

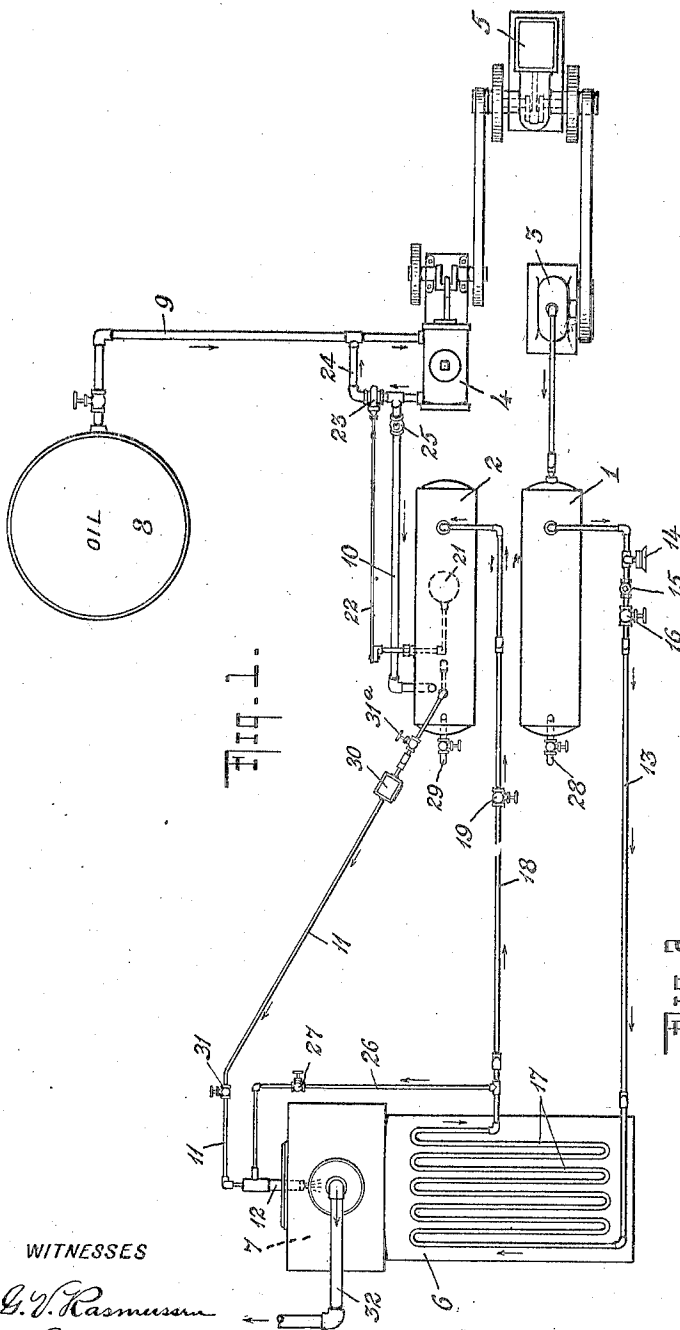
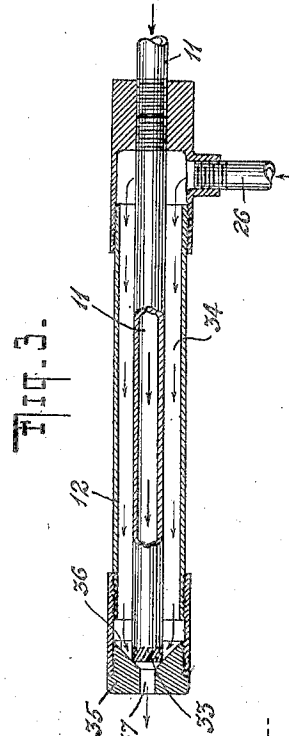
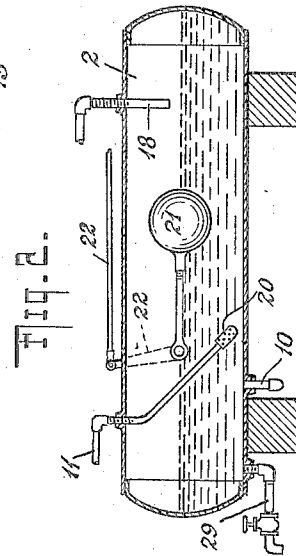
May 1, 1923.

W. P. DUNHAM

1,453,662

FIRING BOILERS BY MEANS OF FUEL OILS

Filed July 16, 1920



WITNESSES
G. V. Rasmussen
John A. Schenck

INVENTOR
WILLIAM P. DUNHAM
BY
Brisson Schenck
ATTORNEYS

UNITED STATES PATENT OFFICE.

WILLIAM P. DUNHAM, OF COPPERAS COVE, TEXAS, ASSIGNOR TO NEBULIZER OIL BURNING COMPANY, A CORPORATION OF DELAWARE.

FIRING BOILERS BY MEANS OF FUEL OILS.

Application filed July 16, 1920. Serial No. 396,700.

To all whom it may concern:

Be it known that I, WILLIAM P. DUNHAM, a citizen of the United States, and resident of Copperas Cove, Coryell County, Texas, have invented certain new and useful Improvements in the Art of Firing Boilers by Means of Fuel Oils, of which the following is a specification.

This invention relates to the art of using fuel oil or crude oil for firing boilers and particularly boilers making steam. The invention has for its object the conservation of the quantity or amount of such fuel oil consumed in such use and to secure improved results in the manipulation and treatment of the fuel oil, as will appear more at large in the specification.

The invention is illustrated in the accompanying drawings in which Figure 1 is a diagrammatic plan view of one form of apparatus adapted for carrying out my invention; Fig. 2 is a vertical sectional view through tank 2 of Fig. 1 and Fig. 3 is a detail of the nozzle at which the oil is atomized and in that form injected into the fire box of the boiler.

It will be understood that the drawings are illustrative only and that my invention may be embodied in a variety of other forms of apparatus. For the purpose of description, however, the particular form of apparatus is excellently suited for a comprehension of the invention. It is, of course, to be understood as associated with some appliance which consumes steam, either directly or as power, and a field in which the invention is of particular advantage is the drilling of oil wells, but obviously the invention is capable of application in many arts on land and sea, including railway, locomotive and steam vessels.

Referring to the drawings, 6 indicates a boiler of standard construction having the usual fire box 7. The steam generated by this boiler leads, let us say, to the engine which operates the drill of an oil well. According to standard practice such a boiler, when fuel oil is employed to generate the required heat, is usually started by building a fire by hand beneath the boiler. Crude oil is poured upon this fire until sufficient heat is developed and the proper amount of steam is registered in the gauge. This generally requires about an hour and a half in time for 110 pounds of steam and

consumes about a barrel and a half of fuel oil. In an industry like that involved in drilling oil wells, this process is repeated about once a week and is obviously wasteful and inefficient. According to the standard practice when sufficient steam has been developed in the boiler, a branch steam line passes a portion of the steam to a nozzle in front of the fire box 7 of the boiler 6. Fuel oil is passed to this nozzle and the steam thereupon breaks up the oil at the point of discharge from the nozzle and sprays the oil mist thus created against a splasher and the atomized oil is then ignited and supplies the further heat required by the boiler. Various special nozzles or jets, patented and unpatented, are in use and the construction of the jet is regarded as one of the most important features for delivering the steam sprayed oil. In giving my attention to the problem of devising a proper means of economically handling fuel oil for conversion into heat, I have concluded that the use of steam created in the boiler is extremely wasteful and extravagant. Some of the reasons for this conclusion are that a very large percentage of the fuel oil which is used must of necessity go to the making of the steam which is required to atomize it and to deliver it against the splasher and all the steam thus used, if conserved for the purposes for which the steam is really created, would constitute a great saving if it were diverted from the boiler directly to the place of its chief need. The steam itself, furthermore, being wet, serves to dampen the atomized oil and thus prevents the efficiency which would be possible were the mist or sprayed oil when delivered against the splasher unaccompanied by the moisture carried in the steam. The use of steam also results in a certain intermittence of discharge, there being intervals of combustion and absence of combustion caused by the periodic accumulation of steam over the percentage of oil which is discharged until sufficient oil has again accumulated to be discharged. A general uncleanness and waste of oil in the immediate vicinity of the boiler is also occasioned by the process generally in use as thus far described by me. Having then concluded that one of the chief factors in this unsatisfactory condition is due to the use of steam as one element

of the atomizing means, I determined to replace the steam used for atomizing by a relatively dry medium or gas such as air, preferably hot, and to use this medium not only for atomizing purposes but also in connection with and as a feeding element for the oil itself. In carrying out the invention I made use of the apparatus which is diagrammatically illustrated in the drawings and which comprises, as stated, the usual boiler 6 with its fire box 7. A storage of the oil which the operations consume is contained in the oil tank 8 from which through a suitably valved connection 9 the oil enters the oil pump 4. This oil pump 4 is driven by a small stationary gas engine 5 which uses about ten gallons of gas in twenty-four hours and runs continuously. The same gas engine 5 also operates the air pump 3. The oil is forced by the oil pump 4 to pass through pipe 10 and into the bottom of the oil supply tank 2 until said tank is approximately half full, at which level the supply of oil in the tank 2 is automatically maintained by the means to be hereinafter described. Through a further connection 11, also provided at appropriate points with valves, the oil is withdrawn from the bottom of the tank 2 and fed to the jet or nozzle 12. The means by which the oil is thus fed from the tank to the nozzle 12, as well as the means which serve to atomize the oil at the mouth of the jet 12, consists of the air which is supplied by the air pump 3. The compressed air is preliminarily conveyed into the air tank 1. A line 13, provided with a gauge 14, a pressure valve 15 and a manually controlled valve 16, leads the air into the coils 17 above and closely adjacent to the boiler itself. These coils 17 are shown as extending longitudinally of the boiler but obviously may extend transversely thereof and they may be located at any appropriate position within the region of heat radiation from the boiler. The object of these coils 17 is to impart to the compressed air a part of the radiated heat from the boiler, which would otherwise be wasted. The heater air from the coils 17 passes through connection 18 into the upper part of the oil supply tank 2, the connection 18 being valved at 19. As shown in Fig. 2, the connection 18 extends into the tank 2 to a point closely above the level of the oil contained therein and as the air is approximately under 100 pounds pressure, the stream of air discharging through pipe 18 into the oil in the oil supply tank 2 (Fig. 2) agitates or whips up said oil and forms what might roughly be described as an aerated oil. The oil supply tank 2 is, of course, as a whole under air pressure which fills the entire upper half of said tank. The air pressure in this tank 2 causes the oil to be forced out of the tank through pipe 11, which preferably extends into the oil in an inclined direction and may be provided with a suitably apertured or perforated cap 20 so as to provide for the free and unobstructed intake of oil (or mixed oil and air). The flow of oil or mixed oil and air through the pipe 11 is continuous and renewed supplies of oil are fed continuously to the bottom of the oil supply tank 2 through the pipe 10 so long as the volume of oil in tank 2 does not rise above a predetermined level, say when the tank is half full. If the supply of incoming oil tends to introduce into tank 2 more oil than will satisfy this predetermined level, it will elevate the float 21 and thereby through connections 22 move the gate valve 23 into its open position. The opening of this gate valve 23 to its completely open position prevents the oil pump 4 from forcing the oil past the check valve 25 and when the gate valve 23 is entirely open, the by-pass connection 24 will permit the oil pump 4 to continue to function uninterruptedly, the oil then merely circulating through the pump without any of it entering pipe 10 through the check valve 25. As the gate valve 23 closes as the result of a lowering of the level of the oil in tank 2 and the consequent descent of the float 21, the oil will be forced through the check valve 25 and will pass into the connection 10 and by these means the level of the oil in tank 2 is automatically maintained. The check valve 25 prevents any back pressure against the oil pump due to excessive air pressure in the tank 2 should that condition arise.

At a point intermediate between the hot air coils 17 and the point where the hot air is admitted into the oil tank 2, a branch line or blow pipe 26 provided with a valve 27 leads to the jet 12 and by this means hot air is permitted to meet the oil from the tank 2 at the nozzle of the jet 12, to which point the oil has been forced by another part of the hot air from the coils 17.

The air tank and oil tank are provided with suitable drain pipes and valves 28, 29 respectively.

A meter 30 records the amount of oil which leaves the oil tank 2 and is consumed at the jet 12. This meter is located between valves 31 and 32, thus enabling the meter to be examined or replaced and a plain pipe connection made in the meantime without interrupting the operations of the apparatus.

The steam from the boiler is brought through pipe 32 to its place of use undiminished in quantity and without exercising any deleterious influence upon the oil consumption or the manner of its use.

The jet 12 is illustrated in one of its preferred forms in Fig. 3. As there shown the jet consists of the hollow casing or outer barrel

12 closed at its rear end except for the admission of the oil pipe 11 and of the air blow pipe 26. The forward end of the oil pipe 11 is provided at the exterior thereof with a series of closely adjacent spiral grooves 33, which grooves are deeper at the forward end than at the rear and preferably at the forward end terminated in frontal notches in the oil pipe 11. A large number of such grooves is desirable and as an illustration I have indicated about twelve of such grooves on a half inch pipe.

The object of these grooves is to impart to the air injected through pipe 26 into the chamber 34 a swirling motion at the nozzle of the jet and to break the oil into innumerable small particles. The front end of the casing 12 is preferably closed by a readily interchangeable cap 35 centrally apertured at 37 and preferably having a dome-shaped internal configuration as indicated at 36 which gives direction to the air supplementing the direction imparted to the air by the grooves 33. The inner surface of this cap 35 abuts against the forward end of the oil pipe 11, the aperture 37 being smaller in diameter than the diameter of the oil pipe 11. The result of this arrangement is extremely efficient; the hot air not only when coming in contact with the forward end of the oil column tends to retard it but during said retarded state to thin and vaporize it but also, by reason of the direction in which the air attacks the oil, atomizes it most effectively. In other words the oil is air-mixed, atomized, vaporized and otherwise brought to a condition where a maximum heat efficiency is made possible with a minimum consumption of fuel. The visible sign that the proper conditions are observed is that the stream coming from the nozzle has the appearance of a white cloud which, when ignited, burns with a brilliant white flame (as distinguished from yellow) producing practically no smoke whatever. The connection between the oil line 11 and air blow pipe 26 and the jet 12 is preferably composed of pipe fittings, commonly known as street Ls coupled together which enable the jet 12 to be at will moved forwardly or backwardly, upwardly or downwardly, laterally or, in fact, to any desired position or inclination with respect to the fire box 7 of the boiler. It will be observed that by tapping the hot air at a point near the boiler 6 the air which reaches the nozzle 12 has a higher temperature than the air which has acted upon the oil in the tank 2 at a somewhat remote distance from the boiler.

From the foregoing arrangement it will be observed that even though the boiler is cold the compressed air will nevertheless, when turned on, produce a substantial and efficient spray of atomized oil from the jet 12 and when this spray is ignited the boiler

will rapidly heat up so that the air becomes more and more heated through the coil 17. There is no delay in starting and no waste and no time is lost in bringing the boiler up to its normal efficiency which, for example, may be stated as 110 pounds of steam. The air being dry or, at any rate, relatively dry as compared with steam, will not reduce the caloric efficiency of the oil sprayed from the nozzle 12 and no part of the steam from the boiler is wasted in supplying motive power for the oil. The discharge of nebulized or atomized oil at the nozzle is regular and continuous and there is no choking at this point due to variations in the relative quantities of oil and spraying fluid.

It will also be observed that when the apparatus is functioning normally after the boiler has been started up, the hot air which enters the oil tank 2 tends to thin the oil therein and to put it into a condition of greater fluidity, while the hot air which is driven into the oil and passes with it through the pipe 11 will be of advantage in further assisting the proper atomization at the nozzle 12. The valves which are provided in the air and oil lines can be readily regulated so that a uniform condition of suitable combustion may be maintained in the fire box of the boiler and the greatest degree of economy and highest efficiency may be thus maintained. The process as hitherto described and as put into practical use by me has proven to be of great benefit. Referring to the example heretofore stated by me, to wit, the drilling of oil wells, the usual steam system which is described as standard in an early part of the specification will consume for a boiler capacity of 110 pounds approximately 30 barrels of oil per day. Operating according to my new process the consumption is approximately 12 barrels per day.

The meter 30 enables me to ascertain exactly the quantity of oil that is used per day or per hour. This economy is obviously very great in oil alone, not counting the increased efficiency from the boiler due to the fact that no part of the steam created by it is wasted in the atomization of the oil.

The valve 27 in the air line 26 and the valve 31 in the oil line 11 makes it possible to regulate the supply of oil and air with respect to each other so that a maximum charge of atomized fuel oil for quick and vigorous firing of the boiler may be obtained at one period of time and may subsequently be reduced to the minimum point of barely maintaining a fire under the boiler, the regulation enabling the charge of atomized fuel oil to be brought to any degree of intensity between the maximum and minimum limits. As the oil and air are under pressure from the same source, the arrangement is obviously one in which the speed of the oil as

it leaves the atomizer nozzle of the burner will never be such as to cause the oil to be ejected as a solid stream, but on the contrary, (so long as the air line is open), the oil column will be retarded within the nozzle by the action of the air cutting across its forward face at that point, coupled with the fact that the front aperture of the nozzle is constricted, whereby this retarding action of the air on the oil column is further enforced. In other words, the speed of the oil column as it flows through its channel in the oil burner, retarded as it is by the action of the air, will not be in excess of the speed of the atomizing air or other agent at the nozzle. I have already pointed out the fact that the hot air in the oil tank 2, as well as at the jet 12, has the effect of thinning the oil, thereby making for the most effective delivery in atomization. And this result is of extreme value in severe freezing weather when, under the old method, the oil would hardly if indeed flow at all. The use of hot air also makes it possible to use a poor grade of heavy crude or fuel oil.

It is to be understood that my invention is capable of application in many modified forms and that the description thereof with respect to the specific apparatus shown is illustrative merely, and that equivalent apparatus or methods of procedure are intended to be included within the scope of my claims.

What I claim is:

1. In the art of firing boilers, that improvement which consists in maintaining a continuous flow of compressed air, into and through an atomizer and also upon oil in a storage vessel to force the oil to the atomizer in a column at a speed which is not greater than the speed of the atomizing air, said oil column being then, within the nozzle of said atomizer, retarded by the stream of pressure air there passing, at its higher speed, across the face of the oil column, said air also, within the confines of the burner, finely dividing the oil and in said condition ejecting the so treated oil particles with the speed of the emerging air.

2. In the art of firing boilers, that improvement which consists in maintaining a continuous flow of compressed air, dividing said flow into two streams, one of which leads to an atomizer, heating said stream on its way thereto, the other stream leading to an oil storage vessel to force the oil to the atomizer in a column at a speed which is not greater than the speed of the atomizing air passing through the atomizer, said oil column being then within the nozzle of said atomizer retarded by the stream of pressure air there passing, at its higher speed, across the face of the oil column, said air also, within the confines of the burner, finely dividing

the oil and heating the same and in said condition ejecting the so treated oil particles with the speed of the emerging air.

3. In the art of firing boilers, that improvement which consists in maintaining in a nozzle a continuous flow of compressed air and a continuous flow of oil under pressure, retarding the stream of oil within the nozzle and then forward of said retarded point but within the confines of the nozzle causing it to be broken up by divided streams of air and in said broken up state to be whirled about and exposed to heat, all within the confines of the nozzle, whereby the mixture of air and oil in the condition to which these treatments have converted it emerges from the nozzle in the form of a white cloud giving a white flame substantially free from smoke when ignited.

4. In the art of firing boilers, that improvement which consists in maintaining a continuous flow of compressed air into and through an atomizer and also upon oil in a storage vessel to force oil therefrom to the atomizer in a column at a speed which, in the atomizer, is not greater than the speed of the atomizing air, heating the air on its way to the atomizer, passing streams of heated pressure air across the face of the oil column within the nozzle of said atomizer at a higher speed to retard the column of oil from said vessel, causing said heated air to finely divide the oil within the confines of the burner, and ejecting the so treated oil particles with the speed of the emerging air.

5. In the art of firing boilers, that improvement which consists in maintaining a continuous flow of compressed air into and through an atomizer and also upon oil in a storage vessel to force oil therefrom to the atomizer in a column at a speed which, in the atomizer, is not greater than the speed of the atomizing air, heating the air on its way to said oil storage vessel, passing streams of the pressure air across the face of the oil column within the nozzle of said atomizer at a higher speed to retard the column of oil from said vessel, causing said heated air to finely divide the oil within the confines of the burner, and ejecting the so treated oil particles with the speed of the emerging air.

6. In the art of firing boilers, that improvement which consists in maintaining a continuous flow of compressed air into and through an atomizer and also upon oil in a storage vessel to force oil therefrom to the atomizer in a column at a speed which, in the atomizer, is not greater than the speed of the atomizing air, heating the air on its way to the atomizer, heating the air leading to the oil storage vessel, passing streams of the heated pressure air across the face of the oil column within the nozzle of said atomizer at a higher speed to retard the

column of oil from said vessel, causing said heated air to finely divide the oil within the confines of the burner, and ejecting the so treated oil particles with the speed of the emerging air.

7. The combination of a boiler, a burner operatively combined therewith, an oil supply, a supplemental oil storage tank, a connection from the latter to said burner and means for continuously forcing an oil column therethrough, a continuously acting pump, a pipe system between the supplemental oil tank and said pump, in which a movement of oil is continuously maintained by the action of said pump, a connection between said pipe system and the supplemental tank, a float in the latter and means controlled by said float whereby, when the latter is elevated, the flow of oil from the pipe system to the supplemental tank is retarded or checked and, when said float descends, the influx of oil from the pipe system into said supplemental tank is resumed, and means within the confines of the burner for passing of pressure air across the face of the oil column at a greater speed than that of the oil column, thereby retarding said column while finely dividing the oil particles removed therefrom before the fuel mixture is ejected from the burner.

8. The combination of a boiler, a fuel oil burner operatively connected therewith, a tank containing a supply of fuel oil, means for maintaining said supply at a predetermined level, a connection from said tank to said burner, an air pipe leading into said tank and arranged to admit pressure air and to cause said air to physically agitate the oil while also forcing it from the tank to the burner, means for introducing through said pipe a supply of air under pressure to agitate the oil and to force it from the tank in a column through the burner, and means within the confines of the burner for passing streams of pressure air across the face of the oil column at a greater speed than that of the oil column, thereby retarding said column while finely dividing the oil particles removed therefrom before the final mixture is ejected from the burner.

9. The combination of a boiler, a fuel oil burner operatively connected therewith, a tank containing a supply of fuel oil, means for maintaining said supply at a predetermined level, a connection from said tank to said burner, an air pipe leading into said tank and arranged to admit pressure air and to cause said air to physically agitate the oil while also forcing it from the tank to the burner, said arrangement embracing a downward extension of said air pipe in said tank and a termination of said air pipe at a point in said tank closely adjacent to, but slightly above, the predeter-

mined oil level therein, means for introducing through said pipe a supply of air under pressure to agitate the oil and to force it from the tank in a column through the burner, and means within the confines of the burner for passing streams of pressure air across the face of the oil column at a greater speed than that of the oil column, thereby retarding said column while finely dividing the oil particles removed therefrom before the final mixture is ejected from the burner.

10. The combination of a boiler, a fuel oil burner operatively connected therewith, a source of fuel oil connected with said burner, a source of compressed air, air ducts leading, respectively, from said source of compressed air to said source of fuel oil and to said burner, one of said ducts, at least, communicating with a pipe line traversed by said pressure air and consisting of a series of consecutive convolutions located exteriorly of the boiler within the external area of intense heat radiation therefrom, whereby the compressed air is heated upon its way to its point of use, means within the confines of the burner for passing streams of the pressure air from one air duct across the face of the oil column, which is forced through the burner by the pressure of the air in the other duct, the pressure air in said burner retarding the oil column while finely dividing the oil particles removed therefrom before the fuel mixture is ejected from the burner.

11. A fuel oil burner adapted for the atomization of oil by a heated gaseous atomizing agent comprising an outer barrel, an oil tube therein, and surrounding said tube, a gas chamber, a gas supply pipe communicating with said chamber and adapted to deliver hot gas thereto under pressure, a cap or nozzle at the forward end of said barrel forward of the front end of the oil tube and provided with an orifice of smaller diameter than that of the oil pipe, the interior face of said cap diverging from said point of contact rearwardly toward the inner wall of the barrel and abutting in said divergent region against the forward end of said oil tube rearwardly of the smaller orifice of the cap, and a series of closely adjacent angularly disposed grooves extending in the direction of the length of the oil pipe and produced upon the outer surface of the oil pipe at its forward end, the exit end of said grooves providing constant communication between the gas chamber and the orifice of the cap.

12. A fuel oil burner adapted for the atomization of oil by a heated gaseous atomizing agent comprising an outer barrel having its forward end closed and provided with a jet orifice, the inner surface of said closed end diverging rearwardly from said jet orifice, an oil tube extending

into said outer barrel and forming there-
with an interior gas chamber, said oil tube
having its exit end in the form of a cylinder
the peripheral terminal edge of which abuts
5 against the diverging inner surface of said
closed end and being of larger diameter
than said jet orifice, a gas supply pipe com-
municating with said chamber adapted to
deliver hot gas thereto under pressure, and
10 a series of closely adjacent angularly dis-
posed grooves extending in the direction of
the length of the oil pipe and produced upon
the outer surface of the oil pipe at its for-
ward end, the exit end of said grooves pene-
15 trating the said oil pipe to provide constant
communication between the gas in the gas
chamber and the orifice of the cap.

13. A fuel oil burner adapted for the
atomization of oil by a heated gaseous
20 atomizing agent comprising an outer bar-
rel, an oil tube therein, and surrounding
said tube, a gas chamber, a gas supply pipe
communicating with said chamber and
adapted to deliver hot gas thereto under
25 pressure, a cap or nozzle at the forward end
of said barrel provided with an orifice of
smaller diameter than that of the oil pipe,
the interior of said cap abutting against
the forward end of said oil pipe and diverg-
30 ing from said point of contact rearwardly

toward the inner wall of the barrel, and a
series of closely adjacent angularly disposed
grooves extending in the direction of the
length of the oil pipe and produced upon
the outer surface of the oil pipe at its for- 35
ward end, said grooves increasing in depth
from their inlet to their outlet end, the exit
end of said grooves providing constant com-
munication between the gas chamber and
the orifice of the cap. 40

14. The combination of a motor, an air
pump and an oil pump, both continuously
driven by said motor, a nozzle, an air con-
duit for conducting the compressed air
through a heat zone to the nozzle, an oil 45
supply and a supplemental oil tank and a
connection between the two, including the
oil pump, a branch air conduit conducting
heated air to the tank, means within the
tank for determining a predetermined oil 50
level therein, said means being effective to
determine the entering volumes of oil and
to limit the air space in said tank, both
without causing interruption of operation
of either pump and a connection from the 55
tank to the nozzle for supplying oil thereto
by the air pressure in said tank.

In testimony whereof I have hereunto
set my hand.

WILLIAM P. DUNHAM.