Aug. 30, 1932. L. M. PERSONS 1,874,710

REGULATOR

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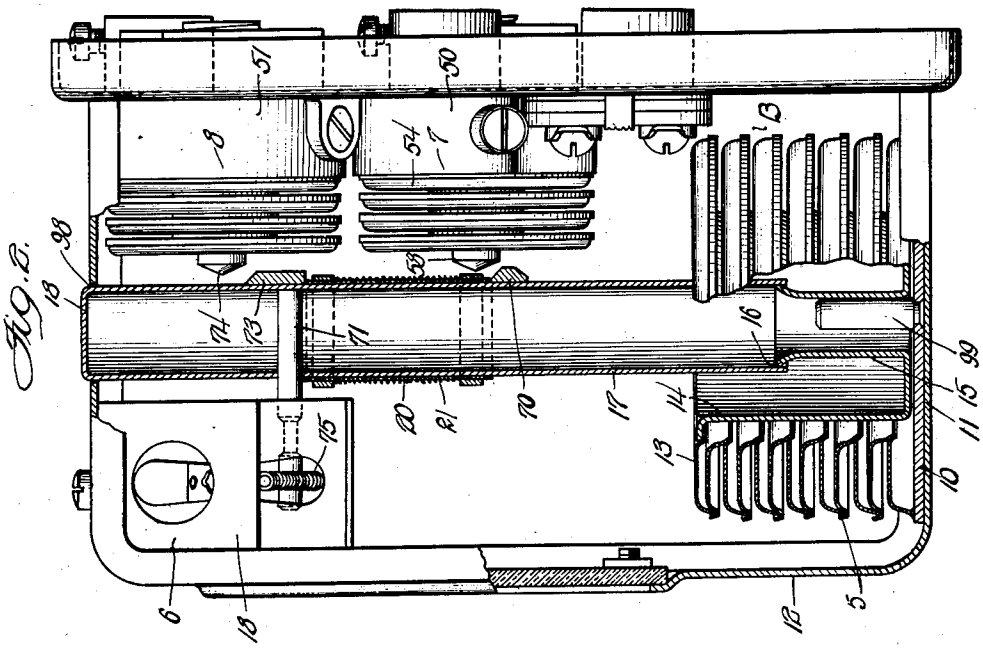


Fig. 2.

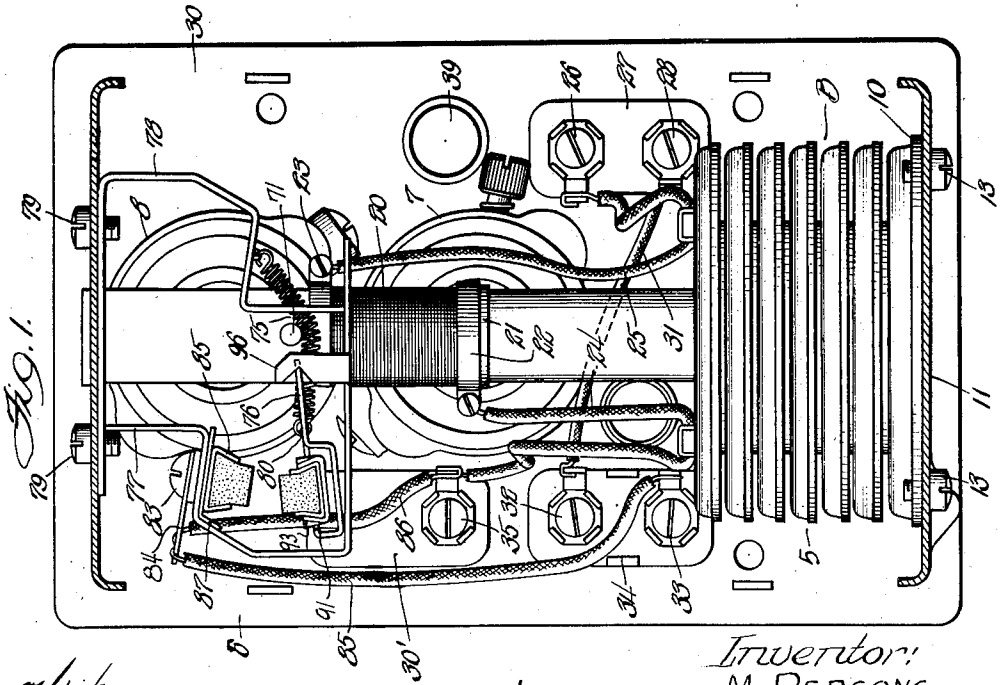


Fig. 1.

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Fig. 3.

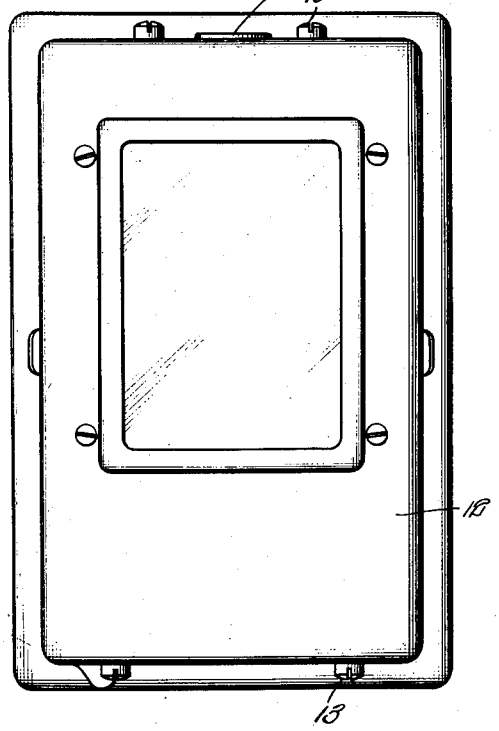


Fig. 4.

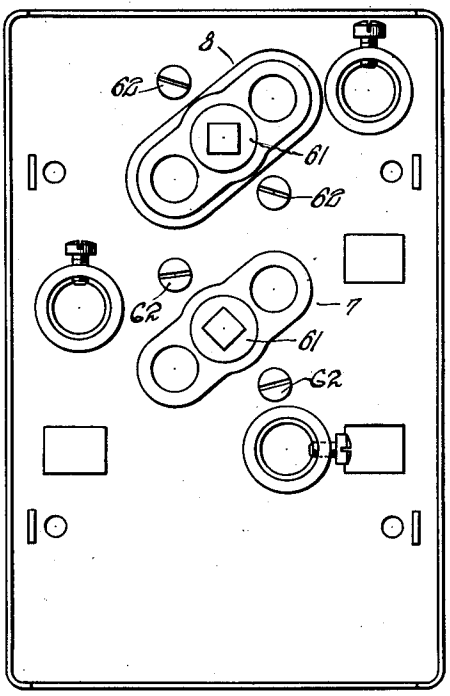


Fig. 5.

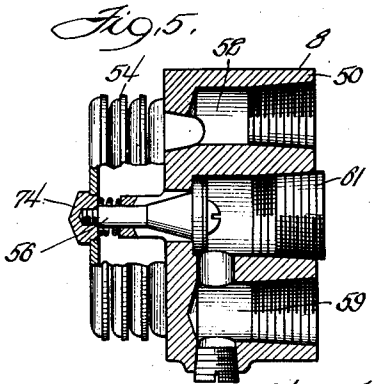


Fig. 6.

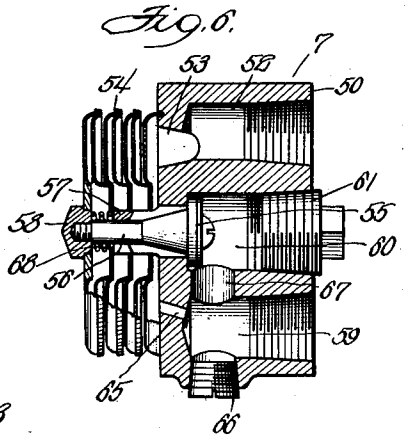


Fig. 7.

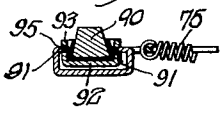
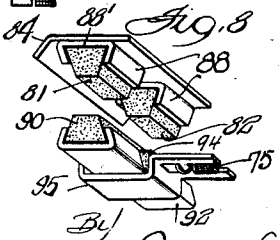


Fig. 8.



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Fig. 9.

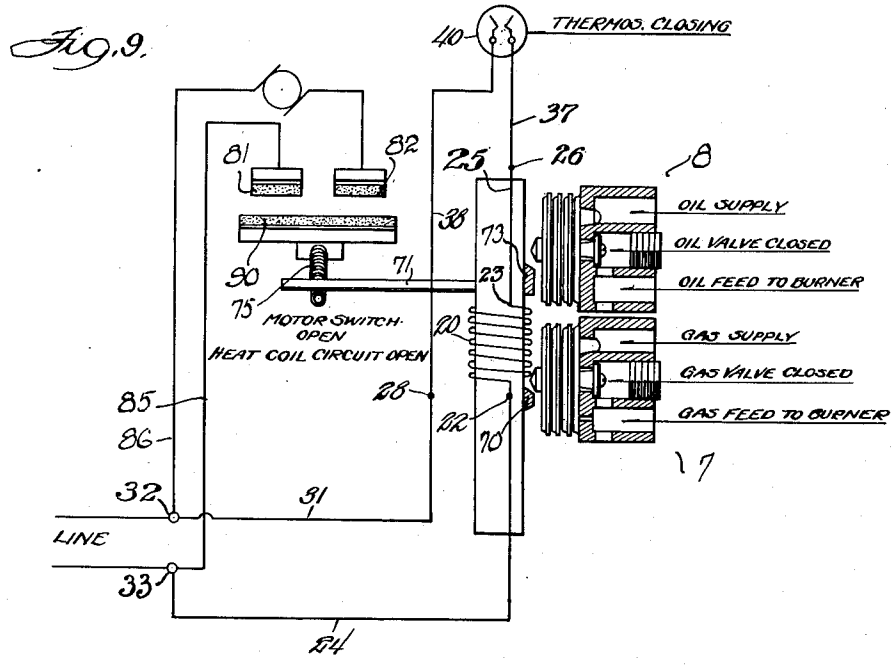
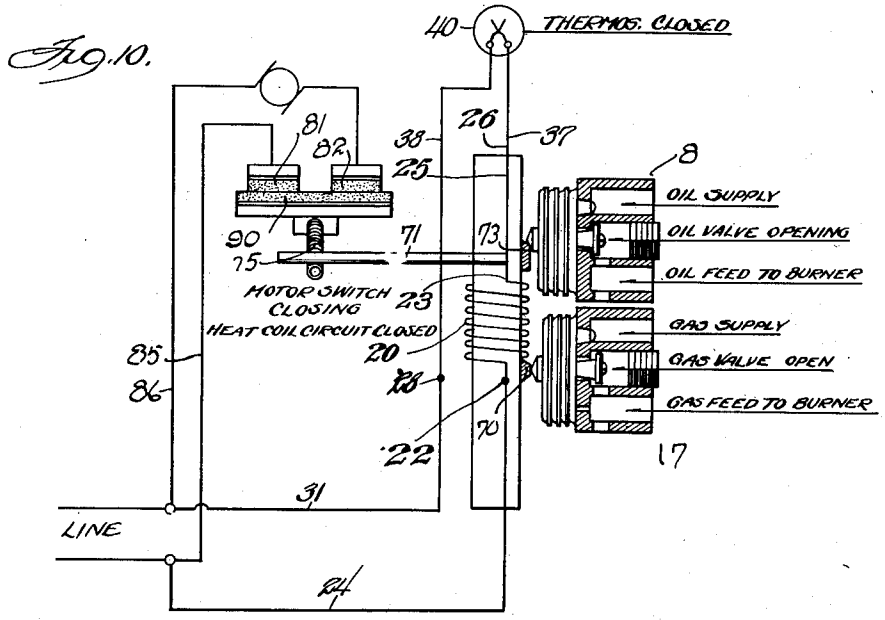


Fig. 10.



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Fig. 11.

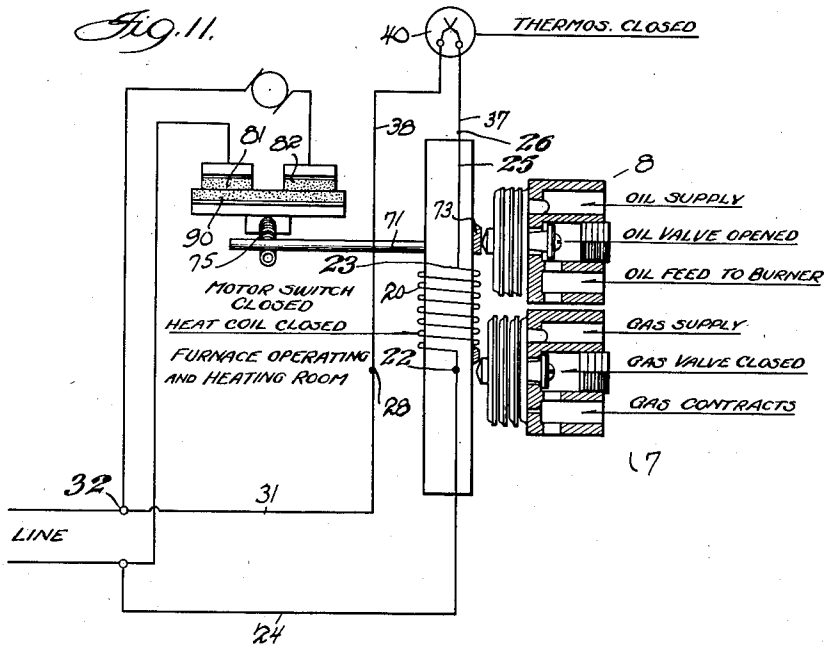
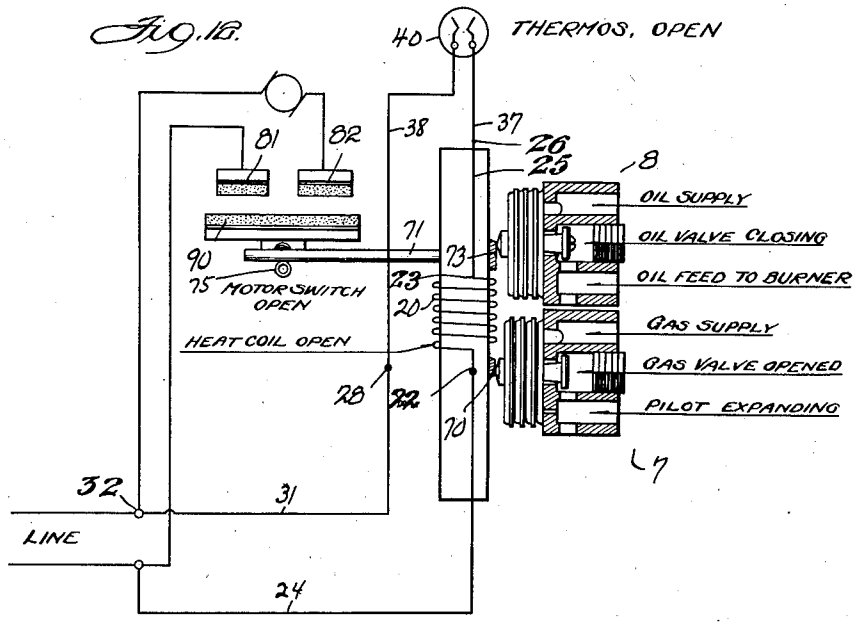


Fig. 12.



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Aug. 30, 1932. L. M. PERSONS 1,874,710

REGULATOR

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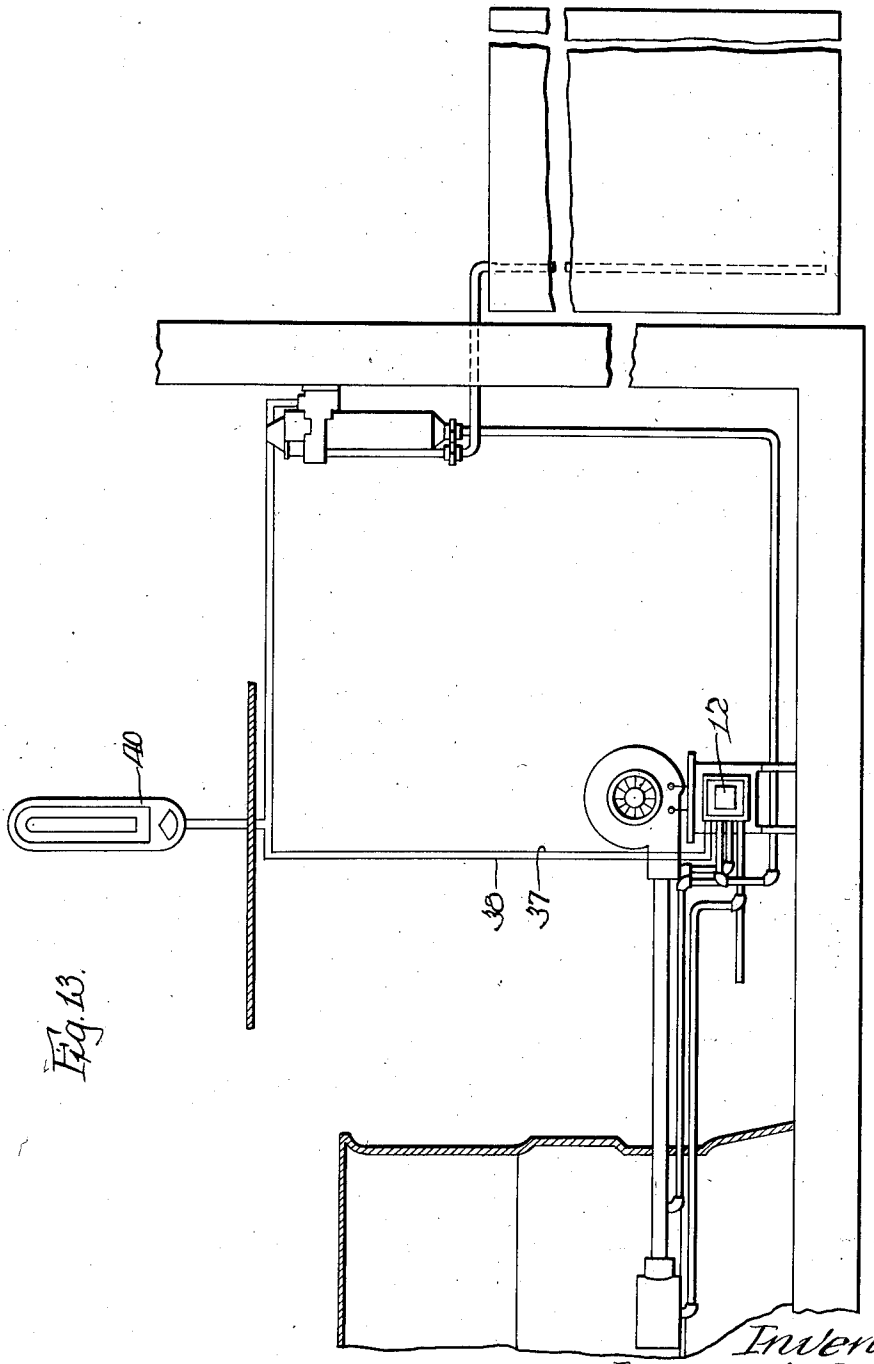


Fig. 13.

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Patented Aug. 30, 1932. 1,874,710

UNITED STATES PATENT OFFICE

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REGULATOR

Application filed June 15, 1925. Serial No. 37,091.

My invention relates to an improved burner control and more particularly to a burner control adapted for use in oil burning systems. While my invention refers particularly to a regulator uniquely adapting itself for use in oil burning systems, I do not desire to limit my invention solely to this adaptation, as it is possible broadly to apply the essentials thereof to controls used for other purposes.

More particularly the subject matter herein disclosed is a continuation in part of my copending application, Serial No. 757,966, filed December 24, 1924, now Patent No. 1,746,674, granted Feb. 11, 1930.

The burner control disclosed herein is an improvement over the time-limit regulator disclosed in said copending application, and includes certain features, which I consider broadly new in the art. Burner controls should preferably operate upon the principle of certainty in order to render the operation of oil burners safe. Experience has proved the need for safety, if the oil burner is to be successful and extensively used as a heating unit for homes and like buildings.

In my copending application, the principle of operation of the burner control is based upon the fact that in a time-limit regulator of the type herein shown, the heating effects of the current flow in an electric circuit are the safest and surest way to secure an accurately timed movement, and that certain results can be secured by depending upon the development of the heat by the current, which can not be obtained through utilization of the magnetic, or other effects.

I am aware that it is customary in the oil burning art to provide certain controls, most of which are operated by the magnetic effects of current, but as I have hereinbefore stated, it is essential that the operation of an oil burning system should be based upon the principle of certainty, rather than upon other considerations. With this in view, it is preferable to provide a thermally controlled element, which is not subject to the current directly, and which in fact has no relation to the current flow as such, inasmuch as its movement is permitted to depend on the heat developed in the circuit by the current flow and is not electrically influenced by it.

A thermostatic device controlled by the temperature of the room to be heated may be provided. The thermostatic circuit may be coupled with the thermally controlled element in a manner permitting the heating effects of the current flow in this circuit to influence the thermally controlled element. This element may function to actuate certain circuit controlling devices, such as a motor switch, and at the same time to actuate certain valve members, which may control the flow of gas to a pilot flame at the burner, and also the flow of oil through the fuel line leading to this burner.

In my copending application the thermally controlled element operates on a time limit principle and preferably does not reach the end of its movement until a certain time interval has elapsed. A control circuit is employed to limit the movement of the thermally controlled element, by being interconnected therewith and so disposed as to open the heating circuit when the end of this movement is reached. Gradual dissipation of the heat starts the thermally controlled element on its return movement, but this merely recloses the control circuit, and consequently, the heating circuit. Thus the regulator automatically operates back and forth until the room temperature causes the heating circuit to be opened by the thermostat.

An object of the present invention is to so arrange the heating circuit with respect to the thermally controlled element as to eliminate the need for the aforesaid control circuit. The provision made for accomplishing this result, which is an important feature of this invention, includes a heating element subjecting a portion only of the thermally controlled element to the heat developed by the current flow. This portion is in effect thermally disconnected from the expanding portion of the thermally controlled element. As a consequence, the mass to be heated is materially lessened and the thermally controlled element is prevented from unduly dissipating the heat by radiation.

A further object of the invention resides in providing the thermally controlled element with a portion of relatively high heat conductivity for conducting the heat developed by the current flow. A highly volatile fluid is expanded and driven into the element, but further effective conduction of heat, so as to cause further expansion of the fluid, is prevented by thermally disconnecting this heat conducting portion, at its point of interconnection with the expanding portion, by means of material having relatively low heat conductivity, and considerably smaller cross-sectional area, if desired.

In order to apprise those skilled in the art how to construct and practice my invention, I shall now describe an embodiment thereof in connection with the accompanying drawings forming a part hereof.

In the drawings:

Figure 1 is a front elevation view of a time limit regulator embodying my invention, the side and front walls of the housing being removed in order to show more clearly the operating parts thereof;

Fig. 2 is a view partly in section and partly in elevation of the device, being taken at right angles to the device as shown in Fig. 1;

Fig. 3 is a front elevation illustrating the device completely enclosed within the housing;

Fig. 4 is a rear view of the device;

Fig. 5 is a vertical sectional view through the oil supply valve;

Fig. 6 is a similar view through the pilot light valve;

Fig. 7 is a cross sectional detail view of the switch arm of the motor switch;

Fig. 8 is a detail perspective view of the contact members of this switch;

Fig. 9 illustrates diagrammatically the relative position of the movable parts of the mechanism when the thermostatic circuit is about to close and place the system in operation;

Fig. 10 is a similar view, but illustrating herein the pilot light flared, the motor switch closed and the oil valve about to open to start the burner operating;

Fig. 11 is also a similar view showing another step in the operation, the position of the parts being that which represents the system in full operation;

Fig. 12 illustrates the relative position of the movable parts when the system is about to shut down; and

Fig. 13 is a diagrammatic view illustrating the control attached to a burner.

Broadly, I contemplate using an electrically operated means having a thermally controlled element B in the form of an expanding bellows 5 as the means by which to actuate the controlling members of the burner control herein shown, and relying upon the heat developed by the current flow in the thermostatic circuit for operating the bellows. A motor switch 6 is so disposed with respect to bellows 5 that it is adapted to be opened and closed by the expanding and contracting movements of the bellows, and in a certain timed relation to the opening and closing of a pilot light valve 7. Further, this motor switch is so disposed with respect to bellows 5 that it is adapted to be opened and closed in a certain timed relation to the opening and closing of an oil valve 8. It will be further noted that the opening and closing of the pilot light valve 7 is related to the opening and closing of the oil valve 8. I preferably rely upon the bellows as the single means by which to carry out substantially the entire operation of this burner control which embodies practically all of the controlling members required in a fuel burning system designed for safety and efficient operation. The operation of these controlling members is automatic and in a certain time relation, or sequence, to one another. When the thermostatic circuit closes, the current flow will immediately develop the heat required to operate bellows 5. Within certain limits, the heat developed need not be accurately pre-determined, due to certain novel means, which I employ herein to limit the conduction of heat, and which forms the essence of the present invention.

My device will now be described more specifically in detail. The expansible and contractible bellows 5 is secured to a base 10. Base 10 may be secured to the bottom, or base 11, of a housing 12 by means of screws 13. Bellows 5 may be of any desired construction, but is preferably of the type disclosed and claimed by me in my copending application, Serial No. 712,177, filed May 10, 1924. The upper section 13 is suitably secured or sealed to a cup 14 lying centrally within the bellows. This cup 14 is of a considerable depth and is adapted to have a narrow hollow neck 15 formed therein. A liquid tight seal is then provided at the point 16 between neck 15 and a vertical tube 17. The tube 17 is closed off at its upper end, as indicated at 18, but is adapted to be in communication with the interior of bellows 5 through the hollow neck 15.

Heating element 20, which is in the form of an electric resistance coil, suitably surrounds the tube 17. This coil is, of course, electrically insulated from the tube 17, but is in close proximity thereto in order to conduct the heat developed by the current flow through the coil to a highly volatile fluid within the tube and bellows. Tube 17 and neck 15 are preferably of different materials. Heat is conducted through the tube to the volatile fluid therein to cause it to expand and be driven through the neck in bellows 5. The conduction of heat to bellows 5 is, however,

checked by means of neck 15, which may be of a smaller cross sectional area and of material of lower heat conductivity. Of the different kinds of material that may be used, I desire to mention that the tube 17 may be of brass, while the neck 15 may be of steel. The brass, being of greater conductivity, will permit the heat to expand the volatile fluid as long as it is within this tube, but further conduction of the heat is checked at the point 16 where the steel neck is secured to the lower end of tube 17. After the volatile fluid is driven in the bellows, I find that further expanding action of the bellows is substantially checked. This is due to several reasons: first, the neck 15 is of a different material than the tube 17, and, consequently, the heat is not conducted as rapidly, and second, the cross sectional area of neck 15 is substantially smaller than that of the tube 17. Moreover, the experiments which I have conducted have shown that the conduction of heat may be checked to a satisfactory degree at the point 16 when the neck is of a smaller cross sectional area only and when the material is of the same or different heat conductivity. On the other hand, I find that the same result can be accomplished when the cross sectional area of the neck is disregarded and material is of a predetermined heat conductivity, preferably lower of course and sufficient to prevent the heat from traveling to the bellows 5. A sheet of insulation 21 may be wrapped about tube 17 at a point where the heat coil 20 is mounted. Terminal bands 22 and 23 secure the ends of the heat coil 20 to the leads 24 and 25. Lead 25 connects to a terminal 26. An insulation plate 27 is suitably attached to a back wall 30 of the burner control device for carrying this terminal 26, as well as another terminal designated 28. From the terminal 28, a lead 31 extends to a terminal 32. The terminal 32, together with a second terminal 33 (which constitute the line terminals), is likewise carried upon a second insulation plate 34 secured to the back wall 30 of the housing. Lead 24 connects between the terminal band 22 and a terminal 35 connected to the back wall 30 on an insulation plate 30', directly above the terminals 32 and 33. From terminals 26 and 28, suitable conductors 37 and 38, shown in Figs. 9 to 12, inclusive, lead through a conduit opening 39 in the back wall of housing 30 to a suitable thermostat 40, that may be located anywhere in the building in which the oil heating system is disposed. Themostat 40 is controlled by the room temperature and serves automatically to open and close the motor circuit. As is well known, this thermostat may be adjusted to maintain a predetermined temperature within the building. If this temperature falls below the point at which the adjustment is made, the thermostat closes, thereby causing the current to flow through the circuit, which includes the heating element 20. The heat developed in element 20 expands the bellows 5 and causes the pilot valve 7 momentarily to open in advance of the closing of motor switch 6. As soon as the motor switch is closed, the oil valve 8 is also opened to feed a sufficient quantity of fuel to the burner. The heating system is allowed to remain in operation until the room temperature reaches the aforesaid point at which the thermostat is adjusted, whereupon this thermostat opens to break the circuit and shut down the system.

In the operation of an oil burning system, it is difficult to ignite a mixture of non-volatile heavy hydrocarbon such as kerosene at a normal temperature and air in sufficient quantity to support complete combustion. The matter of ignition has been a difficult problem in the art of oil burning, due to the fact that usually such a mixture is non-ignitible by an electric spark irregardless of the temperature of the spark. City gas has been employed to maintain an ordinary pilot light, but in order for the oil burning system to be automatic, the pilot light must be kept burning constantly, which is not desirable unless the size of the flame of the pilot light is kept at a minimum so as to effect economy in the cost of operation. Small pilot lights of this type are insufficient to support ignition, especially at low temperature. Where the fuel is first atomized before burned, it is fed with considerable pressure and, as a consequence, there is a tendency to blow out the pilot light, or, on the other hand, to prevent proper ignition due to the fact that the small particles of the atomized liquid usually travel at a high rate of speed and do not remain a sufficient length of time in the zone of heat of the spark or small flame to insure their ignition.

I am aware that expanding pilot lights are old and well known, particularly for illuminating burners, but I intend employing it as part of the burner control disclosed herein so that the pilot light may be flared momentarily before the liquid fuel is fed to the burner. After the pilot flame is flared sufficiently to insure proper ignition, the thermally controlled element B may close the motor circuit by actuating the motor switch 6 and concurrently hold the gas valve 7 open for a period of time sufficient to allow the mixture to ignite and continue to burn at the nozzle.

It will be hereinafter apparent that the oil valve 8 is also opened substantially at the same time as the closing of the motor blower circuit so that oil may be fed to the venturi or other device by which the fuel is projected into the burner pot. Ordinarily the gas valve 7 will be held open by the thermally controlled element B for a period of approximately fifty-five seconds, the initial opening of the gas valve being ten seconds in advance of the closing of the motor blower circuit

by switch 6. I find that a period of approximately forty-five seconds is long enough to allow the mixture to ignite and continue to burn without relying further on the pilot light.

By referring particularly to Figs. 2, 5 and 6, it will be noted that I provide similar valve housings 50 and 51 on wall 30 for gas valve 7 and oil valve 8. The interior construction of housing 50 is shown in Fig. 6. An intake port 52 is preferably provided at one side of the center and communicates by means of a passage 53 with the interior of a bellows 54. Bellows 54 is of a construction similar to but smaller than bellows 5, and is provided to serve as a packing for the movable valve stem 56. Valve 55 is carried on stem 56, guided by an integral extension 57, disposed within the bellows. One end of the valve stem 56 is threaded into a cam head 58 carried in the outer wall of bellows 54. An outlet port 59 may be provided on the opposite side of valve housing 50 and is closed off from communication with the interior of bellows 54 by valve 55 seated within a central valve chamber 60. Valve chamber 60 is adapted to receive a plug 61 to close off its outer opening. I prefer to mount the valve housing 50 on the rear wall 30 and secure it in place by means of screws 62, which enter the wall 30 from the back side and pass into the valve housing. This arrangement also permits plug 61 to be screwed in place from the rear of wall 30. Moreover, it will be seen that it is possible to conveniently connect the gas supply pipe to the intake port 52 through the rear of the burner control, and to likewise connect the pipe leading from the outlet port 59 through the rear wall to the pilot light at the burner.

A by-pass 65 may provide a constant communication between the interior of bellows 54 and the outlet port 59, so that a constant supply of gas to the pilot may be furnished to provide a pilot light of reduced size when valve 55 is seated. It will be noted that a plug 66 is used to close off the outlet port 59 at one side where the drill enters the housing to connect the valve chamber 60 with the outlet port 59 by a passage 67.

Normally the valve tends to remain seated by means of a compression spring 68 coiled about valve stem 56 and confined between the cam head 58 and end extension 57.

A cam 70 is suitably positioned on tube 17 at a point adjacent to cam head 58 so that vertical movement of this tube will cause the cam to engage the head and depress bellows 54 in the direction of valve housing 50. This movement causes valve 55 to unseat and provide an increased flow of gas to expand the pilot flame, which expansion in the particular instance is momentarily during the initial operation of the burner control, so as to insure proper ignition of the liquid fuel when fed to the burner.

I have so arranged motor switch 6 with respect to bellows 5 as to actuate this switch simultaneously with the opening of oil valve 8. This is accomplished by properly positioning a transverse pin 71 on tube 17 so as to engage the switch and close it at a time when a cam 73 engages a cam head 74. By referring to Fig. 5, it will be observed that the oil valve structure 51 is substantially the same as the gas valve 7, illustrated in Fig. 6. The only difference, however, is that the oil valve 8 may not be provided with a by-pass as in the case of the gas valve 7.

I wish to call attention to the fact that cams of different designs are provided for engaging the cam head 58 of the gas valve 7 and the cam head 74 of the oil valve 8. Cam 70 has a relatively short engagement with cam head 58, so that the above mentioned time relation between the operation of the gas valve 7 and the operation of the motor switch 6 and oil valve 8 may be carried out. Cam 73 has a relatively longer engagement with cam head 74 of oil valve 8, so that the oil valve will remain opened after it is once engaged by the cam during the upward movement of tube 17. I am able to determine accurately the expansion and contraction of bellows 5, but often through manufacturing inaccuracies its timed movement may vary slightly. Because of this possible variation, I prefer to provide a larger engaging surface on cam 73, so as to insure retention of the oil valve 8 in open position as long as the motor switch 6 is in closed position.

Pin 71 extends outwardly toward the front of the regulator for the purpose of engaging a spring 75. A switch arm 76 is preferably controlled by spring 75 in that whenever pin 71 is moved downwardly against spring 75, the latter opens the motor switch 6 with a snap action, and whenever the pin 71 moves upwardly with tube 17 during the expansion of bellows 5, the spring 75 releases the switch 6 and closes it. Motor switch 6 is preferably carried on the housing of the burner control by means of a frame comprising two members 77 and 78. These members are in the form of bars. A portion of member 78 is held against the under side of the top wall of the burner control housing by means of screws 79. Member 77 is preferably riveted to the left end of member 78 and extends downwardly and is then off-set slightly to receive the contact members of motor switch 6. The lower portion of member 77 is fastened to the lower end of member 78. Member 78 is provided with a fastening for one end of spring 75, the other end of this spring being connected at 80 to switch arm 76. The contact members of motor switch 6 are shown in detail in Figs. 7 and 8. A pair of carbon contacts 81 and 82 are carried, in insulated relation, on the frame member 77 and are electrically connected through this frame member with ter-

minal screws 83. These terminal screws secure contact bars 84 in position for electrically connecting the motor circuit leads 85 and 86 to carbon contacts 81 and 82. Plate 87 is interposed between these carbon contacts and the frame member 77, and contact carrying members 88 are provided suitably to carry, in insulated relation, these carbon contacts on plate 87. A sheet of mica or other insulated lining 88' may surround these carbon contacts in their seat in the contact carrying members 88. Switch arm 76 is provided with a bridging carbon contact 90 which, when engaging the contacts 81 and 82, closes the motor circuit. I prefer providing a loose pivoted mounting for the carbon contact 90 in switch arm 76. This mounting allows carbon contact 90 to have a limited rocking movement in a longitudinal direction on pivots 91 so as to be self adjustable when seating upon the carbon contacts 81 and 82. Carbon contact 90 may be also seated in electrically insulated relation in a member 92. As is illustrated in Fig. 7, the sides of member 92, substantially at their centers, are extended upwardly in a straight line instead of being bent at an angle as indicated at 93 to embrace the sides of contact 90. The central portions 94 are then apertured to receive projections 91, which serve as pivots for this part of the switch. Projections 91 are formed from the movable switch arm 76, which is provided with a pivotal mounting, at the opposite end, in the form of a point contact on an upstanding projection 96.

In order to facilitate the explanation of the various steps of operation, which my burner control undergoes, I have diagrammatically illustrated in Figs. 9 to 12, inclusive, the different positions assumed by the various parts during operation. In Fig. 9, the device is shown idle with the thermostat 40 closing. During this time, the motor switch 6 is open and the gas valve and oil valve are closed. Assuming that the room temperature has dropped to a point which will close the thermostat 40, the current flow develops heat at the coil 20, which is conducted to the highly volatile fluid within tube 17 and bellows 5. As the heat is generated at this coil 20, the volatile fluid is driven from tube 17 into bellows 5, which action will expand and move tube 17 upwardly. An opening 98 is provided in the burner control housing at the top thereof so as to permit this tube to move upwardly until the bellows has reached its limit of expansion. During the expansion, however, the initial step will be to flare the pilot light by opening gas valve 7. It will be noted in Fig. 10 that this occurs when cam 70 engages cam head 58. Gas valve 7 will be fully opened before the cam 73 acts to open oil valve 8. It will be observed that pin 71 on tube 17 may be arranged to close the motor switch 6 simultaneously with the opening of oil valve 8. This simultaneous action is not exactly required, because the motor blower may be operating before the fuel oil is supplied at the burner, or vice versa, the oil valve 8 may be open to supply this oil before the motor blower is permitted to operate. As before explained, opening of the valve 55 will increase the flow of gas to the pilot light so as to flare the same and insure proper ignition of the fuel. Until all of the volatile fluid is driven out of the tube 17, the bellows 5 will continue to expand and move this tube upwardly. As will be noted, cam 73 is arranged to continue holding the oil valve open, but the cam 70 releases the cam head 58 to close the gas valve (see Fig. 11). The circuit of the heat coil 20 will remain closed during the operation of the burner, but due to the arrangement of this coil about the tube and the thermally insulated mounting of the tube at its base, continued conduction of heat to the bellows is prevented. Consequently, a limit of expansion will be reached and maintained as long as the heat coil is conducting heat to tube 17. The expanded volatile fluid held in the bellows will naturally tend to flow back in the tube 17. This tendency is overcome as long as the tube 17 remains heated. The relative position of the controlling members of my burner control device when the system is in full operation is shown in Figure 11.

Assume now that the room temperature has reached a predetermined point and it is desired to discontinue the supply of heat generated at the burner, the thermostat 40 immediately opens to break the heating circuit including the heat coil 20. The volatile gas will return in the tube 17 and allow the bellows 5 to contract, thereby withdrawing the tube 17 downwardly and bringing the cam 70 back into engagement with cam head 58. This action opens the gas valve 7 to expand the gas or rather flare the pilot light prior to opening the circuit of the blower motor and closing of the oil valve 8. It will be noted in Fig. 12 that tube 17 descends and actuates the various controlling members in practically the same timed relation as it did when ascending during the initial operation of the heating system.

I preferably provide a fixed pin 99 in the base 10 of bellows 5 so as to serve as a guide for the tube 17 and also for the bellows 5 during the expanding and contracting movements thereof. From the foregoing description, it will be observed that I have provided a novel form of burner control operating on a certain time limit principle and having a heat unit that operates the burner control by the heat developed by the current flow in the thermostatic circuit. The thermally controlled element B, subject to this heat, is so constructed as to have a limited expansion ir-

respective of whether the current flow continues developing heat while the thermostatic circuit is closed. I wish to point out that the time relation between the expanding and contracting movements of the bellows may be easily controlled by the position of the heating unit 20 along the tube 17. I further wish to point out that this time relation may likewise be varied by the size and shape of the neck 15 and also by the distance at which the tube 17 is extended in the cup 14 to connect with tube 17.

By referring particularly to the wire diagram illustrated in Fig. 9, the flow of current may be traced as follows:

From the line circuit connecting to terminals 32 and 33, the current first flows from terminal 33 over the wire 24 to terminal 22, through the coil 20 to terminal 23, over wire 37, thermostat 40, wire 38 to terminal 28, returning by wire 31 to the other side of the line circuit connected to terminal 32. The current flows over the motor circuit by beginning at terminal 33, following over wire 85, terminal 81, to terminal 82 by means of the movable contact 90, the motor returning over wire 86 to terminal 32.

Although I have described with great particularity the various objects and advantages of my invention, as well as the structural details thereof, it is apparent that the invention is capable of various modifications and arrangements, and consequently, I intend limiting myself only by the scope of the prior art and the appended claims.

I claim:

1. In a temperature controlling mechanism, the combination with a liquid fuel burning mechanism, of an electric motor for operating said liquid fuel burning mechanism, means responsive to temperature variations for controlling an electric circuit and electrically heated thermal means in said circuit for controlling said electric motor, said thermal means having heat control means to limit the heating effect thereof and said circuit remaining closed until opened by said temperature responsive means.

2. In a regulator or liquid fuel burning mechanism, the combination with a thermostat, an ignition valve, a motor switch and an oil valve, said ignition valve being arranged to open in advance of the closing of said motor switch and of the opening of said oil valve, and a thermal element controlled by the current flow in the circuit of said thermostat to effect normal operation of said valves and motor switch, said thermal element having heat control means to limit the heating effect thereof and remaining actuated to effect normal operation of said parts as long as said thermostat is closed to establish said current flow.

3. In a regulator for liquid fuel burning mechanism, the combination with electrically operated mechanism adapted to stop and start said liquid fuel burning mechanism, of means responsive to temperature variations adapted to control said electrically operated means, and electrically heated thermal means in circuit with said temperature responsive means for operating said electrically operated means, said thermal means having heat control means to limit the heating effect thereof influenced only in its normal operation to control said electrically operated means by the current flow established by the operation of said temperature responsive means.

In witness whereof, I have hereunto subscribed my name.

LAWRENCE M. PERSONS.