Aug. 31, 1926. 1,597,662

F. W. ALSIP

APPARATUS FOR BURNING LIQUID FUELS

Filed May 12, 1924 5 Sheets-Sheet 1

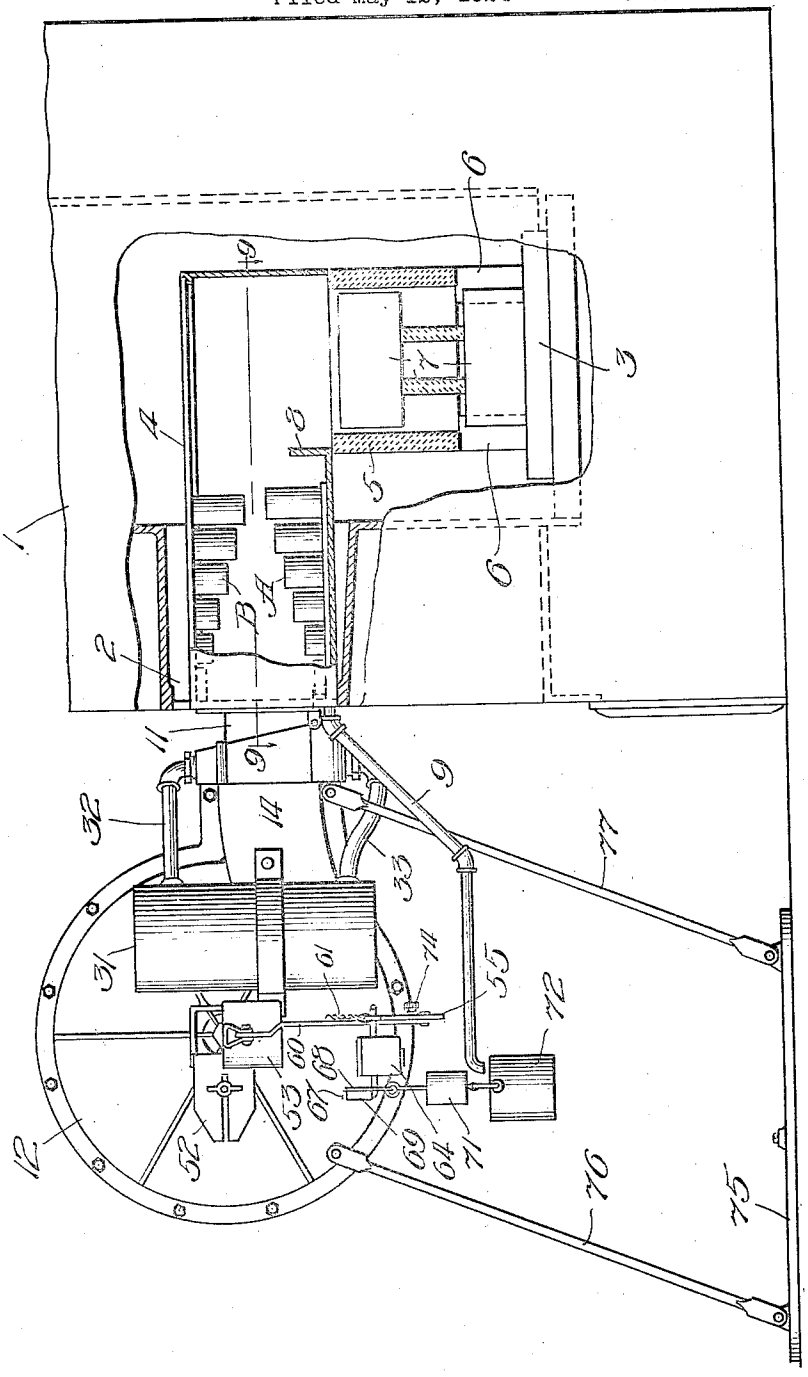


Fig. 1.

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Fig. 2.

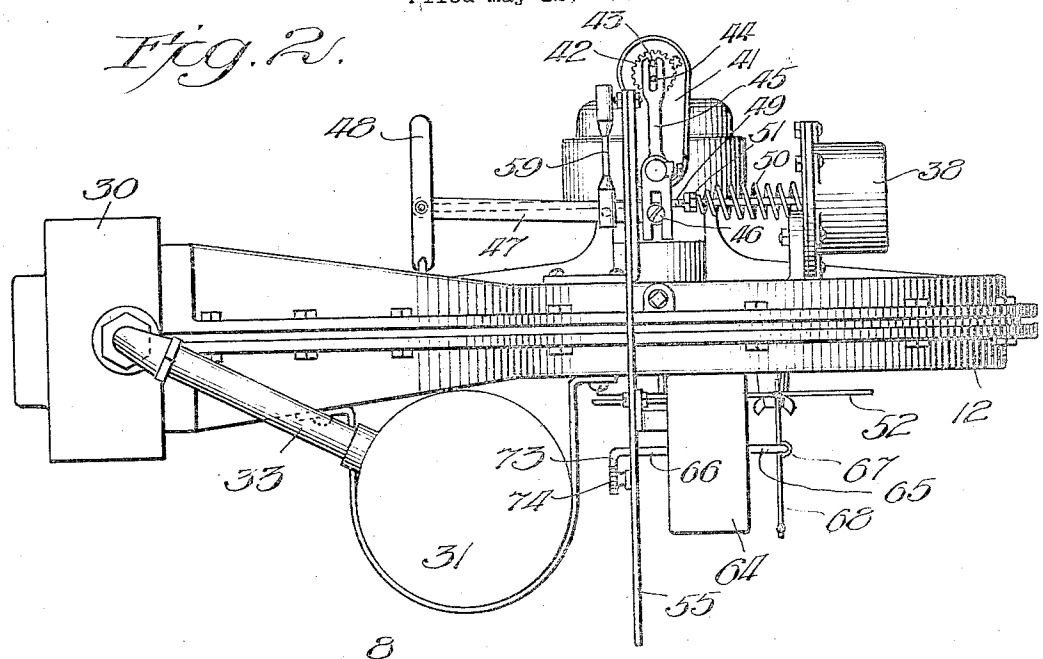
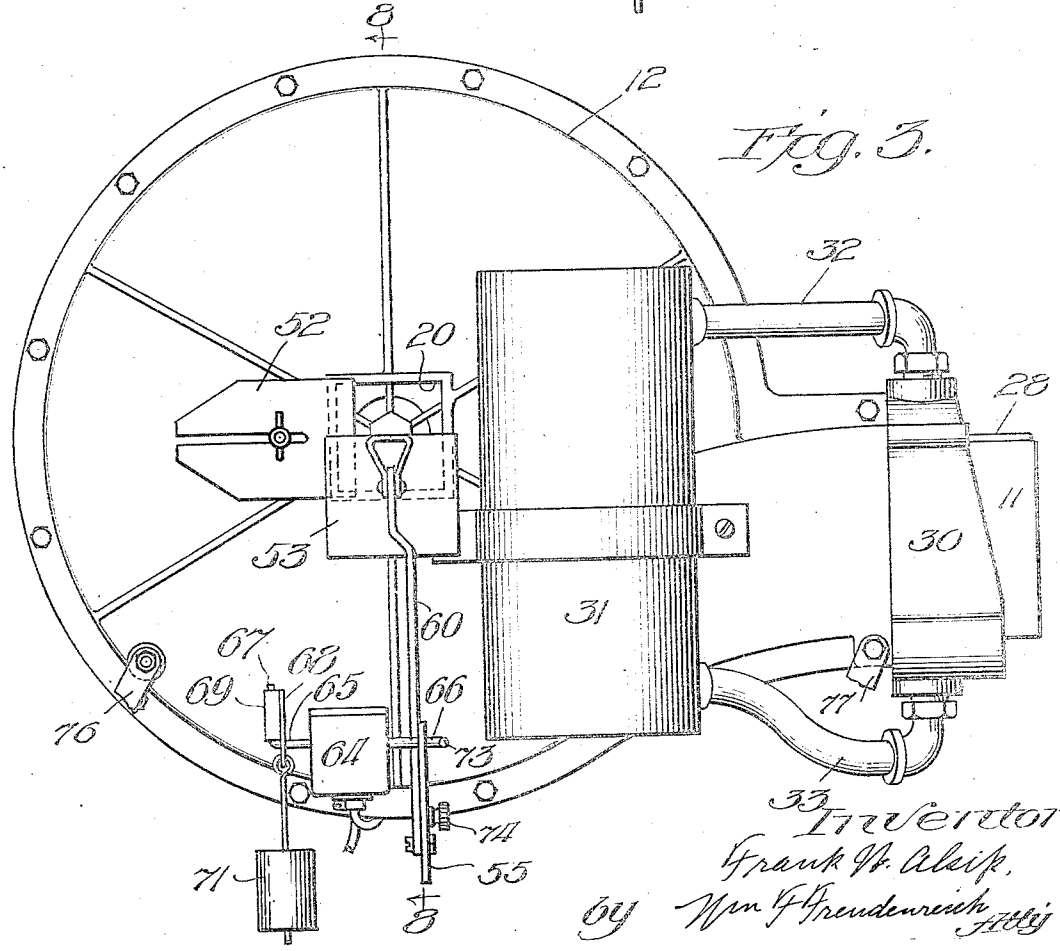


Fig. 3.



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Fig. 4.

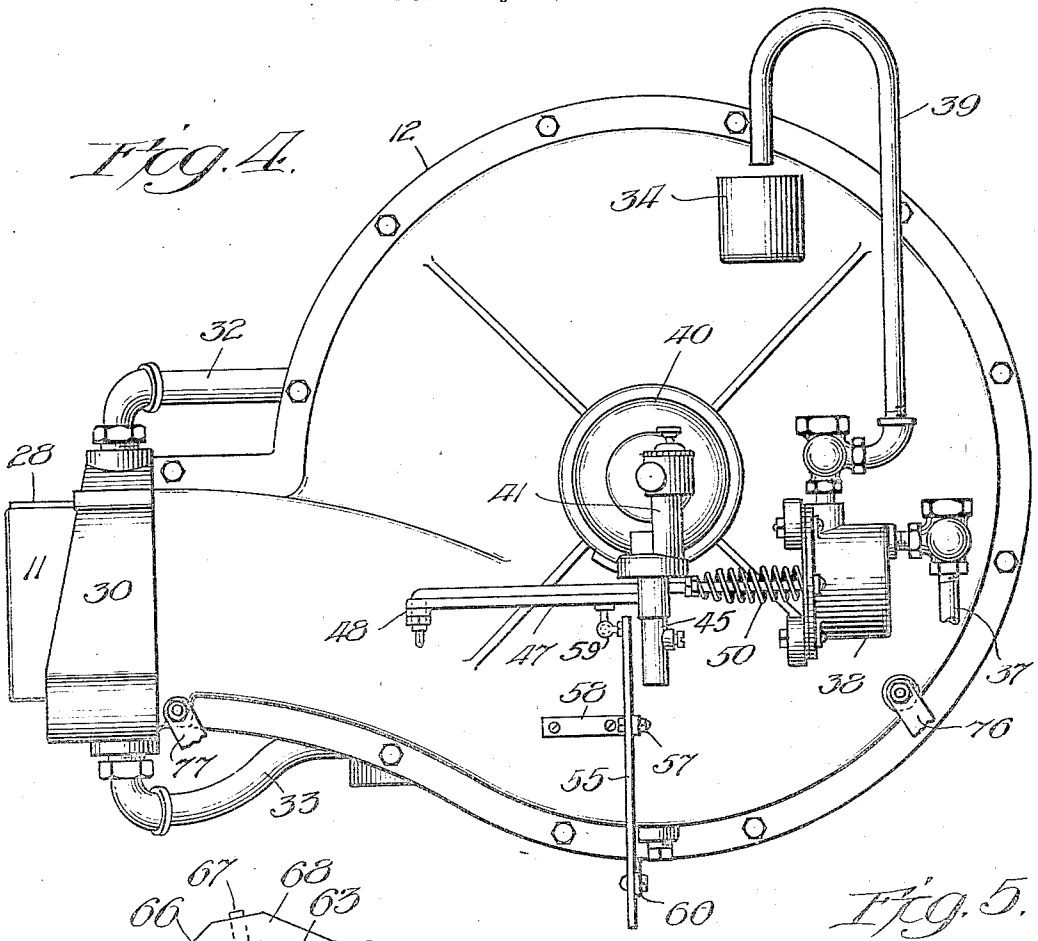


Fig. 5.

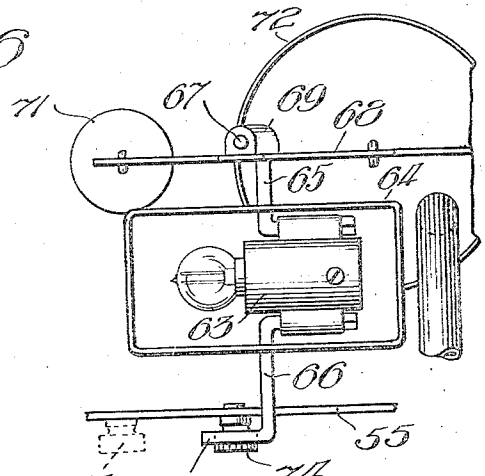
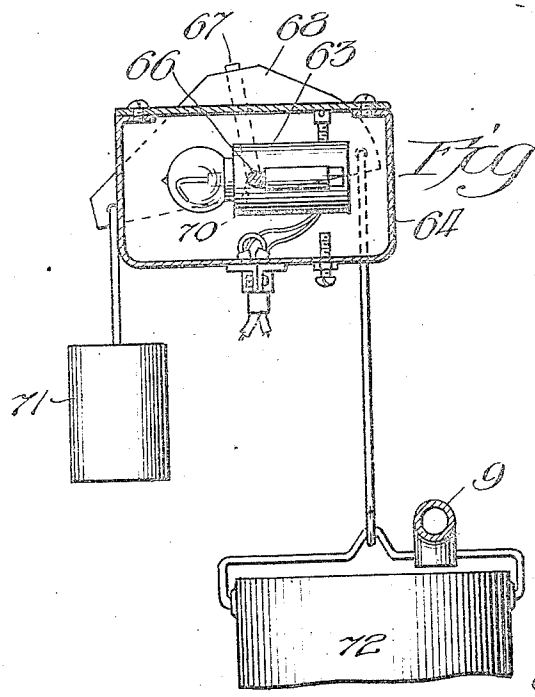


Fig. 6



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Fig. 7.

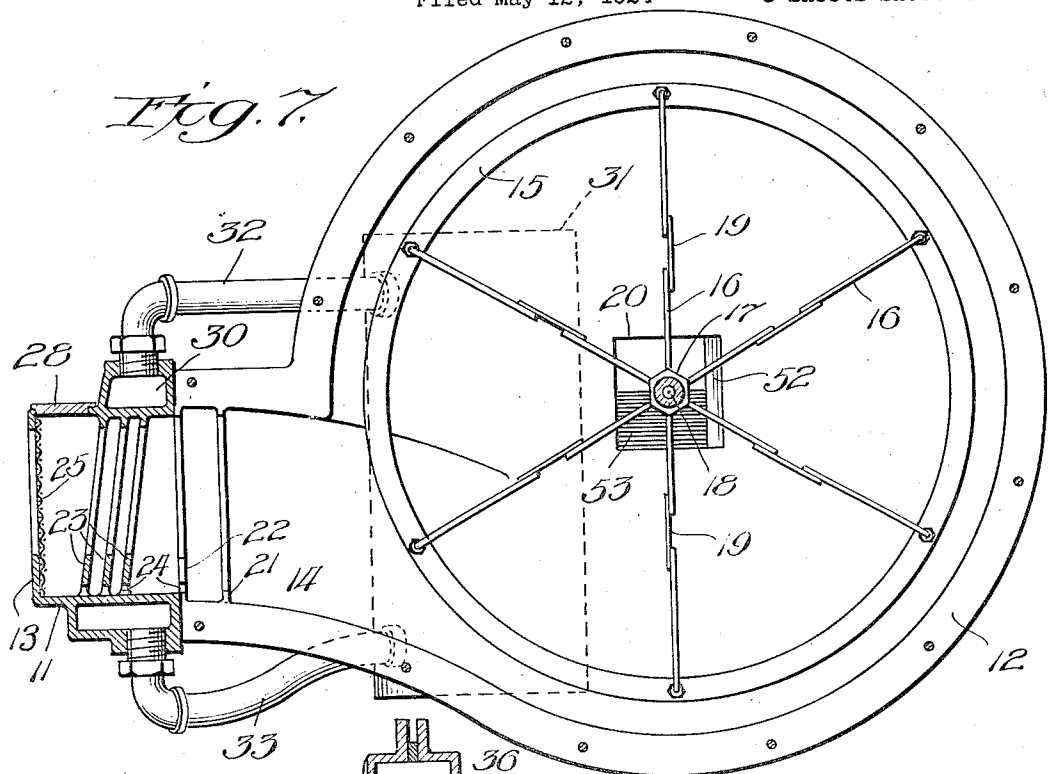
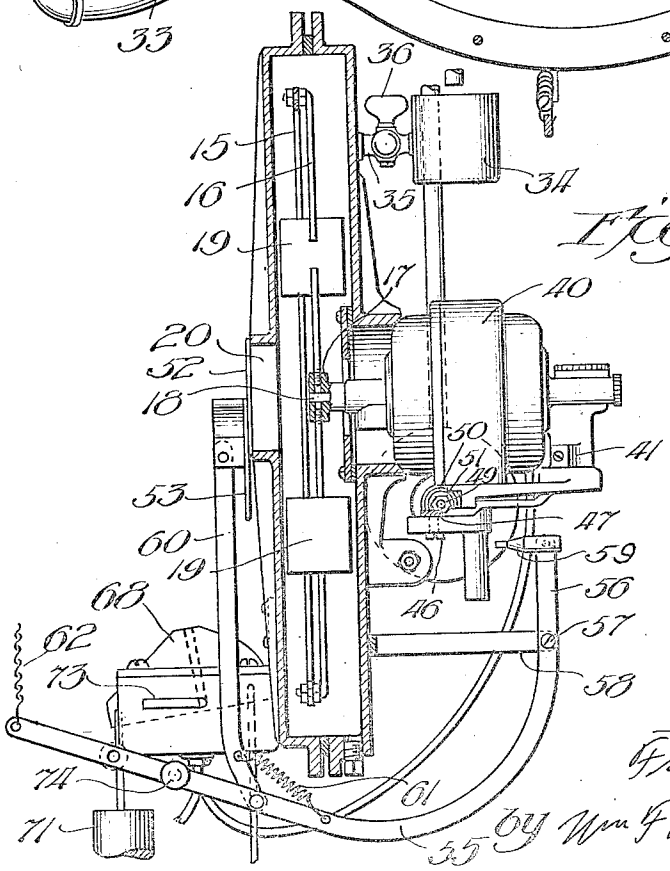


Fig. 8.



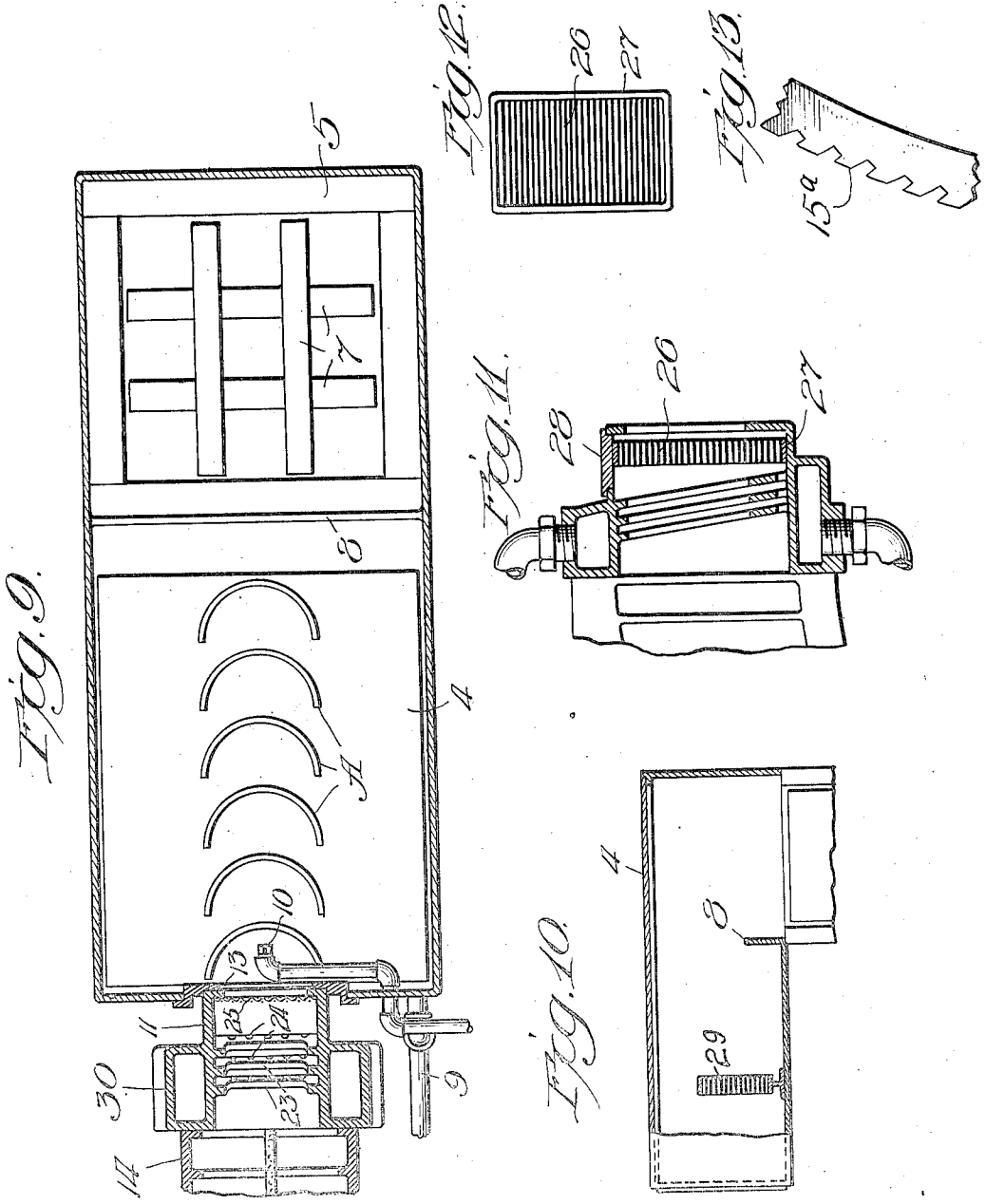
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APPARATUS FOR BURNING LIQUID FUELS

Filed May 12, 1924 5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE.

FRANK W. ALSIP, OF CHICAGO, ILLINOIS.

APPARATUS FOR BURNING LIQUID FUELS.

Application filed May 12, 1924. Serial No. 712,576.

My invention relates more particularly to oil-burning equipment for boilers and furnaces, although it may be useful for other purposes, and it may be said to have for its main object: to insure quietness of operation by reducing to a minimum noise produced by moving parts or mechanisms, and also flame noise; to produce automatic regulation of a nature to insure a maximum degree of efficiency in the translation of latent energy in the fuel into heat that is actually utilized; to reduce the power required for the operation of the apparatus to a point far below the amount required by any other apparatus of which I am aware; to secure ruggedness and capacity to withstand severe treatment in handling the same and in operation of the same; and, generally, to secure sensitiveness of operation without delicacy of structural detail such as could cause the apparatus easily to get out of order.

In carrying out my invention I cause a spray of liquid fuel, in a current of air, to be discharged into the combustion space, interposing in its path means, adapted to the conditions and the nature of the fuel, which mechanically breaks up the fuel. The spray of fuel is produced by a rotating disk or wheel brushing the surface of a body of oil in a well, the rotating member serving also as the rotor of a blower to create the current of air. All small orifices or channels which could become clogged and interfere with the operation of the burner are thereby avoided and uniform, efficient operation is insured. The well is supplied with fuel from a small elevated reservoir into which oil is pumped by a slow-running pump, preferably of the diaphragm type, insuring a steady flow into the well, permitting the use of a standard fan motor and a standard oscillating reduction gear between the same and the pump for driving the latter, and avoiding noise and wear and high power consumption. The combustion mixture is ignited and the flame and products of combustion are carried through a flame conduit and combustion chamber in a turbulent state and are then brought into contact with the lowest portion of the radiating or heating surfaces of the furnace or boiler, whereby the greatest possible amount of heat will be effectively used. It further follows that the confining of the flame for a considerable distance between walls that become heated to incandescence, and the introduction of turbulence in the flame, create very complete combustion, with a minimum excess of air. When a gas pilot light is employed it is placed at such a point below the incoming stream of combustible material that it will not be in danger of being extinguished, but, on the other hand, receives sufficient air to keep it lighted from the gentle current that is produced below the main stream. Consequently a very much smaller pilot light than has heretofore been necessary may be employed and the cost of operation correspondingly reduced. The rate of delivery of air and fuel is controlled by a single lever that may be actuated manually or by a suitable thermostat or pressurestat so as to regulate the delivery of air and fuel according to the demand for heat; varying the size of the flame between maximum and minimum limits and thus controlling the rate at which heat is generated, without alternately operating at full capacity and shutting down completely, as has heretofore been customary in commercial systems. Consequently there need be produced no excess of heat and there need be no waste of fuel or motive power. Furthermore, there are great economies effected through reduction in the stack temperatures because, in any given boiler or furnace, the smaller the flame, the greater will be the proportion between the heat absorbed in the plant and that wasted through the stack. In those systems in which there is always either a flame of maximum size or no flame, there is always a maximum loss through the stack when the burner is on, as well as the loss through natural draft when the burner is turned off. This is an important factor, since the flame must be capable of supplying the greatest demand, whereas a much smaller flame will usually be sufficient the greater part of the time. In addition to regulating capacity, I provide means for stopping the fan motor when the capacity has been reduced to the lowest practical minimum; such means being so arranged that it may be made inoperative at will. During the time the motor controller is inoperative, as, for example, in extremely cold weather, the pilot light may be turned

off and a saving in operation be thus effected. I provide an overflow cut-out device which will stop the motor in case of pilot light failure or when from other cause flooding might result. This cut-out device is so arranged that, whenever the bucket that catches the overflow is removed to be emptied, the motor is shut off and cannot automatically start again until the empty bucket is restored to its working position.

My improved apparatus is designed to be applied to the firing doors of boilers or furnaces without requiring any alteration or dismantling of the latter. Furthermore, all the parts that lie outside of the door are in elevated positions such that they will not be affected by water standing at a considerable height above the floor or surface on which the boiler or furnace is resting. I also provide a simple support for the burner whereby it may be applied to a door placed at any height above the floor. I also provide means for cooling the parts of the burner proper to protect them against radiated heat.

The various features of novelty whereby my invention is characterized will hereinafter be pointed out with particularity in the claims; but, for a full understanding of my invention and of its various objects and advantages, reference may be had to the following detailed description taken in connection with the accompanying drawings, wherein:

Figure 1 is a side elevation of one of my improved burners applied to a furnace, part of the furnace walls being broken away and those portions of the burner apparatus within the furnace being shown in section;

Fig. 2 is a bottom plan view, on a larger scale, of the burner;

Fig. 3 and Fig. 4 are side elevations of the burner, showing the two sides thereof;

Fig. 5 is a top plan view of the automatic switch, with the cover removed;

Fig. 6 is a vertical section through the switch;

Fig. 7 is a central section through the burner on a plane at right angles to the blower shaft;

Fig. 8 is a section taken on line 8—8 of Fig. 3;

Fig. 9 is a section on line 9—9 of Fig. 1, on a larger scale than that of Fig. 1, no part of the furnace being shown;

Fig. 10 is a vertical section through the flame conduit and combustion chamber, showing a modified means for mechanically breaking up light oil;

Fig. 11 is a vertical section through the end of the discharge conduit of the burner, showing a modified interceptor instead of the screen disclosed in Fig. 1;

Fig. 12 is a front elevation of the interceptor shown in Fig. 11; and

Fig. 13 shows a fragment of the disk wheel for creating an oil spray, having a serrated edge.

Referring to the drawings, 1 represents a furnace or boiler having a door opening 2 and a grate 3. The details are of no importance, as they may take any desired forms. Within the combustion space is an L-shaped hollow member comprising a horizontal conduit 4 extending inwardly from the door and a vertical part resting on the grate. The conduit 4 is preferably made of a refractory alloy. The vertical element may be made of a shell 5 of refractory material resting on spaced blocks 6, also of refractory material. Within the member 5 may be a checker work 7 of refractory blocks resting on the grate. The conduit 4 is open at its front end, closed at its rear end, and provided with an opening on the under side registering with the opening in the shell 5. There is an upwardly projecting flange or low wall 8 across the bottom of the conduit just in advance of the bottom opening, this flange or wall preventing liquid that may have collected in the conduit from running down into the shell and through the grate. A pipe 9 extends downwardly and forwardly from the bottom of the front end of the conduit and serves to drain the conduit when any liquid collects therein. The gaseous mixture entering the conduit 4 is ignited by a suitable pilot device, shown as a pilot gas light 10 lying in the bottom of the conduit just within the entrance thereto. The combustible mixture is introduced into the flame conduit through a large conduit 11 forming the discharge outlet from a blower casing 12. The member 11 is smaller in cross-sectional area than the flame conduit and has an inwardly directed flange 13 around the delivery end. The effective delivery opening from the blower, therefore, lies above the pilot light burner, which is therefore out of the direct path of the incoming combustible mixture.

The blower casing is illustrated as taking the form of a shallow cylindrical shell of considerable diameter, arranged with its axis horizontal. The body of the casing and a portion 14 of the discharge conduit therefrom may conveniently be made of two similar castings engaged with each other on a vertical plane at right angles to the longitudinal axis of the casing, while the part 11 is preferably made as a separate casting of copper or the like, fastened to the part 14 of the casing. In the body of the casing is a rotor that may conveniently be made of a rim 15 forming a section of a disk, the same being supported by arms or spokes 16 centering in a hub 17 fixed to a shaft 18. The disk or rim may have a serrated peripheral edge in order better to pick up oil, as indicated at 15* in Fig. 13. On the spokes are

fastened blades 19 considerably nearer the axis of the rotor than is the periphery of the rim. The rotor is somewhat smaller in diameter than the internal diameter of the casing so as to leave space in the bottom of the casing below the rotor to serve as a well adapted to contain oil. When the rotor is driven at a high speed, there being sufficient oil in the casing to reach a level somewhat above the lowermost point of the rotor, oil will be picked up and driven in a spray tangentially through the discharge conduit. As the oil must be lifted somewhat before it is accelerated sufficiently to fly from the disk or rim, the discharge conduit must lie above the bottom of the casing and must gradually rise toward its outer end in order to permit the main stream of oil spray to pass through it in the lengthwise direction. The casing has a central air inlet 20 at one side and, as the rotor revolves, air will be drawn in and be discharged with the oil. Some of the oil will be driven against the sides of the discharge conduit and will flow from there back into the well. In order to prevent such oil from being carried on by the air current, I provide baffles in the form of continuous ribs or flanges projecting inwardly slightly from the walls of the discharge conduit. In the arrangement shown there are two of these baffles, 21 and 22, in the part 14 of the conduit, and three of them, 23, in the part 11. Those portions of the baffles rising from the bottom wall of the conduit are preferably somewhat deeper than the remaining portions because they are required to take care of all the oil that drops or flows down from the other walls. Any oil striking the baffles or collected on the walls behind them is prevented from being carried forward by the air stream and can flow back into the well. The baffles 23 are preferably inclined outwardly from the top to the bottom to make it easier for the oil to run down along the same. The bottom members of the baffles 22 and 23 are perforated, as indicated at 24, near the lower margins to permit the oil to flow along the bottom wall of the conduit to the well. The flange 13 forms the final barrier or baffle.

It will therefore be seen that there will be no large masses of oil entering the flame conduit but all such oil will be in the form of a spray. The treatment of the oil just described will not ordinarily be sufficient to insure complete combustion and additional treatment, depending on the character of the oil being used, must be given. In some cases it will suffice to cause the stream of air and oil to impinge on a screen 25 of comparatively fine mesh placed at the outlet end of the discharge conduit, as shown in Fig. 7. Where light oils are being burned the screen may be replaced by a series of horizontal vanes 26, conveniently fixed in a frame 27 that may be set in the member 11 between the baffles 23 and the flange 13, such an arrangement being shown in Figs. 11 and 12. The part 11 is provided in the top with a door 28 through which the pilot light may be ignited and the screen or other barrier may be inserted and removed through the door opening at will. Sometimes a barrier such as illustrated in Figs. 11 and 12 should be set in the flame conduit as indicated at 29 in Fig. 10. Those barriers should be made of a refractory alloy or other material so that they may become hot enough in use to avoid the formation of carbon thereon. In burning very heavy oils, still different treatment is desirable. In addition to the screen for mechanically breaking up the oil, I employ means which will give a tubular shape to the flame in the flame conduit, so that the incoming stream of combustible material will be wholly surrounded by flame and, in passing through the flame conduit, will be made turbulent, thus insuring satisfactory atomization of the oil and a continual agitation of the mixture as combustion proceeds. This can be accomplished by the use of curved, preferably semi-cylindrical, spaced plates placed in a lengthwise row along the bottom of the flame conduit and a second row depending from the top wall of that conduit, the concave sides of the plates being directed outwardly toward the incoming combustible material. The lower series of plates is indicated as A and the upper series as B in Figs. 1 and 9. The plates may all be of the same length but each is preferably shallower or of less height than the one immediately behind it, thus producing a step formation.

The formation of carbon on surfaces may be prevented by keeping them either very hot or else cool. All surfaces beyond the discharge conduit, including the screen or other barrier in the latter, if there be one, will become and remain extremely hot in use. The discharge conduit itself must be kept cool, as it is outside of the furnace and as it would transmit heat to the parts of the apparatus still farther out; and, since the discharge conduit will receive heat during the operation of the burner it must be artificially cooled. This may conveniently be accomplished by surrounding the member 11 with a water jacket 30 through which a circulation of water from a tank 31 through pipes 32 and 33 is maintained. This water need not be pumped, as the tank will radiate heat sufficiently to bring about a natural circulation of water.

Oil is fed into the blower casing from a small, elevated reservoir 34 attached to the upper part of the casing by a pipe or nipple having therein a controlling valve 36 by means of which the rate of flow from the reservoir may be regulated. Oil is drawn through a pipe 37 from a suitable source of

supply by a small pump 38, preferably of the diaphragm type, and is delivered to the reservoir by the pump through a pipe 39. Thus, although the pump does not discharge a continuous stream, the stream flowing from the reservoir into the blower casing is continuous. The pump is driven by the fan motor 40, whose shaft may be the rotor shaft 18 heretofore mentioned. The motor runs at a high speed, the pump should operate slowly, and it should be possible to vary the capacity of the pump relatively to that of the motor in order to suit individual conditions. I have therefore provided a novel driving connection which I shall now describe. The motor shaft operates a standard reduction gear device 41, the last element of which, indicated at 42 in Fig. 2, has thereon a stud 43 placed at some distance from the axis of rotation of the element 42. If desired, more than one hole may be provided into which the stud may be placed, these holes being at different distances from the axis. In the arrangement shown, the stud may be shifted from the position it is occupying to a hole 44 nearer the axis. The stud lies in a slot or fork at one end of a rocker arm 45. The other end of the rocker arm is also forked or slotted to receive a pin 46 carried on one end of a connecting rod 47. The opposite end of the connecting rod is pivoted to a lever or handle 48 pivoted at one end to the blower casing. The actuating rod or stem 49 for the pump is also attached at one end to the lever or handle 48. Therefore, as the motor rotates, it will oscillate the rocker arm 45, and reciprocate the connecting rod and the pump stem, causing the pump to operate. When it is desired to prime the burner, the stud 43 may be unscrewed, permitting the pump to be manually operated through long strokes by means of the lever or handle 48.

The heaviest portion of the load on the pump comes on the suction stroke in pumping heavy oil. In order to equalize the load on the motor and lower the peak, I have placed around the pump stem a spring 50 that bears at its ends respectively against the pump casing and a nut or shoulder 51 on the stem. During the discharge stroke of the pump this spring is compressed, storing up energy to assist the pump during the suction stroke.

It will be seen that the stroke of the pump may be varied in two ways: first, by shifting the stud 43; and, second, by adjusting the pin 46 lengthwise of the rocker arm. The volume of oil and air in the combustible mixture must bear definite relations to each other to secure efficiency of operation of the burner and, as the character of the oil or the rate of delivery of the oil under various adjustments of the pumping mechanism varies, the volume of air that is delivered should also be varied. This can conveniently be accomplished by providing the air inlet to the blower casing with an adjustable shutter or shutters. In the arrangement shown, there are two such shutters, 52 and 53, the former being adapted to be set by hand and the latter being intended to be automatically adjusted as the stroke of the pump is automatically adjusted in the manner to be described.

The automatic adjustment of the stroke of the pump is effected by shifting the pin 46 along the rocker arm. There is an L-shaped lever having one arm 55 extending transversely of the blower casing underneath the same, while the other arm 56 extends upwardly beside the casing; the lever as a whole lying a little to one side of the rocker arm 45. The arm 56 of the lever is pivoted, as at 57, to a part 58 fixed to the casing. A connecting rod 59 extends between the upper end of the arm 56 of the lever and the connecting rod 47, the joints at both ends of the member 59 being of the universal type. Therefore, when the controlling lever is rocked in one direction or the other it will also rock the connecting rod 47, moving the pin 46 from or toward the pivotal axis of the rocker arm 45, as the case may be. Movement is also imparted to the automatic shutter 53 by the controlling lever so that this shutter is adjusted at the same time as the stroke of the pump. As best shown in Fig. 8, the shutter 53 is mounted on the upper end of a bar 60, the lower end of which is pivoted to the horizontal arm of the controlling lever. A spring 61, between the bar and the lever, draws the bar laterally toward the blower casing and thus holds the automatic damper yieldingly against those portions of the casing bounding the air inlet 20. The free end of the controlling lever is connected by a chain 62 to a suitable thermostat or pressurestat or other regulating device so that the supply of oil and air will be automatically regulated to suit changing conditions.

The motor should be automatically shut off when the combustible mixture is being delivered but is not burning and, if desired, after the flame has been made so small that further reduction in size would not result in economy. In the arrangement shown, the motor circuit is controlled by an oscillatory mercury switch, best shown in Figs. 5 and 6, and this switch is controlled by the controlling lever for the oil and air and also by oil flowing out of the flame conduit through the pipe 9. The switch, indicated as a whole by the number 63, is located in a suitable housing 64, being fixed to a rock shaft journaled in opposed walls of the housing. In the arrangement shown, the rock shaft is made in two L-shaped parts, 65 and 66, two of whose arms lie against

and are fixed to opposite sides of the switch while the remaining two arms extend from the switch in opposite directions in axial alignment with each other out through the sides of the housing. The parts are so proportioned that the switch rocks into an "open" position when free to do so. The shaft member 65 has an up-turned arm 67 at the outer end. A plate 68, having a boss 69 perforated to receive said arm 67, is mounted on said arm. The plate is provided in its lower edge with a notch 70 receiving the horizontal portion of the shaft 65, thus holding the plate at right angles to the axis of the rock shaft. On one end of the plate is hung a counterweight 71 and on the other end a bucket 72. When the bucket is empty, the counterweight is heavy enough to overbalance it and the switch and hold the switch in its "closed" position. The connection between the plate, the counterweight and the bucket is permanent, so that the bucket cannot be removed to empty it without also removing the plate and thus causing the switch to open and interrupt the motor circuit. The discharge end of the pipe 9 terminates over the bucket, and therefore, if the flame conduit begins to flood with oil, such oil will flow out into the bucket and stop the motor.

The member 66 of the rock shaft has a horizontal arm 73 extending at right angles thereto at its outer end. On the capacity-controlling lever is a knob 74 that engages with the arm 73 when the controlling lever has been swung into a position in which the capacity is reduced to the lowest practicable minimum and oscillates the switch against the resistance of the counterweight into the "open" position. When it is not desired to employ this latter method of controlling the motor, as, for example, in cold weather during which the burner should be in operation continuously, the knob 74 may be shifted on the lever from the full line position in Fig. 5 to the dotted line position beyond the end of the arm 73.

Another feature of my invention has to do with the support of the blower from the floor and at any desired height, within limits above the floor. To this end I employ a base plate 75 that may be fastened to the floor in front of the furnace by screws or the like. Parallel legs, 76 and 77, rise from the front and rear ends of the base to the blower casing. These legs are pivoted at their ends to the base and to the casing and are made long enough that they will always be inclined more or less, their upper ends being nearer the front end of the furnace than are their lower ends. The inclination of the legs varies with the height of the firing door above the floor, being least when this door is high and being greatest when the door is low. No attention need be paid to the adjustment of the support because this takes place automatically by simply allowing the base to drop down on the floor when the burner has been properly located with respect to the firing door.

Although, for the sake of brevity, I have illustrated only a single preferred embodiment of my invention, with slight modifications, and, for the sake of clarity, have described the details of construction of such embodiment with considerable particularity, it will, of course, be understood that the structural details and even the general forms may be widely varied without departing from the principle of my invention. The general forms and the details of construction, illustrated and described, are intended rather as illustrative examples than as limits or boundaries of my invention; and I intend to cover all forms and arrangements that come within the definitions of my invention constituting the appended claims.

I claim:

1. In combination, a blower provided with means to produce a spray of liquid in addition to the air stream discharged thereby, a motor driving the blower, means including a controlling lever for varying the size of the air inlet to the blower and simultaneously varying the rate of delivery of liquid to the blower, and a motor switch located and arranged to be opened by said lever when the latter reaches a predetermined position.

2. In a burner apparatus, a blower provided with a discharge conduit and means for discharging a mixture of air and liquid through the same, said conduit having in the vicinity of the outlet end a plurality of internal ribs or flanges extending around the same along the walls thereof, the bottom of said conduit sloping downwardly from its outer end, and those portions of the ribs or flanges on the bottom walls being perforated to permit liquid collecting on the bottom of the conduit to flow back along the conduit.

3. In combination, a blower, means for introducing liquid into the air stream discharged by the blower, a motor driving the blower, means including a controlling lever for varying the amount of air discharged by the blower and simultaneously varying the rate of delivery of liquid, to reduce the capacity, and a motor switch located in such a position that it is opened by said lever when the capacity has been reduced to a predetermined minimum.

4. In combination, means including a blower operable at a constant speed, for discharging a stream of air and a spray of liquid, means for simultaneously varying the amount of air delivered by the blower and the rate at which liquid is delivered to

vary the capacity, and means for stopping the blower and interrupting the delivery of liquid when the capactiy has been reduced to a point at which only a small amount of liquid is being delivered.

5. In combination, a rotary blower having a well for liquid, an element on the rotor of the blower adapted to dip into the liquid in the well and discharge a spray therefrom with the air stream, means for feeding liquid into said well, and means for simultaneously varying the amount of air discharged by the blower and the rate of delivery of the liquid to the well.

In testimony whereof, I sign this specification.

FRANK W. ALSIP.