

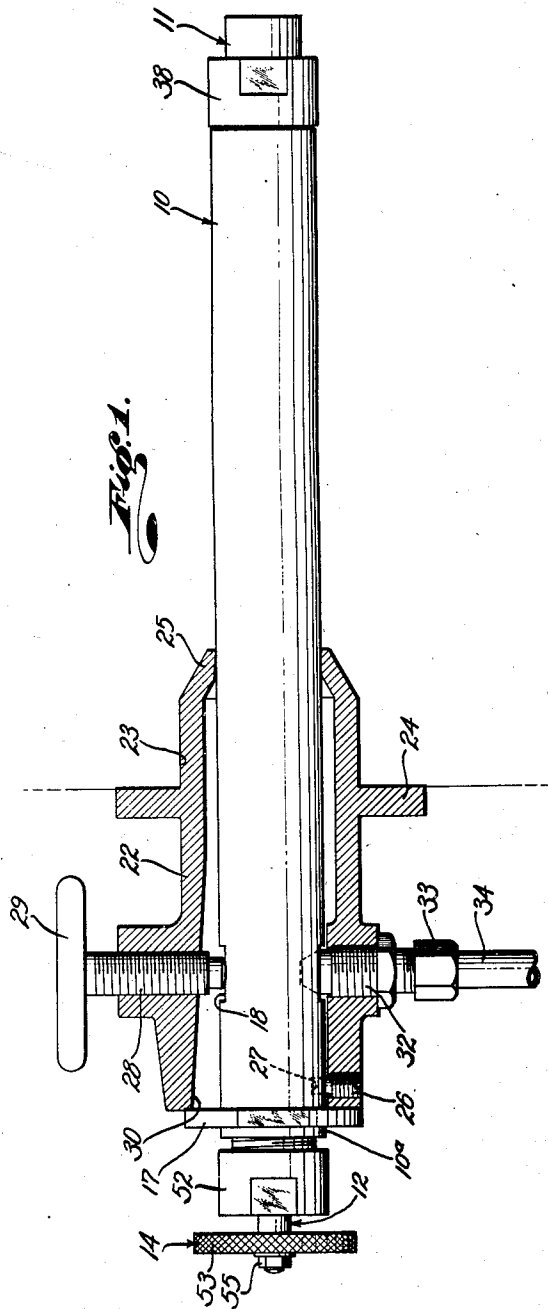
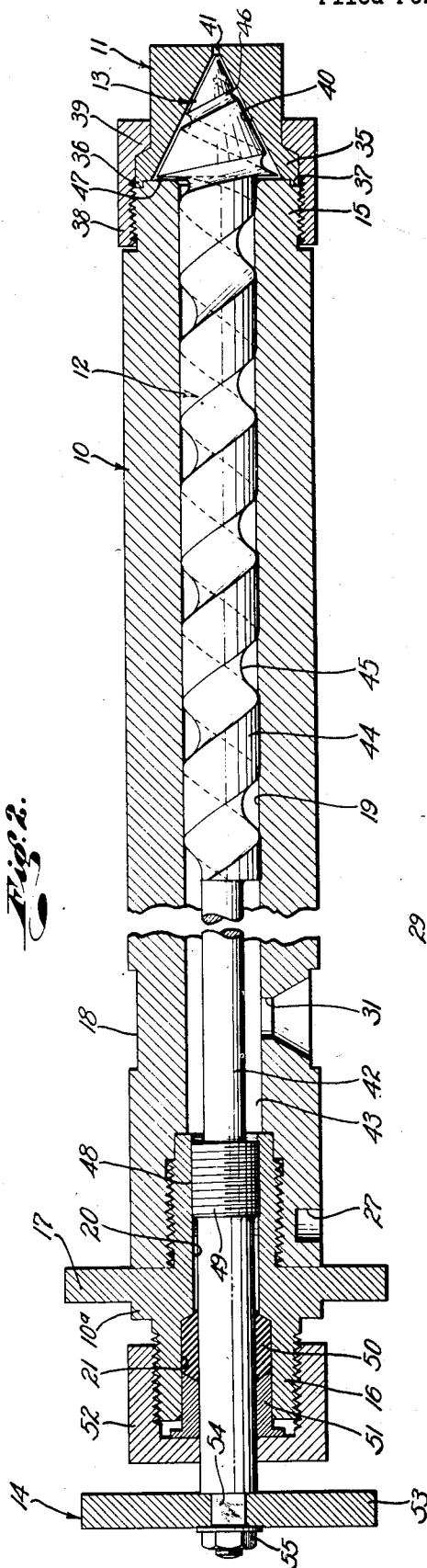
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FUEL OIL BURNER

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## UNITED STATES PATENT OFFICE

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## FUEL OIL BURNER

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7 Claims. (Cl. 299-119)

This invention relates to burners and relates more particularly to burners for burning fluid fuels such as oil under pressure. A general object of this invention is to provide a simple, practical and particularly efficient burner of the character mentioned.

Another object of this invention is to provide a burner of the character mentioned embodying novel means for imparting turbulence to the fuel and for increasing the velocity of the fuel to assure the full atomization of the fuel as it discharges from the burner orifice, and thus obtain the highest efficiency.

Another object of this invention is to provide a burner of the character mentioned in which the fuel under pressure is made to follow a helical course in a reduced volume to increase its turbulence, and at the same time the velocity of the fuel is increased by stages, until the fuel is discharged from the burner orifice. In the improved burner of this invention the fuel is made turbulent by its helical path and its velocity is increased so that the fuel is discharged from the burner in a turbulent state and at a high velocity to obtain complete combustion.

Another object of this invention is to provide a fluid fuel burner of the character mentioned in which the temperature of the fuel is progressively or gradually increased by reason of the heat generated as its velocity is increased, and by the fire-box heat absorbed from the burner body, so that its viscosity is appreciably lowered before it is discharged from the burner orifice and atomized.

A further object of this invention is to provide a fluid fuel burner of the character mentioned that is fully regulable or adjustable by a single effective control means to properly handle fuels of different gravities and viscosities and to obtain maximum efficiency with different fuels.

The various objects and features of my invention will be fully understood from the following detailed description of a typical preferred form and application of the invention, throughout which description reference is made to the accompanying drawing, in which:

Fig. 1 is a side elevation of the improved burner of this invention arranged in its operative position showing the adapter or carrier supporting the burner on a firebox or boiler wall, and Fig. 2 is an enlarged longitudinal detailed sectional view of the burner.

The improved burner of the present invention may be said to comprise, generally, a tubular body 10, a discharge head 11 on the forward end

of the body 10, a grooved stem 12 extending through the body 10 and provided at its forward end with an atomizing tip or head 13, and means 14 for controlling or adjusting the stem 12 and its head 13.

The body 10 serves to carry the other elements of the burner and, as shown, is an elongated tubular member. In the preferred construction the body 10 is integral except for an outer end section 10<sup>a</sup> threaded into the rear end of the body 10 proper. The body 10 is provided with a reduced forward end portion 15 and a similar reduced portion 16 is formed on the outer or rear end of its section 10<sup>a</sup>. An external flange 17 is formed on the body section 10<sup>a</sup> and preferably has flat marginal surfaces. An external flat surface 18 is provided on the body 10 and is spaced forwardly from the flange 17. The longitudinal opening 19 of the tubular body 10 is uniform in diameter except for a portion 20 of reduced diameter and a rear socket 21 in the body section 10<sup>a</sup>. The burner body 10 may project into the fire-box, furnace, or the like, and appropriate means is provided to support or mount the burner body. This means may comprise a tubular carrier 22 adapted to fit an opening 23 in the wall of the fire-box and provided with a flange 24 adapted for attachment to the fire-box. The forward portion of the carrier 22 has an intumed lip 25 accurately receiving the body 10 while the remainder of the carrier 22 passes the body 10 with suitable clearance. The flange 17 engages the rear end of the carrier 22 to limit the inward movement of the body 10 and to steady the burner. A set screw 26 is arranged through an opening in the wall of the carrier 22 and extends into a socket 27 in the body 10 to locate or position the body and to prevent turning of the body. A screw 28 having a suitable wheel or handle 29 is threaded through a radial opening in the carrier 22 and is adapted to clamp against the flat body surface 18 to removably secure the body in place. The upper portion of the opening in the tubular carrier 22 is flared at 30 so that following backing off of the screw 28 the body 10 may be raised to disengage the pin 26 from the socket 27 whereupon the body may be pulled from the carrier.

Means is provided for delivering fluid fuel to the body opening 19. This means comprises a lateral port 31 in the wall of the body 10 in spaced adjacent relation to the reduced portion 20 of the body opening. The port 31 preferably has a flaring mouth. A fitting 22 is threaded in

a lateral opening in the carrier 22 and has a union or coupling 33 for connecting it with a supply pipe 34. The inner end of the fitting 32 is tapered to seal in the flaring mouth of the port 31. The supply pipe 34 conducts fuel such as oil under a suitable pressure and, of course, may be controlled by the usual valves (not shown).

The head 11 may be termed the orifice head or atomizing head, and is secured to the inner or forward end of the body 10. In practice the head 11 may be a generally cylindrical block provided with a radially projecting flange 35 and an annular bead or rim 36. The rim 36 projects from the rear side of the head 11 and fits a complementary groove 37 in the end of the body 10 to locate the head and to provide a seal. A collar or sleeve 38 is removably threaded on the reduced forward portion 15 of the body 10 and has an inturned lip 39 cooperating with the flange 35 to clamp and hold the head 11 in place. The flange 35 and the lip 39 preferably have engaging tapered surfaces.

The interior of the head 11 is of special formation to receive the atomizing head 13 and to discharge the fuel under pressure. A conical or tapering socket 40 is provided in the head 11 and has its large end or base in communication with the forward end of the body opening 19. The large end of the tapering socket 40 is larger in diameter than the opening 19. The small end or forward end of the tapering socket 40 is near the forward end of the head 11 and a small cylindrical opening or orifice 41 extends forwardly from the socket 40 to discharge at the front face of the head. It will be noted that the head 11 is of simple construction and easily removed for cleaning, replacement, etc.

The stem 12 is arranged longitudinally in the body opening 19 and serves to carry the atomizing head 13 and to give turbulence and added velocity to the fuel flowing to the discharge head 11. In accordance with the invention the stem 12 has a portion 42 of reduced diameter received in the body opening 19 with substantial clearance, leaving an annular chamber 43 into which the port 31 discharges the fluid fuel. The stem 12 has a portion 44 of larger diameter extending forwardly through the body opening 19 from the chamber 43 to the socket 40. The stem portion 44 is proportioned and machined to accurately fit the body opening 19 and is sufficiently long to extend a short distance forwardly beyond the opening 19.

The stem portion 44 is shaped or grooved to provide a passage for delivering the fuel to the socket 40 of the head 11. In the preferred construction a helical groove 45 is provided in the stem portion 44 and extends throughout its length providing a passage that connects the chamber 43 with the interior of the discharge head 11. The groove 45 may have a rounded or concave wall and, together with the wall of the body opening 19, forms a tortuous or helical opening through which the fuel under pressure is obliged to flow. The length of the stem portion 44 and the pitch of the groove 45 are such that the groove has a plurality of convolutions, say five, as illustrated. In the construction illustrated in the drawing the fluid capacity of the groove 45 and the helical pitch of the groove are uniform except at the forward extremity of the stem, it being understood that the invention contemplates the gradual or progressive reduction of the fluid capacity of the groove and/or the gradual or progressive reduction in the helical pitch of

the groove as it continues forwardly. The fuel under pressure passing through the groove 45 is, of course, made to whirl or rotate and is thus made turbulent, and because of the limited fluid capacity of the groove the velocity of the fuel is increased. The fuel being obliged to take a helical path travels a greatly increased distance and is exposed to the fire-box heat transmitted through the burner body 10 throughout its increased path of travel.

The atomizing head 13 of the stem 12 is preferably rigid with the stem so that the stem and head form a unit that is easily controlled, removed, etc. In practice the head 13 may be integral with the stem 12. The head 13 is tapered or conical and occupies the tapering socket 40. The surface of the tapering head 13 may have substantially the same pitch as the wall of the socket 40 but the head 13 is somewhat shorter than the socket providing for axial adjustment in the socket. The apex or point of the tapering head 13 is centrally located at the inner end of the discharge orifice 41 and controls the discharge from the orifice.

In accordance with the invention the atomizing head 13 has a helical fuel conducting groove 46 varying in fluid capacity and preferably varying in pitch. The groove 45 where it merges with the groove 46 is diminished in width and fluid capacity providing for an increase in the velocity of the fuel and an accompanying reduction in volume. The inner or rear portion of the groove 46 in the atomizing head 13 is greater in capacity than the forward end portion of the groove 46. In practice the reduction in the fluid handling capacity of the groove 46 may be gradual. It will be observed that the grooves 45 and 46 join at the base of the conical head 13 and that a chamber or space 47 occurs at this point by reason of the clearance between the base of the head 13 and the end of the body 10. In the preferred construction the groove 46 in the head 13 has a plurality of convolutions and is a single continuous passage or groove. In the construction disclosed the groove 46 has at least two complete convolutions. This assures an effective turbulence in the fuel immediately prior to and during its discharge from the orifice 41. While the groove 46 may continue to the forward extremity of the head 13 it is preferred to have the groove 46 die out adjacent the tip of the head 13, as illustrated. Where the groove 46 dies out in this manner the velocity of the fuel is greatly increased as it passes to and through the small orifice 41. The helical pitch of the groove 46 is preferably varying or non-uniform. As illustrated, the rear portion of the groove 46 joining the groove 45 has a helical pitch less than that of the groove 45, while the forward portion of the groove 46 has an increased helical pitch. The change in pitch of the groove 46 may be gradual.

The means 14 for controlling or adjusting the burner is operable to produce relative longitudinal movement between the body 10 and the stem 12 to regulate the relationship or spacing of the surfaces of the socket 40 and the head 13. The regulating means comprises mating threads 48 on the wall of the reduced opening portion 20 and a stem portion 49 of increased diameter. The stem 12 extends outwardly or rearwardly from its enlarged portion 49 to project from the rear end of the body section 10. Packing means is provided for sealing about the stem 12. This packing means may comprise suitable packing 75

50 arranged in the socket 21, a gland or follower 51 for compressing the packing 50 and a cap 52 threaded on the reduced body portion 16 to actuate the follower. Suitable manual actuating means is provided on the projecting part of the stem 12. This means may comprise a suitable hand wheel or handle 53 removably and non-rotatably secured to the stem 12. In practice the stem 12 may have a reduced polygonal portion 54 received in a correspondingly shaped opening in the handle 53 and a nut 55 may be threaded on the stem 12 to retain the handle 53 on the portion 54. Upon rotation of the stem 12 the threads 48 produce longitudinal movement of the stem so that the atomizing head 13 is moved toward or away from the orifice 41.

In operation the fuel, say fuel oil, is delivered to the chamber 43 by the pipe 34 under a suitable superatmospheric pressure. The fuel flows from the chamber 43 through the helical groove 45 to the groove 46. The groove 45 causes the fuel to follow a helical path producing desirable turbulence in the fuel, and the velocity of the fuel is increased as the fuel passes through the groove. The burner body 10 may project into the fire box and its temperature is usually quite high. The fuel obliged to flow through the helical groove 45 traverses a greatly extended course in the heated body 10 and is thus effectively warmed or heated before being delivered to the head 11. In this connection it is to be observed that the groove 45 is of substantial length and has numerous convolutions so that the fuel must flow a substantial distance before reaching the atomizing head 11.

Upon reaching the head 11 the fuel is delivered to the large rear portion of the groove 46 and flows through the diminishing groove 46. The passage of the fuel through the groove 46 increases the turbulence of the fuel and greatly increases its velocity. Where the groove 46 dies out adjacent the forward extremity of the head 13 its velocity is greatly increased and this increase in velocity is accompanied by an increase in the turbulence due to the flow of the fuel through the groove of helical form and varying pitch. With the atomizing head 13 in the operating position there is a certain amount of clearance between the surface of the head and the wall of the socket 40 so that the fuel discharging from the reduced extremity of the groove 46 at a high velocity reaches the restricted orifice 41.

The fuel under pressure discharges from the orifice 41 at a high velocity and in a turbulent state to be finely divided or fully atomized. The conical surfaces of the socket 40 and the head 13 direct the fuel in such a manner that the turbulence is greatly increased just before the fuel discharges from the orifice 41 and aid in providing a stream or discharge of desirable configuration. The fuel is, of course, further heated as it travels through the groove 46 and the socket 40 so that its viscosity is reduced for the best atomization possible. The handle 53 may be turned to vary the position of the head 13 with respect to the orifice 41 and the wall of the socket 40 to adapt the burner for the proper handling of fuels of different gravities and viscosities. The burner may be easily and quickly removed from the carrier 22 in the manner described above, and upon the removal of the sleeve 38, the head 11 and the handle 53, the stem 12 and the head 13 may be removed as a unit for cleaning, etc.

The burner is adjustable to effectively handle fuel oils of practically all gravities without vary-

ing the pressure under which the oil is delivered and without supplying the oil at high temperatures. To adjust the burner to handle the lighter oils the head 13 is brought to a forward position so that the clearance between the wall of the socket 40 and the surface of the tapered head is reduced to maintain a high velocity at the point of discharge. When a very heavy oil is to be used the head 13 is retracted so that its flat base engages or is adjacent to the flat seat forming the bottom wall of the socket 40. This eliminates or reduces the chamber 47 and obliges the oil to pass into the groove 46 from the groove 45 increasing the velocity at this point and at the same time increases the volume of the space around the tapering surface of the head 13. The velocity and turbulence of the heavy oil is maintained while providing for required volume and freedom of flow at the point of discharge from the jet or burner.

Having described only a typical preferred form and application of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear to those skilled in the art or fall within the scope of the following claims.

Having described my invention, I claim:

1. A fluid fuel burner comprising a body having an opening, a tip on the body having a tapering socket joining said opening and a discharge orifice leading from the forward end of the socket, the rear portion of the socket being larger in diameter than said opening and the rear wall of the socket forming a seat, a stem arranged in said opening, and a tapering enlarged head on the stem occupying and substantially conforming to the socket, the rear end of the head being larger in diameter than said opening and adapted to cooperate with the seat, and means for conducting the fuel to said opening, said stem having a helical groove for carrying the fuel to the socket and continuing along said head to carry the fuel from said means to the orifice, the rear end of the head being engageable with the seat to oblige the fuel to flow through said groove into the socket.

2. A fluid fuel burner comprising a body having an elongate opening, means for admitting fuel to the opening, a discharge member having a tapered socket communicating with an end of said opening and a discharge orifice leading from the forward end of the socket, the rear wall of the socket forming a shoulder, a longitudinally adjustable stem arranged longitudinally in said opening having a helical groove receiving the fuel and conducting it to the socket, and an atomizing head on the stem occupying the socket and tapered at the same angles as the socket and provided with a helical groove joining the first named groove for conducting the fuel forwardly to the orifice, the rear end of the head being adapted to approach and engage said shoulder to cause the fuel to flow from said first named groove into the second named groove, the last named groove diminishing in capacity as it extends forwardly to increase the velocity of the fuel as it flows therethrough.

3. A fluid fuel burner comprising a body having an elongate opening, means for admitting fuel to the opening, a discharge member having a tapered socket communicating with an end of said opening and a discharge orifice leading from the socket, the rear portion of the socket being larger in diameter than said opening so that the rear wall of the socket forms a forwardly facing

seat, a longitudinally shiftable stem arranged longitudinally in said opening having a helical groove receiving the fuel from said means and conducting it to the socket, an atomizing head on the stem occupying and substantially conforming to the socket and provided with a helical groove which joins the first named groove to conduct the fuel forwardly to the orifice, the rear end of the head presenting a shoulder which is engageable with said seat to oblige the fuel to flow from the first named groove into the second named groove when the head is fully retracted, the last named groove being of maximum depth at the rear end of the head and of reduced depth at the forward end of the head to increase the velocity of the fuel preparatory to its discharge, and means for shifting the stem to adjust the head between a position where said end cooperates with said seat and the periphery of the head is clear of the socket wall and a position where said end is spaced from said seat and the periphery of the head engages or just clears the wall of the socket.

4. A fluid fuel burner comprising a body having an elongate opening, means for admitting fuel to the opening, a discharge member having a tapered socket communicating with an end of said opening and a discharge orifice leading from the socket, the rear of the socket communicating with the forward end of the opening and being larger in diameter than the opening so that the rear end of the socket forms a seat, a longitudinally adjustable stem extending longitudinally in the opening and having a helical groove receiving the fuel from said means and conducting it forwardly, and a tapering atomizing head on the forward end of the stem occupying and substantially conforming to the socket, the rear end of the head forming a shoulder which is movable into and out of engagement with said seat with longitudinal adjustment of the stem, the head having a helical groove joining the forward end of the first named groove and conducting the fuel forwardly to the orifice, the second named groove changing in helical pitch and diminishing in fluid capacity as it continues forwardly.

5. A fluid fuel burner comprising a body having an elongate opening, means for admitting fuel to the opening, a discharge member having a tapered socket communicating with an end of said opening and a discharge orifice leading from the socket, the rear of the socket communicating with the forward end of the opening and being larger in diameter than the opening so that the rear end of the socket forms a seat, a shiftable stem extending longitudinally in the opening and having a helical groove receiving the fuel from

said means and conducting it forwardly, a tapering atomizing head on the forward end of the stem substantially conforming to the socket and controlling said orifice, the rear end of the head being movable into and out of engagement with said seat, the head having a helical groove joining the first named groove and extending forwardly to discharge adjacent the orifice, the second named groove diminishing in fluid capacity as it continues forwardly, and means for producing relative longitudinal movement between body and stem so that the discharge may be controlled.

6. A fluid fuel burner comprising a body having an elongate opening, means for admitting fuel to the opening, a discharge member having a tapered socket communicating with an end of said opening and a discharge orifice leading from the socket, the rear portion of the socket being larger in diameter than said opening so that the rear wall of the socket forms a seat, a longitudinally shiftable stem arranged longitudinally in said opening having a helical groove receiving the fuel and conducting it to the socket, and an enlarged atomizing head on the stem occupying and substantially conforming to the socket and provided with a helical groove joining the first named groove for conducting the fuel forwardly to the orifice, the rear end of the head being movable into and out of engagement with said seat upon shifting of the stem, the last named groove diminishing in capacity as it extends forwardly and dying out before reaching the forward end of the head.

7. A fluid fuel burner comprising a body having an elongated opening, means for admitting fuel to the opening, a discharge member having a tapered socket communicating with an end of said opening and a discharge orifice leading from the socket, the rear of the socket communicating with the forward end of the opening and being larger in diameter than the opening so that the rear end of the socket forms a seat, a shiftable stem extending longitudinally in the opening and having a helical groove receiving the fuel from said means and conducting it forwardly, and an enlarged tapering atomizing head on the forward end of the stem occupying and substantially conforming to the socket, the rear end of the head being cooperable with said seat, the head having a helical groove joining the forward end of the first named groove and conducting the fuel forwardly to the orifice, said first named groove diminishing in capacity where it merges with the second named groove, the second named groove diminishing in fluid capacity as it continues forwardly.

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