Dec. 8, 1936. J. T. VOORHEIS 2,063,713

NONCLOG ATOMIZED OIL BURNER

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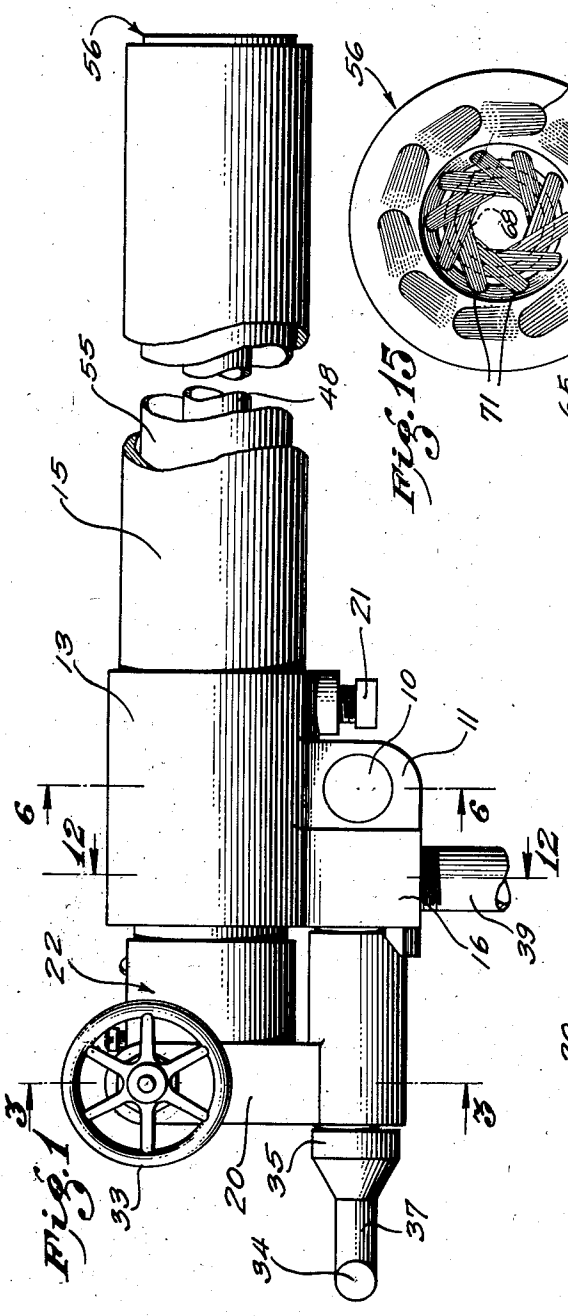


Fig. 1

Fig. 1B

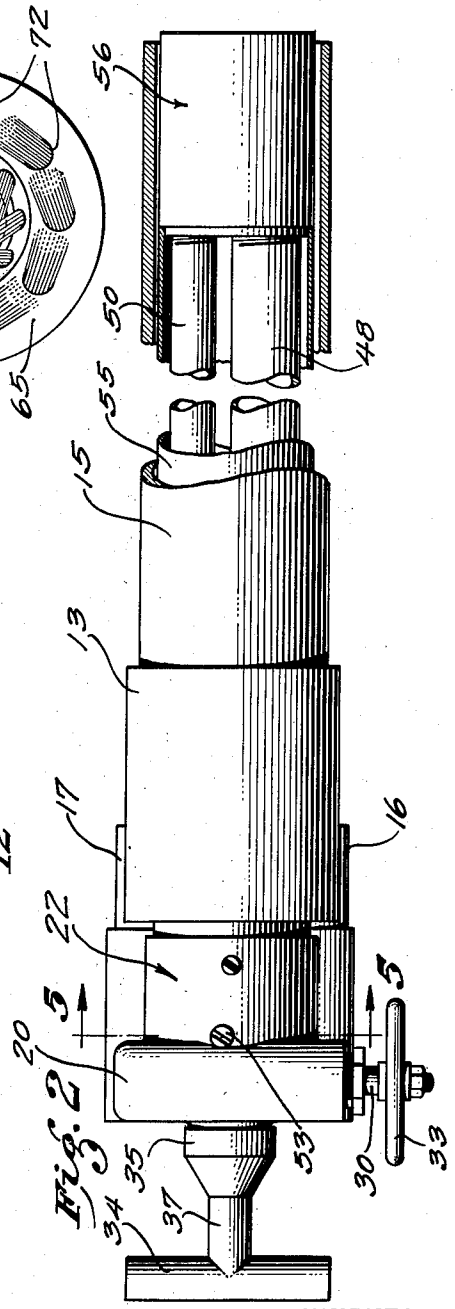


Fig. 2

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Fig. 3

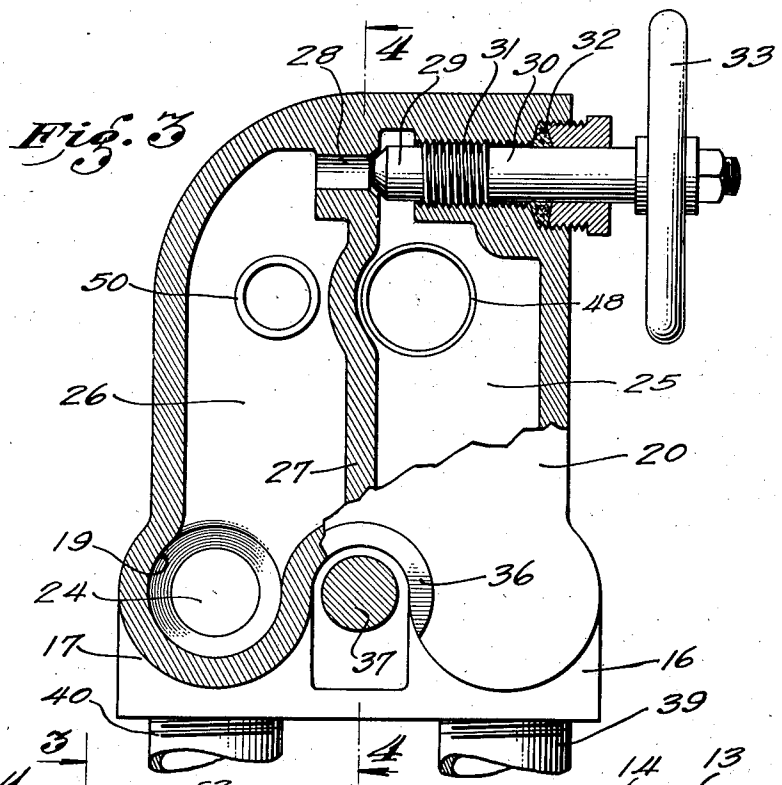
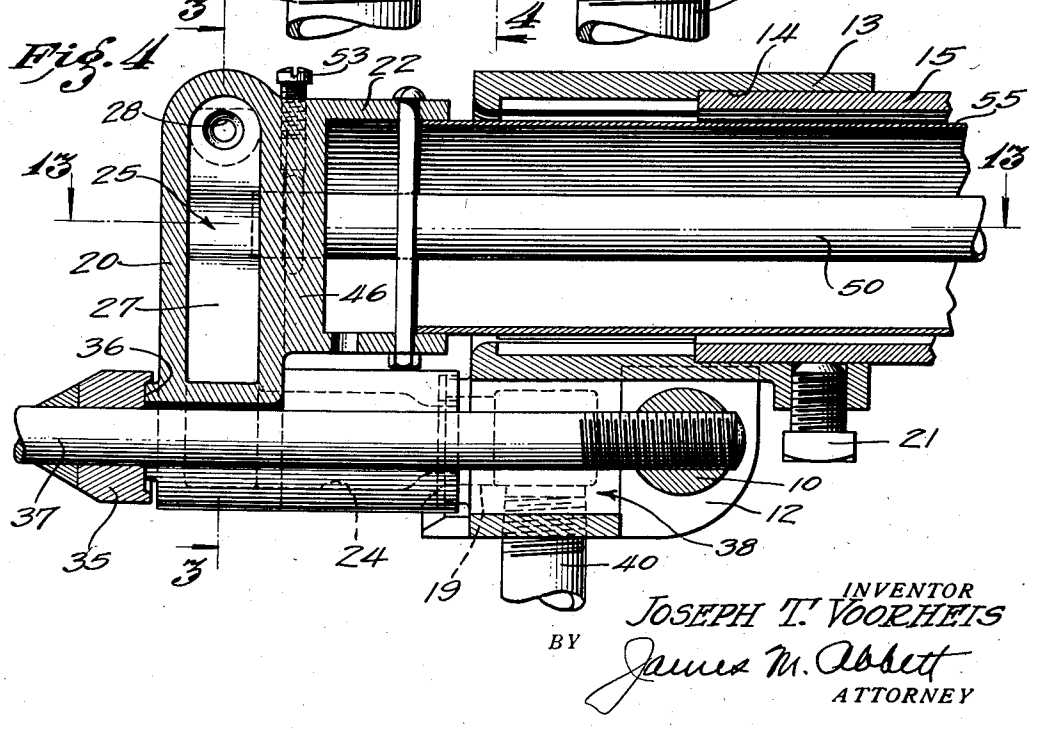


Fig. 4



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Fig. 5

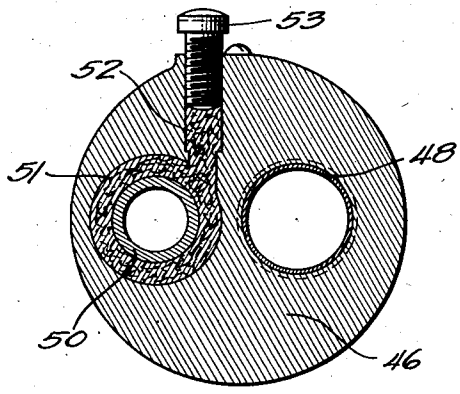


Fig. 6

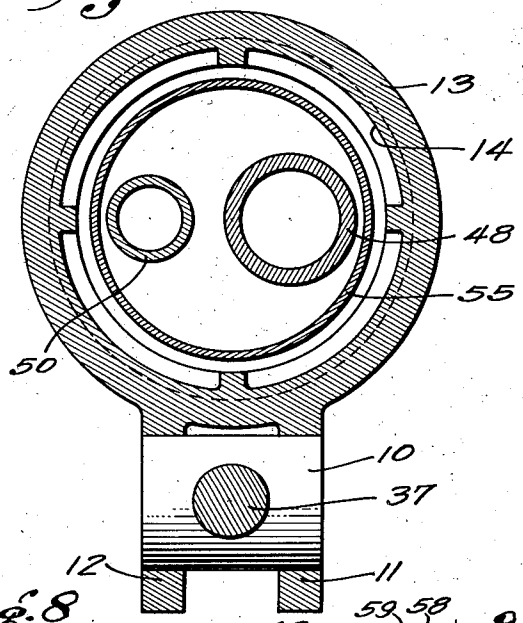


Fig. 7

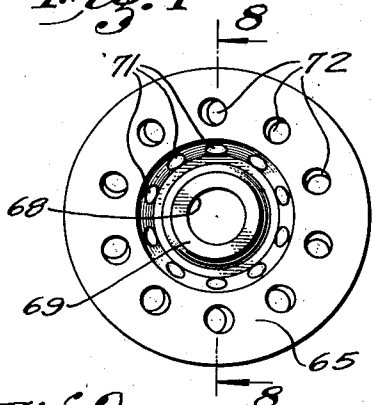


Fig. 8

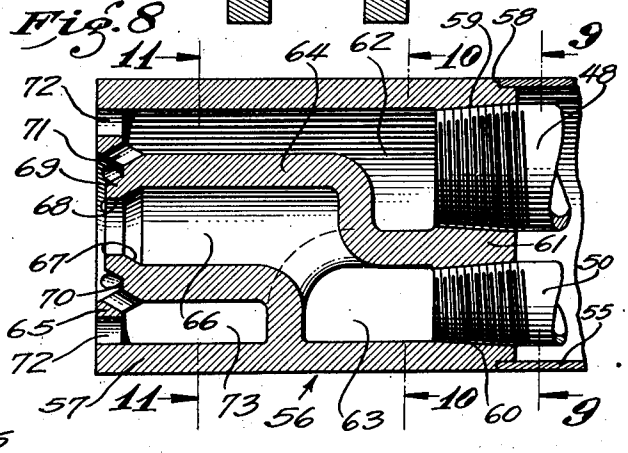
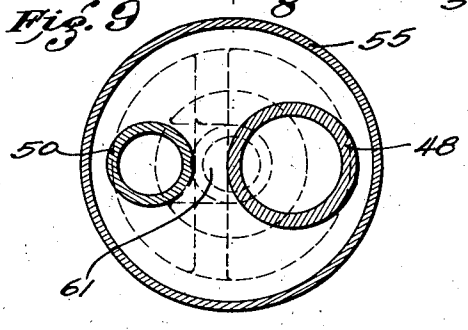


Fig. 9



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Fig. 10

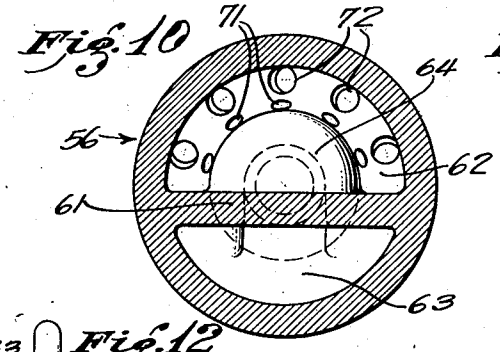


Fig. 11

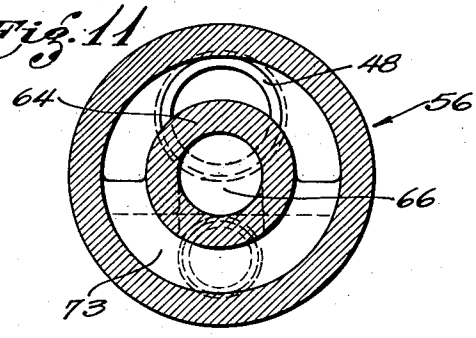


Fig. 12

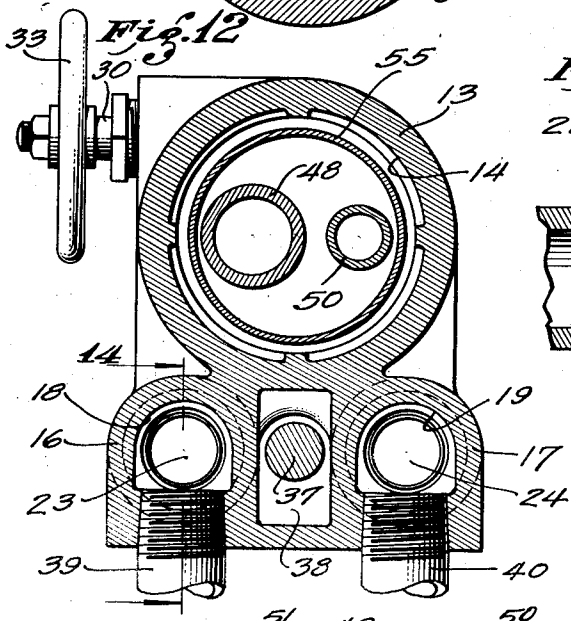


Fig. 14

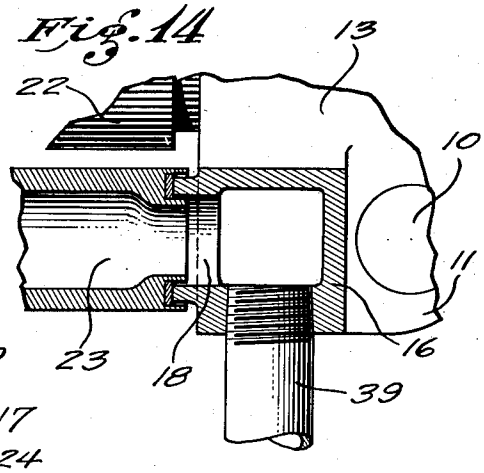
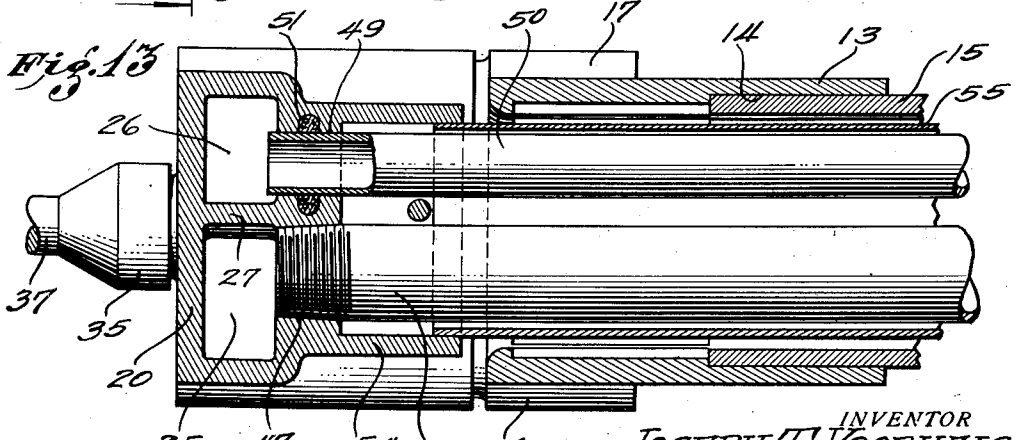


Fig. 13



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UNITED STATES PATENT OFFICE

2,063,713

NONCLOG ATOMIZED OIL BURNER

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Application June 22, 1934, Serial No. 731,846

12 Claims. (Cl. 299—143)

This invention relates to fuel burners, and particularly pertains to an atomizing oil burner.

In the operation of fuel oil burners it is imperative that the fuel oil be properly atomized, that it be uniformly and continuously projected from the jet, and that the jet be non-clogging. It is difficult to accomplish these results when the fuel is of low grade, such for example as heavy oils and sludges, and it is the principal object of the present invention to provide a liquid fuel burner which embodies means to properly atomize the fluid and control the shape and direction of movement of the jet projected from the burner, and, in addition, to insure that fluids will not have an opportunity to produce a corrosive action upon the parts of the burner, or to become clogged within the burner.

The present invention contemplates the provision of a fuel burner fitted with a nozzle from which a fuel oil and a vapor, such as steam, may be discharged, and which nozzle is so designed as to control the separate jets, fuel and vapor in a manner to produce atomization of the fuel and to establish the shape and spread of the jet created by the combined fuel and atomizing agent.

The invention is illustrated by way of example in the accompanying drawings, in which:—

Figure 1 is a view in side elevation showing the complete assembled burner with which the present invention is concerned.

Fig. 2 is a view partly in longitudinal central section showing other details of the burner and particularly disclosing details of the valve head and the nozzle head.

Fig. 3 is a view in transverse section through the valve head as seen on the line 3—3 of Fig. 1, as showing in detail the blow-out valve.

Fig. 4 is a fragmentary view in longitudinal section as seen on the line 4—4 of Fig. 3 showing the various passageways.

Fig. 5 is a view in transverse section through the valve head as seen on the line 5—5 of Fig. 2 and as showing the oil tube packing.

Fig. 6 is a view in transverse section through the burner as seen on the line 6—6 of Fig. 1 and as showing the clamp hinge pin structure.

Fig. 7 is a view in end elevation showing the nozzle structure.

Fig. 8 is a view in central longitudinal section showing the nozzle structure as seen on the line 8—8 of Fig. 7.

Fig. 9 is a view showing the inner end of the nozzle head as seen on the line 9—9 of Fig. 8.

Fig. 10 is a view in transverse section through the nozzle head as seen on the line 10—10 of Fig. 8.

Fig. 11 is a view in transverse section through the nozzle head as seen on the line 11—11 of Fig. 8.

Fig. 12 is a transverse vertical section through the burner socket as shown on the line 12—12 of Fig. 1, and discloses the steam and oil inlet connections.

Fig. 13 is a view in transverse section as seen on the line 13—13 of Fig. 4.

Fig. 14 is a fragmentary view in vertical section showing the gasket joint of the oil and steam lines between burner head and socket.

Fig. 15 is a view in end elevation showing the manner in which the primary and secondary steam jets act upon the stream of liquid projected from the nozzle.

Referring more particularly to the drawings, 10 indicates a pin through which the clamp 34 is screwed and supported. This pin passes through a pair of ears 11 and 12. These ears extend downwardly as shown in Figs. 1 and 6 of the drawings, and are formed as a part of a cylindrical burner socket 13. This cylindrical socket is formed with a central passageway 14 therethrough to receive the end of a guide pipe 15. The outer end of the cylindrical socket, as shown in Fig. 12, is formed with a pair of complementary bosses 16 and 17 for steam and oil, respectively. These bosses provide tapered threaded openings to receive steam and oil pipes and longitudinal passageways 18 and 19 through which the steam and oil may flow to the valve head unit 20. The burner socket 14 is fastened around the outer end of the guide pipe 15 by a set screw 21. The valve housing is adapted to abut against the end of the burner socket and is formed with a cylindrical portion 22 in longitudinal alignment with the central axis of the burner socket. Passageways 23 and 24 are formed in the valve head casting at the lower end thereof and communicate directly with the passageways 18 and 19 in the valve socket. These passageways extend longitudinally and then communicate with upturned passageways 25 and 26 which are separated by a central partition wall 27. At the upper end of the passageways a by-pass opening 28 is formed through the partition 27 and is closed by a valve member 29 mounted on a valve stem 30 which is threaded into a bore 31 of the valve head. The outer end of this stem is suitably packed by packing means 32 and carries an operating hand wheel 33 by which the valve 29 may be opened or closed. This is desirable in order to introduce steam to blow through the oil conduits of the system and free the oil prior to removing the burner from its operative position.

It is understood that in some installations the blowout valve might not be necessary, and in that event the wall 27 would be a solid one, insuring that there would be no possibility of leakage of the steam into the oil conduit. This is highly desirable when heavy oil sludge is used, since this sludge usually has an acid content and

the comingling of the acid sludge with the steam content would cause a chemical action which would produce an undesirable effect when contacting with any of the metal of the burner structure. It is, therefore, one of the objects in the design of the present invention to insure that the steam and oil will not comingle until after they have both been discharged from their respective separate nozzle jets at the end of the burner.

Secured at the end of the valve head is a T handle 34 by which socket 13 and the valve head are secured together and the gasket joints as shown in Fig. 14 are made tight. This handle is provided with a shoulder 35 adapted to abut against a lip 36 on the end of the valve head and is also fitted with a longitudinally extending pin 37 which projects through the burner socket housing in the passageway 38 and is threaded into the hinge pin 10 carried in the burner housing. By this arrangement the valve housing and the burner socket may be rigidly drawn together.

A steam pipe 39 connects with the threaded opening of the boss 16 in the burner socket, and an oil pipe 40 connects with the threaded opening in the boss 17 of the burner socket. These pipes are fitted with valves 41 and 42 to regulate the flow of fluid through them and to control the supply of fluid used in the burner.

The valve head 22 is formed with a vertical partition wall at its rear end indicated at 27 and upon opposite sides of which is a vertical oil passageway 26 and a vertical steam passageway 25. The valve head is provided with a front wall 46 defining the width of the passageways 25 and 26. On the steam side of this wall a threaded opening 47 is made to receive the threaded end of a steam tube 48. On the oil side of this wall a smooth opening 49 is formed through which an oil tube 50 may have a tight sliding fit. The object of this arrangement is to insure that inequality in length of the steam tube 48 and the oil tube 50 as produced by expansion and contraction of the metal under separate temperature conditions will not cause one of the tubes to buckle. A packing of special design is, therefore, provided within the opening 49 and around the oil tube 50. The wall of the opening 49 is formed with an annular recess 51 which continues in a gland 52 disposed tangent to the recess and which extends upwardly and outwardly through the wall of the valve head. Plastic packing material or other suitable packing may be placed in the recess 51 around the tube and may be filled into the tangential passageway 52. This is forced downwardly by a packing screw 53 so that the material may be forced around the tube 50 to form a tight joint therewith at all times.

The wall 46 of the valve head is formed with an outwardly projecting cylindrical skirt 54 which receives the end of the metal tube jacket 55. The jacket 55 houses the steam and oil tubes 48 and 50, and at its forward end supports a nozzle head 56. The nozzle head as particularly shown in Figs. 8 to 11, inclusive, has a cylindrical outer wall 57 formed at its rear end with a shoulder 58 to receive the forwardly projecting end of the jacket 55. The rear wall of the nozzle head is formed with a pair of threaded openings 59 and 60 to receive the steam and oil tubes 48 and 50, respectively. A longitudinally extending transverse wall 61 separates the openings 59 and 60 and provides two segmental passageways 62 and 63. The passageway 62 is in communication with the steam pipe 48, and the passageway 63 is in communication with an oil pipe 50. Formed centrally of the nozzle head and in advance of the transverse partition 61 is a cylindrical nozzle tube 64 which communicates with the passageway 63 and through which oil may flow. The outer end of this tube is formed integral with the end wall 65 of the nozzle head. A central duct 66 extends within the tube, its outer end being inwardly tapered as shown at 67 and communicating with a central oil jet opening 68 which is of a diameter less than the diameter of the conduit 66. Circumscribing the jet opening 68 is a burner tip 69, the end face of which is in a plane parallel to the end face of the end wall 65 and set in therefrom. The burner tip is circumscribed by an annular substantially V-shaped groove 70, the outer end wall of which is formed with steam ducts 71. These ducts are disposed at an angle suitable to project jets of steam inwardly to intersect the perimeter of the stream of oil projected from the opening 68 of the nozzle head at a point in advance of the end thereof. If desired, these ducts may be arranged tangentially so as to create a whirling effect in the jet of oil being forced longitudinally from the end of the burner tip 69.

The flat end face of the end wall 65 of the nozzle head is formed with a plurality of steam ducts 72 which are directed to define the shape and spread of the atomized liquid spray desired. These ducts may also be arranged tangentially to create a whirling spray. The result will be that a central stream or jet of oil will be projected longitudinally from the burner tip having a cross section of relatively large diameter so that the opening 68 from the duct 66 will not have a tendency to clog even when heavy sludge is used as fuel. The steam jet openings 71 will produce jets of steam directed outwardly to strike and disintegrate the solid stream of oil into a relatively heavy spray by what may be termed a primary set of steam jets. This spreading action of the oil as produced by the primary steam jets throws the oil into the path of the secondary steam jets passing from ducts 72 to complete atomization and to create the shape of spray desired. Thus atomization will be completed and the flame angle will be determined and controlled by the secondary jets, and the initial breaking up of the oil stream in a manner to produce proper combustion of the fuel particles will be created by the primary jets.

In operation of the invention the structure is assembled as shown in Figs. 1 and 2, and the oil and steam tubes 48 and 49 properly threaded into the nozzle head 56, and with the steam tube 48 threaded into the valve head 22. The oil tube 50 is properly positioned within the opening 49 of the valve head and packed by pressure of the packing screw 53 against a suitable packing material disposed within the gland 52 and the circumscribing recess 51. The jacket 55 is mounted in position, and the guide pipe 15 is placed in a circumscribing position around the jacket. Steam and oil supply pipes 39 and 40 are connected with the burner socket and fuel is regulated by the valves 41 and 42 fitted thereon. The fuel oil passes through the tube 50 and into the duct 66, centrally of the burner head 56. As has been previously pointed out, the sectional area of the duct 66 is relatively large. As for the outlet opening 68 at the end thereof, this causes a liquid fuel jet of large size to be ejected from the end of the nozzle head in a solid stream and with practically no spread. Steam enters

the nozzle head **56** from the tube **48** and occupies the circumscribing chamber **73**.

It is to be understood that while the structure has been described as especially suitable for use with a liquid fuel as the material to be atomized that the apparatus may be used in connection with various other liquids requiring atomization, and as has been previously pointed out the apparatus is especially suitable for atomizing heavy liquids which cannot be practically forced through small jet openings. The column or stream of liquid to be atomized is therefore in the present case forced outwardly through a relatively large opening in a solid stream and is attacked and acted upon by the primary and secondary steam jets passing from the ducts **71** and **72** in a manner to disburse and disintegrate the solid column of liquid. In this operation the primary jets of steam passing from ducts **71** are directed tangentially to and against the circumference of the solid stream of liquid. The ducts **71** are uniformly spaced around the central nozzle opening and are not only disposed tangentially of the circumference of the liquid stream, but also extend outwardly so that each jet strikes the stream at a predetermined distance beyond the face of the nozzle, and so that the individual jets will strike the stream in uniformly and equally distributed zones around the nozzle. The result of the impact of the primary steam jets against the liquid stream and the result of the centrifugal force imparted to the liquid stream by the tangentially impinging primary jets will be to convert the solid stream of liquid into a hollow conical spray which is thrown into the path of the secondary jets of steam passing from the ducts **72**. The liquid particles in the hollow cone of spray will be relatively large, but when passing into the path of the secondary steam jets will be broken up and finely atomized to a suitable degree of fineness for combustion. At the same time the secondary jets, due to their directional effect will determine and control the shape of the finely atomized spray which is projected into the combustion zone. The relative spreads of the liquid fuel and the primary and secondary jets are indicated in Fig. 15 of the drawings.

By the arrangement here shown, it will be seen that there is no mixture of steam and oil at any place within the burner structure, thus making it possible to use various liquid fuels, even those which contain acids and other chemical elements which might react unfavorably on the metallic parts due to moisture and the temperature of the steam. In the present instance, the oil and steam have their only comingling action at a point beyond the end of the nozzle head, while the jets of oil and steam are all moving away from the end face of the nozzle. It will also be evident that by providing two sets of steam jets, a primary set of jets producing initial atomization of the particles of the liquid fuel and throwing the liquid into a secondary set of jets for completing atomization and defining the shape of the spray, a high degree of atomization of even a very thick and otherwise unsuitable liquid can be attained without danger of clogging the nozzle head.

The construction of the burner head whereby steam may be conveniently blown through the oil conduits and nozzle is also of considerable novelty, due to the fact that with heavy viscous fluids the steam may be conveniently used to maintain the nozzle clean and in a non-clogging condition.

In the present application of the invention, steam has been described as the atomizing agent for the liquid. It will be understood that under some circumstances it might be desirable to utilize another fluid for this purpose in which event such fluid could be readily substituted therefor.

While I have shown the preferred form of my invention, as now known to me, it will be understood that various changes may be made in combination, construction, and arrangement of parts by those skilled in the art without departing from the spirit of my invention as claimed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:—

1. A method of atomizing a liquid which consists in projecting a solid stream of liquid of relatively large cross section from an orifice, thereafter projecting a plurality of relatively small jets of an atomizing fluid tangentially of the stream of liquid and impinging thereagainst in uniformly spaced zones therearound, whereby rotational movement of the stream of liquid will be set up within the column and whereby dispersion of the liquid will be brought about due to the impact of the jets with the stream and the centrifugal force created in the stream particles.

2. A method of atomizing a liquid which consists in projecting a solid stream of liquid of relatively large cross section from an orifice, thereafter projecting a plurality of relatively small jets of an atomizing fluid tangentially of the stream of liquid and impinging thereagainst in uniformly spaced zones therearound, whereby rotational movement of the stream of liquid will be set up within the column and whereby dispersion of the liquid will be brought about due to the impact of the jets with the stream and the centrifugal force created in the stream particles, and then causing another set of jets to encounter the dispersed spray of particles whereby final atomization of the spray will be produced and the shape of the atomized spray defined.

3. A liquid nozzle structure comprising a central passageway through which a solid stream of liquid may be projected and means embodied in the nozzle for creating separate steam jets, said jets projecting tangentially of the stream of liquid at a point beyond the end of the nozzle to atomize the same.

4. A liquid nozzle structure comprising a central passageway through which a solid stream of liquid may be projected and means embodied in the nozzle for creating separate steam jets, said jets projecting tangentially of the stream of liquid at a point beyond the end of the nozzle to atomize the same, and other means embodied in the nozzle structure for creating a second series of steam jets adapted to create further atomization of the liquid and define and limit the spread of the atomized liquid.

5. A liquid nozzle head comprising a central cylindrical member through which a relatively large solid stream of liquid may flow and from the unrestricted opened end of which it may be projected from the nozzle head, a circumscribing passageway within the nozzle head and around said liquid passageway and into which pressure fluid is delivered, the forward end of said passageway being closed with an end wall which wall is formed with a plurality of relatively small openings directing jets of said pressure fluid tangentially of the solid stream of liquid and to impinge thereagainst such action atomizing the

solid stream of liquid at a point beyond the end of the nozzle head.

6. A liquid nozzle head comprising a central cylindrical member through which a relatively large solid stream of liquid may flow and from the unrestricted opened end of which it may be projected from the nozzle head, a circumscribing passageway within the nozzle head and around said liquid fuel passageway and through which a pressure fluid is delivered, the forward end of said passageway being closed with an end wall which wall is formed with a plurality of relatively small openings disposed in equal spaced relation to each other along a circle concentric with the axis of the liquid passageway and directed to produce jets of the pressure fluid tangentially of the solid liquid stream so as to impinge against the periphery of and atomize said solid stream of liquid beyond the end of the nozzle head.

7. A liquid nozzle head comprising a central cylindrical member through which a relatively large solid stream of liquid may flow and from the unrestricted opened end of which it may be projected from the nozzle head, a circumscribing passageway within the nozzle head and around said liquid passageway and through which a pressure fluid is delivered, the forward end of said passageway being closed with an end wall which wall is formed with a plurality of relatively small openings disposed in equal spaced relation to each other along a circle concentric with the axis of the liquid passageway directed outwardly to impinge tangentially against and tend to atomize the solid stream of liquid at a point beyond the end of the nozzle head, the end wall being also formed with a second set of openings disposed along a circle concentric with the liquid passageway and adapted to project jets of a pressure fluid outwardly from the end of the nozzle head in a manner to aid in the disbursement of the atomized liquid and to define the spread of the jet of atomized liquid.

8. A nozzle head for comprising a central longitudinally extending cylindrical oil passageway, a circumscribing shell concentric with said passageway and spaced a distance therefrom to form a compartment between the shell and the wall of the passageway, an oil conduit connected with the central passageway, a steam conduit connected with the circumscribing compartment, an end wall formed as a part of said nozzle head and having a central opening through which the oil is projected in a substantially undisturbed solid stream, said end wall being formed with a plurality of relatively small outlet openings arranged concentrically of the oil opening and communicating with the circumscribing compartment whereby jets of steam may be projected outwardly and tangentially of the oil stream to impinge thereagainst and atomize the stream of oil.

9. A nozzle head for oil burners comprising a central longitudinally extending cylindrical oil passageway, a circumscribing shell concentric with said passageway and spaced a distance therefrom to form a compartment between the shell and the wall of the passageway, an oil conduit connected with the central passageway, a steam conduit connected with the circumscribing compartment, an end wall formed as a part of said nozzle head and having a central opening through which the oil is projected in a substantially unobstructed stream, said end wall being further formed with a plurality of relatively small outlet openings arranged concentrically of the oil opening and communicating with the circumscribing compartment whereby jets of steam may be projected outwardly and tangentially of the oil stream to impinge thereagainst at a point beyond the nozzle and atomize the stream of oil, the end wall being further formed with a second set of relatively small openings through which steam may be projected in jets tending to define and limit the spread of the atomized fuel jet created by the nozzle head.

10. A nozzle head for oil burners comprising a central longitudinally extending cylindrical oil passageway, a circumscribing shell concentric with said passageway and spaced a distance therefrom to form a compartment between the shell and the wall of the passageway, an oil conduit connected with the central passageway, a steam conduit connected with the circumscribing compartment, an end wall formed as a part of said nozzle head and having a central opening through which the oil is projected in a substantially unobstructed stream, said end wall being further formed with a plurality of relatively small outlet openings arranged concentrically of the oil opening and communicating with the circumscribing compartment whereby jets of steam may be projected outwardly and tangentially of the oil stream to impinge thereagainst and to tend to atomize the stream of oil, the end wall being further formed with a second set of relatively small openings through which steam may be projected in jets tending to further atomize said stream and to define and limit the spread of the atomized fuel jet created by the nozzle head, said steam jet openings being formed in opposite walls of a circular V-shaped groove in the face of the nozzle head and concentric with the axis of the oil opening.

11. A liquid nozzle structure comprising a central passageway through which a solid stream of liquid may be projected longitudinally of the nozzle and means embodied in the nozzle for creating separate steam jets projected tangentially against the periphery of the solid oil stream to produce a rotation and atomization of the solid oil stream, a second series of steam jets to further atomize the dispersed spray of the first mentioned series of steam jets and to also define the shape of the atomized spray.

12. A nozzle head for an atomized oil burner of the type described comprising a central cylindrical member through which a relatively large solid stream of liquid may flow and from the unrestricted open end of which it may be projected from the nozzle head, a circumscribing passageway within the nozzle head and around said liquid passageway and into which fluid under pressure is delivered, the forward end of which is closed by an end wall, which wall is formed with a plurality of relatively small openings directing jets of fluid under pressure tangentially against the periphery of the solid stream of liquid to cause an atomization and propelling rotation of the said solid stream of liquid, a second series of pressure fluid openings for further atomizing the dispersed first atomized fluid and to centralize and define the oil burner flame.

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