

July 15, 1941.

A. MACCHI

2,249,482

OIL BURNER NOZZLE

Filed Feb. 24, 1940

Fig. 1.

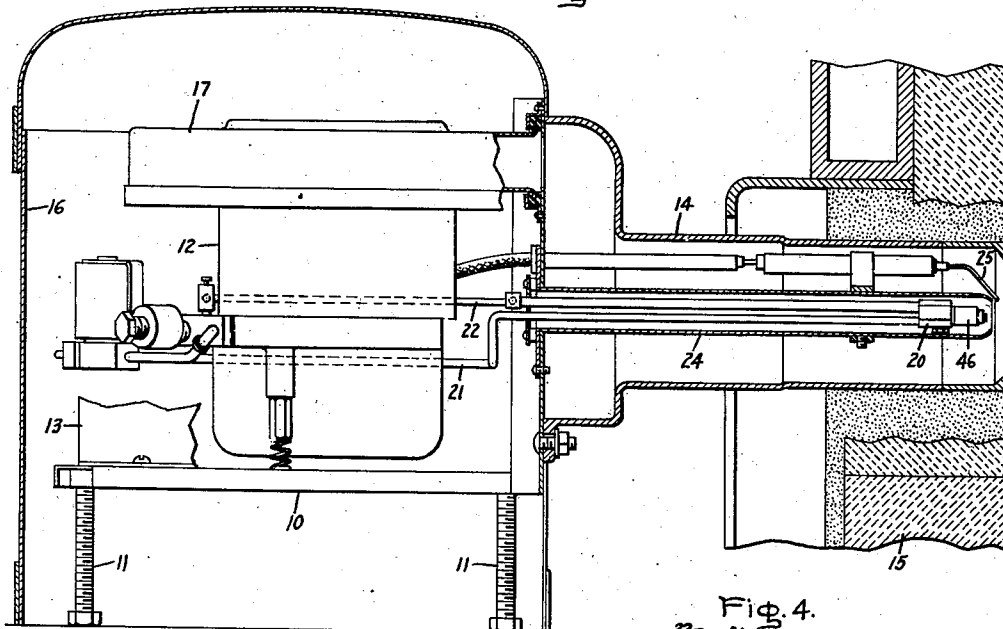


Fig. 4.

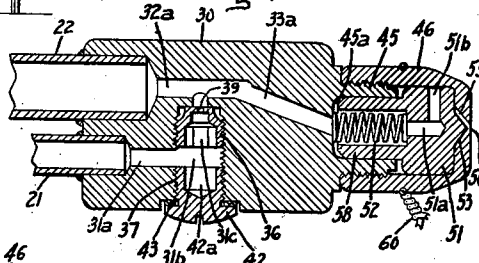


Fig. 2.

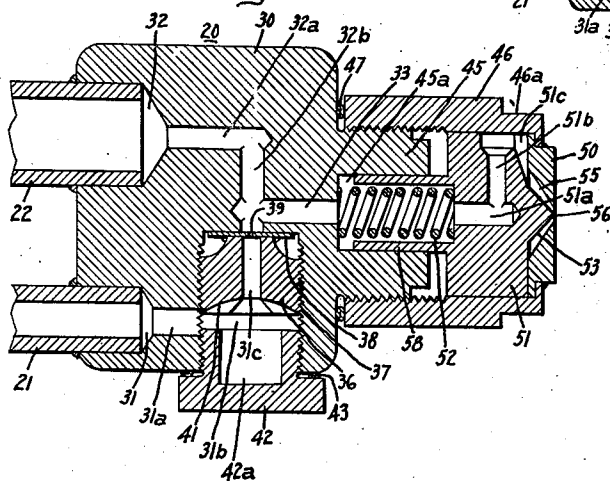
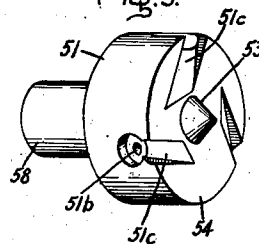


Fig. 3.



Inventor:
Aldo Macchi,
by *Harry E. Dunham*
His Attorney.

UNITED STATES PATENT OFFICE

2,249,482

OIL BURNER NOZZLE

Aldo Macchi, Belleville, N. J., assignor to General Electric Company, a corporation of New York

Application February 24, 1940, Serial No. 320,558

6 Claims. (Cl. 299-140)

This invention relates to oil burner nozzles, particularly of the general type disclosed in my Patent 2,022,513, granted November 26, 1935, wherein air under pressure is mixed and discharged with the oil at the nozzle tip to effect atomization thereof.

The object of the present invention is to produce uniform and effective atomization of the oil by means of an improved nozzle structure capable of operating at relatively low air and oil pressures.

A particular object is to enable the rate of oil discharge from the nozzle tip to be accurately predetermined and also varied by means of a readily replaceable calibrated oil flow orifice embodied in the improved atomizing nozzle structure.

A further object is to provide an improved air pressure oil atomizing nozzle structure having a junction or connection block provided with socket means at one end thereof for removably mounting an oil and air mixing nozzle tip and provided with separate oil and air pipe sockets at the other end with internal passages extending therefrom and joined together to form an initial oil and air mixing chamber inside the block and with the block also provided with a special inverted well having a metering plug mounted therein with a thin walled sharp edged orifice disposed in the oil supply passage directly adjacent the mixing chamber for controlling the initial mixture of the oil with the air.

Other objects are to promote intimate and thorough mixture of the oil and air under pressure by means of a double mixing action within the nozzle body before the discharge thereof and to enable the angle of the discharge atomized oil stream to be varied upon variation of the atomizing air pressure.

Other objects will appear in the following description of the accompanying drawing illustrating preferred embodiments of the invention and in which Fig. 1 is a side view partially in section of an automatic electrically operated conversion oil burner unit provided with the improved atomizing nozzle of the present invention; Fig. 2 is an enlarged sectional view showing the internal arrangement of the various parts of the improved atomizing nozzle embodying the present invention; Fig. 3 is a perspective view of one of the inner nozzle tip parts shown in Fig. 2, and Fig. 4 is a sectional view of a modified form of atomizing nozzle embodying the invention.

The conversion oil burner unit illustrated in Fig. 1 is shown as of the improved type more fully described and claimed in my copending

application, Serial No. 320,557 filed concurrently herewith. Briefly, the improved burner unit comprises a base 10 with adjustable legs 11 upon which base are mounted all of the principal operating and control parts of the burner unit including the electric motor driven blower and oil and air pumping mechanism 12, the high voltage electric ignition transformer 13, as well as the burner combustion air supply nozzle structure 14 which is adapted to be sealed into the refractory wall 15 of a boiler furnace or other type of furnace to which the conversion oil burner unit is applied. The removable jacket or cover 16 serves to enclose all of the operating parts of the burner except the nozzle. Combustion air under pressure is supplied from the motor driven blower 17 into the interior of the combustion air nozzle 14.

The motor driven mechanism 12 constitutes the electric motor driven oil and air pressure supply means for the improved oil atomizing nozzle 20 of the present invention, the structural details of which are more clearly shown in the enlarged views of Figs. 2 and 3. Preferably the motor driven mechanism 12 is of the improved type described and claimed in the Lum Patent 2,032,291, granted February 25, 1936, although any other suitable type of motor driven blower and oil and air pumping means may be provided for supplying the improved atomizing nozzle 20 with oil and air under pressure through the oil supply pipe 21 and the air supply pipe 22.

Preferably the improved atomizing nozzle 20 of the present invention is mounted inside of the cooling air flow tube 24 so as to discharge substantially horizontally a stream of atomized oil along the axis of the combustion air nozzle 14 and adjacent the discharge end thereof. The atomized stream of oil preferably is ignited by electric arc produced between a pair of electrodes 25 located above and closely adjacent the end of the oil atomizing nozzle 20.

As shown in the enlarged sectional view of Fig. 2, the improved structure of the atomizing nozzle 20 comprises the nozzle body or junction block 30 preferably of external hexagonal form and provided at one end with the enlarged openings or bores 31 and 32 one above the other to form sockets into which are sealed respectively the oil supply pipe 21 and the air supply pipe 22, as by silver soldering, brazing, or the like. The nozzle body 30 thus constitutes a junction or connection block for the oil and air pipes 21 and 22 and is also provided with the interconnected internal oil passageways 31a, 31b, 31c, and the internal

air passageways or bores 32a and 32b in order to mix the oil and air supplied from pipes 21 and 22 together under pressure and then permit the oil and air mixture to flow to the atomizing orifice of the nozzle through the interconnecting axial passage 33.

The oil passage 31c is formed by a bore extending axially through the removable annular metering plug 36 which is screw-threaded into the enlarged vertical opening or bore 37 which extends upwardly into the nozzle body 30 to form an inverted well or socket for the metering plug 36. The removable metering plug 36 carries secured to the chamfered upper end thereof the calibrated oil flow thin metering disc 38 with the sharp edged thin walled oil flow control orifice 39 formed in the center thereof in alignment with the axis of the oil passage 31c. In this way the upwardly directed thin walled sharp edged oil flow control orifice 39 is removably embedded within the connection block 30 directly adjacent to the junction of the separate oil and air supply passages so as to control most effectively the initial intermixing of the oil and air under pressure. The removable plug 36 is provided with suitable shoulders 41 for receiving a special wrench so that the orifice disc 38 may be tightly seated against the upper end of the threaded vertical opening 37.

The readily removable sealing plug 42 is screwed into the bottom entrance of the threaded opening or inverted well 37 preferably with a compression washer 43 between the head of the plug 42 and the bottom of the nozzle body or connection block 30 so as to close the threaded opening 37 and form the passageway 31b between the top surface of the plug 42 and the bottom surface of the plug 36. Preferably sealing plug 42 is provided with a sediment well 42a as shown to protect orifice 39.

In the form of nozzle shown in Fig. 2, the oil passage 31c is in opposing vertical alignment with the air passage 32b so that the oil stream issuing from the sharp-edged oil metering orifice 39 will be projected directly upward into the downwardly moving air stream in the passage 32b. This results in an oil geyser-like action that produces an initial intimate and thorough mixture of the oil and air under pressure in the vertical passage 32 with the mixing action continuing in the passages 33 and 45a. In case there are any small air bubbles or vapors in the oil supply coming through pipe 21, these air bubbles or vapors will readily pass through the upwardly directed metering orifice 39 along with the oil and without separating from the oil, thereby preventing air pockets which might cause an appreciable discontinuity of the oil flow.

It is important to note that the flow of oil under pressure through the oil supply pipe 21 and the sharp edge thin disc metering orifice 39 provides a viscosity compensated oil flow control of the improved type described and claimed in the Lum Patent 2,072,761, granted March 2, 1937. Thus in accordance with the viscosity compensating flow control principles set forth in said Lum patent, the improved nozzle structure of the present invention is capable of maintaining a practically constant oil rate in the oil burner irrespective of variations of the viscosity of the fuel oil within predetermined limits, these limits being sufficiently wide to include the various grades of fuel oil ordinarily used in oil burners of the domestic type. It is also important

to note that by removing the sealing plug 42 and substituting different internal plugs 36 carrying different sized oil metering orifices 39, the rate of oil discharged from the improved nozzle structure may be quite accurately predetermined and also readily varied as desired. In this way the burner heat output may be readily varied between wide limits.

The end of the nozzle body or junction block 30 opposite the oil and air inlet pipes 21 and 22 is provided with an externally threaded annular boss 45 for receiving the internally threaded nozzle tip clamping nut 46 with a compression washer 47 for sealing the clamping nut 46 to the nozzle body or block 30. The clamping nut 46 carries the atomizing nozzle orifice tip 50 preferably brazed or welded thereto in cooperating relation with the inner nozzle tip plug 51 which is biased by the spring 52 into firm engagement with the inner face of the discharge orifice tip 50.

The special shape of the inner nozzle tip plug 51 is more clearly illustrated in the perspective view of Fig. 3. The small cone portion 53 extending from the face 54 of the plug 51 is adapted to fit in nesting relation within the complementary internal conical depression 55 formed centrally in coaxial relation in the atomizing orifice tip 50 with the tip of the cone 53 in registering spaced apart relation with the restricted atomizing discharge orifice 56 located at the apex of the conical depression 55.

The tubular extension 58 from the nozzle tip plug 51 forms a close sliding fit within the cylindrical opening or socket 45a formed in the annular boss 45 preferably in axial alignment with the oil and air mixture flow passage 33 and in communication therewith. Thus the improved nozzle junction or connection block 30 is provided not only with the sockets for sealing the separate oil and air pressure supply pipes at one end thereof and with the separate inverted well or socket for removably embedding the oil metering plugs 36 with its upwardly directed thin walled sharp edged metering orifice 39 directly at the junction of the oil and air pressure supply passages but also with a nozzle tip socket for removably mounting therein the oil and air mixing tip parts.

In operation the oil and air mixture flows under pressure from the mixing passage 33 into the large opening 45a and further mixes in and around the biasing spring 52 and also in the central passage 51a formed in the nozzle tip plug 51. Several equilaterally spaced radial passages 51b (that in Fig. 3 are limited to three) are provided to subdivide and carry the oil and air mixture from the mixing passage 51a into the equal number of communicating diagonal tapering slots 51c formed diagonally in the face 54 of the plug 51, as shown in Fig. 3. The slots 51c discharge the oil and air mixture in separate diagonal streams into the annular mixing chamber formed between the conical depression 55 and the opposing cone 53, thus serving to impart a rapid and turbulent rotary motion to the oil and air mixture around the cone 53. As a result the oil and air are given a further violent intermixing under pressure before the discharge of the mixture through the restricted atomizing orifice 56 occurs.

The double oil and air mixing action obtained by means of the improved atomizing nozzle structure produces in operation a very intimate and thorough intermixture of the oil and air under pressure with a uniform and effective atomiza-

tion of the oil resulting from the rapid expansion of the air particles upon the discharge of the mixture through the restricted orifice 56. Furthermore, the rapid rotary motion imparted to the air and oil mixture just prior to discharge produces a relatively wide angle stream of atomized oil when the oil and air are supplied to the atomizing nozzle at relatively low pressure. This enables the combustion air discharging from the air nozzle 14 to intimately intermix with the wide angle stream of atomized oil so as to produce a stable flame with relatively uniform and efficient combustion of the oil. Preferably the angle of the combustion air stream discharged from the air nozzle 14 is always maintained slightly greater than that of the stream of atomized oil in order to provide some excess of air at the boundary of the atomized oil stream and thereby insure as complete combustion of the oil as possible.

Preferably the external surface of the nozzle body or junction block 30 is formed hexagonal so as to allow proper seating of the sealing gasket 43 on one of the flat outer faces thereof when the sealing nut 42 is screwed into the opening 37. Also the nozzle tip clamping nut 46 preferably is provided with a hexagonally formed portion 46a in order to facilitate the ready assembly and disassembly of the nozzle parts by means of ordinary wrenches.

In the modified form of atomizing nozzle structure embodying the improvement of the present invention as shown in Fig. 4, the oil and air supply pipes 21, 22 are sealed in socket form somewhat closer together in the nozzle body or junction block 30 and the oil metering orifice 39 is located so as to discharge directly upwardly into the air passage 32a. The inner plug 36 carrying the oil metering disc 38 is of slightly modified form so as to receive an internal socket wrench for seating and removing the plug 36 from the orifice plug opening 37 in the nozzle body. Also the external sealing plug 42 is of slightly modified form so as to be mounted in a machined recess formed in the bottom of the nozzle body or junction block 30.

The initial oil and air mixture formed by the upward discharge of oil through the orifice 39 into the air passage 32a is further mixed in the downwardly inclined passage 33a and in passages 52 and 51a of the orifice tip parts of the nozzle all of which are only slightly modified from the form thereof previously described. It will be noted however that the clamping nut 46 extends integrally across the front of the nozzle so that the conical depressions 55 and the atomizing orifice 56 may be formed directly therein. The inner orifice plug 51 is substantially of the same form as shown in Fig. 3 so that the same final turbulent rotary intermixing action of the oil and air in the annular chamber formed between the conical depression 55 and the cone 53 is obtained in the manner previously described.

In order to localize any dripping of oil which may accumulate on the outer surface of the nozzle clamping nut 46, a twisted wire 60 preferably is disposed in a suitable groove formed on the exterior of the nut 46 so that the oil may drip from the twisted ends of the wire 60 through a suitable small opening formed in the bottom of cooling air tube 24. This will prevent any accumulation of carbonized oil that might interfere with the flow of cooling air through the tube 24 around the nozzle 20.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In an atomizing nozzle for oil burners, in combination, a body having separate oil and air inlet passages formed therein with said passages joined together inside said body to form an oil and air mixing chamber in said body, and a pair of cooperating orifice elements removably clamped to said body in spring biased engagement with each other and provided with complementary nested and spaced apart opposing conical portions forming therebetween an annular oil and air mixing chamber communicating with said first mixing chamber in said nozzle body with one of said cooperating orifice elements having a restricted discharge orifice located at the apex of the said conical portion thereof.

2. In an oil and air mixing nozzle for oil burners, in combination, a nozzle tip having an orifice formed therein for discharging the oil and air mixture, a nozzle body removably connected with said nozzle tip and having a passage for air under pressure formed therein in communication with said orifice and provided with an enlarged opening communicating with said air passage with an oil inlet passage formed in said body in communication with said enlarged opening, a removable plug mounted in said enlarged opening and provided with a thin walled sharp edged metering orifice for regulating the flow of liquid oil from said oil inlet passage to said air passage through said enlarged opening, and a second removable plug mounted in said enlarged opening in spaced apart relation with said first plug for sealing said enlarged opening.

3. In an atomizing nozzle for oil burners, in combination a nozzle tip having a discharge orifice and oil and air mixing means adjacent said orifice, a connection block having means at one end thereof for removably mounting said nozzle tip, said block having separate oil and air pressure supply pipe sockets formed at the other end thereof and an air pressure supply passage communicating between said air pipe socket and said nozzle tip orifice means, said block having a well formed in a side thereof with the end of the well adjacent to and communicating with said air pressure supply passage and having a passage communicating between the side of said well and said oil pipe socket, an annular plug removably seated within said well and provided with a thin walled sharp edged orifice at the end of said well for controlling the initial mixing of the oil with the air, and a sealing plug removably mounted in the mouth of said well.

4. An atomizing nozzle for burners including an air and oil mixing nozzle tip, a connection block therefor having means for removably mounting said nozzle tip with the axis of the tip substantially horizontal and having separate substantially horizontal oil and air pressure inlet passages with said oil inlet passage disposed below the level of said air inlet passage and having an inverted well extending upwardly from the bottom side of said block and joining said oil inlet passage with said air inlet passage to form an initial oil and air mixing chamber, a thin walled sharp edged metering orifice element, means for mounting said element at the upper end of said inverted well adjacent said air inlet passage for projecting a stream of oil upwardly into said air passage, and removable means for sealing the mouth of said well.

5. An oil atomizing nozzle for burners including a nozzle tip having a restricted orifice for

discharging a mixture of oil and air under pressure, a nozzle tip plug removably mounted in said nozzle tip and provided with a central oil and air mixing chamber with a plurality of separate passages communicating between said mixing chamber and said orifice with said plurality of separate passages joined together adjacent said orifice to form a final oil and air mixing chamber, a connection block having means for removably mounting said nozzle tip and plug at one end thereof, said block having separate oil and air pressure supply pipe sockets at the other end thereof and provided with an air pressure supply passage communicating between said air pipe socket and said central chamber in said nozzle plug, said block having a well formed in the side thereof with a passage connecting the side of said well with said oil pipe socket and with the end of said well adjacent to and communicating with said air pressure supply passage to mix oil with the air, a thin walled sharp edged metering orifice element having means for

removably mounting said element in said well adjacent said air passage for projecting a stream of oil into said air passage, and a removable cover for sealing said well.

5 6. An air pressure oil atomizing nozzle for burners including an oil and air mixing nozzle tip, a connection block therefor having means for removably mounting said nozzle tip thereon and having separate oil and air pressure inlet passages and an initial oil and air mixing chamber 10 formed therein with said chamber communicating between said nozzle tip and said air inlet passage and having a well open to the exterior of said block and communicating between said oil inlet passage and said mixing chamber, a thin 15 walled sharp edged metering orifice element having means for removably mounting said element in said well for projecting a stream of oil into said chamber, and a removable cover for sealing 20 the mouth of said well.

ALDO MACCHI.