Nov. 4, 1930. R. F. METCALFE 1,780,357

FUEL BURNER AND CONTROL THEREFOR

Filed Nov. 3, 1925 3 Sheets-Sheet 1

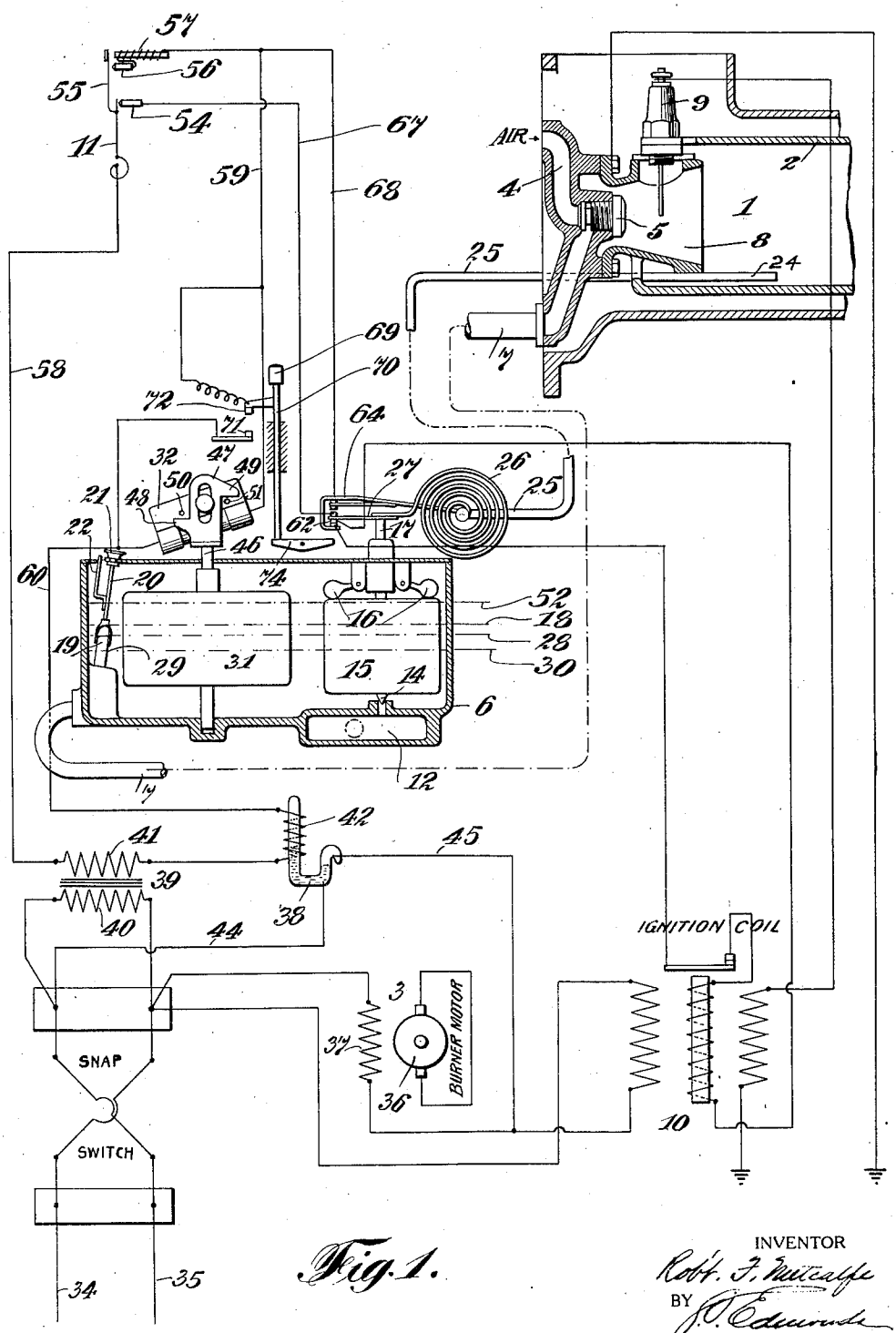


Fig. 1.

INVENTOR
Robt. F. Metcalfe
BY J. C. Edmunds
ATTORNEY

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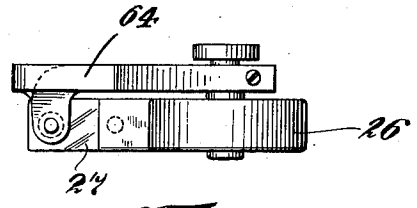


Fig. 3.

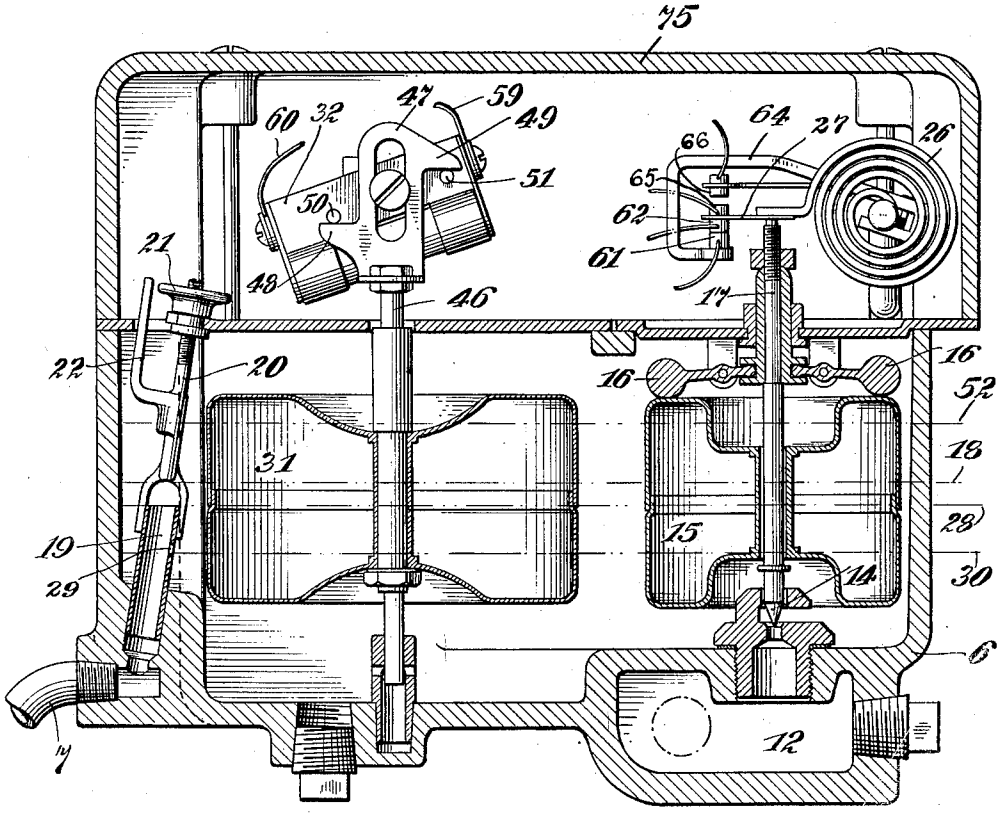


Fig. 2.

INVENTOR
Robt F. Metcalfe
BY
J. O. Edmonds
ATTORNEY

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Filed Nov. 3, 1925 3 Sheets-Sheet 3

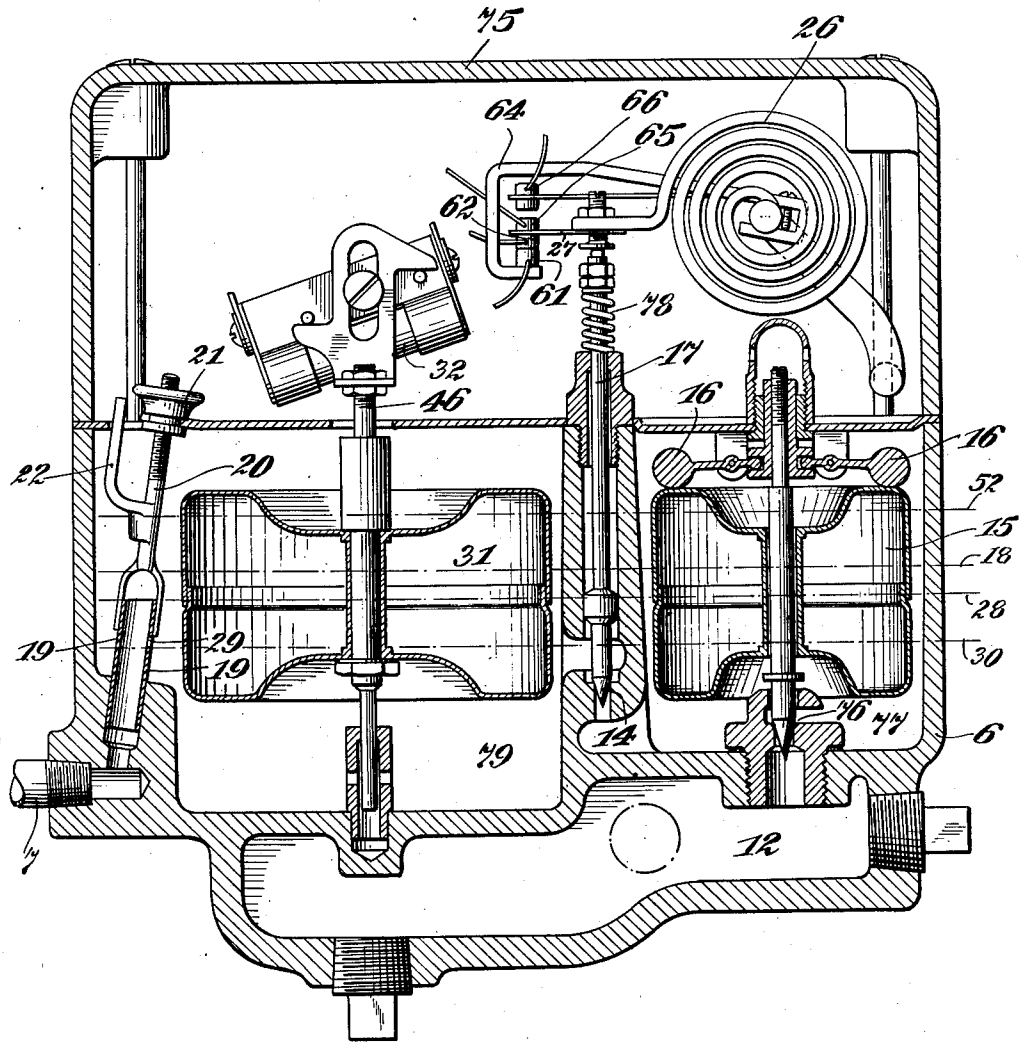


Fig. 4.

INVENTOR
Robt. F. Metcalfe
BY
J. C. Edmunds
ATTORNEY

Patented Nov. 4, 1930 1,780,357

UNITED STATES PATENT OFFICE

ROBERT F. METCALFE, OF BROOKLYN, NEW YORK, ASSIGNOR TO SOCONY BURNER CORPORATION, OF BROOKLYN, NEW YORK, A CORPORATION OF DELAWARE

FUEL BURNER AND CONTROL THEREFOR

Application filed November 3, 1925. Serial No. 66,464.

This invention pertains to fuel burners, and more especially the invention relates to those burners which are semi-automatic or automatic in their operations.

The preferred apparatus, which has been selected for the purposes for illustrating and describing this invention, is a fuel burner commonly known as an oil burner. The particular oil burner selected is one that is especially adapted to heat dwellings. While the invention will be disclosed as incorporated in such an automatic or semiautomatic oil burner for the home, it is to be understood that the principles of operation herein described may be employed in oil burners for either home uses or for industrial purposes, or in other fuel burners.

It is well known in the automatic or semi-automatic fuel burner field that safety precautions against fire hazard, explosions and damages to the burner and to property form one of prime requisite to safe, efficient and successful operation.

The invention also pertains to a new and improved method of operation of combustion systems, especially oil fuel burners. This improved and novel method of operation of such burners includes the feeding of a predetermined quantity of fuel at the starting of the burner and when combustion has been satisfactorily initiated in the burner, then the supply from the large reservoir of fuel is automatically established so as to feed fuel directly to the burner. Thus, the supply from the tank to the burner will never be opened until after combustion has been initiated; a predetermined amount of fuel being used for the purpose of initiating combustion.

Heretofore in fuel burners of any type especially those of intermittent operation, it has been the custom upon the starting of a burner to immediately throw into operation the mechanism which feeds the fuel to the burner, and to permit this mechanism to continue to feed fuel until the apparatus is closed down or stopped by an individual, or by a thermostat located in the room of a house or by a thermostat in the boiler or heating plant which is being fired, or stopped by some other means. It will be seen that in such burners the fuel feeding mechanism is connected with and is dependent upon the main operating mechanism of the burner. Also in such burners in case there is failure of ignition of fuel at the start, as for instance in oil burners, the oil in many cases will flood the burner or will pour into the furnace or onto the floor of the boiler room thus creating serious fire hazard.

It is recognized that there have been several types of safety means which are arranged to stop the operations of the burner in case ignition does not take place at the start of operation, or at the beginning of any of the intermittent operations thereof. It is recognized that some of these safety devices have been satisfactorily incorporated in such burners. Usually the safety means have been associated in one form or another with the main operating mechanism of the burner and function to act thereupon. It has been noted that other parts of the apparatus which are subject to influences other than a failure of initial ignition are associated with the non-ignition safety means and consequently the safety means becomes affected and operative in response to conditions which are not due to the failure of initial ignition of a fuel.

The invention herein disclosed has particularly to do with a safety means which governs directly the feed of the fuel. The preferred safety means for this purpose provides for the admission of fuel from the main source of supply after initial ignition has been obtained from a predetermined quantity of fuel fed to the burner at the start of its operation, be the burner adapted for oil. It will, therefore, be seen that if ignition has not been completed at the start that there will only be a predetermined amount of fuel fed to the burner and that the main source of supply cannot be drawn upon until ignition of this predetermined or limited amount of fuel has been accomplished. Thus there is eliminated the flooding of the burner, flooding of the floor or choking of the burner with a large quantity of unconsumed fuel. In the operation of a fuel burner having incorporated

therein the principles of this invention there will be a safety means which has not heretofore been provided. Any burner with this invention incorporated therein may be regulated or adjusted to feed only a sufficient quantity of fuel which will readily give ignition of the fuel employed. Thus at the start of any operation of a fuel burner a limited quantity of fuel is admitted to the burner for the purpose of obtaining initial combustion and that thereafter the fuel from the main source thereof will be opened or fed, but it will be apparent that combustion conditions must bave been obtained before fuel from the main source will be permitted to be moved to the fuel combustion chamber.

It is, therefore, the main object of the invention to provide a new and improved fuel burning apparatus and to provide a novel, safe and efficient method of operating the same.

It will be seen that another object of the invention is to incorporate in a fuel burner the feature of permitting only a limited amount of fuel to be delivered at the start of the burner, and to thereafter, depending upon initial ignition, to admit a further supply of fuel.

A further object of this invention is to maintain the main supply of fuel in a non-operative condition until ignition has taken place.

A still further object is to provide a novel and improved fuel burner which will automatically close down or stop after a predetermined quantity of fuel has been fed and ignition thereof has not been obtained.

A particular detailed object of the invention is to provide a novel oil burner which will consume a predetermined amount of oil at the start of operation thereof, and upon non-ignition will automatically close down or stop the main operating parts thereof in response to the condition of the fuel supply from which the predetermined amount of fuel is taken.

A still further object of the invention is to provide a novel control means for governing the operations of the burner.

Another object is to provide an adjustable device which is adapted to govern the quantity of fuel which constitutes the predetermined amount fed to obtain initial combustion.

Other objects and advantages of this invention will be readily noted in the detailed description hereof and the claims which will be set forth below in detail.

A preferred embodiment of this invention is illustrated in the accompanying drawings which show particular portions of an oil burner, which burner in its complete assemblage may be noted in my Patent #1,491,156, dated April 22, 1924.

In the drawings herewith:

Fig. 1 shows a wiring diagram of an electrical system for a fuel burner, parts of the burner mechanism and a fuel feed system in section and other portions of the operating mechanism of the burner;

Fig. 2 is a sectional view on an enlarged scale of part of a fuel feeding means for the oil burner;

Fig. 3 is a top plan view of a particular type of Bourdon tube construction incorporated with the preferred type of control apparatus and shows an electrical contact carrying mechanism; and

Fig. 4 is a modified form in section of the apparatus disclosed in Fig. 2.

In any fuel burner of the automatic or semi-automatic type there is provided a burner proper, a motor for operating the same, some means for feeding and conducting the fuel to the burner from a source of supply, some form of mechanism for igniting the fuel, and a system for controlling the operation of the burner. The burner is so constructed as to provide for the mixing of the fuel with a combustion supporting medium. In an oil burner, the mixing of the oil with air or steam is usually accomplished by means of a nozzle. In any case, however, there is provided in association with the burner a combustion chamber. This combustion chamber may form part of the complete burner, or it may be a part of the boiler or furnace being fired. In some instances, especially in oil burners there is provided a generator tube which forms part of the combustion chamber and the boiler or furnace being fired forms another part of the chamber. The tube and that part of the boiler form the complete combustion chamber. In the burner herein described there is a generator tube associated with the burner proper which will be referred to generally as the combustion chamber although part of the boiler cooperates therewith for the complete burning of the fuel.

Referring now to the drawings, there is shown in Fig. 1 a combustion chamber 1 which forms part of the burner illustrated in the patent above mentioned. This chamber is formed by a generator tube 2. A suitable motor 3 is provided for operating the burner and for operating air supply means to conduit 4 which leads to a suitable mixing nozzle 5. The fuel is supplied to the burner from a source of supply (not shown) by passing into a reservoir 6 and from there through conduit 7 to the nozzle 5. In this particular type of burner the fuel and air, as mixed, are ignited in an ignition cone 8 by means of a suitable ignition means, such for instance as spark-plug 9. This ignited mixture passes from the cone 8 to the generator tube 2 where additional air is supplied which assists finally in obtaining complete combustion of the fuel. A suitable ignition coil 10 is provided for creating the high tension electrical supply to

the spark-plug 9. As the details of this ignition coil form no part of this invention further attention thereto will not be had. A suitable electrical control system is provided for operating burner motor 3 and in that system there is provided a thermostat 11 for governing the normal operations of the burner. When this burner is employed to heat dwellings the thermostat 11 is usually placed in one of the rooms or it may be positioned at any suitable place so that the operation of the burner and the heating furnace associated therewith will give a uniform heat throughout the dwelling. It is understood that any of the well known safety means may be included in this control circuit. Such safety means for instance being a low water cut-out device, or a fuse responsive to excess heat passing through the flue of the boiler, or any of the other like devices.

As the fuel feeding means becomes an important part of this invention, it will now be described.

The burner or its combustion chamber may be connected to a source of fuel supply in any desired manner. This connection may be by means of a single conduit, or by a conduit system which may also be known as a pipe line. The complete apparatus for conducting the fuel from a supply to the burner is to be understood as meaning a fuel feeding system, be it a single pipe or a complete system. As an important part of this invention is to feed a minimum predetermined quantity or limited quantity of fuel to the combustion chamber for the purpose of obtaining initial combustion therein, the invention also includes the closing off or interrupting the fuel from the source of supply during any start of the burner so that in the event of not obtaining combustion of the predetermined or preliminary quantity of fuel there will be no further amount of fuel fed to the burner that will form a combustible mixture with the air. In the broad aspect of these features it is desired to place a stopping or interrupting means in the fuel system so that normally there will be a limited quantity of fuel available to pass to the combustion chamber at the starting of the burner and that the main source of supply will be closed. When the conduit system consists of a single pipe the intercepting means will be placed so that upon the normal stopping of the burner this intercepting means will hold in the conduit between itself and the combustion chamber a limited quantity of the fuel which will be available to pass to the combustion chamber upon again starting the burner.

It is to be understood that in the broad aspect of permitting only a predetermined quantity of fuel to be fed to the burner at the starting of its operations, that this predetermined quantity may be fuel which has been derived from the main source of supply, or it may be an entirely different fuel which will be more readily ignited. Any particular type of mechanical construction may be employed to hold a limited quantity of fuel employed for ignition purposes, or the fuel feeding system may have a separate and distinct reservoir or receiver for holding a limited quantity of the fuel and this receiver may or may not be so positioned as to have the fuel pass from said source of supply through it to the burner after combustion has been accomplished. All such changes or modifications are considered as being within the scope of this invention.

In the embodiment herein disclosed fuel may flow from a main source of supply through a suitable pipe (not shown) to chamber 12 in the reservoir or receiver 6 and pass therefrom through valve 14 into the bowl of the reservoir 6, which reservoir is of limited capacity in respect to a main or large source of supply. The quantity of oil permitted to flow to this reservoir may be governed in any desired manner as for instance by means of a float 15 which operates in the normal way through weights 16 which operate upon a stem 17 of the valve 14. See Figs. 2 and 4. Normally the limited quantity of oil in the reservoir 6 is indicated by level line 18. This level is to be considered as the normal operating fuel level.

In controlling the quantity of oil which will pass from this reservoir to the combustion chamber for purposes of initiating combustion there is here shown one satisfactory form of apparatus for accomplishing this purpose. This particular apparatus consists of a tube or weir 19 which is positioned in the frame of the reservoir as shown in Fig. 2 and adjusted to a desired level by means of a rod 20 controlled by a thumb screw 21 and maintained from turning by an off set rod 22. It will be noted from Figs. 2 and 4 that the oil may pass through weir 19 into pipe or conduit 7 and pass from there to the mixing nozzle of the burner. It will be seen that the top level or the top of the main passage of this weir may be varied so that it may be placed at different positions below the normal operating fuel level 18 thereby adjusting the amount of fuel which is available to be fed to the burner at the start thereof. It will also be readily seen that as soon as the oil level in reservoir 6 has been lowered to the top of the weir that no further oil in sufficient quantity to support combustion will pass to the combustion chamber until after valve 14 has been opened to permit more of the fuel to pass into the reservoir 6 from the source of supply. It will also be seen that valve 14 forms the intercepting means in the fuel feeding system and that a certain proportion of the oil held in reservoir 6 is available to pass to the combustion chamber upon starting the burner.

In order to maintain the valve 14 closed to prevent fuel from passing to the reservoir until after combustion has been obtained in the combustion chamber, any suitable form of control may be employed. A particular form of control which has operated satisfactorily consists of a thermostat 24 mounted in heat relation to the combustion chamber and operates when combustion conditions exist to compress a gas in pipe 25 which also fills a suitable form of Bourdon tube 26 and expands that tube so that an arm 27 on the Bourdon tube may be raised from stem 17 and thereby permit fuel to be fed from the main source of supply to said reservoir, as the float 15 and weight 16 will drop causing stem 17 to rise as will be more clearly seen in the sectional view of Figs. 2 and 4. It has been found from experience that the weir 19 may be so adjusted that only a relatively small amount of oil may be fed to the combustion chamber before ignition thereof takes place and that the thermostat 24 and the Bourdon tube 26 function to permit additional fuel to flow to the reservoir 6 and from there to the combustion chamber. While there is herein described this particular form of thermostat 24 and Bourdon tube 26 it is to be understood that any means effected by the heat of combustion in the combustion chamber may be employed to release valve stem 17 and consequently valve 14 from its normal closed position. If desired mercury may fill thermostat 24 and Bourdon tube 26. In the construction herein disclosed the fuel is drawn from the reservoir 6 to the combustion chamber 1 by means of suction provided by the passing of air through conduit 4 and nozzle 5. It is to be understood that a pump means may be employed to move the oil if desired.

Upon the starting of the burner the motor 3 is immediately set into operation and supplies air to the conduit 4. It will be noted that by the use of the adjustable weir 19 that after the predetermined or primary or charge quantity of fuel has been permitted to pass to the combustion chamber without obtaining combustion conditions in the chamber, air will be drawn into the pipe 7 through weir 19 and the motor 3 will continue operation, but there will be no substantial amount of oil drawn by the suction. By the feeding of the predetermined quantity of oil, the level of fuel in reservoir 6 is lowered from level line 18 to level line 28. It is desirable to close down or stop the burner when this condition has taken place without having accomplished combustion, and one means of accomplishing this end is by providing the weir 19 with a leak, herein shown as a perforation or hole 29. It is preferred that the size of this hole or opening shall be relatively small but that it will permit a very small quantity of the fuel to flow into the pipe 7. This quantity, however, will not mix with the air in the nozzle 5 to form a combustion supporting mixture. When the fuel level in the reservoir 6 is lowered to a point even with the leak 29 as represented by level line 30, a float 31 also carried in the reservoir 6 will operate a switch 32 in the control system and will open the circuit to the motor 3 thereby stopping the motor and the burner operations.

From the foregoing description it will be seen that upon starting the burner a predetermined quantity of oil or fuel will be fed to the burner in such quantity as to produce a combustion supporting mixture with the air. It will further be noted that in the event combustion of the predetermined quantity of the fuel has been accomplished that a further supply of fuel in combustion supporting quantity will be supplied to the burner or combustion chamber so that the initiated combustion will be continued. In the event the predetermined quantity of fuel originally fed to the combustion chamber is not ignited, a small quantity of the fuel in a proportion which will not support combustion will be fed to the burner. This last quantity acts purely for the purpose of controlling the closing down or stopping of the burner motor. Thus under abnormal conditions the burner motor will be stopped by the condition of fuel in the fuel feeding system.

The system of controlling the burner may now be described. The disclosure herein provides for an electrical operating control system and derives the electrical power from electrical supply lines 34 and 35. This electrical supply is provided with a snap switch as shown for opening or closing the electrical supply at will. The desired type of motor is herein shown as one with its rotor 36 short circuited, and its field 37 is controlled by a suitable type of switch such as a mercury switch 38. Connected across the supply line is a transformer 39 provided with a primary winding 40 and a secondary winding 41 thereby providing a low potential for the governing part of the electrical control system. Such a transformer may or may not be employed. It has been illustrated here for showing one form. In this low potential system the circuit is provided with a coil 42 surrounding the switch 38 so that when the circuit is closed the coil 42 operates to pull down a core (not shown) which is mounted inside the switch 38 thereby forcing the mercury in the switch to complete an electrical path from electrical conductor 44 to conductor 45 and from there through field 37 of the motor back to the other side of the supply line thus starting the motor.

In series with the coil 42 and the secondary winding 41 there is connected the switch 32 preferably of the ordinary typical mercury tube type. This switch is mounted on a suitable pivot and is adapted to be oscillated by

the float 31 to open the circuit of the motor 3. One form of construction means for having the switch 32 moved by the float is by providing a stem 46 which is carried by the float 31, and a suitable plate 47 having ears 48 and 49 which are adapted to engage pins 50 and 51 respectively. The switch 32 is normally closed and in the event of the level of the fuel in reservoir 6 reaching level line 30 the ear 49 will engage the pin 51 and rock the switch to open the electrical circuit therethrough thereby opening the circuit to the motor 3. Should there be a leak in the valve 14 and fuel should rise in the reservoir 16 to level 52 the ear 48 will engage pin 50 and rock the switch to thereby open the same and stop the burner motor 3. It is assumed that fuel may be made to flow from the main fuel supply to the reservoir 6 by means of a suitable pump driven by the motor 3 and therefore when the motor stops no further fuel will be delivered to the reservoir 6.

The particular type of room thermostat 11 herein employed consists of a heat responsive arm which first engages a contact 54 upon cooling and the further cooling brings the extended member 55 of the thermostat into engagement with contact 56. By reason of an electro-magnet 57 associated with the contact, the heat responsive arm is drawn closely against contact 56 and is positively held there for a given length of time thus the usual "fluttering" of the heat responsive arm is prevented and the circuit is held closed to permit normal operations of the burner to continue without interruption.

The operation of the fuel burner may be described as follows:—

Assume that the oil in the reservoir 6 is at level 18 and that the switch 32 is closed. When the room becomes cooled thermostat 11 closes against contact 54 and upon further cooling closes against contact 56. The electrical circuit from the secondary winding 41 is then completed through conductor 58, thermostat arm, extension 55, contact 56, magnet 57, conductor 59, switch 32, conductor 60, coil 42 to the other side of the secondary winding 41. This operates mercury switch 38 to close the circuit through the motor 3 which starts the burner. The passing of air through conduit 4 and nozzle 5 creates a suction in pipe 7, which draws fuel from reservoir 6 through weir 19 and a combustion supporting mixture passes to cone 8. The spark-plug operates by reason of the ignition coil 10 being excited as contacts 61 and 62 are closed.

The contact 61 is carried on an arm 64 associated with the support of the Bourdon tube 26. This Bourdon tube is normally contracted, thus closing the contacts 61 and 62 thereby permitting the operation of the ignition coil.

Assume now that combustion of the predetermined quantity of fuel has been obtained in combustion chamber 1. The thermostat 24 operates to extend Bourdon tube 26 causing contacts 61 and 62 to separate thereby causing the fuel ignition means to open, and thus the spark-plug 9 becomes ineffective. The contacts 61 and 62 are separated by the raising of arm 27 and this movement carries the arm 27 off from valve stem 17 thereby permitting weights 16 to lower and valve 14 to open so that fuel may pass from the main supply to the reservoir 6 and from there through weir 19, pipe 7 to be mixed with air at the nozzle 5 and to thereby continue combustion. In the separating of contacts 61 and 62, contacts 65 and 66 engage and thus shunt the low potential electrical current from magnet 57 causing the current to pass through contact 54, conductor 67, contacts 65 and 66, conductor 68, conductor 59, switch 32, conductor 60, coil 42 to the transformer 39. By shunting the magnet 57 the thermostat 11 will respond readily to the heat in the room so that the circuit to the burner motor may be readily opened and the fuel burner closed down or stopped. It will be noted that in stopping the burner, thermostat 24 will cool and arm 27 will be forced by the contraction of the Bourdon tube 26 to move valve stem 17 downward to close valve 14 thus leaving the fuel in reservoir 6 at normal level 18 so that there is a predetermined supply of fuel available for the restarting of the burner.

In the event combustion is not obtained in combustion chamber 1 after the feeding of the minimum predetermined quantity of fuel through weir 19 the motor will be stopped as fully described above by float 31 falling to an extent to cause switch 32 to be opened.

In the event of stopping the motor by reason of non-ignition of the predetermined quantity of fuel there is provided a suitable means for refilling the reservoir 6 to bring the fuel level back to normal level 18. A preferred apparatus herein disclosed for this purpose consists of a suitable push button 69 for manual operation to cause a stem 70 to be moved downward to close electrical contacts 71 and 72 to shunt the switch 32 which has been opened by reason of the fuel level in reservoir 6 dropping to the level 13. The downward movement of shaft 70 causes a rocker arm 74 to engage support 64 to raise the same so that stem 17 is free to be controlled by float 15 thereby permitting fuel to enter reservoir 6 to raise the fuel level to level 18. The contacts 71 and 72 engage and the thermostat 11 is closed, the burner will be started as above described and oil will be permitted to flow to said combustion chamber 1 as the capacity of oil flow through valve 14 is greater than the outlet capacity through weir 19.

It will readily be seen, after combustion has been accomplished and the continuing combustion fuel is being fed to the burner permitting the burner to operate under nor-

mal conditions, that upon cessation of combustion in the combustion chamber for any reason, the burner will automatically be stopped. This action is accomplished by the cooling of the thermostat 24, contracting of Bourdon tube 26 and the forcing closed of valve 14 by arm 27 thereby preventing further fuel flow or movement in the fuel feeding system. The burner motor will be closed by the falling of the level of fuel in reservoir 6 thereby opening switch 32 which controls the motor circuit.

It will be noted in the apparatus herein disclosed that only a definite amount of fuel may be introduced into the burner during the starting period thereof, and that a main supply of fuel is open to the burner only after combustion of the starting quantity of the fuel has been accomplished. After the burner has been started and is operating on fuel from the main supply the normal control of the burner is taken away from the starting control and is placed on the room thermostat. This thermostat will continue to govern the normal operation of the burner unless there should be cessation of combustion for any reason, and in that event the burner will be automatically stopped.

The detailed constructional features of the reservoir 6 and a suitable cap 75 therefor which covers the Bourdon tube and the switch 32 may be fully appreciated by references to Figs. 2 and 4. The cap 75 is not necessary but when in position provides protection for the operating parts and prevents changes of adjustments.

Referring particularly to Fig. 4 there is shown a modified form of the bowl of reservoir 6 wherein the valve stem 17 is placed independent of the float 15. In this construction it will be noted that the oil will pass into chamber 12 and will then pass through valve 76 into a compartment 77 of reservoir 6. The operation of the valve 76 will be automatically controlled by float 15 and weights 16. The fuel will pass through valve 14 in the same manner as above described. The stem 17 is provided with a suitable spring 78 for raising the same when the Bourdon tube 26 has been expanded thus fuel may pass from compartment 77 to a compartment 79 in reservoir 6 in which is mounted the weir 19 and the float 31 and from weir 19 through pipe 7 to nozzle 5.

This construction illustrated in Fig. 4 provides for an independent operation of the valve 14 and in many cases such construction is advantageous for the purposes of making adjustments, repairs or replacements.

From the foregoing description it will be readily seen that a novel fuel burner apparatus and method of operating the same have been provided and it has been found from experience that the operation thereof has been successful. It will further be noted that a simple, safe and efficient means has been provided for operating any fuel burner in such a manner as to practically eliminate most fire hazards. This safety condition has been obtained preferably by feeding, at the start of operation of the burner, only a predetermined quantity of fuel. If ignition of this fuel is obtained then further supply of fuel is permitted to flow to the burner to continue combustion. If there is failure of ignition of the predetermined quantity of fuel fed to the burner at the beginning then there is no further dangerous amount of fuel or quantity thereof fed to the burner, and in such a condition the burner operating mechanism is closed down or stopped.

It will be understood that while I have here described in detail a particular embodiment of my invention for purposes of full disclosures, and some detailed features which I am specifically claiming for a special advantage, many changes and modifications may be made in the particular construction and arrangement of parts without departing from the broad scope of my invention which is outlined in the sub-joined claims.

What I claim is:—

1. In a fuel burner, the combination of a combustion chamber, a fuel supply, fuel ignition means, a conduit system for conducting the fuel from said supply to said chamber, a reservoir placed in said system to receive fuel from said supply and to permit the same to pass to said chamber, a valve in said reservoir for controlling the flow of fuel from said supply, a stem for controlling said valve, an automatic float control associated with said stem for normally governing the quantity of fuel in said reservoir, a thermostat mounted in said combustion chamber, a Bourdon tube connected to said thermostat and operated thereby, and an arm on said tube for moving said stem to close said valve when said thermostat is cold and for releasing the operation of said stem to said float control when said thermostat is hot to thereby permit fuel to be fed from said supply to said reservoir, the passage from said reservoir to said chamber being open to permit a limited quantity of fuel to be supplied to said chamber at the start of operation for initiating combustion conditions in said chamber.

2. In an oil burner, the combination of a combustion chamber in said burner, a fuel supply for said chamber, a conduit system for conducting fuel from said supply to said chamber, a reservoir of limited capacity placed within said conduit system, means for maintaining a limited quantity of fuel in said reservoir, an exit weir from said reservoir, means for mixing said fuel with a combustion supporting medium, ignition means in said chamber, means in said conduit system for closing the flow of fuel to said reservoir, means responsive to the heat of initial com-

bustion in said chamber for opening the fuel flow from said supply to said reservoir, and means associated with said weir for permitting a leaking of fuel from said reservoir to lower the level thereof in said reservoir, said leaking becoming effective only upon failure to initiate combustion in said chamber, and means responsive to the lowering of said level to stop the operations of said burner.

3. In a fuel burner, the combination of a combustion chamber, a fuel supply system for said burner, said system including a reservoir for holding a limited quantity of fuel, a float controlled valve in said reservoir for admitting fuel to said reservoir from a main fuel source, a second float in said reservoir, an adjustable weir through which fuel passes from said reservoir to said chamber, said weir being provided with a leak below its main opening, said main opening being at a predetermined distance below the normal level of the fuel in said reservoir thereby permitting a predetermined quantity of fuel to pass to said chamber upon starting the burner, a thermostat associated with said combustion chamber, a Bourdon tube responsive to said thermostat, an arm at the end of said Bourdon tube for maintaining closed the float controlled valve in said reservoir until released by the action of heat of combustion in said chamber, a motor for driving the burner, an electrical control system having a room thermostat therein for controlling the normal operations of said motor, a switch in said circuit connected with the second float in said reservoir, said switch adapted to open the electrical supply to said motor in the event of failure of ignition of the predetermined quantity of fuel and after the level of fuel in said reservoir has been lowered by passing through said leak in said weir, and means or resetting the electrical circuit and for bringing the level of fuel in said reservoir to normal level after said burner motor has stopped by reason of non-ignition.

4. In a liquid fuel heating system, the combination with a burner, of means for supplying fuel thereto comprising a constant level supply chamber, a fuel admission valve, a float so related to the valve as to close the same when the fuel rises but permitting the valve to open when the level lowers, means tending to open the valve when the fuel level lowers, a thermostat responsive to the operation of the burner and means actuated through the thermostat to close the valve irrespective of the float.

5. In a liquid-fuel heating system, the combination with a burner, of a motor-driven pump for feeding fuel to the burner, a constant-level fuel-supply chamber, a float adapted during the operation of the burner to admit fuel to the supply chamber but to cut off the supply when the fuel level rises to a predetermined height, a device to cut off the supply of fuel to the supply chamber irrespective of the position of the float, and a thermostat device exposed to the heat of the burner for rendering said cut off device effective when the burner flame fails.

6. In a liquid-fuel heating system, the combination with a burner, of a motor-driven pump for a feeding fuel to the burner, a constant-level fuel supply chamber, a float adapted during the operation of the burner to admit fuel to the supply chamber but to cut off the supply when the fuel level rises to a predetermined height, and means, including a thermostat device exposed to the heat of the burner, for cutting off the supply of fuel to the supply chamber irrespective of the position of the float when the burner flame fails.

7. In a liquid-fuel heating system, the combination with a burner, of means for supplying fuel thereto comprising a constant-level supply chamber with a float for controlling the level thereof, a fuel cut off valve, a member associated with said valve and acting when lowered to close the valve irrespective of the level of the fuel in the supply chamber, a thermostat exposed to the heat of the burner, and means controlled by said thermostat for lifting said member while the burner flame persists but for causing its descent to close the valve when the burner flame fails.

8. In a liquid-fuel heating system, the combination with a burner, of means for supplying liquid fuel thereto comprising a constant-level supply chamber, a fuel admission valve, a float connected to close said valve when the fuel level rises to a predetermined height, the valve being permitted to open only when the fuel level drops and the float descends, a member associated with the valve and acting when lowered to close the valve irrespective of the position of the float, and means, including a thermostat exposed to the heat of the burner, for causing said member to descend and close the valve when the burner flame fails.

9. In a liquid-fuel heating system, the combination with a burner, of means for supplying liquid fuel thereto comprising a constant-level supply chamber, a fuel admission valve, a float connected to close said valve when the fuel level rises to a predetermined height, the valve being permitted to open only when the fuel level drops and the float descends, a member associated with the valve and acting when lowered to close the valve irrespective of the position of the float, and means, including a thermostat exposed to the heat of the burner, for elevating said member while the burner flame persists but for causing said member to descend and close the valve when the burner flame fails.

10. In a liquid-fuel heating system, the

combination with a burner, of a motor-driven pump for feeding fuel to the burner, a constant-level fuel supply chamber, a float adapted during the operation of the burner to admit fuel to the supply chamber but to cut off the supply when the fuel level rises to a predetermined height, and means for cutting off the supply of fuel to the supply chamber irrespective of the position of the float, said means comprising a valve actuating member, a device for raising said member to allow the valve to be opened under the control of the float, and a thermostat exposed to the heat of the burner for causing said member to descend and close the valve when the burner flame fails.

11. In a liquid-fuel heating system, the combination with a burner, of a constant-level, fuel-supply chamber, float means adapted during the operation of the burner to admit fuel to the supply chamber but to cut off the supply when the fuel level rises to a predetermined height, a device to cut off the supply of fuel to the supply chamber irrespective of the position of the float means, a thermostat exposed to the heat of the burner for rendering said cut off device effective when the burner flame fails, motor-driven means for supplying fuel from said supply chamber to the burner, and means for opening the motor circuit when the float means descends to a predetermined level.

12. In a liquid-fuel heating system, the combination with a burner, of means for supplying fuel thereto comprising a constant level supply chamber, a fuel admission valve, a float with connections comprising a counterweighted lever for causing the valve to close when the fuel level rises but permitting the same to open when the fuel level lowers, and means including a thermostat responsive to the operation of the burner adapted to close the valve irrespective of the float.

13. In a liquid-fuel heating system, the combination with a burner, of means for supplying fuel thereto comprising a constant level supply chamber, a fuel admission valve, a float so related to the valve as to close the same when the fuel rises but permitting the same to open when the fuel level lowers, means tending to open the valve when the fuel level lowers, a valve actuating member adapted to close the valve irrespective of the position of the float, and means responsive to the operation of the burner for controlling said valve actuating member.

This specification signed this 2 day of November, 1925.

ROBERT F. METCALFE.