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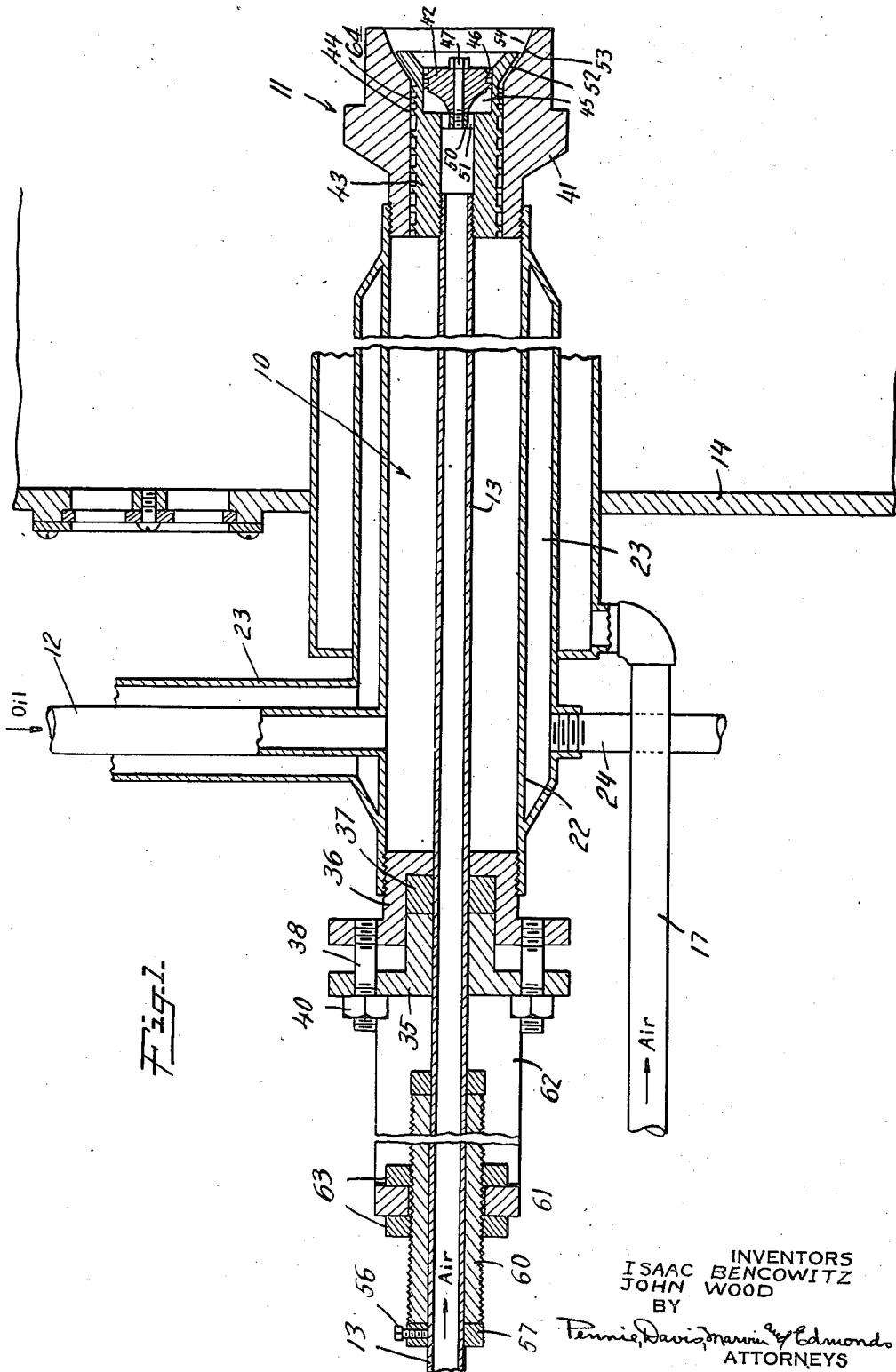
I. BENCOWITZ ET AL

2,049,150

FUEL BURNER

Filed March 12, 1932

2 Sheets-Sheet 1



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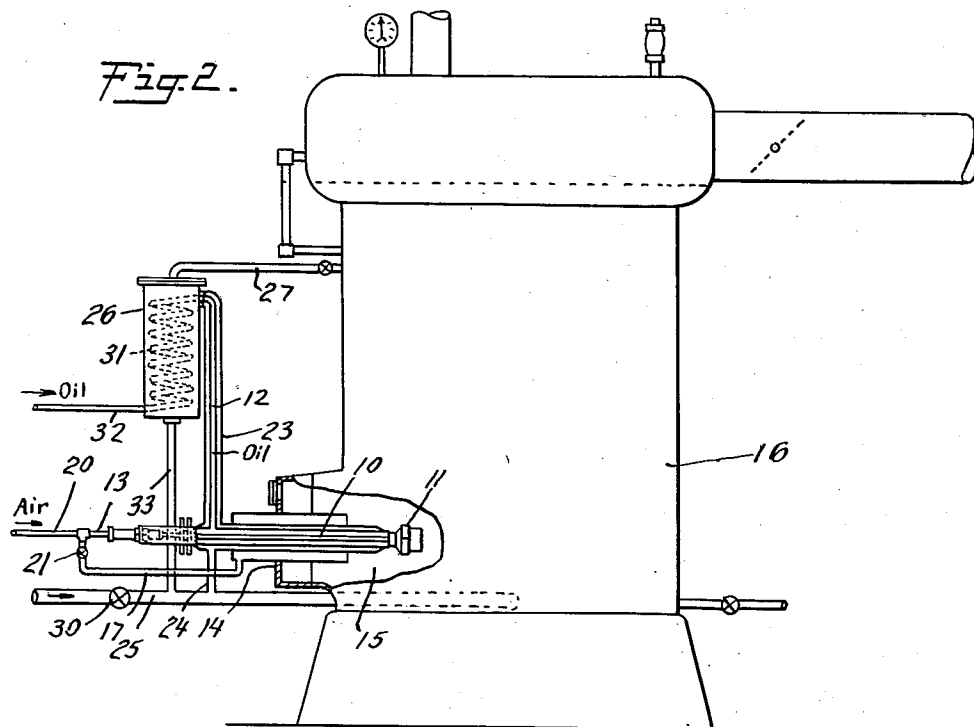
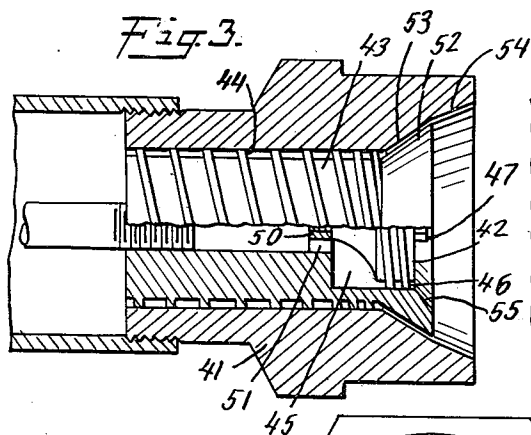
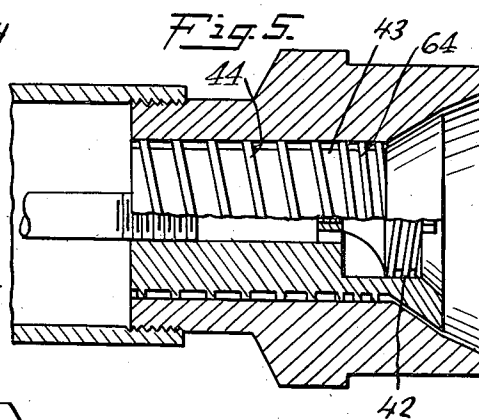
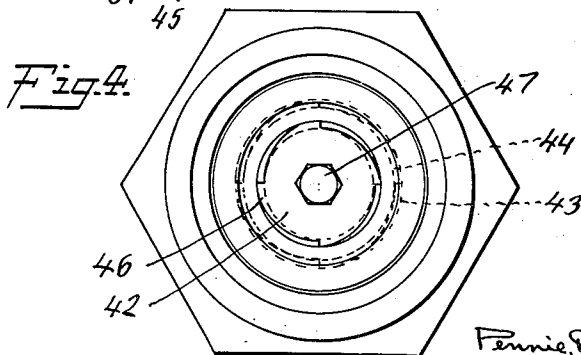
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UNITED STATES PATENT OFFICE

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FUEL BURNER

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4 Claims. (Cl. 158—76)

This invention relates to the combustion of fuels and has for an object the provision of an improved apparatus therefor.

The present invention contemplates the provision of an improved apparatus by means of which the efficiency of heating operations involving the combustion of fluid fuels such, for example, as fuel oil and gaseous carbonaceous materials may be increased. The invention provides an improved apparatus for producing combustible mixtures of air and fuel.

According to the invention, an intimate mixture of air and fuel is produced by impinging air and fuel currents, one of which rotates with respect to the other. The operation may be so conducted that a whirling, diverging current of fuel is caused to impinge a whirling current of combustion supporting gas such, for example, as air or steam to effect an intimate mixture of the two currents. Apparatus constructed in accordance with the invention may comprise a combustion chamber and means for forming and introducing into the combustion chamber a whirling mixture of air and fuel. Apparatus utilizing liquid fuel may also be provided with means for heating the liquid to increase its fluidity.

The apparatus as preferably constructed comprises a combustion chamber and a burner or other means for introducing finely divided or atomized fuel into the combustion chamber. In the preferred form of apparatus according to the invention, means are provided for directing a stream or current of high pressure gas such as air against a stream or current of fluid containing combustible matter. The fluid stream containing the fuel or combustible matter may be composed entirely of gas or entirely of liquid, or it may comprise a mixture of gas and finely divided solid material. The air or other gas is preferably directed against the fuel stream in the form of a whirling current of high velocity. When air is directed against the fuel stream, the amount employed may be sufficient to completely oxidize the combustible matter or, the amount of air may be insufficient to completely oxidize the combustible matter, and the remainder of the required air may be introduced into the combustion chamber separately as secondary air.

When a gaseous fuel is employed it is advisable to employ a high velocity stream of air in order to form an intimate mixture of air and the gaseous fuel. Any suitable gas may be employed in conjunction with liquid fuels. The high velocity gas stream serves to atomize the liquid fuel to permit

intimate contact of relatively small particles with a suitable oxidizing gas. Any suitable gas may also be employed in conjunction with finely divided solid fuels in gaseous suspension.

The apparatus may comprise a burner provided with means for imparting whirling movements to both the high pressure gas and the fuel. Thus, for example, the fuel and high pressure gas may be passed through a burner having separate passages provided with worm threads adjacent their discharge ends. The preferred form of burner comprises a nozzle mounted on the adjacent ends of a pair of telescoping tubes or conduits and comprising telescoping worm screws. The spaces between the worm threads communicate with the passage in the inner tube and a passage formed between the two tubes. Means are provided for introducing fuel and air or other gas under high pressure into the inner tube and the passage between the tubes. Air or other gas supply means are preferably connected to the inner tube, and the construction of the nozzle is preferably such that whirling currents of fuel and air or other gas are produced, the whirling current of air or other gas being formed interiorly of the whirling current of fuel and crossing the path of the whirling current of fuel beyond its point of formation. The construction of the nozzle may be such that the whirling masses rotate in the same direction, or it may be such that the whirling masses rotate in opposite directions. When a gaseous fuel is employed, it is advisable to employ a nozzle construction which will cause the whirling streams of air and fuel to rotate in opposite directions.

The invention will be better understood from a consideration of the following description in conjunction with the accompanying drawings, in which

Fig. 1 is a sectional elevation showing a burner constructed in accordance with the invention;

Fig. 2 shows the apparatus of Fig. 1 applied to a combustion chamber associated with a hot-water heating plant;

Fig. 3 is a sectional view of the nozzle of the burner shown in Fig. 1;

Fig. 4 is an end view of the nozzle shown in Fig. 3; and

Fig. 5 is a sectional view of a nozzle similar to that shown in Fig. 3 but in which the inner and outer worm screws are oppositely threaded.

The apparatus illustrated in the drawings comprises a burner 10 provided adjacent one end with a nozzle 11 and adjacent the other end with

conduits 12 and 13 for the introduction of fuel oil and high pressure air, respectively, from suitable sources of supply (not shown).

The burner 10 projects through a casing 14 communicating with an opening in a wall of a combustion chamber 15 associated with a hot-water heating plant 16 of usual construction. The casing 14 provides a passage for the introduction of air into the combustion chamber around a spray issuing from the nozzle 11. The casing is connected by means of a conduit 17 to a main air supply line 20. A valve 21 is provided in the conduit 17 for controlling the flow of secondary air to the casing 14.

The burner comprises an inner tube which forms a continuation of the conduit 13 and an outer tube 22 of greater diameter than the inner tube telescoping with the inner tube and mounted in axial alignment therewith, the walls of the inner and outer tubes being spaced apart to provide an annular passage therebetween. The outer tube 22 communicates with the oil supply conduit 12. The outer tube 22 and the supply conduit 12 are surrounded by a hot water heating jacket 23. The jacket 23 is connected in circuit with the water jacket of the heating plant 16 by means of a conduit 24 connected to the usual water supply conduit 25 and by means of a tank or receptacle 26 which communicates with the water jacket of the heating plant through a conduit 27. The water supply conduit 25 is provided with a valve 30 and the conduit 24 is connected thereto at a point between the valve and the point of connection of the water supply conduit with the lower portion of the water jacket of the heating plant. A coil 31 through which oil flows from a supply conduit 32 to the supply conduit 12 is disposed within the tank or receptacle 26. A conduit 33, in conjunction with the water supply conduit 25, provides means of communication between the lower portion of the tank 26 and the lower portion of the water jacket of the heating plant.

The opposite ends of the outer tube 22 of the burner are threaded internally to receive the threaded end portions of a gland and the nozzle 11. The gland is of usual construction, comprising centrally bored male and female members 35 and 36 and an annular relatively soft packing element 37. Stud bolts 38 and nuts 40 are provided for maintaining the male and female members of the gland in properly adjusted positions. The gland provides a seal for one end of the space between the inner and outer tubes.

The nozzle 11 comprises an outer substantially tubular or hollow casing 41 and telescoping worm screws 42 and 43. The outer worm screw 43 is mounted on a threaded end portion of the inner or air tube 13 with the peripheral surfaces of its worm threads 44 in substantial engagement with the inner cylindrical surface of the casing 41. The inner worm screw 42 is mounted within a recess 45 formed in the outer end portion of the outer worm screw 43 with the peripheral surfaces of its worm threads 46 in substantial engagement with the inner cylindrical surface of the recess 45.

The inner worm screw 42 is held in position within the recess 46 by means of a bolt 47 extending centrally therethrough and having a threaded end portion which enters a threaded opening in a wall 50 within and formed integrally with the outer worm screw. The wall 50 is provided with openings 51 which provide means of communication between the air pipe 13 and the space be-

tween the worm threads 46 of the inner worm screw.

The inner worm screw is provided with four threads of equal lengths and uniformly spaced apart. The outer worm screw is provided with four threads of two different lengths. Two worm threads 44 extend the entire length of the worm screw, and two shorter worm threads 64 are disposed between the long threads on the discharge end portion of the worm screw. The inlet end portion of the nozzle is thus provided with two passages and the discharge end portion with four passages for the flow of fuel oil between the outer worm screw and the nozzle casing 41. The discharge end portion of the outer worm screw is flared outwardly to provide a frusto-conical surface 52 which is disposed adjacent a similar surface 53 formed internally on the discharge end portion of the nozzle casing. The internal surface of the discharge end portion of the nozzle casing is beveled at two different angles to provide two different contiguous, axially aligned, frusto-conical surfaces 53 and 54, the elements of the outermost one of which (54) form the smaller angles with the common axis. The inner surface of the discharge end portion of the outer worm screw is beveled to provide a frusto-conical surface 55 in axial alignment with the frusto-conical surfaces 52, 53 and 54 and the elements of which form greater angles with the common axis than the elements of the surface 54. The inner worm screw 42, the outer worm screw 43 and frusto-conical surface 54 are so disposed relatively to one another that the path of travel of fluid issuing from the spaces between the worm threads of the inner worm screw will cross the path of travel of fluid issuing from the spaces between the worm threads of the outer worm screw.

The nozzle illustrated in Fig. 5 is identical with the nozzle illustrated in Figs. 1, 3 and 4 except that the inner worm screws of the two nozzles are threaded oppositely. Masses of two different fluids issuing from a nozzle of the type illustrated in Fig. 5 will rotate in opposite directions, while masses of two different fluids issuing from a nozzle of the type illustrated in Figs. 1, 3 and 4 will rotate in the same direction.

The inner air tube 13 and the worm screws mounted thereon are locked in their proper operative positions with respect to the nozzle casing by means of a set screw 56 extending through a threaded opening in a collar 57 which forms part of a hollow externally threaded adjusting member 60 through which the air tube 13 extends. The adjusting member 60 extends through a threaded opening in the transverse portion 61 of a yoke having a pair of longitudinally extending arms 62 rigidly attached at their ends to the outer tube 22. Lock nuts 63 are provided on opposite sides of the member 61 for locking the adjusting member in its adjusted positions. Rough adjustments may be made by sliding the air tube longitudinally, and the finer adjustments may be made by rotating the adjusting member 60 after the air tube has been locked against relative movement by means of the set screw 56.

In the operation of the apparatus, fuel oil under any suitable pressure is introduced into the passage between the inner tube 13 and the outer tube 22 through the conduits 32 and 12 and flows longitudinally therethrough toward the discharge nozzle. Upon entering the discharge nozzle, the direction of flow is changed by the worm threads and the fuel oil issues from the discharge

nozzle in the form of a whirling stream. High pressure air, introduced into the inner tube 13, flows longitudinally therethrough until it reaches the discharge nozzle wherein its direction of flow is changed by the worm threads, and it issues from the discharge nozzle as a whirling current. The relatively high-velocity whirling current of air upon striking the relatively low-velocity stream of fuel oil produces a whirling spray comprising an intimate mixture of air and finely divided fuel oil. The oil-air mixture may be ignited initially in any suitable manner. The amount of air introduced through the inner air tube 13 should be sufficient to result in the production of a suitable whirling spray. Secondary air for completing the oxidation of the fuel oil may be introduced into the combustion chamber around the spray through the conduit 17 and the casing 14.

Air or other gas under any suitable pressure may be employed for producing the spray or forming the intimate mixture. We have employed successfully air under pressures in excess of thirty pounds per square inch for both gaseous and liquid fuels, and we have found it to be advisable to employ air under a pressure of about thirty to eighty pounds per square inch when liquid fuels are employed. Secondary air, when employed, may be provided in any suitable manner and at any suitable pressure. Thus, for example, the secondary air may be supplied from a suitable source of air under pressure or it may be supplied by means of draft pressure through a suitable opening in the combustion chamber.

We claim:

1. Apparatus of the class described comprising a pair of concentric tubes having their walls spaced apart to provide an annular passage therebetween, means for introducing a combus-

tion supporting gas into the interior of the inner of the concentric tubes, means for introducing fuel into the annular passage between the tubes, a discharge nozzle associated with adjacent ends of the concentric tubes, said nozzle comprising relatively long outer helical threads defining relatively long outer helical passages communicating with the annular passage between the tubes and extending to the discharge opening of the nozzle, relatively short outer helical threads disposed between the relatively long outer helical threads adjacent the discharge end of the nozzle to provide an increased number of outer helical passages adjacent the discharge opening of the nozzle, and inner helical threads defining an inner helical passage within the nozzle communicating with the interior of the inner of the concentric tubes, said several helical passages serving to impart a whirling motion to gas and fuel issuing from the nozzle.

2. Apparatus according to claim 1 provided with a heating element surrounding the outer tube, for aiding in maintaining the fuel in a suitably fluid condition.

3. Apparatus according to claim 1 wherein the discharge nozzle has an opening of substantially frusto-conical shape in its outer end, the larger end of the opening being adjacent the outer end of the nozzle.

4. Apparatus according to claim 1 in which a third tube, open at its end adjacent the discharge nozzle, is disposed around the other two tubes, means being provided for supplying primary air under pressure to the interior of the innermost tube and secondary air under pressure to the space between the outermost tube and the middle tube.

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