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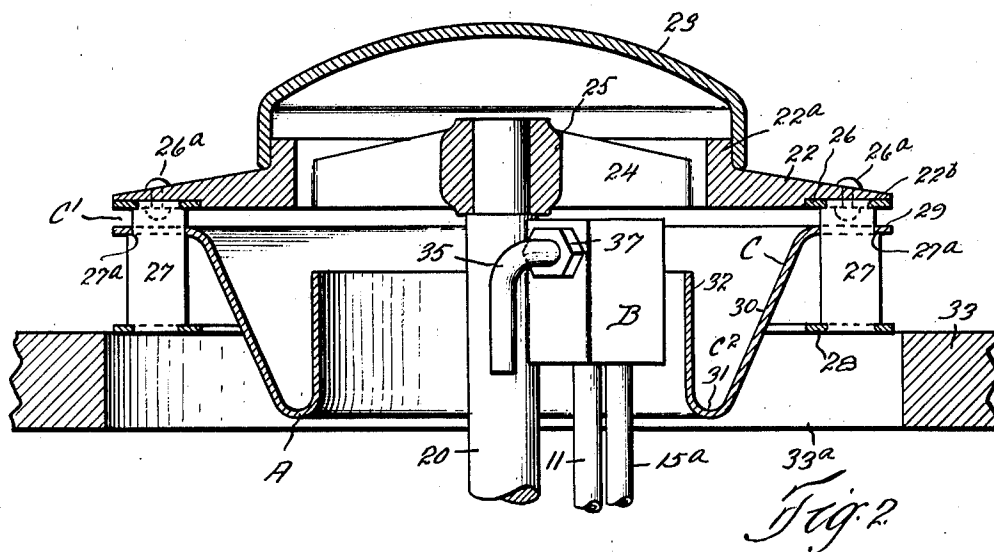
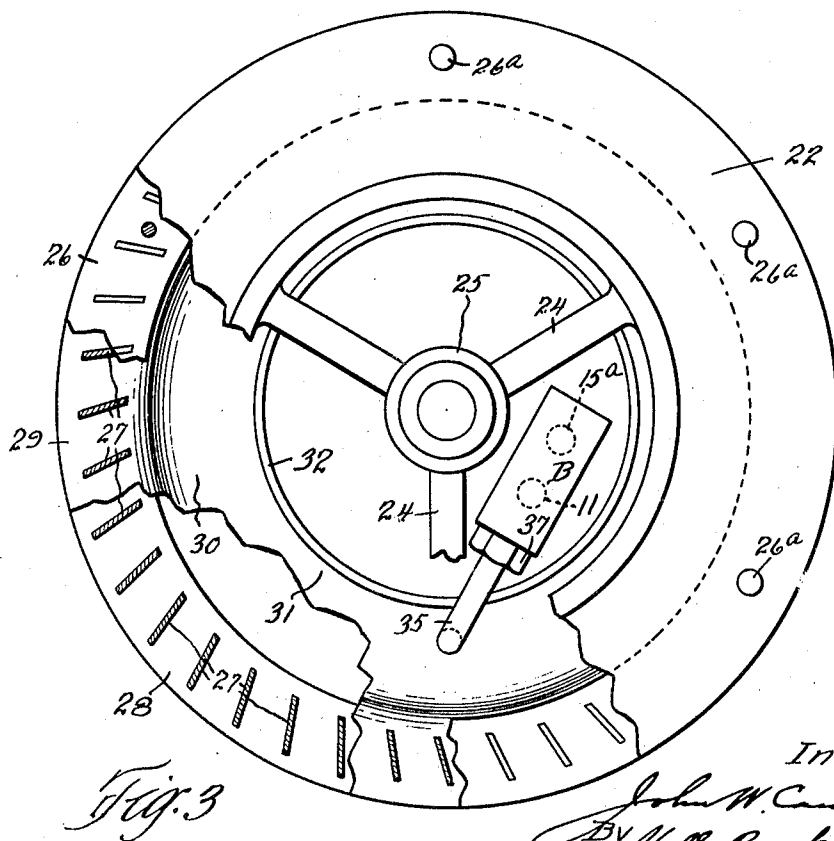
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J. W. CANNON

APPARATUS FOR BURNING LIQUID FUEL

Filed May 29, 1925

4 Sheets-Sheet 2



Inventor

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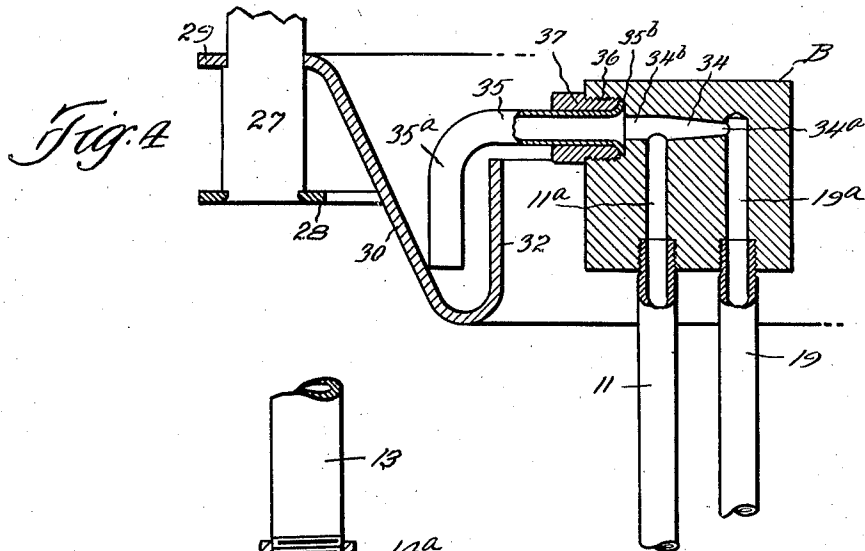
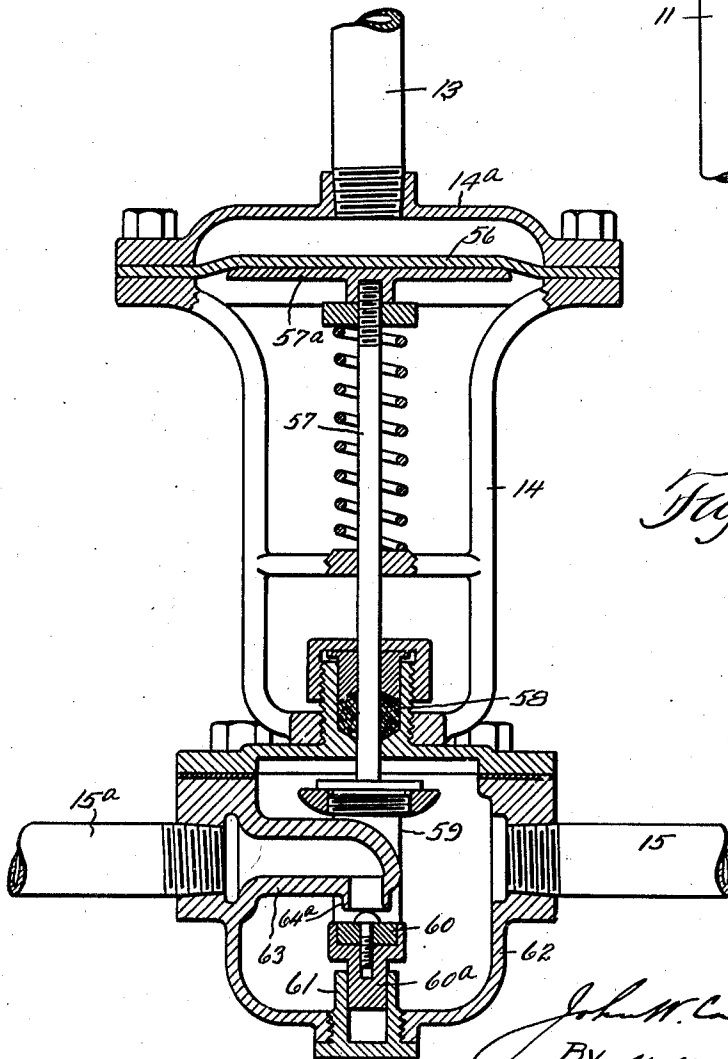
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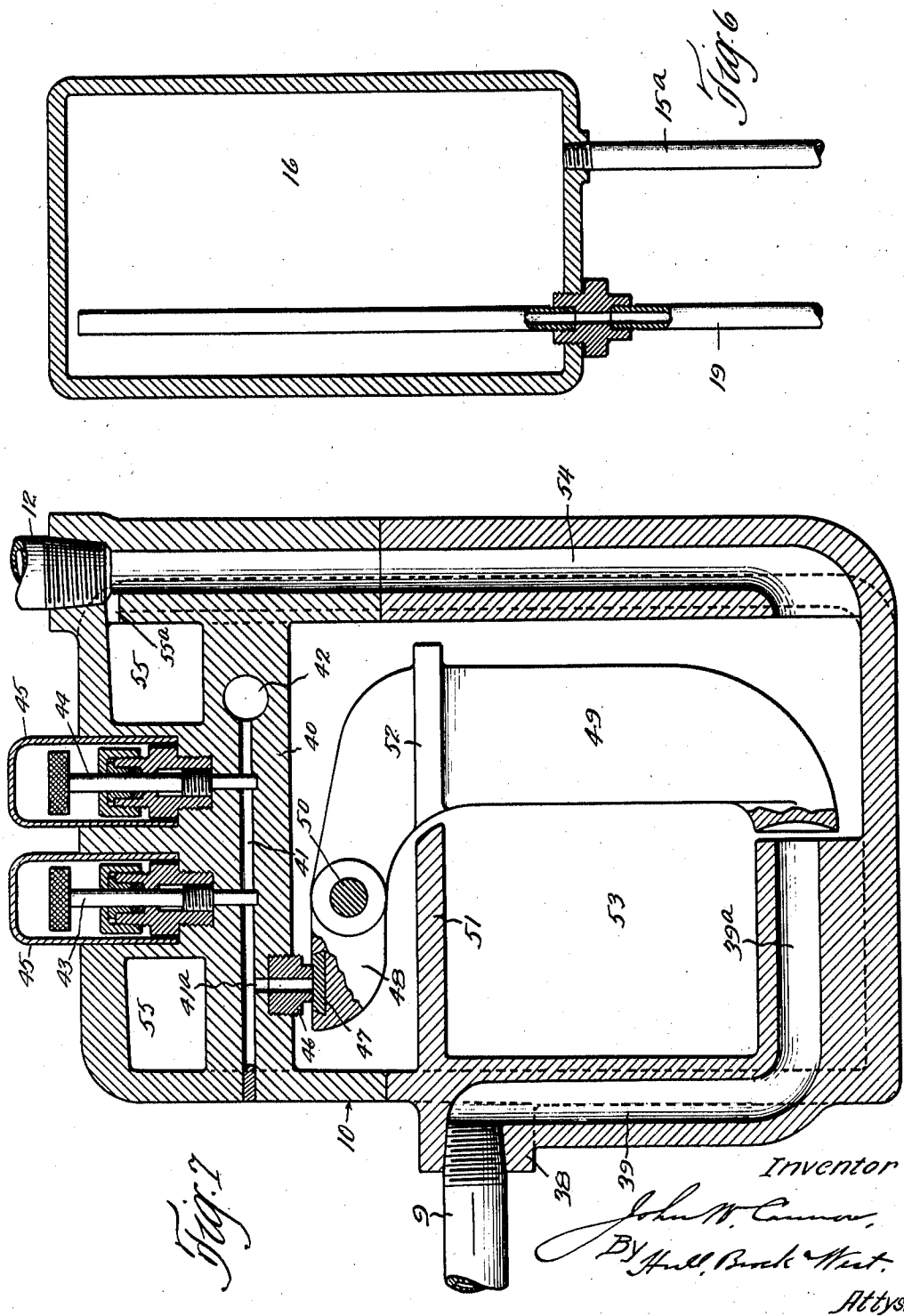
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4 Sheets-Sheet 4



UNITED STATES PATENT OFFICE.

JOHN W. CANNON, OF PROVIDENCE, RHODE ISLAND.

APPARATUS FOR BURNING LIQUID FUEL.

Application filed May 29, 1925. Serial No. 33,626.

To all whom it may concern:

Be it known that I, JOHN W. CANNON, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented a certain new and useful Improvement in Apparatus for Burning Liquid Fuel, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

This invention relates to an apparatus for burning liquid fuel, such as oil, and has for its general object to secure complete combustion of such fuel and to obtain maximum heating efficiency therefrom. Further and more limited objects of the invention will be pointed out in the specification. As disclosed herein, the process is realized in and through the operation of an apparatus which has been found to be particularly adapted for house-heating purposes and in conjunction with a centrifugal type of burner for oil—hereinafter referred to specifically as typifying the liquid fuel.

Referring to the drawings, Fig. 1 represents a sectional elevation of a system or apparatus embodying my invention and by means of which my process is realized; Fig. 2 a central vertical sectional view of the burner employed in such apparatus; Fig. 3 a plan view of the burner, the cap being removed and certain parts being broken away; Fig. 4 a detail in vertical section through a part of the burner; Fig. 5 a vertical sectional view through the diaphragm valve which controls the flow of water to the steam generator; Fig. 6 is a sectional view through the steam generator; and Fig. 7 a similar view through the bypass tank for the oil supply to the burner.

Describing the various parts by reference characters, 1 represents the main oil tank of the system, connected by pipes 2 and 3 with a smaller elevated siphon check-tank 4, from the lower part of which a pipe 5 leads to the inlet side of a pump 6 driven by a motor 7, the motor indicated being any standard electric motor driving the pump 6 through a shaft 8. The pipe 2 is provided with a downwardly-seating check valve 2^a,

and is connected with the pipe 5, in the tank 4, by an elbow 5^a. The elbow is also provided with a small vent 4^a and the tank with a filling plug 4^b.

9 denotes a pipe delivering oil from the outlet side of the pump to the by-pass tank 10, from which tank a pipe 11 leads to an atomizer B within the burner, indicated generally at A. From the tank 10 another pipe 12 leads to the top of the tank 4. A pipe 13 leads from the pipe 9 to the upper end of a diaphragm valve-chamber 14, the lower end of said chamber being provided with a pipe 15 which receives water from any source of supply, as the city main. From the delivery side of the diaphragm valve chamber, a pipe 15^a conducts the water passing therethrough to a steam generator 16, within the fire pot of a furnace or heater 17, the particular furnace shown being indicated as an ordinary vapor or steam-generator having an annular chamber or water leg 18. The pipe 15^a is provided with a globe valve 15^b, whereby the water supplied to the generator may be controlled by the diaphragm valve as well as regulated by the hand-operated valve.

From the steam generator 16, a pipe 19 conducts the steam to the atomizer B within the burner A.

The burner is of the centrifugal type, comprising generally a cover which is secured to a vertical shaft 20, and a bottom plate, the bottom plate of the burner being spaced from the top or cover of the burner to provide a slot therebetween for the discharge of the combustible mixture by centrifugal action, the cover and the bottom being connected by fan blades. The bottom of the shaft 20 is provided with a bevel gear 20^a meshing with a bevel pinion 21^a on a shaft 21 driven by the motor 7.

The details of the various parts of the system or apparatus thus outlined will be set forth at length and under appropriate sub-headings.

Burner construction.

The burner A comprises a cover having an outer ring 22 (preferably cast), and a cap

- 23 fitted over a vertical flange 22^a at the central portion of said ring. The ring 22 is connected by ribs 24 with a hub 25 which is rigid with the shaft 20. The ring or plate 22 is also provided with a recess 22^b in the under face thereof in which an annular plate 26 is secured, as by means of rivets 26^a. The plate 22 has secured thereto the upper ends of the fan blades 27, the blades being such as are used with centrifugal fans. Each blade 27 is provided with a step 27^a, a short distance below the plate 26, and these steps support the peripheral portion of the bottom plate of the burner, indicated generally at C, the blades extending through the peripheral portion of the bottom plate and having their bottoms fastened to a plate 28 surrounding and spaced from the bottom plate C.
- 20 The bottom plate C as shown herein is given a conformation which not only provides a comparatively narrow peripheral slot C' with the ring or plate 22, but which admits air freely to the space between the top and bottom members and prevents the mixture delivered to such space from being drawn out of the burner by the action of the lower fan provided by the blades 27 and the plate 28 and the peripheral portion 29 of the plate C. It will be noted that the peripheral part 29 of the lower plate is substantially parallel to the plate 26, providing therewith a narrow peripheral slot for delivering the mixture into the fire pot D. From the inner end of such peripheral portion 29, the plate C extends downwardly and inwardly, as shown at 30, and is then bent upon itself, at 31, and extends upwardly parallel with the axis of the shaft 20 and spaced from said shaft, the upwardly extending portion or flange of the plate being shown at 32, thus providing a trough C² at the central portion of said plate. The burner is located above an opening 33^a in a deck or floor 33 which closes the bottom of the fire pot D, except for the said central opening. The opening is approximately of the same diameter as the diameter of the upper and lower plates of the burner. The space between the plates 22 and C is supplied with a mixture of oil and steam from the atomizer B, the details of which will now be described. As pointed out hereinbefore, the water is conducted to the generator 16, shown in Fig. 6, it being noted that this generator is shown as a simple receptacle into the bottom of which water is delivered by the pipe 15^a and from the top of which steam is taken by the pipe 19 to the atomizer.
- It will be noted that, by supporting the burner from the shaft 20 by means of the ribs 24, connected to the upper ring or plate 22, a practically free and unobstructed open center is provided for the supply of air to the mixture of steam and atomized oil delivered between the upper and lower burner plates or parts and against the bottom of the central depression of the lower plate. The burner constructed as described gives a complete admixture of air with the steam and atomized oil between the upper and lower parts of the burner—producing an intense concentrated flame extending substantially horizontally from the burner to the fire ring 33^a and upwardly from said ring and in suspension in the fire pot. This not only secures perfect combustion of the oil, without the accumulation of carbon or soot within or upon the burner and the boiler, but also prevents the destruction of or injury to the burner and boiler and the parts thereof by the flame. Furthermore, by constructing and operating the burner in the manner described, I am enabled to run the burner at a materially reduced speed, as compared with burners of similar types, thereby enabling me to prolong the life of the moving parts and economize in the use of current for the motor without sacrificing any of the advantages pointed out hereinbefore.
- Reference has been made heretofore to the particular shape of the bottom plate C of the burner. In small installations, it will be given the shape shown herein, with the deep trough C², formed by the walls 30 and 32, surrounding the shaft 20. In larger installations, however, this trough may be comparatively shallow; and in both cases the construction prevents the combustible mixture between the plates 22 and C from being drawn around the inner edge of the part 32 by virtue of the action of the lower fan which is provided between the peripheral portion 29 of the lower plate and the plate 28. In both large and small installations, however, a narrow air way will be provided between the top of the inner wall 32 of the trough and the inner edge of the ring 22. Because of the fact that the superheated steam and atomized oil are delivered forcibly into the trough in the form of a mist, there is danger that the large fan provided beneath the bottom plate C by the blades 27 will draw the fuel mixture from inside the burner beneath the plate C. By extending the inner wall 32 of the trough upwardly so as to provide a narrow air way between such upper edge and the inner edge of the plate 22, this undesirable action will be prevented.
- Oil atomizing and mixing device.*
- The oil atomizing and mixing device is located within the central part of the burner and between the vertical flange 32 of the lower plate and the shaft 20. It may be a metallic block, as indicated, having therein a vertical passage 19^a constituting a con-

tinuation of the steam pipe 19, and a vertical passage 11^a constituting an extension of the oil pipe 11. Steam is delivered from the top of the passage 19^a into a transverse or horizontal passage 34, which passageway has a relatively restricted inlet end 34^a but is of increasing cross-sectional area toward its intersection with the top of the passage 11. This arrangement enables the steam which is delivered from the top of the passage 19^a to expand as it flows through the passage 34 and enables the steam to operate in a most efficient manner upon and for the atomization of the oil delivered from the top of the passage 11^a. The duct comprising the passages 34, 34^a and 34^b delivers the mixture into a nozzle 35, the lower end of which projects downwardly within the space between the walls 30 and 32, as indicated at 35^a. The nozzle is shown as connected to the mixer B by means of a threaded recess 36 forming an enlarged extension of the passage 34^b, with a bushing 37 surrounding the flanged end 35^b of the nozzle 35, the said bushing being threaded into the seat 36. This construction enables the nozzle to be conveniently connected to and disconnected from the mixer B and provides the nozzle with a flared receiving end for the mixture delivered thereinto from the passages 34, 34^b.

By-pass tank.

In order to insure efficient operation of the burner under all ordinary incidents of use, the pump should be capable of supplying a sufficient quantity of oil to enable the burner to operate under its maximum capacity. In order to accommodate the system for variations in burner oil-supply without the necessity for changing the speed at which the pump is driven, I provide the by-pass tank referred to, such by-pass tank enabling oil which is pumped from the tanks 1 and 4, but which is not required for the burner, to be delivered back into the tank 4 and thence into the tank 1.

The by-pass tank, indicated generally at 10 (see Fig. 7) is provided with an inlet connection 38 with which the pipe 9 communicates, the wall of the tank having such connection being provided with a passage 39 extending downwardly from said connection and then inwardly, as shown at 39^a, a short distance above the bottom of the tank. Across the upper part of the tank and below the top thereof there extends a rib 40 provided with a passage 41 the delivery end of which communicates with a connection 42 for the pipe 11 leading to the atomizer B. The passage 41 is provided with a pair of valves 43 and 44, each provided with a cover, indicated at 45, which covers can be locked in place so that one of the valves may be set in a position to prevent more than a certain

quantity of oil from passing to the mixer or atomizer. The passage 41 receives oil from the chamber therebeneath through a vertical passage 41^a formed in the rib and in a bushing 46, the lower end of which bushing cooperates with a valve seat 47 carried by the short arm 48 of a bent lever the long arm 49 whereof projects in front of the delivery end of the passage 39, 39^a, the lever being pivoted near the rib 40, as shown at 50. A partition 51, extending from the tank wall having the connection 38 and partition wings 52 carried by the lever 49 provide an expansion and sediment chamber 53 in the lower part of the tank 10. This chamber serves to slow the velocity of the oil entering the by-pass tank, prevents the surging of the oil in the passage 41 and also enables the sediment entering said chamber to be delivered to the passage 54 and returned to the tank 1 without entering the passage 41 and the burner. The wall of the tank 10 which is opposite the connection 38 is provided with a vertical passage 54 extending from the bottom of the tank to the top thereof and having its upper end connected to the pipe 12 which leads to the siphon check tank 4. In the top of the by-pass tank is a chamber 55 which delivers air liberated from the oil into the passage 54 through a port 55^a. The valve arrangement ensures the closing of the passage 41 as soon as the pump stops, thereby preventing siphoning of oil to the burner; it also prevents the valve 47 from sticking.

Control of water by oil pressure.

Reference has been made hereinbefore to the control of the water to the generator 16 by the pressure of the oil delivered from the pump 6. The manner in which this result is obtained will be explained in connection with Fig. 5 wherein 14 denotes the lower or body portion of the diaphragm valve chamber and 14^a the cover for said chamber, the diaphragm 56 being clamped between the parts 14 and 14^a. 57 denotes a rod which is connected to a disk 57^a on the bottom of the diaphragm and which extends through a stuffing box 58 at the bottom of said chamber and carries a yoke 59 having the valve 60, the yoke being provided with an extension 60^a guided within a bushing 61 which is threaded into the bottom of the chamber 62 to which water is supplied through the pipe 15. The inner end of the pipe 15^a communicates with an extension 63 which has a downturned valve seat 64^a cooperating with the valve 60. This construction prevents water from being supplied to the generator 16 until the pump has created a predetermined pressure of oil. When the pump is shut down and the fire extinguished, the valve 60 will engage its seat, but there will be a delivery of steam for a short time through the burner slot, which will ensure the burning of any oil

vapors that may remain, and the cleanness of the burner parts.

With the parts constructed and arranged as described, the operation will be as follows: The motor 7 being started, the shafts 8 and 21 will be driven, the former shaft operating the pump which will deliver oil from the storage tank 1 into the tank 4 and thence to the pump inlet. Oil from the pump outlet will be delivered through the pipe 9 into the by-pass chamber 10, whence the quantity necessary for the operation of the burner will be conducted to the atomizing and mixing device B through the pipe 11, the remainder of the oil, in excess of such burner supply, being delivered from the by-pass tank through the pipe 12 into the tank 4, whence any excess of oil may flow into the tank 1. In its passage through the tank 10, any sediment that may be in the oil is kept out of the burner pipe-line 11, and surging, or fluctuations in pressure, of the oil delivered into the burner are avoided. Part of the oil delivered from the pump will fill the pipe 13 and will operate the diaphragm 56 to open the valve 60, permitting water from the main (or other source of supply) to flow through the pipe 15 and past the globe valve 15^b into the generator 16.

Prior to operating the burner, the generator may be heated by any source of heat, as a torch, to provide steam necessary for the initial atomizing of the oil; or the burner may operate, as is the case with burners of this general type, with a mixture of oil and air until the generator is heated sufficiently by the flame from the burner to generate superheated steam, after which the steam will atomize and be mixed with the oil in the manner described hereinbefore, and the mixture of steam, air and atomized oil will be thrown from the slot C' provided between the upper and lower plates, this action being facilitated by constructing the burner on the principle of a sirocco fan. The additional air for completing the combustion will be thrown into the fire pot, beneath the flame, by the fan provided by the lower portions of the blades 27 and the plates 28 and 29.

The operation of the apparatus thus described accomplishes a process of burning the oil which consists broadly in supplying to a revolving centrifugal distributing oil burner a mixture of steam, atomized oil and air, the practice of this general process resulting in a complete and concentrated combustion of the oil, with an elimination of the roaring or "drumming" noise which is usually attendant upon the operation of burners of this kind and with a complete combustion of the oil, without any deposit of carbon or soot within the burner or within the parts of the boiler or other apparatus heated thereby and without injury

to the burner and the boiler by the flame. Furthermore, the use of steam in the manner described, in burners of this type, positively prevents any "flashing back" of the flame within the burner, an action which has characterized burners of the general type of that shown and described herein. The prevention of "flashing back" is further insured by the velocity of the fuel mixture through the space provided between the upper and lower burner members. The mixture of atomized oil, air and superheated steam enters the space at great velocity, is greatly expanded in such space; and flows through the narrow slot C' at such velocity as will prevent the propagation of flame into such space.

Also, in the practice of my process, by using superheated steam (at approximately 1000° F.) and delivering the mixture of the same with atomized oil and air into the space or chamber formed between the burner plates, I am enabled to effect a gasification of the oil, as soon as the burner becomes heated to approximately normal operating temperature, and the burner thus operates to deliver gas into the fire pot. This gasification is facilitated by the heating of the upper burner plate 22 and cap 23 by the combustion within the fire pot and the transmission of the heat from these parts to the gasifying mixture within the burner. By locating the atomizer B within the burner and particularly in the central portion thereof, the atomizer is protected from destruction by the parts 22 and 23 thereabove from the extreme heat within the combustion chamber, being also cooled by the air which flows upwardly within the inner wall 32 of the trough A. Furthermore, the parts are located so that only a short nozzle or conduit 35 need be employed to deliver the superheated steam and atomized oil into the burner trough.

It should be noted that, in the operation of the process, the steam is delivered across the top of the oil passage 11", at substantially right angles thereto. The use of the by-pass enables me to feed the oil slowly, or under a comparatively light pressure, to the point at which the steam encounters the oil and thus enables the steam to operate in a most efficient manner in atomizing the oil. Furthermore, in the operation of my process, it should be noted that the supply of water to the generator 16 (and hence the supply of steam to the mixing and atomizing device B) is controlled in part by the pressure of the oil which is delivered to the said device. The apparatus and process described herein have proven to be of great efficiency in securing perfect combustion of oil without injury to the burners and the heating appliances with which the burners are associated, and in securing maximum efficiency

from the combustion of a given quantity of oil.

Having thus described my invention, what I claim is:

5 1. In a burner, the combination of an upper and a lower member arranged to provide a slotted peripheral outlet therebetween, the bottom member having a practically unobstructed central opening for the
10 supply of air to the space between said members, a shaft projecting through said opening and having its upper end connected to the upper member, the upper and lower members being connected whereby they may
15 be driven together by said shaft, an atomizing device located within the interior of the said burner, means for supplying oil and superheated steam to said device, a nozzle for delivering the mixture of steam
20 and atomized oil to the space between said members, and means for driving said shaft.

2. The combination, with a combustion chamber, of a burner located in said combustion chamber and exposed to the heat
25 therein, the said burner comprising an upper and a lower member arranged to provide a peripheral outlet therebetween, the bottom member having a practically unobstructed central opening for the supply of
30 air to the space between said members, a shaft projecting through said opening and having its upper end connected to the upper member, the upper and lower members being connected whereby they may be driven
35 together by said shaft, an atomizing device, means for supplying oil and superheated fluid to said device, a nozzle for delivering the mixture of superheated fluid and atomized oil to the space between said mem-
40 bers, and means for driving said shaft.

3. The combination, with a combustion chamber, of a burner located in said combustion chamber and exposed to the heat
45 therein, said burner comprising an upper and a lower member arranged to provide a peripheral outlet therebetween, the bottom member having a practically unobstructed central opening for the supply of
50 air to the space between said members, a shaft projecting through said openings and having its upper end connected to the upper member, the upper and lower members being connected whereby they may be driven
55 together by said shaft, an atomizing device, a superheater in said combustion chamber, means for supplying superheated fluid from the superheater to the said atomizing device, means for supplying oil to said atomizing
60 ing device, means for delivering a mixture of superheated fluid and atomized oil from said device to the space between said members, and means for driving said shaft.

4. In a burner, the combination of an
65 upper and a lower plate arranged to provide a slotted peripheral outlet therebe-

tween, the bottom plate having a downwardly extending trough the inner wall whereof provides a passageway for air within the burner, a shaft projecting through said opening and having its upper
70 end connected to the upper plate, the upper and lower plates being connected whereby they may be driven together by said shaft, an atomizing device located within the inner wall of the trough in the lower plate, means
75 for supplying oil and steam to said device, a nozzle extending from said device and projecting downwardly toward the bottom of said trough whereby the mixture of steam and atomized oil is delivered forcibly
80 against the bottom of said trough, and means for driving said shaft.

5. In a burner, the combination of an upper and a lower member arranged to provide a slotted peripheral outlet therebetween, the bottom member having a downwardly extending trough the inner wall
85 whereof projects upwardly to provide a central passageway for air to the burner and a narrow air way between the upper edge of such inner wall and the upper member of
90 said burner, a shaft projecting through said opening and having its upper end connected to the upper plate, the upper and lower plates being connected whereby they may be driven together by said shaft, an atomizing
95 device, means for supplying oil and superheated fluid to said device, a nozzle extending from said device and projecting downwardly toward the bottom of said trough whereby the mixture of superheated fluid
100 and atomized oil is delivered forcibly against the bottom of said trough, and means for driving said shaft.

6. In a burner, the combination of an
105 upper and a lower plate arranged to provide a slotted peripheral outlet therebetween, there being fan blades connecting the peripheral portions of said plates, a centrifugal fan projecting downwardly from
110 the peripheral portion of the bottom plate, means for delivering a mixture of fluid and atomized oil to the space between said plates, the bottom plate being provided with an upwardly extending inner wall which
115 defines a central opening within the burner and which provides a narrow air way between the top of the same and the upper plate to prevent the withdrawal of the combustible mixture from the space between
120 said plates by the downwardly projecting fan, and means for rotating said burner.

7. The combination, with a combustion chamber, of a burner within said combustion chamber and subjected to the heat
125 thereof, said burner comprising an upper and a lower plate arranged to provide a peripheral outlet therebetween, the lower plate having a central passageway for admitting air to the space between said plates,
130

a superheater in said combustion chamber, an atomizing device located within the central opening of the lower burner plate, means for conducting oil to said atomizing device, 5 means for conducting superheated steam from the superheater to said atomizing device, there being a narrow air way provided between the inner edge of the lower plate and the upper plate, and means for delivering the mixture of superheated steam and 10 atomized oil from the atomizing device to the space between said plates.

In testimony whereof, I hereunto affix my signature.

JOHN W. CANNON.