations in outside temperature.

13. Method of heating which comprises applying heat to the space heated, whenever the temperature in said space is below that desired, at a rate slightly higher than the normal rate required to keep the space heated at the desired temperature, reducing said rate of heat application whenever the temperature in said space is above that desired, and determining said first named rate of heat application by, and in accordance with, the outdoor temperature and the temperature of the heating medium.

14. Method of heating which comprises applying heat to the space heated, whenever the temperature in said space is above that desired, at a rate slightly lower than the normal rate required to keep the space heated at the desired temperature, increasing said rate of heat application whenever the temperature in said space is below that desired, and determining said first named rate of heat application by, and in accordance with, the outdoor temperature and the temperature of the heating medium.

15. Method of heating which comprises applying heat to the space heated, whenever the temperature in said space is below that desired, at a rate slightly higher than the normal rate required to keep the space heated at the desired temperature, reducing said rate of heat application, whenever the temperature in said space is above that desired, to a rate slightly lower than the normal rate required to keep the space heated at the desired temperature, and determining said rates of heat application by, and in accordance with, the outdoor temperature and the temperature of the heating medium.

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