April 7, 1931. J. B. HOFF 1,799,902

AUTOMATIC SAFETY OIL BURNING SYSTEM

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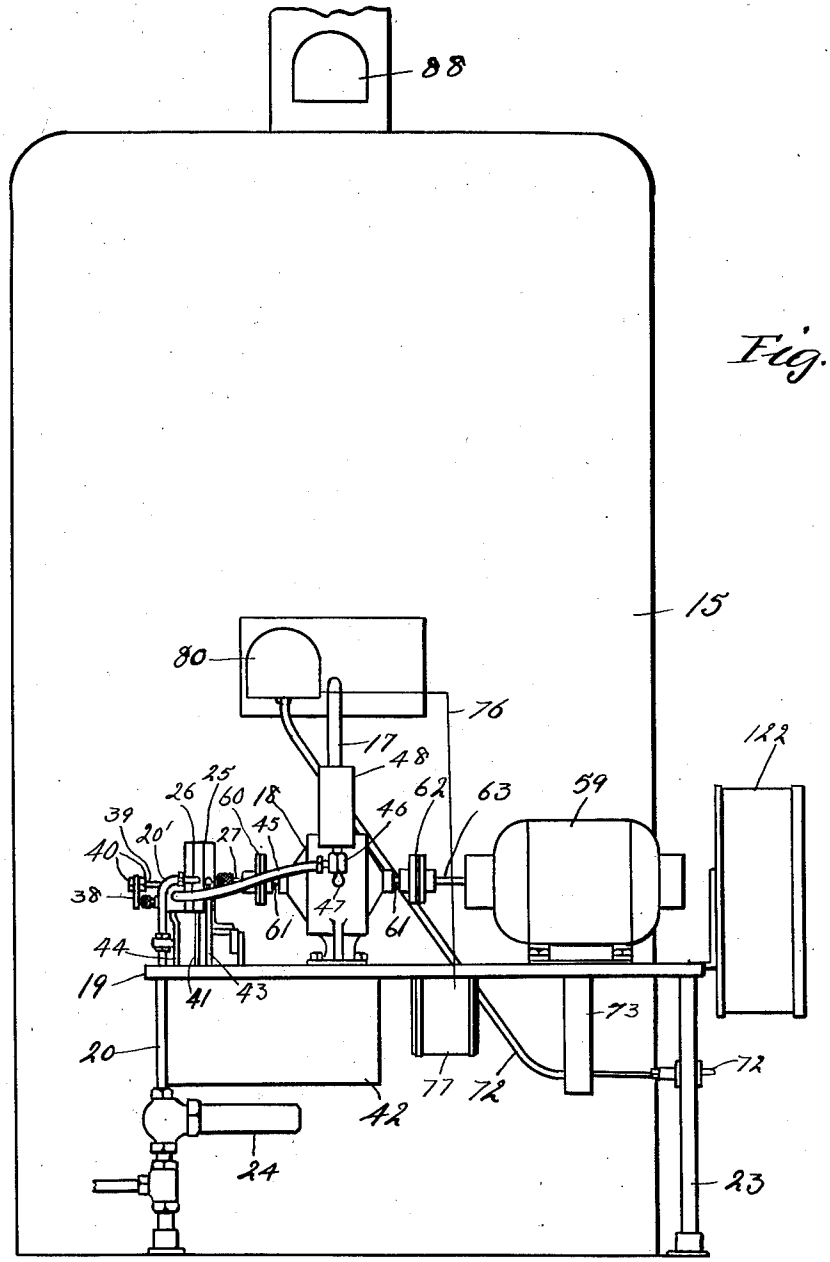



Fig. 1.

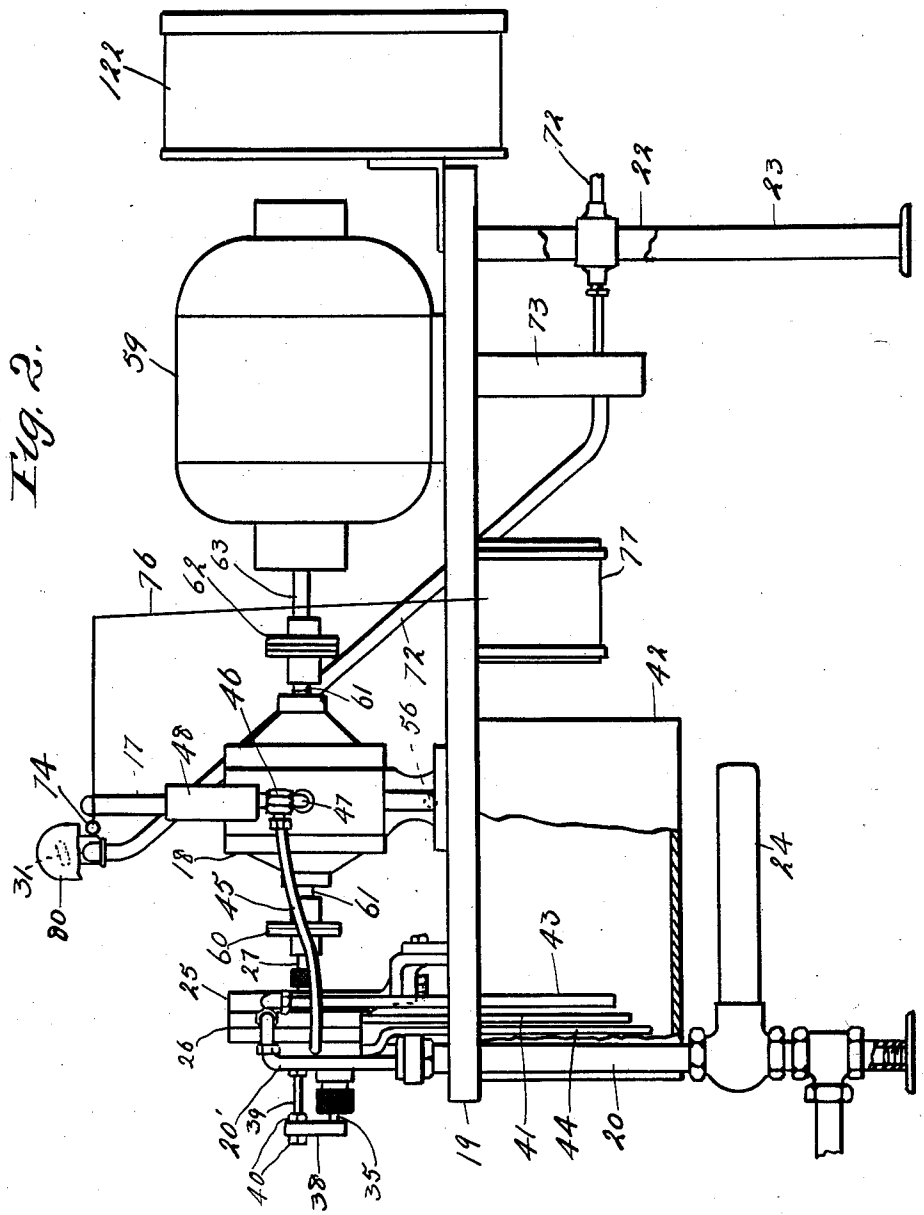
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AUTOMATIC SAFETY OIL BURNING SYSTEM

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Fig. 2.




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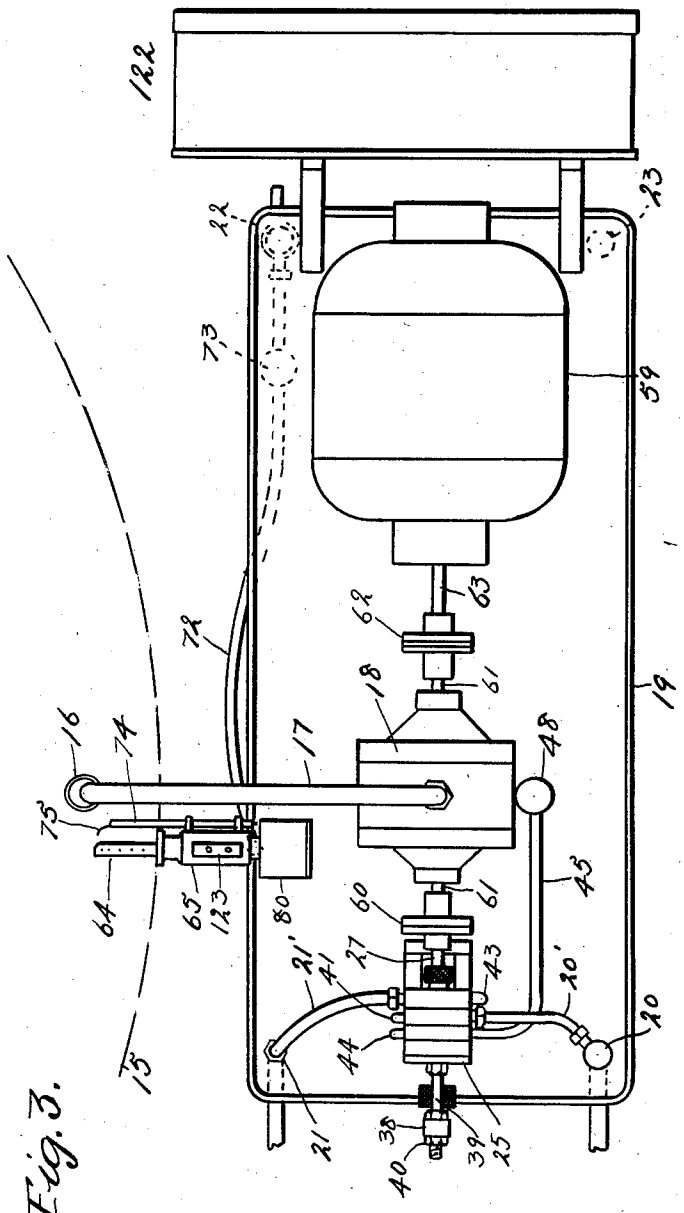



Fig. 3.

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Fig. 5.

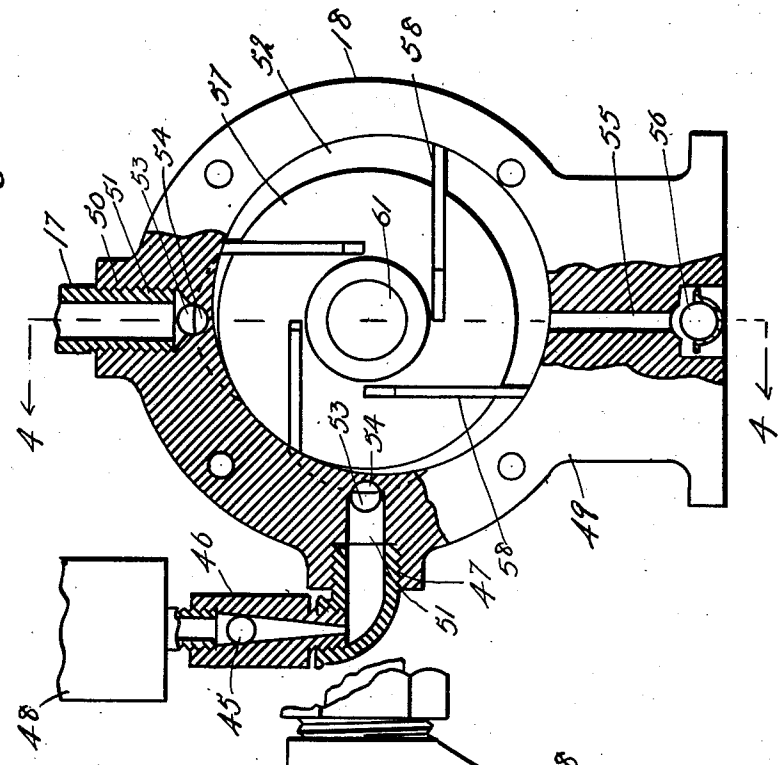
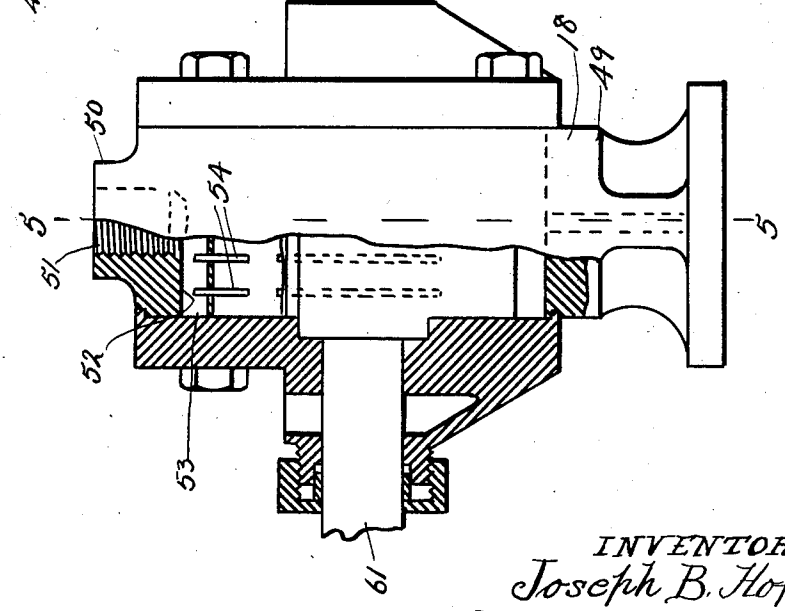



Fig. 4.




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AUTOMATIC SAFETY OIL BURNING SYSTEM

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Fig. 6.

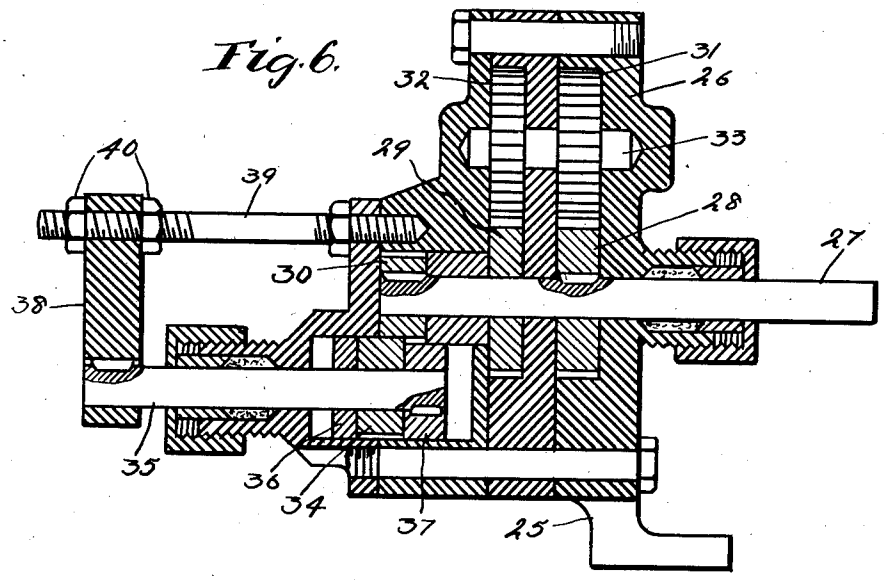



Fig. 7.

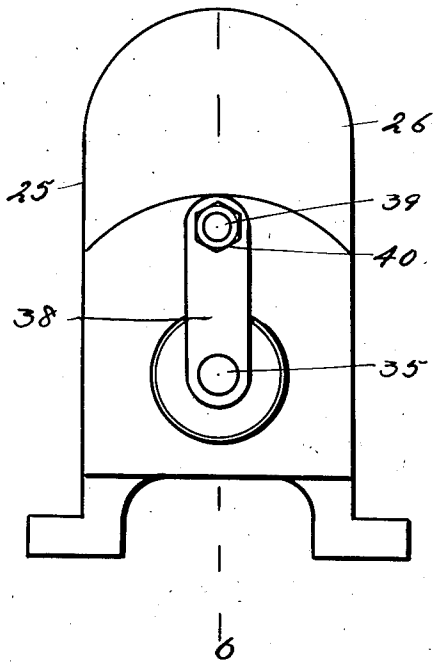
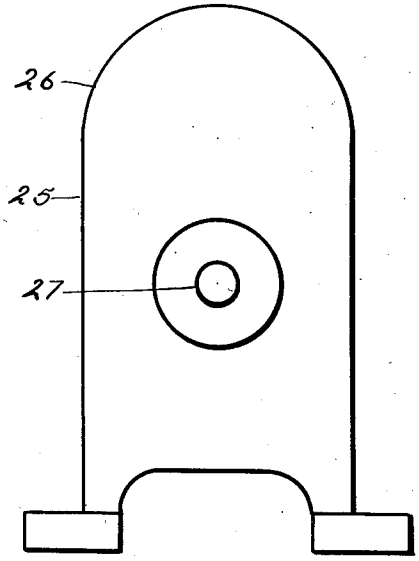



Fig. 8.




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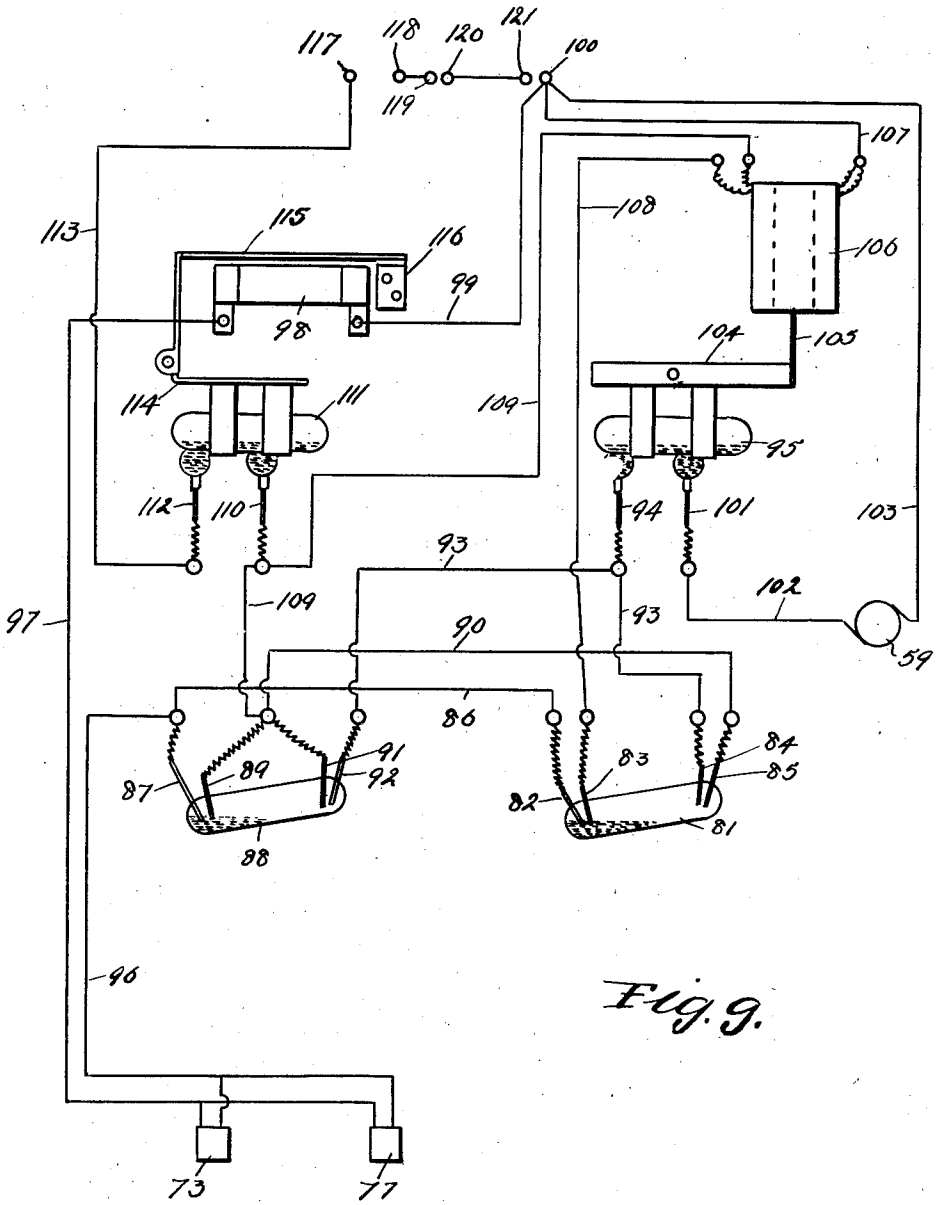


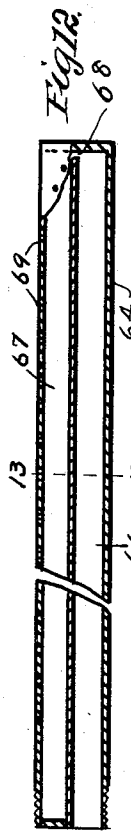

Fig. 9.

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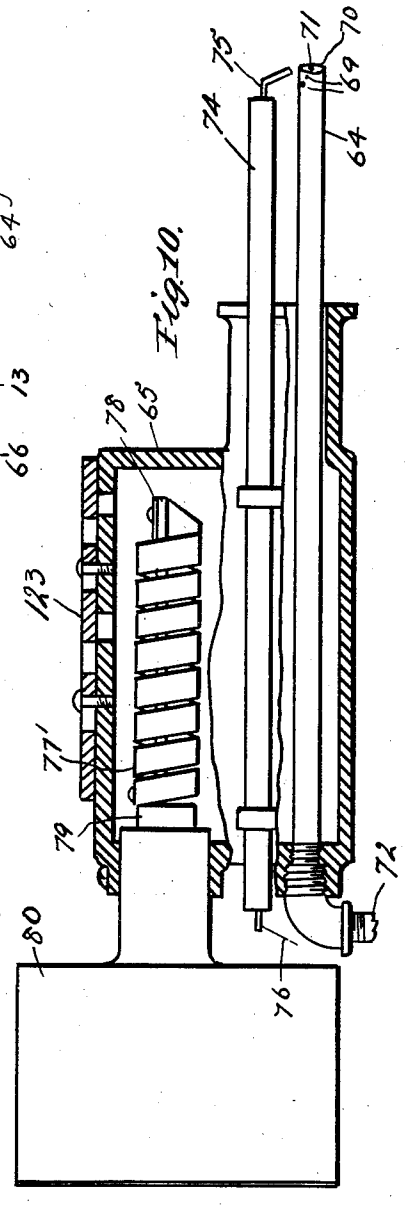
AUTOMATIC SAFETY OIL BURNING SYSTEM

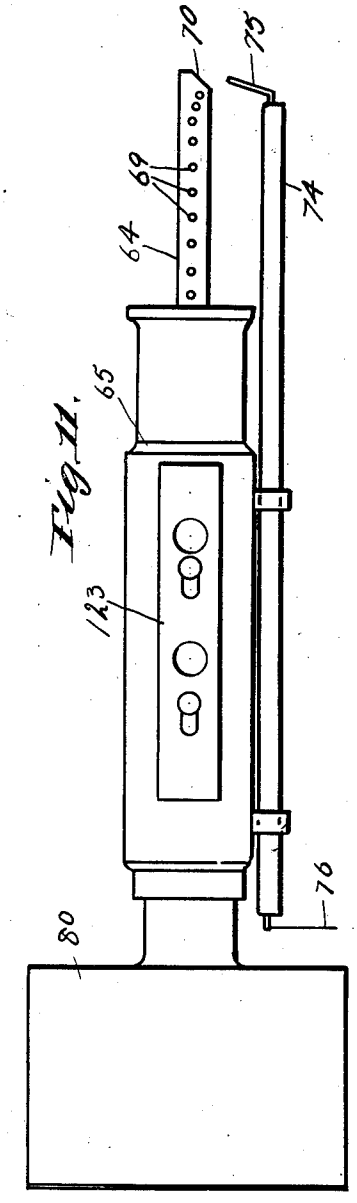
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Patented Apr. 7, 1931 1,799,902

# UNITED STATES PATENT OFFICE

JOSEPH B. HOFF, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO GRANT HOME HEATER CORPORATION, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY

## AUTOMATIC SAFETY OIL-BURNING SYSTEM

Application filed June 28, 1929. Serial No. 374,532.

My invention relates to new and useful improvements in an automatic safety oil burning system and has for one of its objects to provide an improved and unique method of atomizing and burning heavy fuel oil, and automatically controlling the several steps necessary to accomplish the burning thereof.

Another object of the invention is to provide for maintaining a predetermined supply of oil in a secondary reservoir and for returning any additional oil to the main reservoir over and above the predetermined quantity which may be required in the secondary reservoir.

A further object of the invention is to provide means for pumping oil from a main reservoir to a secondary reservoir, said means including an element to maintain the oil in the secondary reservoir at a predetermined level and said means also including an element to supply oil from the secondary reservoir to an atomizer, where it will be thoroughly atomized and mixed with air at a high velocity and carried through the air pump for projection into the furnace at the burner tip, said pump having an automatic check valve controlled outlet in communication with the secondary reservoir whereby the oil within the pump and burner pipe, after the flame has been extinguished, by the stopping of the burner motor, will return to said secondary reservoir, said oil being lighted by an electrically controlled gas burner providing sufficient pressure of gas is supplied to support a flame to ignite the oil and produce sufficient heat, to actuate a thermostat, to close an electric circuit for starting the motor which controls the workings of the air and oil pump.

With these ends in view, this invention consists in the details of construction and combination of elements hereinafter set forth, and then specifically designated by the claims.

In order that those skilled in the art to which this invention appertains may understand how to make and use the same, I will describe its construction in detail, referring by numerals to the accompanying drawings forming a part of this application, in which:—

Fig. 1, is a rear elevation of my oil burner and atomizer embodied in my automatic safety oil burning system and illustrating its association with a heating appliance.

Fig. 2, is an enlarged rear elevation of the main working parts of the apparatus constituting elements of my automatic safety oil burning system with a portion of the secondary reservoir broken away and shown in section to illustrate details of construction, and a portion of one of the hollow legs being broken away to show one manner of providing connection with a main reservoir.

Fig. 3, is a plan view of the apparatus shown in Fig. 2, and also including a portion of the appliance to illustrate the connection between the parts.

Fig. 4, is an enlarged sectional view of the mixing pump on approximately the line 4—4 of Fig. 5 with parts left in elevation.

Fig. 5, is an end view of Fig. 4 with one of the caps or heads removed and then the portions broken away to approximately the center line as indicated by 5—5 in Fig. 4 to more readily illustrate details of construction.

Fig. 6, is a section of the triple oil pump on the line 6—6 of Fig. 7.

Fig. 7, is a front end view thereof or looking toward the left hand end of Fig. 6.

Fig. 8, is an opposite end view thereof.

Fig. 9, is a diagrammatic view of the electric circuit or circuits included as a part of my safety control system.

Fig. 10, is an enlarged longitudinal sectional view of the casing for the thermostat of the ignition controlled motor starting switch and the gas burner, a portion of said casing being left in elevation to illustrate the means for supporting the ignition electrode.

Fig. 11, is a top plan view thereof.

Fig. 12, is an enlarged longitudinal sectional view of the gas burner, a portion being left in elevation to show the arrangement and location of the burner openings.

Fig. 13, is a section on the line 13—13 of Fig. 12.

In carrying out my invention as herein

embodied, 15 represents a furnace or heating appliance which, for example, may be considered as a hot water boiler, although it is to be understood that the invention is not limited to the heating of hot water boilers. Within the boiler is located the oil burner or burning tip 16 which is supplied with the hydro-carbon fuel or a mixture of oil and air through a conduit 17 leading from the mixing pump 18.

The mixing pump as well as other appurtenances of the device are mounted upon a suitable stand or support 19 which may be likened unto a metal table or top supported by legs or uprights 20, 21, 22 and 23, and if found desirable, certain of these may be hollow, particularly the ones designated 20 and 21, for use as conduits.

The conduit 20 communicates with a main or primary reservoir wherein is kept a supply of oil and in said conduit is a strainer 24 so that the oil will be strained before entering the triple pump or the burner.

The triple gear pump 25 is mounted upon the stand or support and this triple pump includes a casing 26 having a drive shaft 27 suitably journalled, on which are fixed or keyed two pinions 28, and 30. The pinions 28 and 30 mesh with and drive gears 31 and 34 which are located in oil tight compartments, both having inlets and outlets. Gears 31 and 32 are fixed upon a common axle 33 passing through and into the different parts of the casing and gear 32 drives gear 29 which is loosely fixed to shaft 27, eliminating any possibility of the suction pump, which is composed of the gears 29 and 32, being operated, and drawing oil from main storage tank without the return pump, which is composed of the gears 28 and 31, being in operation, thereby avoiding the overflowing of the secondary reservoir with oil.

The pinion 30 meshes with and drives a gear 34 also located in an oil tight compartment having an inlet and outlet. The gear 34 is mounted to revolve upon an axle 35 slidably mounted in the pump casing so as to carry the gear 34 backward and forward within its compartment and this is accomplished by mounting the gear between the discs 36 and 37.

As the revolving of the gears produces the pumping actions, the changing of the position of the gear 34 regulates the flow of oil past this particular gear as only the portion which is in mesh with its pinion is operative.

The axle 34 passes through a suitable stuffing box and its outer end is fixed to one end of the connector 38, the latter being slidably mounted upon a rod 39 and capable of being held in different adjusted positions on said rod by means of the nuts 40. The rod 39 is suitably mounted in the pump casing, gears 30 and 34 running in their housings constituting an adjustable fuel feed supply pump for giving a continuous non-pulsating supply of heavy fuel oil to the atomizer nozzle.

The conduit 20 which, as above stated, communicates with a main or primary reservoir also communicates with, as through a branch conduit 20′, with the inlet of the pump leading to the compartment housing the gear 32 while from the outlet of said compartment leads a conduit 41 to the secondary reservoir 42 so that when the device is in operation, oil will be pumped continuously from the main or primary reservoir to the secondary reservoir 42.

In order to maintain the oil in the secondary reservoir 42 at the proper or predetermined level, a conduit 43 projects into the secondary reservoir with the end of said conduit 43 terminating a desirable distance above the bottom of said secondary reservoir and said conduit 43 connects with the inlet of the compartment housing the gear 31, while the outlet of said compartment is connected by a branch conduit 21′ with the return conduit 21 leading to the primary or main reservoir.

Gears 28 and 31, which constitute the return pump, are of the same diameters and run at the same speed as gears 29 and 32, which constitute the suction pump, drawing oil from the primary reservoir and delivering the entire amount in the secondary reservoir. Gears 28 and 31 which constitute the return pump having a wider face, consequently a greater capacity, further insuring against the overflowing of the secondary reservoir with oil.

Another conduit 44 projects into the secondary reservoir and terminates at a point below the level maintaining conduit 43 and connects with the inlet to the compartment housing the gear 34 and from the outlet of this compartment leads the feed conduit 45 to the atomizer nozzle 46 connected with the inlet 47 of the air pump 18.

The atomizer nozzle 46 is open from end to end for the passage of air, while the feed pipe communicates at the side of the nozzle with the tapered bore of said nozzle and in order to reduce the noise incident to drawing air into the nozzle, a muffler 48 is provided. By changing the area of the orifice of the atomizer nozzle, the air and oil velocity will be changed accordingly.

The air pump 18 includes a suitable housing 49 provided with the aforesaid inlet 47 and an outlet 50, both constructed to include a hole 51, leading from the exterior of the casing inward but terminating short of the rotor chamber 52 and crosswise of the hole 51 and in communication therewith is another hole 53 which communicates with a number of slots 54, said slots communicating with the rotor chamber 52, thus the oil and air passing through the inlet is distributed throughout the width of the rotor chamber and when

passing to the outlet is retracted from the entire width of the rotor chamber into the outlet.

Leading from the bottom of the rotor chamber 52 is a sump outlet 55 which is normally open when the air pump is not in operation, but will be closed by a check valve 56 due to the suction created by the operation of said air pump and said sump outlet communicates directly with the secondary reservoir 42, permitting the oil in the air pump 18 and burner pipe 19 to return to secondary reservoir upon the stopping of the driving motor.

Within the rotor chamber 52 is revolvably mounted the rotor 57 positioned eccentric to said chamber and in this rotor are slidably mounted a number of blades 58 which coact with the wall of the chamber and cause the atomized air and oil to be drawn into the chamber and then forced out of said chamber into and through the conduit 17 of the burner nozzle 16.

As should now be obvious, during the revolution of the rotor 57, a suction action will be created which will draw the check valve 56 to its seat and close the sump outlet 55 so that all of the air taken in by the air pump must pass through the atomizing nozzle with the fuel oil, but when the rotor stops, the check valve 56 will be released and the oil will gradually flow to the bottom of the chamber 52 and thence through the outlet into the secondary reservoir. This arrangement eliminates all chance of any oil being left in the air pump and piping to the burner nozzle to be fed to the burner nozzle immediately upon the starting of the operations of the device.

It might be well to state at this time that the blades of the rotor are moved outward by centrifugal force so that as the speed of the rotor is slowed down prior to actual stopping, the blades which had been moved would not again travel out to the walls of the rotor chamber so that the oil can readily escape through the sump outlet.

The oil pump, the air pump and the prime mover or electric motor 59 are all arranged in endwise alignment, particularly when considered with relation to their shafts and the shafts 27 of the oil pump, is connected, as by a flexible coupling 60 with one end of the shaft 61 of the rotor of the air pump, while the other end of said shaft 61 of the air pump rotor is connected, as by a flexible coupling 62 with the shaft 63 of the prime mover or electric motor 59.

Adjacent the burner nozzle or tip is located a gas burner 64 passing through the housing 65 of the ignition apparatus. This housing is located so as to be adjacent the burner nozzle and preferably has one end attached in some suitable way to the heating appliance 15 so that the burner 64 projects into the heating appliance.

As shown in Figs. 12 and 13, the burner or gas ignition conduit comprises two longitudinal compartments 66 and 67, the latter being in communication at its inner end only through an opening 68 with the inner end of the compartment 67, said compartment 67 being closed at both ends but having a series of perforations 69, the majority of which are along the top side of the burner or ignition conduit for heating the helix 77′, but at the inner end of said burner, the perforations run off to the side for leading the flame of the gas from the orifice 71 where it is ignited from the electric spark by way of the perforations or orifices back under the helix 77.

If found desirable, the inner end of the gas burner may be beveled, as indicated at 70, and have a suitable sized hole 71 in said beveled part so that a large single flame of gas can project from the hole 71 into the zone of atomized oil.

The outer end of the gas burner 64 is connected by a suitable conduit 72 leading from a source of gas supply and in the conduit 72 for controlling the flow of gas is an electrically operated valve indicated by the numeral 73.

Carried by the housing 65, as on the outside thereof is a spark plug 74 including an electrode 75, the inner end of which is positioned adjacent the inner end of the gas burner so that a spark will jump the gap between them. The outer end of the electrode is electrically connected through a suitable conductor 76 with the spark producing device 77 which may be a spark coil or transformer as best suits the purpose and said spark producing device is electrically connected with a source of electric current.

Within the housing 65 above the gas burner is located a thermostat 77′ preferably of helical form and generally termed a helix with one end fixed to a shaft or axle 78, as the movable element, and the other end fixed to a sleeve 79, as the stationary element, said sleeve being a part of the casing 80, housing a mercury switch, to be presently described, which switch is connected with the shaft or axle 78 for actuation thereby. The preferred form of this apparatus is described in my patent application, filed August 17th, 1927, bearing Serial No. 213,491.

The unique construction and arrangement of the parts forming the ignition apparatus will prevent operation of the controlling device unless there is sufficient pressure or supply of gas to produce a flame not only at the forward or inner end of the gas burner but also along the rear part of the burner within the housing 65 so that the temperature within said housing will be raised sufficiently to cause the thermostat to operate and ac-

tuate the mercury switch for completing a circuit through the motor, all of which will be presently described.

In the circuit diagram illustrated in Fig. 9, 81 represents the mercury switch which is located in the casing 80 and connected with the shaft or axle 78 and is provided with a pair of terminals 82 and 83 at one end and another pair of terminals 84 and 85 at the other end. This switch might properly be called the ignition controlled motor starting switch, and one of the terminals, as 82 is connected by a suitable conductor 86 with a terminal 87 of a pair located at one end of the combustion control or stack mercury switch 88.

The other terminal 89 of the pair at one end of the switch 88 is connected by a conductor 90 with the terminal 85 of the switch 71 and in this part of the circuit there is a branch from the conductor 90 connected with the terminal 91 at the other end of the switch 88 and its coacting terminal 92 is connected by a conductor 93 with the terminal 84 of the switch 81 and also with the terminal 94 of the solenoid mercury switch 95.

The terminal 87 of the switch 88 and the terminal 82 of the switch 81 are both electrically connected by a conductor 96 with one side of both the electrically operated gas valve and the spark coil or transformer, while the other sides of said electrically operated gas valve and spark coil or transformer are connected by a conductor 97 with a heating element 98 and said heating element is connected by a conductor 99 with a terminal or binding post 100 of a pressurestat.

The other terminal 101 of the solenoid switch is connected by a conductor 102 to one pole of the motor 59 while the other pole thereof is connected by a conductor 103 with the binding post or terminal 100 of the pressurestat. The solenoid switch 95 is carried by a tilting frame 104 having one end connected with the core rod 105 of the solenoid 106. The coils of the solenoids are so arranged as to provide for lifting the core and then for holding said core rod in the elevated position and both of such coils are connected by a conductor 107 with the terminal or binding post 100 of the pressurestat while another side of the lifting coil is connected by a conductor 108 with the terminal 83 of the ignition control motor starting switch 81 and the other side of the holding coil is connected by a conductor 109 with the terminal 110 of the master switch 111 and also with the terminals 89 and 91 of the combustion control or stack switch.

The other terminal 112 of the master switch is connected by a conductor 113 with a source of electrical energy or one of the line wires and said master switch is supported in a tilting frame 114 connected with a thermostat 115, preferably in the form of a bi-metal strip associated with the heating unit and having one end fixed to a bracket 116 so that when the heating unit has become hot from the current passing therethrough, the thermostat 115 will actuate the master switch to open the circuit through it.

The conductor 113 may be connected with a terminal or binding post 117 and the other side of the line or source of current is represented by a terminal or binding post 118 which is connected to one side of a thermostat or sets of thermostats, represented by the terminal or binding post 119, located at a distant point or distant points. The other side of the thermostat is represented by the binding post or terminal 120 and this is connected with the binding post or terminal 121 at the other side of the pressurestat. It is to be understood that the pressurestat is the boiler temperature control device.

The electrical connections above referred to are fully described in my Patent No. 1,596,836, issued August 17, 1926.

While the combustion control or stack switch is generally located in the smokestack of the furnace or heating appliance, I have found that in very large furnaces, it is advisable to locate this switch adjacent the location of the usual fire door, but the master switch, the heating unit with its component and associated parts, the solenoid switch and the solenoid with its associated and component parts are all located within the control box 122, preferably mounted on the supporting frame of the device.

From the foregoing description, the operation of my safety control system for automatic oil burners will be obviously as follows:—

When heat or pressure is required, the thermostat, pressurestate or other means for controlling the primary electric circuit will be closed, therefore the current will pass from one side of the line or source of current supply through the conductor 113, the switch 111, a part of the conductor 109 through the holding coil of the solenoid and then through the conductor 107 to the other side of the line. At the same time the current will pass through the other part of the conductor 109, thence through the switch 88, it being understood that all the parts shown in Fig. 9 of the drawings are in the cold positions, then through conductor 96, the electrically operated gas valve 73, the spark coil 77, conductor 97, heating element 98, conductor 99 to the other side of the main line. Also current will pass through the conductor 86, the terminals 82 and 83 of the switch 81, the conductor 108, the lifting coils of the solenoid and the conductor 107 to the other side of the line, and thus the switch 95 is shown in its operative position since the core rod 105 of the solenoid will have been drawn in to close the switch 95 and thus the circuit

through said switch and the motor 59 is partly closed, but only in so far as concerns the solenoid switch 95.

The current flowing through the several closed circuits thus far described will operate the gas valve and turn on the gas to the burner 64 and at the same time produce a spark at the gap between the electrode and said gas burner.

If a sufficient flow of gas is passing through the burner so that when ignited by the spark, a flame will be supported throughout the length of said burner due to the gas passing through the chamber 66 then through the hole 68 into the chamber 67 and out from the series of perforations 69, the temperature in the housing 65 will be gradually raised until the helix 77 turns the ignition controlled motor starting switch 81 into a position opposite that shown in Fig. 9, thereby closing a circuit from one side of the main through the conductor 113, switch 111, a part of the conductor 109, conductor 90, the terminals 84 and 85 of the switch 81, conductor 93, terminals 94 and 101 of the solenoid switch 95, conductor 102, motor 59 and conductor 103 to the other side of the main so that the motor is now in operation and pumping atomized fuel to the oil burner and said oil will be ignited by the gas flame issuing from the gas burner 64 and more particularly the tongue of flame which will issue from the hole 71 at the inner tip end of the gas burner. The temperature within the housing 65 for operating the helix 77 may be regulated by means of a damper 123 controlling apertures in the upper part of the housing 65.

If there is not a sufficient flow of gas to heat the helix 77 and therefore operate the switch 81, the motor cannot be started and the current will continue to flow through the heating element 98 until the thermostat 115 operates and tilts the master switch 111, thus breaking the circuit between the terminals of the switch 111 and the holding and lifting coils of the solenoid will be de-energized, causing the switch 95 to be tilted so as to break the contact between the terminals 94 and 101 of said switch 95, and consequently the motor cannot start to operate and oil will not be fed to the oil burner.

Assuming that everything is in proper condition, as soon as the motor starts, it will feed atomized fuel to the oil burner nozzle and the heat produced within the heating appliance or furnace will operate a helix in the stack or other part of the furnace so that the switch 88 will be tilted to a position opposite that shown in Fig. 9 and the circuit to the motor will be maintained through the master switch 111, a portion of the conductor 109, the terminals 91 and 92 of the switch 88, the conductor 93 and the switch 95 and its terminals and the circuit through the holding coil of the solenoid will remain as before, but the circuit through the electrically operated gas valve and spark coil, as well as the heating element 98, will have been opened and such circuit not closed again until the circuit through the controlling or distant thermostat, pressurestat or the like has been opened so that the parts return to the positions shown in Fig. 9, with the exception of the switch 95, and said distant thermostat, pressurestat or the like, again close when the operations above set forth will be repeated.

As soon as the motor stops, any oil in the oil burner and the air pump 49 will flow to the bottom of the rotor chamber of the air pump and then through the sump outlet back into the secondary reservoir 42 so that the next time the burner is started, oil will have to be pumped from the secondary reservoir through the conduit 45 for mixture with the air and be atomized before passing through the air pump into the oil burner.

Of course I do not wish to be limited to the exact details of construction as herein shown, as these may be varied within the limits of the appended claims without departing from the spirit of my invention.

Having thus fully described my invention, what I claim as new and useful is:—

1. In a device of the kind stated, a secondary reservoir, a pump having an intake and discharge, means to supply air and oil to the pump intake, a communication between said reservoir and the suction part of the pump, a check valve in said communication to close when the pump is in operation and to open when the pump stops to permit any oil in the pump to drain to the secondary reservoir.

2. The structure set forth in claim 1 in combination with a burner located in an elevated position relative to the discharge from the pump, and a conduit connecting the discharge for the pump with the burner and so positioned that when the flame is extinguished, any oil in the burner and said conduit will return to the pump for drainage to the secondary reservoir.

In testimony whereof, I have hereunto affixed my signature.

JOSEPH B. HOFF.