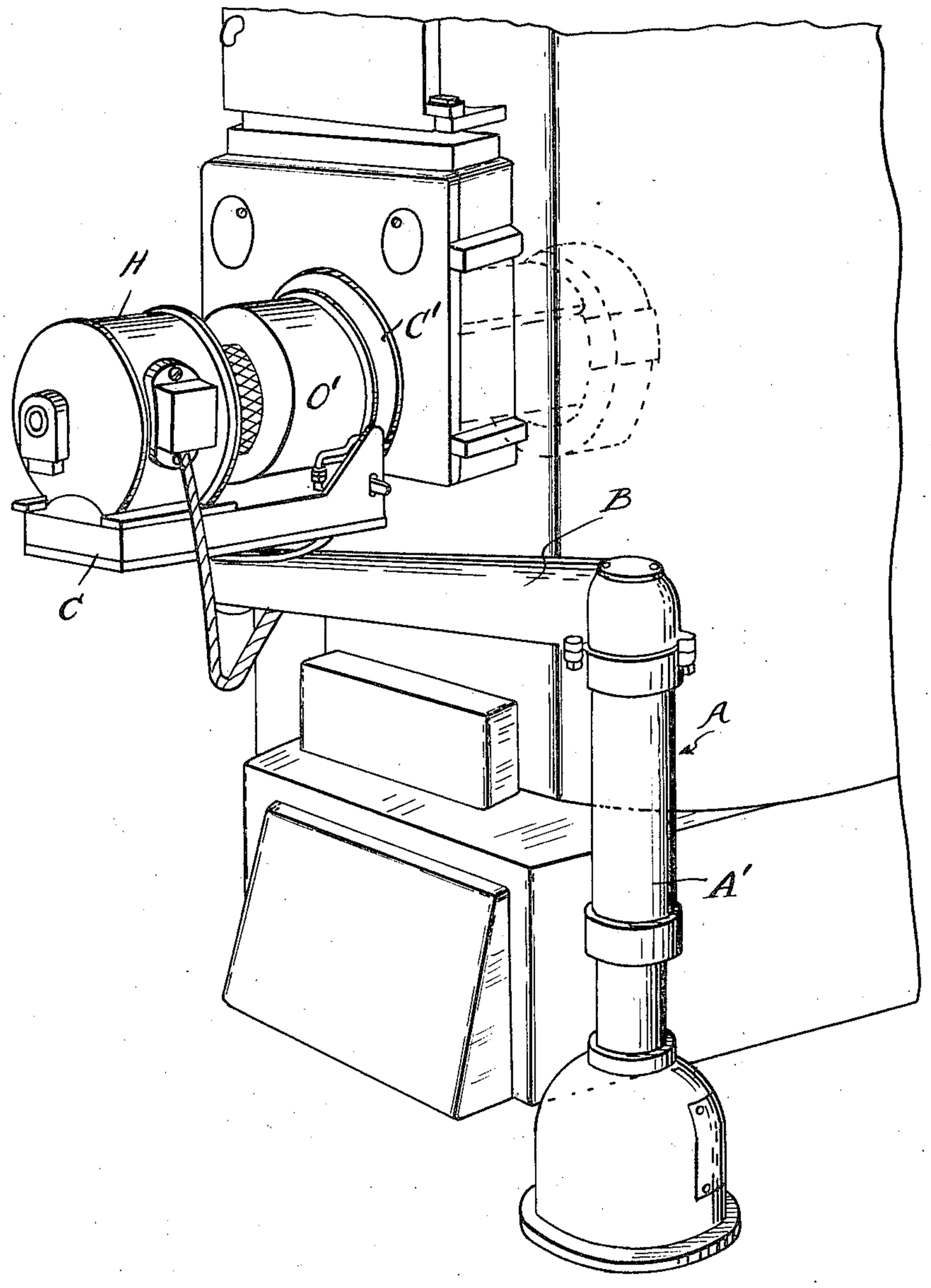
Aug. 20, 1935. W. G. LATIMER 2,011,901

OIL BURNER

Filed Oct. 13, 1930 3 Sheets-Sheet 1

Fig. 1.



INVENTOR

William G. Latimer

BY Whittemore Hulbert

Whittemore & Belknap

ATTORNEYS

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OIL BURNER

Filed Oct. 13, 1930 3 Sheets-Sheet 2

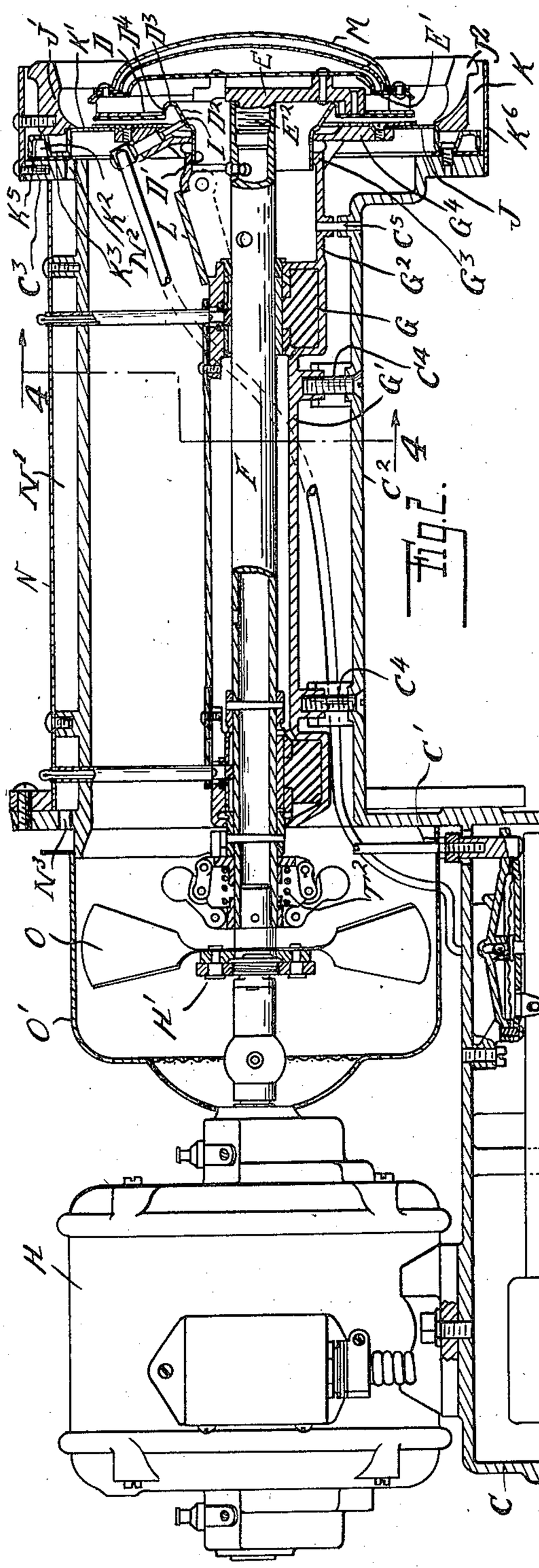

FIG. 2.

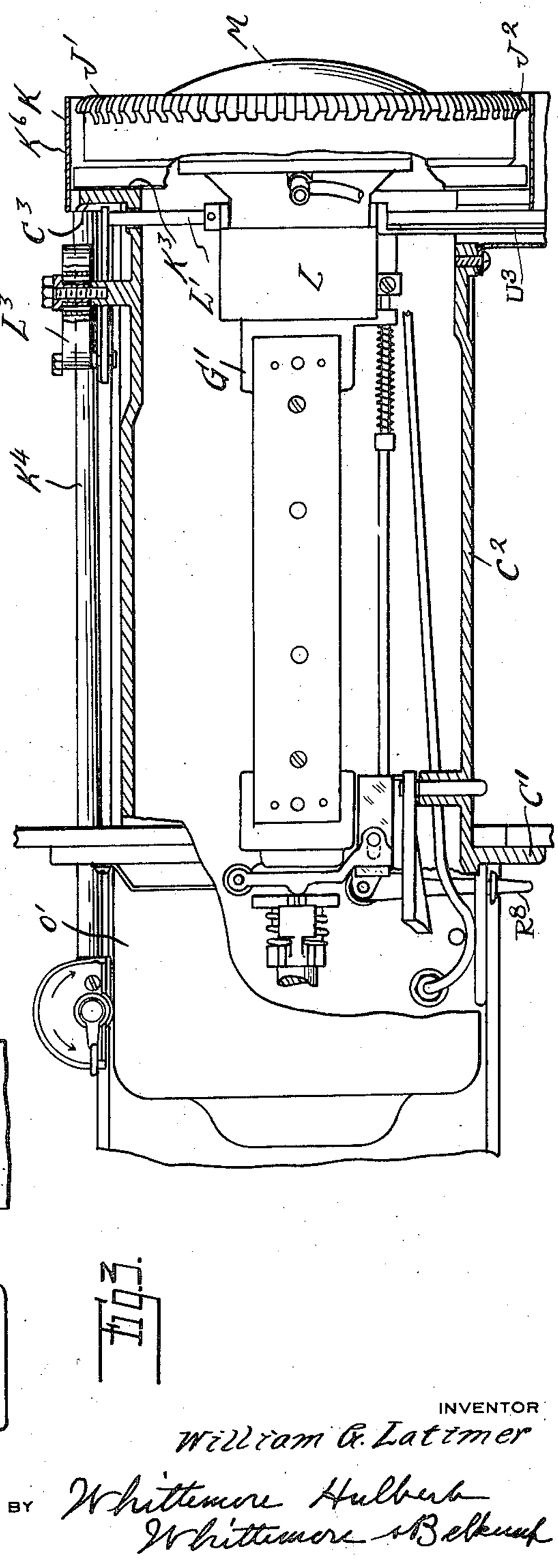

FIG. 3.

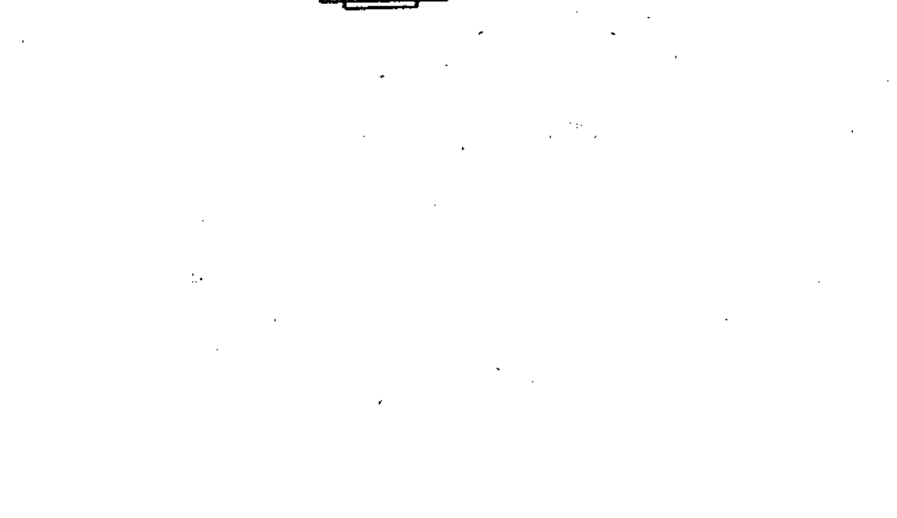

FIG. 4.

INVENTOR
William G. Latimer
BY Whittemore Hulbert & Whittemore & Belknap
ATTORNEYS

Aug. 20, 1935. W. G. LATIMER 2,011,901

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Filed Oct. 13, 1930 3 Sheets-Sheet 3

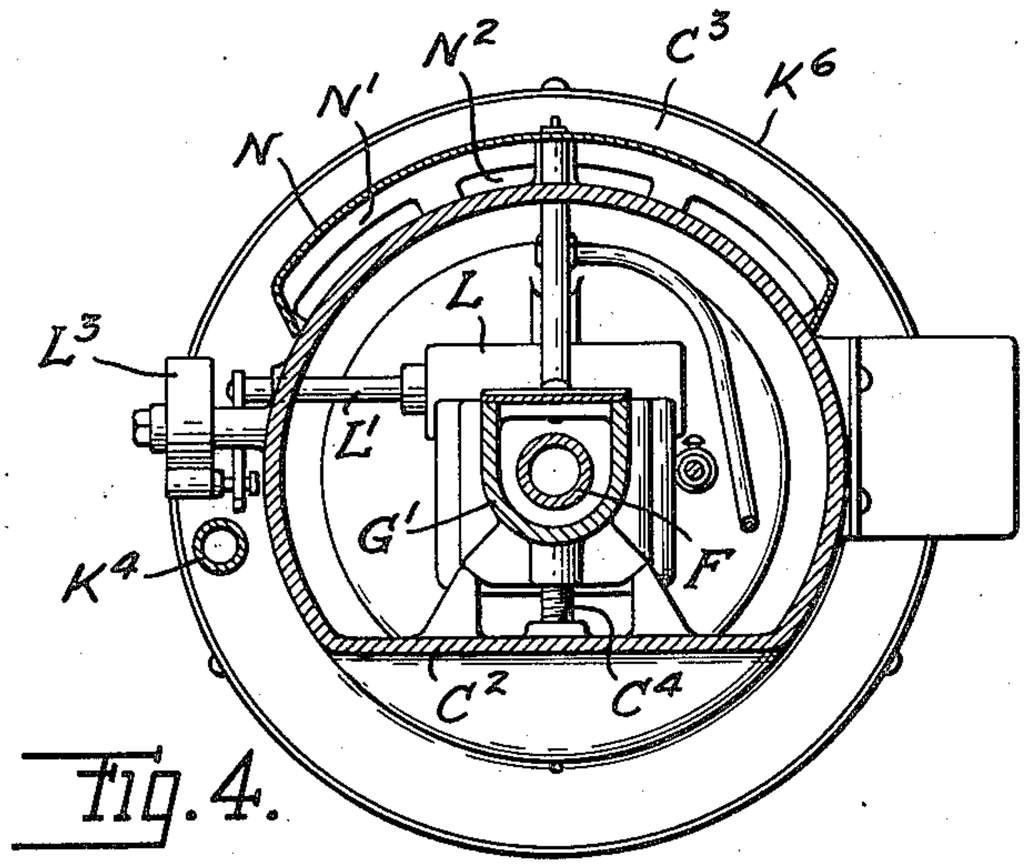

Fig. 4.

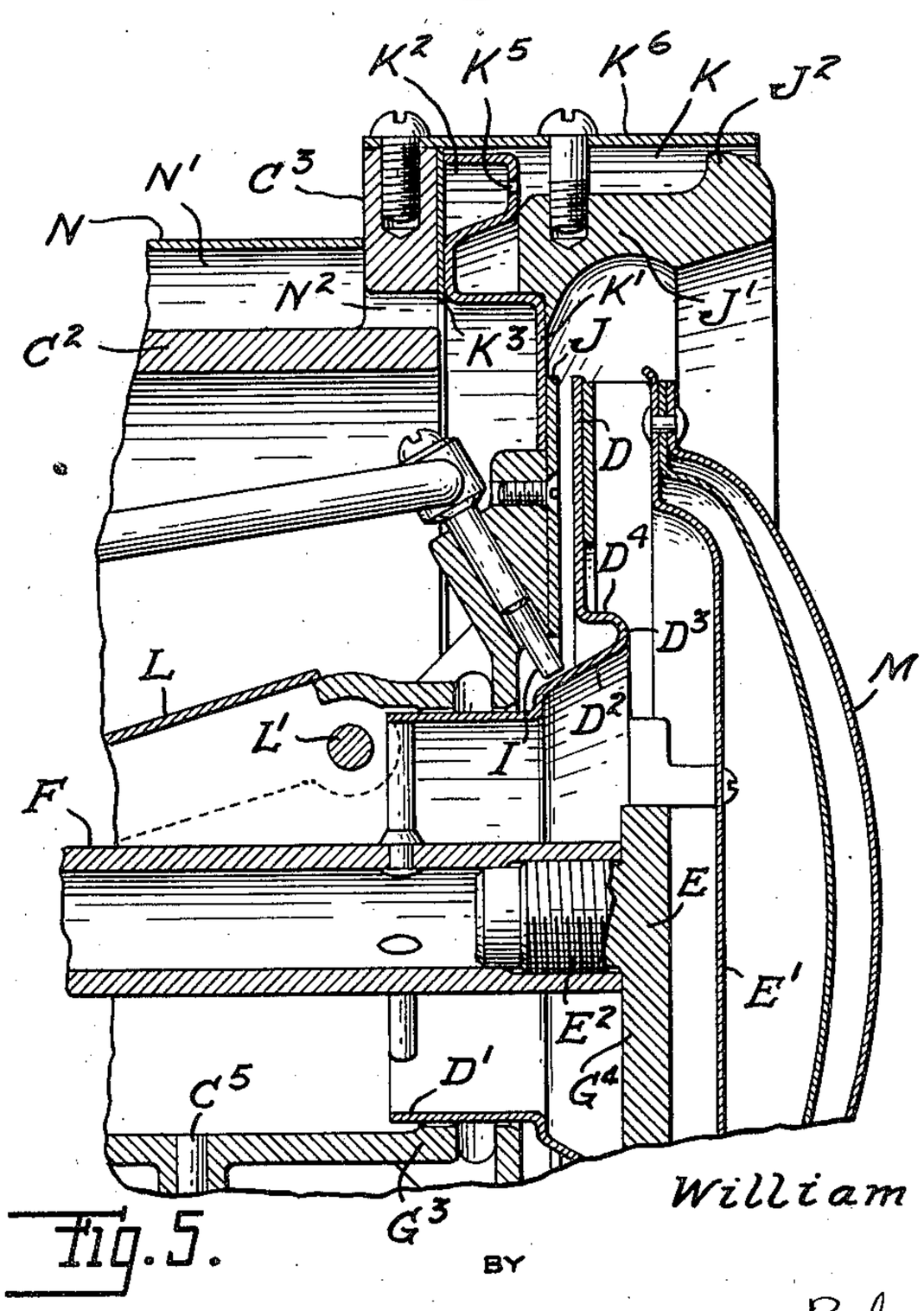

Fig. 5.

INVENTOR

William G. Latimer

BY

Ralph E. Baker

ATTORNEY

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UNITED STATES PATENT OFFICE

2,011,901

OIL BURNER

William G. Latimer, Detroit, Mich., assignor, by mesne assignments, to Kelvinator Corporation, Detroit, Mich., a corporation of Michigan

Application October 13, 1930, Serial No. 488,521

20 Claims. (Cl. 158—77)

This invention relates to oil burners more particularly designed for installation in connection with household heating plants, and has among its objects the following:

First: To obtain a construction which may be applied to any type of heating furnace without any alteration therein, either by way of removal of grates or other parts, thus leaving the furnace in condition for use at any time with solid fuel.

Second: The mounting of the apparatus in such a manner that it may be instantaneously inserted in or removed from the furnace without detachment of any of the fuel or electrical connections and when removed will not interfere with the use of the furnace with other fuels.

Third: To obtain an exceedingly efficient burner construction which is continuous instead of being intermittent in its operation, thereby dispensing with the necessity for a pilot light or other ignition device.

Fourth: To obtain regulating means through which the quantity of fuel supplied to the burner is varied to increase or diminish the flame area and the heat generation.

Fifth: To obtain automatic means for varying the quantity of air supplied to the flame according to its need, so as to obtain proper combustion and efficiency in all positions of adjustment.

Sixth: To so control the feeding and the distribution of the liquid fuel, as to prevent the production of carbon, which would clog or interfere with the proper operation of the apparatus, and which also substantially vaporizes the fuel before ignition.

Seventh: To cool the portions of the apparatus that may be injured by overheating and to utilize the heat abstracted in cooling for the preheating of the air supplied to the flame.

Eighth: To provide a gas starter for use in raising the burner to the proper temperature for operation with liquid fuel, which starter may, if desired, be utilized for the heating of the furnace in place of the liquid fuel, particularly where only a little heat is required for a short time.

With these and many other minor objects in view, the invention consists in the construction as hereinafter set forth.

In the drawings:

Figure 1 is a perspective view of my burner as applied to a furnace;

Figure 2 is a vertical central longitudinal section through the burner;

Figure 3 is a horizontal section thereof partly in elevation;

Figure 4 is a sectional view taken on line 4—4 of Fig. 2; and

Figure 5 is a sectional view on a large scale of part of the burner as shown in Fig. 2.

As has been stated, my improved burner is so mounted that it may be applied to or removed from the furnace without detachment of the fuel and electrical connections. To accomplish this, I first provide a hollow pedestal A on the upper portion of which is mounted a laterally extending hollow arm B carrying at its outer end a shelf C for supporting the motor. This shelf is preferably formed integral with a vertically extending plate C′ which forms a closure for the fuel door opening of the furnace. Projecting inwardly from this plate or closure and preferably formed integral therewith is a cylindrical casing C^2 which extends to substantially the central plane of the furnace fire pot and has mounted at its inner end a rotary burner as hereinafter described.

The burner is of that type in which the fuel is fed outward over a revolving disc and is discharged from the periphery of this disk to produce the flame. However, the construction differs radically from those usually employed, first, in the manner of feeding and distributing the liquid fuel thereon and second, in the means employed for preventing combustion or overheating of the fuel until it is discharged from the periphery of the burner disc, the detailed construction being as follows:

D is a disc preferably formed of sheet metal and integral and coaxial with a cylindrical sleeve portion D′. Between the cylindrical portion D′ and the disc is a slightly flaring or conical portion D^2 which extends outward beyond the plane of the disc and is then return bent at D^3 with a substantially cylindrical portion D^4 extending backward and merging into the disc. The disc D is mounted upon a spider which also carries a disc E′ spaced from the disc D. The spider E is provided at its center with the hub E^2 detachably secured to a shaft F preferably by a threaded engagement therewith. This shaft is journaled in bearings G which are preferably carried by an inner tubular housing member G′ mounted within and secured at C^4 to the outer cylindrical housing C^2. The opposite end of the shaft F is connected to the shaft of the motor H preferably through the medium of a universal joint H′ permitting of slight inaccuracy in alignment. Thus the shaft will be driven at motor speed and

will communicate its movement first to the spider E and then to the disc D and sleeve D'.

The fuel is supplied to the burner through a nozzle I which is arranged to discharge the liquid at the base of the flaring portion D^2 of the sleeve D'. The sleeve D' extends into a housing G^2 at the inner end of the housing G' and which forms an air chamber through which air is to be supplied to the burner. The arrangement is such that the sleeve D' is in close proximity to an annular bearing G^3 in the housing G^2 to form practically a sealed joint and beyond this bearing is an annular portion G^4 which extends in proximity to the disc D. On this annular portion G^4 is mounted a non-revoluble disc J which is spaced from the disc D a sufficient distance to permit the passage outward of the liquid fuel film but close enough to protect the fuel from ignition until it is discharged from the periphery of the disc. Thus in operation the fuel discharged from the nozzle I will first come in contact with the outer surface of the conical portion D^2 of the sleeve D' and through the combined action of capillarity and centrifugal force will be fed spirally outward on the revolving cone. This continues until the fuel reaches the return bend D^3 where its progress is checked by the cylindrical return bent portion D^4 so that by the time the fuel reaches the disc D it is quite uniformly distributed. From this point centrifugal action causes the film to move radially outward until it is finally discharged from the periphery of the disc D. The operation of the burner will be fully described hereinafter, but the effect of the mechanism thus far described is to produce a uniformly distributed film of liquid fuel upon the peripheral portion of the disc D and without regard to whether the quantity of fuel discharged by the nozzle I is large or small.

To render the fuel ignitible it is necessary that it should be raised in temperature to near the vaporizing point and to support combustion there must be supplied the proper quantity of air preferably also preheated. The heating of the fuel is effected by surrounding the disc D with an annular member J' which as will be hereinafter explained, is maintained at a temperature above the vaporizing point of the fuel. Thus the film of fuel which is discharged from the periphery of the disk will be vaporized when in proximity to the member J' and will be discharged from the outer end of said member as a combustible gas burning in close proximity thereto. A portion of the heat of combustion will be conducted back through the member J' and will thus maintain said member at the desired temperature. It is, however, necessary to first raise the temperature of the member J' by other means and to this end I have provided a preheating gas burner K. This is preferably formed by a disc K' secured to and extending outward from the disk J and fashioned to form an annular channel K^2 which abuts against a flange C^3 at the outer end of the tubular housing C^2. A gasket K^3 seals the joint between the disk K' and flange C^3 so as to form a gas tight conduit which communicates at one point with a gas conduit K^4 extending parallel to the casing C^2 from outside the furnace door. The outer wall of the channel K^2 is perforated at K^5 to form gas jets adjacent to the periphery of the member J', and an annular shield K^6 confines the gas with only a restricted channel between the same and a flange J^2 upon the member J'. Thus in starting, when gas is supplied through the conduit K^4 it will burn just outside the restricted passage between the member K^6 and flange J^2 and will supply sufficient heat to the member J' for the initial vaporization of the liquid fuel.

The air for supporting combustion is supplied to the flame through the space between the discs D and E^1. This space communicates through the interior of the sleeve D' with the chamber within the housing G^2. Mounted on the housing G^2 is a damper or air valve L which when open will establish communication between the chamber in the housing G^2 and the space within the cylindrical housing C^2. The air is propelled longitudinally through the housing C^2 by means of a suitable fan O or other air propelling device driven by the motor, and as shown this fan is mounted upon the universal joint H' and is arranged within a housing O' between the motor H and the door C'. Whenever the damper L is opened a portion of this air will pass into the housing G^2 and through the space between the discs D and E^1 radially outward against the flame. The valve L is preferably thermostatically controlled and to this end is mounted on a rock shaft L' passing horizontally outward through the cylinder C^2 and having attached at its outer end a spiral thermostat L^3. When the parts are cold the damper or valve L will be substantially closed but after the burner is heated the thermostat L^3 by expanding will rock the shaft L' and open the valve. The degree to which it is opened depends upon the temperature of the casing which in turn depends upon the size of the flame that is issuing from the burner. Consequently whenever the flame is increased by a greater supply of liquid fuel the increased heat will affect the further opening of the valve L so as to supply additional air for the flame. A further function that is performed by the passage of air through this course is the cooling of the shaft and inner portions of the disc E^1, while the absorbed heat will raise the temperature of the air to increase its efficiency in supporting combustion. Further protection against overheating the shaft and connecting parts is through one or more secondary shields M which are arranged outside of the disc E^1 to the peripheral portion of which they are attached. Thus air pockets are formed between the shields M and the disc E^1 which lessens the amount of heat that can penetrate to the disc E^1.

To further protect the mechanism from overheating I arrange between the housing G' and the outer housing C^2 one or more tubular partitions and circulate the surplus air propelled by the fan and not entering the housing G^2, through the passages between said partitions. As shown in Figure 2 a segmental cylindrical shield N surrounding a portion of the housing C^2 forms a channel N^1 for the air through which a portion of the air passing inward through the housing C^2 will be returned outward through the ports N^2, channel N^1 and ports N^3 and will be discharged outside of the furnace. This circulation of air will be constant during the operation of the furnace and will therefore prevent the overheating of the housing C^2 and the air passing therethrough. This in turn will prevent overheating of the bearings G. As a further precaution the inner housing G' is supported within the housing C^2 by members of restricted cross section such as the screws C^4 and dowel pin C^5 so that very little heat can be conducted inward through these members.

The oil conduit, gas conduit and the electrical conductors for the motor all pass upward

through the hollow pedestal A and the laterally extending arm B to the shelf C.

In the event the fuel heating member J^1 should cool to such low temperature that the fuel is not properly vaporized to support proper combustion, as for example, in case the fuel supply is exhausted, means are provided for preventing flow of fuel to the burner after the fuel tank is replenished. A thermostat U, similar to spiral thermostat L^3, is employed for this purpose. This thermostat when cooling will rock a bell-crank lever U^1 which in turn will move the rod S^4 to the right (as viewed in Fig. 4) causing stop S to move to the right. The bell-crank lever U^1 is loosely mounted on the rod L^1 and comprises an arm U^2 which lies in the path of spiral thermostat U and is engaged by the end of the thermostat and forced upwardly when the thermostat cools. The bell-crank lever U^1 includes a depending arm U^3 arranged to engage the projection S^8 on the rod S^4.

The spiral thermostat U being disposed adjacent the heating ring J^1, it is responsive to the temperature thereof, therefore, when the ring cools the thermostat will cool to rock the bell-crank lever U^1 causing the arm U^3 to move the projection S^8 to the right. This movement causes the stop S to release rod R^6 whereby the weight R^5 is effective to close the valve R^1 to shut off the flow of fuel to the burner.

From the description above given the operations of installing and of running the oil burner will be understood, but briefly described are as follows: The pedestal A being suitably positioned, the arm B is free to swing from a position where the shelf C and burner are clear of the furnace to a position where the burner may be inserted through the furnace door opening. Such movement is permitted by forming the pedestal A with a swingable telescopic upper portion A^1, the latter carrying the arm B. The regular furnace door is then either removed or swung to a completely open position after which the arm B is swung inward to carry the burner through the opening. During this adjustment the upper telescopic portion A^1 of the pedestal A is raised sufficiently for the inner end of the burner to clear the bottom of the door opening, but after insertion it is lowered so that the housing C^2 rests upon the bottom of said door opening. The plate C' is then pressed against the front of the door frame so as to completely close the opening. If it is desired to immediately run the burner the gas starter may be first lighted before the insertion of the burner and is then run for a sufficient length of time to do the preliminary heating. The motor is then started which communicates rotary motion to the shaft F and disc D after which the liquid fuel valve is opened to permit the feeding of the fuel through the nozzle I. This, as before described, passes first on the inclined or flaring portion D^2 of the sleeve around the return bend D^3, D^4 and back onto the face of the disk D. The outer portion of the disk has already been heated so that the film of oil passing radially outward meeting the hot portion of the disk will be vaporized and will issue as a stream of gas from the periphery of the disk. At the same time air which has passed from the fan through the space within the inner partition N will reach the partly open valve L and a portion will pass into the housing G^2 and then through the space between the discs D and E, striking against the flame at the periphery of the disc. This will support smokeless combustion but as the air is not commingled with the gas the flame will be white. In other words, a flame that is high in radiant heat is produced, this being the most efficient way of heating the furnace. The construction is one which requires very little attention after it is once started, but if for any reason it should be required to clean the burner this may be easily accomplished by swinging the burner out from the furnace chamber and detaching the rotary disk from the end of the shaft.

The annular groove which is formed by the return bent portion D^3, D^4 of the disk constitutes in effect an annular distributing well in which a certain amount of the liquid fuel is temporarily detained. The larger the capacity of this well the longer the fuel will be detained, which modifies both the degree of heat which is imparted to the fuel and the cooling effect on the disk. Due to this fact I am enabled to adapt my burner for either mild or very cold weather by merely exchanging discs. Thus the greatest efficiency is obtained when the burner is operating low, as in the spring and fall of the year, when used with a disc having a comparatively shallow well but in mid-winter greater efficiency is obtained by using a disc having a deeper well. The changing of the discs is so easily effected that this method of operation may be much more satisfactory than retaining the one construction for all seasons of the year.

Where the burner is operating low, it is highly desirable to maintain uninterrupted feeding of the liquid fuel as otherwise there would be danger of the burner going out. It is, however, difficult to maintain a continuous liquid stream where the quantity is small but I have avoided this difficulty by placing the discharge end of the nozzle I in very close proximity to the surface D^2 on which the liquid is discharged. This has the effect of maintaining the continuity of the liquid stream due to capillarity, whereas if the nozzle were spaced further from the revolving surface the liquid might break up into drops. Furthermore, a positive propulsion force for the fuel is exerted as an air seal is formed which prevents back atmospheric pressure against the fuel in the nozzle and therefore a syphon effect is produced by the revolving disc. Thus the liquid fuel will be fed successfully however small the quantity.

What I claim as my invention is:

1. The combination with a rotary shaft, of a disc mounted at the end of said shaft, a sleeve portion surrounding and coaxial with the shaft, an annular distributing well intermediate said sleeve portion and disc, and means for feeding liquid fuel onto the outside surface of said sleeve whereby the combined forces of capillarity and centrifugal action will feed the liquid to the well and distribute the same from the well uniformly over the surface of said disc from which it is peripherally discharged.

2. In an oil burner, the combination with a rotary shaft, of a disc mounted on the end of said shaft, a slightly conical sleeve portion surrounding and coaxial with said shaft, an annular distributing well connecting said conical sleeve portion with said disc, and means for feeding liquid fuel onto the conical portion of said sleeve from which it is distributed by the combined force of capillarity and centrifugal action to the well and radially outward of said disc to be discharged from the peripheral edge thereof.

3. In an oil burner, the combination with a ro-

tary shaft, of a disc mounted on the end of said shaft, a sleeve portion surrounding and coaxial with the shaft, means for feeding liquid fuel on the outer surface of said sleeve portion from which it is distributed in a film over the surface of said disc, and means for preventing the propagation of flame on the oil film side of said disk including a stationary member parallel to said disc on the liquid film side thereof and in close juxtaposition with the periphery of the disk and the film side of said disk.

4. In an oil burner, the combination with a rotary shaft, of a housing surrounding said shaft, a disc at the end of said housing mounted on the end of said rotary shaft, a sleeve surrounding and coaxial with the shaft, a member on said housing parallel and in close proximity to said disc, means for feeding liquid fuel on the outer surface of said sleeve whereby it is distributed therefrom in a film passing radially out between said disc and the adjacent member, and means for passing air through said sleeve and upon the outer side of said disc to meet the fuel at the periphery of the disc.

5. In an oil burner, the combination with a rotary shaft, of a housing surrounding said shaft and forming a conduit for air current, a disc mounted on said shaft at the end of said housing, a sleeve surrounding and coaxial with said shaft, a member on said housing arranged parallel and in close proximity to said disc and extending to said sleeve, means for feeding liquid fuel upon the outside of said sleeve from which it is distributed in a film over said disc and between the same and the adjacent parallel member, regulable means for passing air from said housing through said sleeve and along said disc to meet the fuel at the periphery of the disc and to support combustion whereby the heat of the flame will be conducted radially inward of said disc and said air current will cool the central portion of the disc.

6. In an oil burner, the combination with a plate forming a closure for a door opening of a furnace, of a motor mounted on the outside of said plate, a shaft driven by said motor extending through said plate and into the furnace chamber, a housing surrounding said shaft also projecting inward from said plate, a disc adjacent to the end of said housing mounted on said shaft to revolve therewith, a sleeve portion extending into said housing and coaxial with said shaft, a stationary disc mounted on said housing to extend radially inward parallel to said rotary disk in close proximity thereto, the inner end of said stationary disc being attached to an inner housing in close proximity to said sleeve, means for feeding liquid fuel upon the outer surface of said sleeve between the same and said inner housing whereby the fuel is distributed over said rotary disc in the space between the same and said stationary disc and is discharged from the periphery, a shield spaced from said rotary disc on the side opposite said stationary disc and connected and revolving with the shaft, means for passing air through said housing and through said sleeve into the space between said rotary disc and shield and radially outward therethrough to meet the fuel at the periphery of the disc, means for regulating the quantity of fuel fed to said sleeve, and automatic means for correspondingly regulating the quantity of air passing through said sleeve and to the periphery of the disc.

7. In an oil burner, the combination of a rotary disc, a sleeve, a shield mounted upon and spaced from said disc on the side opposite said sleeve, a member parallel to said disc and in close proximity thereto on the side opposite from said shield, means for feeding liquid fuel onto said sleeve to be distributed therefrom radially outward from said disc between the same and the member in close proximity thereto, and means for passing air through said sleeve and between said shield and disc, to meet the fuel at the periphery of the disc.

8. In an oil burner, the combination of a rotary disc, a sleeve, members arranged on opposite sides of said disc to protect the same from heat, means for feeding liquid fuel on the outer surface of said sleeve from which it is distributed radially outward on said disc between the same and one of said protecting members, and means for feeding air through said sleeve and between said disc and the other of said protecting members whereby the central portion of said disc is cooled by said liquid fuel and air and the heat of combustion passes by conduction from the periphery of said disc radially inward.

9. In an oil burner, the combination with a plate forming a closure for a door opening of the furnace, of a motor mounted outside said plate, a shaft driven by said motor extending through said plate and inward into the furnace, a housing mounted on said plate and surrounding said shaft to also extend inward into the furnace, an inner housing provided with journal bearings for said shaft, a disc mounted upon the inner end of said shaft having its periphery adjacent to said outer housing, a sleeve extending adjacent to said inner housing, a stationary disc extending between said outer and inner housings, adjacent and in close proximity to said rotary disc, a shield mounted on said shaft on the opposite side of said disc and spaced therefrom, means for feeding liquid fuel onto the outer surface of said sleeve from which it is distributed radially outward of said rotary disc between the same and the member in close proximity thereto, means for feeding air between said outer and inner housings, and a damper for closing an opening in said inner housing adjustable to deflect a portion of said air through said inner housing and sleeve and between said shield and disc to meet the fuel at the periphery of said disc.

10. In an oil burner, the combination with a plate forming a closure for a door opening of the furnace, of a motor mounted outside said plate, a shaft driven by said motor extending through said plate and inward into the furnace, a housing mounted on said plate and surrounding said shaft to also extend inward into the furnace, an inner housing provided with journal bearings for said shaft, a disc mounted upon the inner end of said shaft having its periphery adjacent to said outer housing, a sleeve extending adjacent to said inner housing, a disc extending between said outer and inner housings adjacent and in close proximity to said rotary disc, a shield mounted on said shaft on the opposite sides of said disc and spaced therefrom, means for feeding liquid fuel onto the outer surface of said sleeve from which it is distributed radially outward of said rotary disc between the same and the member in close proximity thereto, means for feeding air between said outer and inner housings, a damper for closing an opening in said inner housing adjustable to deflect a portion of said air through said inner housing and sleeve and between said shield and disc to meet the fuel at the periphery of said disc, and thermostatic means operated by the

heat of combustion and automatically adjusting said damper.

11. In an oil burner, the combination with a closure for a door opening of the furnace, of a motor mounted on the outside of said closure, a shaft driven by said motor extending through said closure and into the furnace chamber, a housing surrounding said shaft, a disc mounted on said shaft at the inner end of said housing, a sleeve surrounding and coaxial to said shaft, a pre-heating burner surrounding said housing adjacent to the periphery of said disc, a stationary disc secured to said housing and extending parallel and in close proximity to said rotary disc, means for feeding liquid fuel on said sleeve from which it is distributed over said rotary disc between the same and the parallel stationary disc, a shield secured to and rotating with said shaft and disc arranged on the opposite side from said stationary disc and spaced from said rotary disc, and means for feeding air through said housing and through said sleeve into the space between said shield and rotary disc and radially outward to meet the fuel at the periphery of the disc, whereby the central portion of said disc is cooled by said liquid fuel and air and the outer portion of the disc is heated initially by said pre-heating burner and subsequently from the combustion of the liquid fuel.

12. In an oil burner, the combination of a hollow pedestal, a swinging hollow arm mounted on the upper end of said pedestal, a shelf mounted on the outer end of said swinging arm and providing a support for a motor, a plate extending upward from said shelf forming a closure for a door opening of the furnace, a burner housing projecting inward from said plate, a rotary disc at the inner end of said burner housing, a shaft for coupling said motor with the said rotary disc, a gas operated pre-heating burner at the inner end of said burner housing, a nozzle for supplying liquid fuel to said rotary disc, conduits for supplying gas and liquid fuel arranged within said hollow pedestal and swinging arm and connected respectively with said pre-heating burner and nozzle and electrical connections also passing through said pedestal and hollow arm to said motor whereby the whole burner assembly may be swung upon said hollow arm into or out of engagement with the furnace.

13. In an oil burner, the combination with a hollow pedestal, of telescopic extension for said pedestal, a swinging hollow arm mounted on said telescopic extension, a shelf mounted on the free end of said hollow arm, a plate forming a closure for a door opening in the furnace secured to said shelf, a motor mounted on said shelf, a shaft driven by said motor extending through said plate and into the furnace chamber, a housing surrounding said shaft, a disc at the inner end of said housing mounted on said shaft, a nozzle for supplying liquid fuel to said disc, a pre-heating gas burner on said housing adjacent to the periphery of said disc, and conduits for supplying gas and liquid fuel respectively to said pre-heating burner and nozzle passing upward through said pedestal and through said hollow arm, said conduits permitting of the telescopic movement of said pedestal permitting both the telescopic movement of said pedestal and the swinging of said arm whereby said burner may be introduced or removed from the furnace chamber without interference.

14. In an oil burner, the combination with a rotary shaft, of a disk mounted on the end of said shaft, a sleeve surrounding and concentric with the shaft, a nozzle for feeding liquid fuel onto the outer surface of said sleeve portion and having the outlet thereof arranged in such close proximity to the sleeve as to maintain a constant liquid seal between the outlet of the nozzle and the sleeve whereby an unbroken column of liquid will be maintained, however small the quantity which will be distributed by the combined force of capillarity and centrifugal action.

15. The combination with a rotary shaft, of a conically shaped sleeve driven by the shaft, rotatable radially extending fuel directing means driven by the shaft, a distributing well in fuel receiving relationship with the sleeve for supplying fuel to the fuel directing means, and means for delivering fuel to the sleeve.

16. The combination with a rotary shaft, of a conically shaped sleeve driven by the shaft, rotatable disk like fuel directing means driven by the shaft, a distributing well in fuel receiving relationship with the sleeve for supplying fuel to the fuel directing means, and means for delivering fuel to the sleeve.

17. In an oil burner, the combination with a rotatable radially extending fuel directing means, of a sleeve on one side of said means for feeding fuel to said side of said means, means for delivering fuel to said sleeve, means for passing air through said sleeve, and a shield on the other side of said means for causing the air to meet the fuel discharged from said fuel directing means.

18. In an oil burner, the combination with a rotary fuel directing device, a liquid fuel feeding nozzle having an inlet connected with a source of liquid fuel, said nozzle having an outlet arranged in fuel wiping relation with the rotary fuel directing device and substantially parallel with the oil receiving surface thereof to maintain a constant film of fuel between the outlet of the nozzle and the rotary device when the flow of fuel is reduced to a minimum.

19. A heating system comprising in combination a furnace, a fuel burner having its burner end within the furnace, said end including moving elements, and means for causing air from the exterior of the furnace to circulate in close proximity with said moving elements for cooling the elements, and means to discharge said air exteriorly of the furnace.

20. A heating system comprising in combination, a furnace, a fuel burner having its burner end within the furnace, said end including moving elements, and means for causing air from the exterior of the furnace to circulate in close proximity with said moving elements for cooling the elements, and means to discharge said air exteriorly of the furnace, said first named means also supplying air to support combustion.

WILLIAM G. LATIMER.