Aug. 20, 1929.

F. EGERSDÖRFER

1,725,066

ATOMIZER FOR LIQUID FUEL

Filed May 13, 1925

5 Sheets-Sheet 1

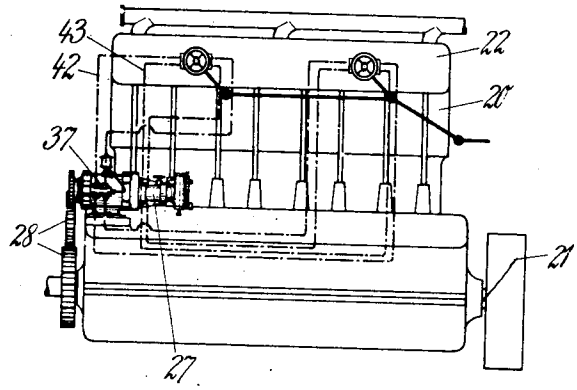


Fig. 1

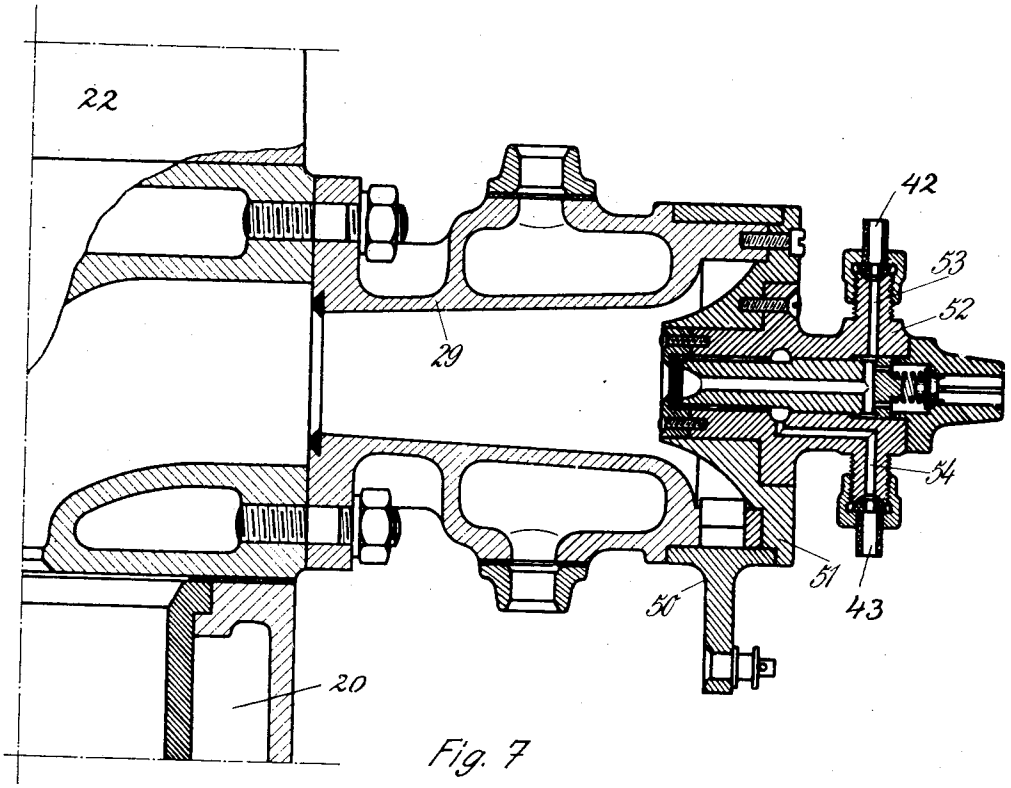


Fig. 7

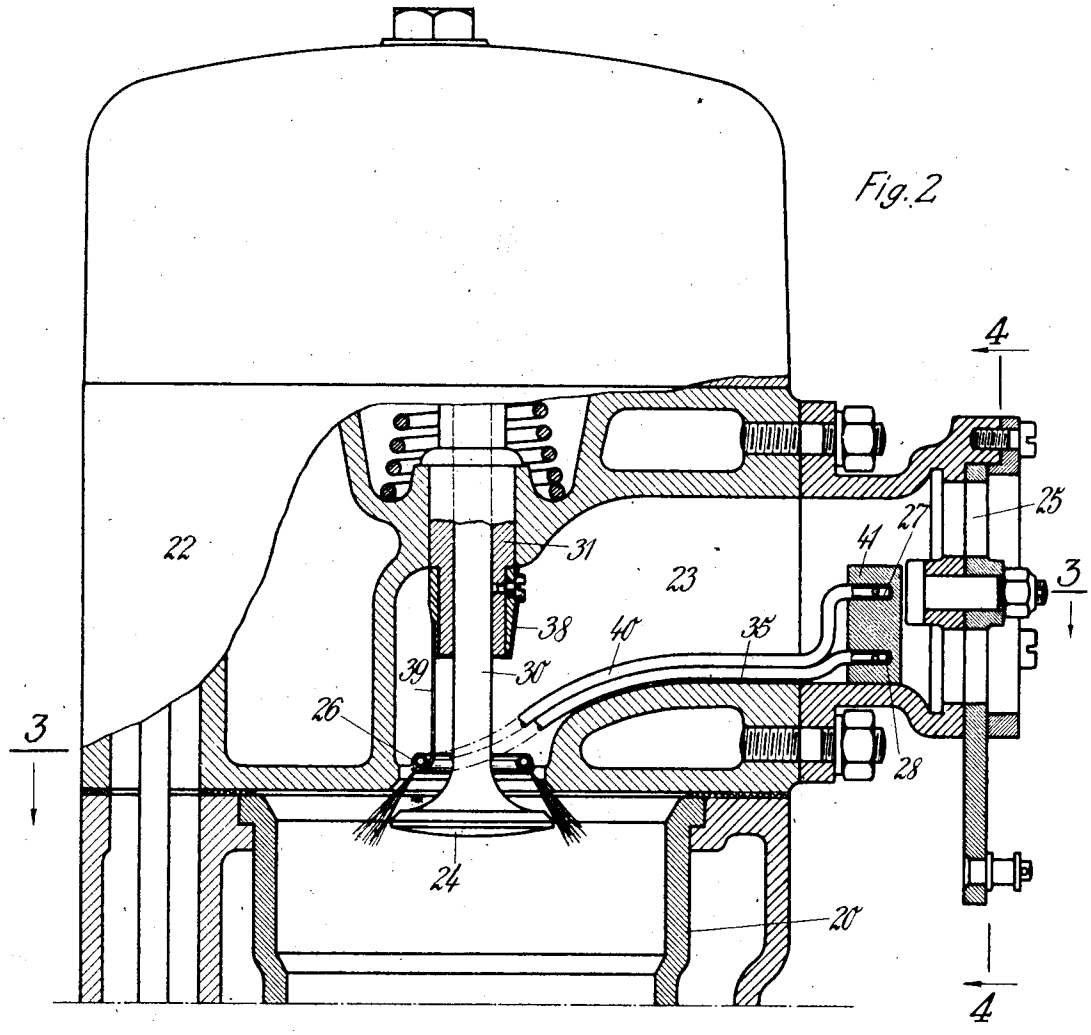
Inventor:
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ATOMIZER FOR LIQUID FUEL

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Fig. 2



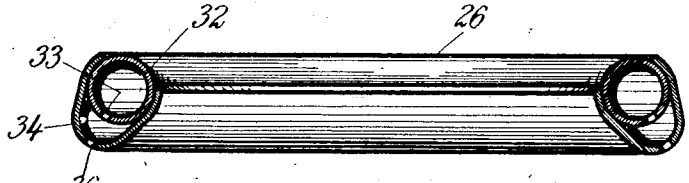


Fig. 5

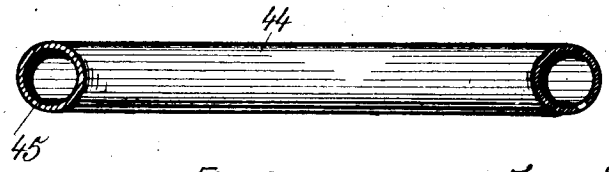


Fig. 6

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ATOMIZER FOR LIQUID FUEL

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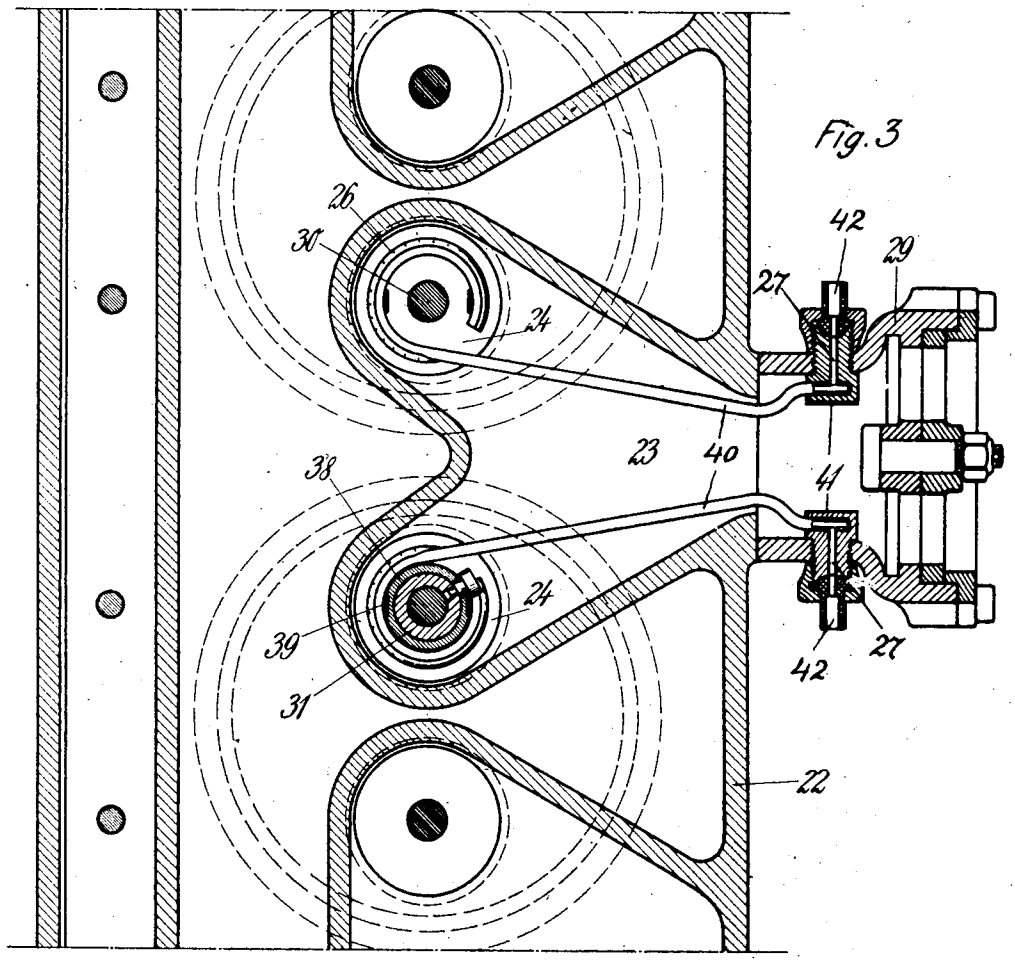


Fig. 3

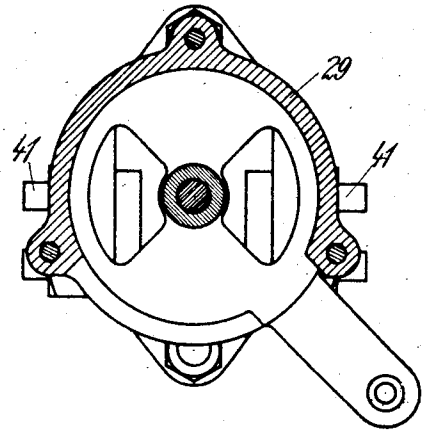


Fig. 4

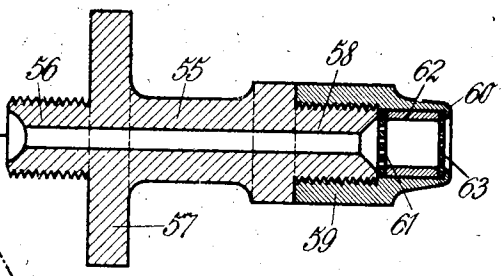
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Fig. 8



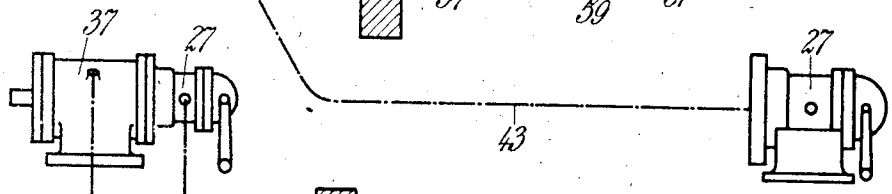


Fig. 10

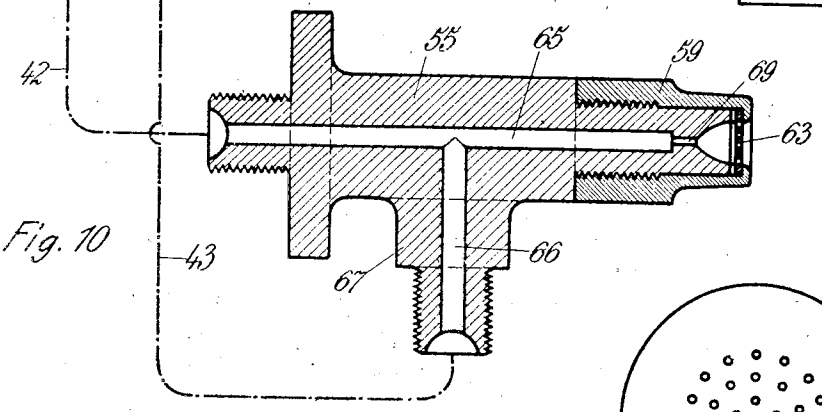
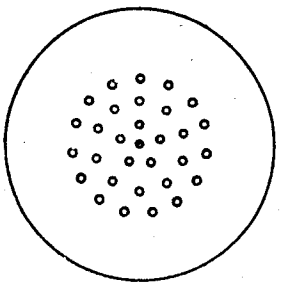


Fig. 9



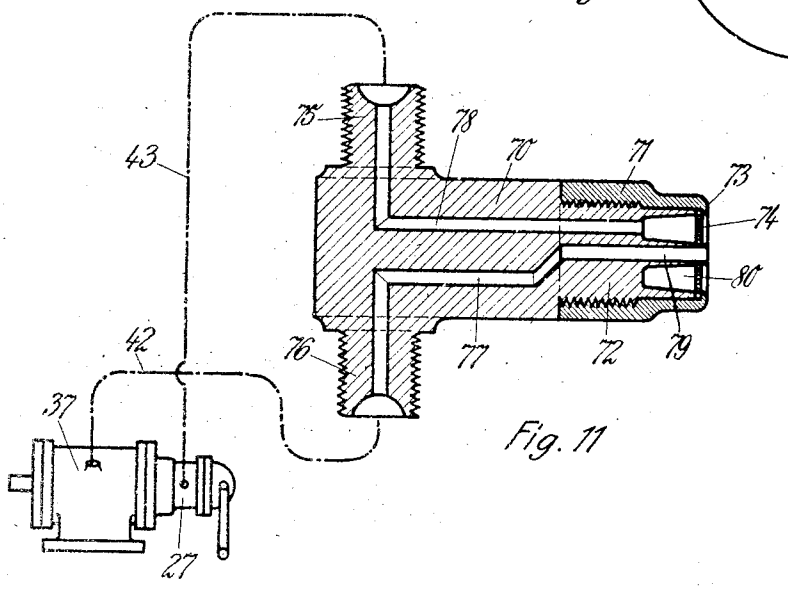


Fig. 11

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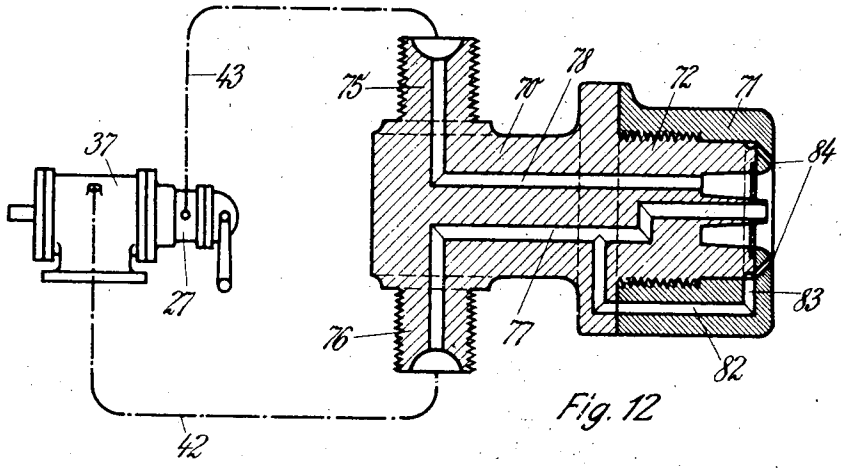


Fig. 12

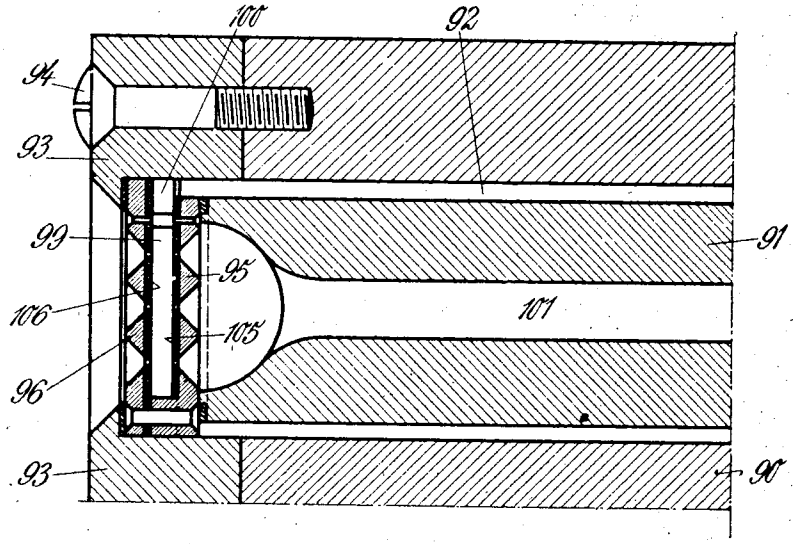


Fig. 14

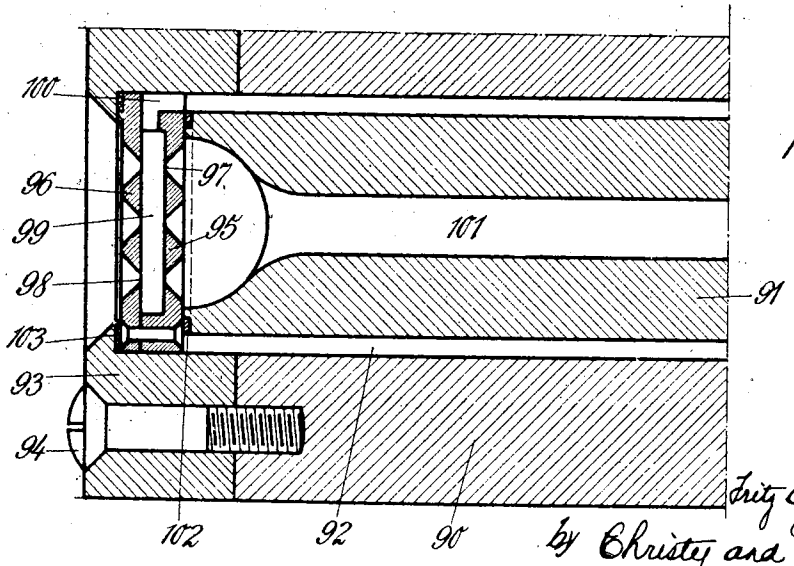


Fig. 13

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Patented Aug. 20, 1929. 1,725,066

UNITED STATES PATENT OFFICE.

FRITZ EGERSDÖRFER, OF CHARLOTTENBURG, GERMANY.

ATOMIZER FOR LIQUID FUEL.

Application filed May 13, 1925, Serial No. 30,114, and in Germany October 9, 1924.

My invention relates to improvements in atomizers for liquid fuel, such as are used for example for supplying liquid fuel in a state of minute distribution to fire places and to the cylinders of internal combustion engines. More particularly my invention relates to atomizers of the type in which the nozzle is provided with small apertures for the discharge of the fuel therethrough. The object of the improvements is to provide a nozzle by means of which the fuel is atomized to such an extent that even liquid fuel of median and high specific gravities can be economically burnt in internal combustion engines or in fire places, and with this object in view my invention consists in providing the nozzle with minute delivery passages each of a diameter of from 0.3 to 0.03 millimeters or less, and supplying the fuel to the said nozzle under pressure, for example by means of a fuel pump. I have found that the vacuum produced for example in the intake passage of an internal combustion engine is not capable of drawing the fuel in the form of a spray through the said minute apertures, but that sprays are produced by means of a fuel pump, and that the fuel discharged from the nozzle is minutely broken up, so that even fuels of median and high specific gravity are completely burnt in internal combustion engines.

For further atomizing the fuel I provide the nozzle with a supply of air under pressure for breaking up the particles of fuel. I have found that the supply of compressed air is desirable in nozzles for feeding liquid fuel of boiling temperatures of 350° C. or more to internal combustion engines.

When using the atomizer in internal combustion engines I dispose the same near the intake valve and in such a position that the atomized fuel is thrown on the hot valve cone or into the annular passage provided between the said cone and its seat when opening the valve, so that the fuel is delivered into the current of air at the part where its velocity is at its maximum. Thereby the atomized fuel is thoroughly mixed with the air, and recondensation within the intake passage is made impossible.

For the purpose of explaining the invention several examples embodying the same have been shown in the accompanying drawings in which the same reference characters have been used in all the views to indicate corresponding parts. In said drawings,

Fig. 1, is a digrammatical elevation showing an internal combustion engine equipped with my improved atomizing apparatus,

Fig. 2, is a sectional elevation showing the head of an internal combustion engine and the admission valve,

Fig. 3, is a horizontal section taken on the line 3—3 of Fig. 2,

Fig. 4, is a section taken on the line 4—4 of Fig. 2,

Fig. 5, is a detail sectional view showing the ring nozzle on an enlarged scale,

Fig. 6, is a detail sectional view showing a modification of the ring nozzle,

Fig. 7, is a sectional elevation of the head of the cylinder of an internal combustion engine provided with a fuel nozzle of a modified construction,

Fig. 8, is a detail sectional view showing a modification of the atomizing nozzle provided in the engine and in addition the fuel pump,

Fig. 9, is a detail view on an enlarged scale showing the foraminated disk of the nozzle shown in Fig. 8,

Fig. 10, is a sectional elevation showing a nozzle having a supply of compressed air,

Figs. 11 to 14 are similar views showing modifications.

In Figs. 1 to 3, I have shown an internal combustion engine comprising four cylinders 20, a crank shaft 21, a head 22, admission passages 23, admission valves 24, butterflies 25, nozzles 26 for the atomization of liquid fuel, and a combined air compressor and pump 27, 37 connected with the machine crank by suitable gearing 28. The butterfly 25 is combined with a tubular member 29 secured to the head 22. Any known type of air compressor and pump may be provided in the engine, but I prefer to provide an air compressor and a fuel pump of the type shown and described in the patents of the United States Nr. 1,466,092 granted to me August 28, 1923 and Nr. 1,422,946 granted to me July 22, 1922, the rotary members of the said compressor and pump being mounted on a common shaft.

Referring now more in detail to the construction shown in Figs. 2 to 5, the stem 30 of the admission valve 24 is guided in a

bushing 31 fitted in a bore of the head 22, and the nozzle 26 is in the form of a ring comprising an annular pipe 32 made integral with a pipe 40 and communicating with the compressor 37 through a pipe 42. The annular pipe 32 is formed with small discharges 33 disposed all around its circumference, and it has a circumferentially split pipe 34 secured thereto, the pipe 34 forming an annular chamber and being formed with minute apertures 36 in alignment with the passages 33. The split pipe 34 is made integral with a pipe 35 communicating through a pipe 43 with the pump 27. The discharges 33 and 36 are arranged so as to throw the fuel through the open valve directly into the cylinder and at a point where the current of air drawn into the cylinder has high velocity and temperature. Therefore no fuel is condensed and deposited on the wall of the admission passage. As shown the ring nozzle 32, 34 is secured by means of a ring 38 and arms 39 to the bushing 31. The pipes 40, 42 and 35, 43 for the supply of air and fuel end in blocks 41 formed with passages 27 and 28. Preferably the fuel pump is provided with means for regulating the amount of fuel delivered to the nozzle, so that the supply of fuel to the cylinder can be exactly regulated. The diameter of the bores 33 and 36 is from 0.03 to 0.3 millimeters.

In the operation of the system the air and fuel are supplied to the nozzle at the proper periods of time and the air delivered through the passages 33 blows the fuel through the passages 36 thus breaking the same up into sprays of minute particles.

I have found that by thus regulating the supply of the fuel, atomizing the same, and directly throwing the same into the cylinder I am enabled to insure complete combustion of heavy fuels which heretofore could not be used in engines provided with ordinary carbureters.

In cases in which light fuel of median specific gravity is used the supply of air under pressure to the ring nozzle may be dispensed with. In such cases my improved ring nozzle consists of a single annular pipe connected with a fuel pump for supplying thereto regulated amounts of fuel. A nozzle of this type has been shown in Fig. 6, in which the ring nozzle and the bores thereof have received the reference characters 44 and 45 respectively.

In another modification of the invention I make use of a ring nozzle of the construction shown in Fig. 5, and I supply fuel through the pipe 32, while the pipe 34 communicates with the outer air, the passages 36 being preferably enlarged as compared to the bores 33. The fuel delivered through the bores 33 and 36 takes along air from the pipe 34, and the said air assists in the atomization of the fuel.

In Figs. 7 to 14 I have shown modifications in which the minute bores for the delivery of the fuel are made in disks and the nozzles are axially mounted in the tubular members secured to the head 22 of the engine. The general construction of the engine may be the same as that of the engine shown in Figs. 2 and 3 and I have shown only the cylinder 20, the head 22 and the tubular member 29. The butterfly 50 is disposed circumferentially of the member 29. To the end of the tubular member an annular member 51 is secured which has a tubular member or nozzle 52 fitted therein. The tubular member 52 is provided with inlet passages 53 and 54 communicating respectively with the pipes 42 and 43 and the air compressor 37 and fuel pump 27. It will be understood that any of the nozzles shown in Figs. 8 to 14, may be mounted on the engine in the manner shown in Fig. 7 and I shall now describe the said nozzles in detail.

The atomizing nozzle illustrated in Fig. 8 is provided only with a supply of liquid fuel, the supply of compressed air being dispensed with. As shown the nozzle comprises a tubular member 55 having a screw-threaded end portion 56 and a flange 57 for securing the same to the annular member 51. The front or delivery end 58 of the member 55 is reduced in cross-section, and it has a nipple 59 screwed thereto, which nipple is formed at its front end with an inwardly directed flange 60. Between the said flange and the front face of the reduced portion 58 there are a filtering disk or sieve 61, a spacing sleeve 62 and a thin steel disk 63 provided with minute bores having diameters of from 0,03 to 0,3 millimeters, the bores of smaller diameters being used in connection with fuel of high boiling temperatures and those of larger diameters in connection with fuels of lower boiling temperatures. By unscrewing the nipple 59 the plate 63 may be removed for putting in a plate provided with bores of other diameters or for cleaning the same.

The tubular member 55 is connected by the pipe 43 with the fuel pump 27.

In the operation of the apparatus liquid fuel is forced by the pump through the small bores of the disk 63, the pressure imparted by the pump to the fuel depending on the diameter of the said bores, and by the combination of the pump and a nozzle having minute bores I am enabled to divide the fuel into jets of any desired degree of fineness.

Now, I have found that the satisfactory atomization of heavy oils permitting complete combustion thereof in internal combustion engines depends on the possibility of dividing the fuel into minute jets thrown into the air in such a way that the particles of fuel can not be condensed into drops, which drops would not be burnt, and would spoil the cylinder. It will be understood by those

skilled in the art, that with my improved combination the fuel is thrown into the current of air in a state permitting the feeding of liquid fuel of comparatively high boiling temperature.

In the example shown in Fig. 10 the construction of the fuel nozzle and pump is substantially the same as that described with reference to Fig. 8, and the same reference characters have been used to indicate corresponding parts. However, the axial passage 65 is connected with the air compressor 37 and the fuel from the pump is admitted through a transverse bore 66 made in a transverse portion 67 and communicating with the fuel pump 27 through the pipe 43. The passage 65 ends in a nozzle 69 which discharges through the foraminated steel disk 63.

In the operation of the nozzle the current of compressed air moving through the bore 65 takes up the fuel, the mixture of air and atomized fuel being forced through the nozzle 69 and the minute bores of the disk 63. The mixture delivered through the said bores is minutely atomized.

In Figs. 11 and 12 I have shown modifications in which the fuel is acted upon by the compressed air only after being delivered from the nozzle, the jets of fuel being atomized by the expansion of the compressed air discharged from the nozzle.

In the construction shown in Fig. 11 the nozzle comprises a body 70 having a nipple 75 and 76 respectively connected by the being formed with an internal flange 73 holding the thin steel plate 74 in position on the front face of the portion 72. Further the body 70 is provided with a pair of studs 75 and 76 respectively connected by the pipes 43 and 42 with the pump 27 and the compressor 37. The body 70 is formed with two bores 77 and 78 communicating respectively with the pipe 42 and the air compressor, and the pipe 43 and the pump. The bore 77 ends in a nozzle 79 passed axially through a hole made in the disk 74, and the bore 78 ends in an annular chamber 80 disposed concentrically of the nozzle 79.

In the operation of the apparatus the fuel is discharged through the annular chamber 80 and the bores of the disk 74, and it is further atomized by expansion of the compressed air discharged from the nozzle 79.

The construction shown in Fig. 12 is similar to the one described with reference to Fig. 11, and the same reference characters have been used to indicate corresponding parts. The bore 77 communicates through a branch passage 82 with an annular passage 83 from which compressed air is discharged through passages 84 directed outwardly and towards the axis of the nozzle, the converging jets of air having the function to confine the atomized fuel and to prevent the same from being thrown outwardly and against the wall of the admission pipe of the internal combustion engine.

In Figs. 13 and 14 I have shown modifications in which the current of air is divided into a plurality of jets forced through the liquid fuel and through fine bores disposed in alignment with the bores through which the jets of air are delivered, the operation being similar in this respect to the construction shown in Figs. 2 to 5.

In the example shown in Fig. 13 the nozzle comprises cylindrical bodies 90 and 91 concentrically disposed one within the other and providing an annular passage 92. To the front face of the member 90 a ring 93 is secured by means of screws 94, and between the said ring and the front face of the member 91 two disks 95 and 96 are mounted which are provided with minute holes 97 and 98. As shown the said holes are conical in form and at the smallest part the diameter is from 0,03 mm. to 0,3 mm. The inner disk 95 is provided with a recess thus providing a fuel chamber 99 communicating through a passage 100 with the annular passage 92. The body 91 is provided with an axial passage 101 flaring outwardly at its end and covered by the foraminated part of the disk 95. Between the disks 95 and 96 and the ring 93 and the end face of the body 91 packing rings 102 and 103 are provided.

In the operation of the nozzle fuel is supplied to the chamber 99 from the fuel pump and through the passages 92 and 100, and compressed air is supplied from the air compressor and through the passage 101 to the holes 97 of the disk 95. The fuel is forced from the chamber 99 through the bores 98, and the compressed air is forced through the bores 97, the fuel chamber 99, and the bores 98, thus driving the liquid fuel through the bores 98 and atomizing the same.

In the operation of the nozzle it is important that the diameter of the holes 97 be equal to or nearly equal to the diameter of the bores 98.

For convenience in the manufacture of the fine bores I prefer to combine with the disks 95 and 96 thin steel plates 105 and 106 having the minute bores made therein, while the bores made in the disks 95 and 96 have larger diameters, as is shown in Fig. 14. The construction of the nozzle is substantially the same as has been described with reference to Fig. 13, and the same reference characters have been used to indicate corresponding parts.

While in describing the invention reference has been made to the use of the nozzle in internal combustion engines I wish it to be understood that my invention is not limited in all of its aspects to such use, and

that the improved nozzle may be used in connection with burners for various fireplaces.

I claim:

1. In an internal combustion engine, the combination, with the cylinder, and the intake valve, of a ring nozzle around the valve cone comprising two annular passages one for fuel and the other one for air under pressure, the fuel passage being formed with delivery orifices so arranged as to deliver the fuel directly into the current of air drawn into the cylinder when the valve is open, and the air passage having orifices opening into the fuel passage and in alignment with the delivery orifices of said fuel passage, and means to supply air under pressure to said air passage.

2. In an internal combustion engine, the combination, with the cylinder, of the intake valve, an annular nozzle disposed concentrically of said valve and comprising two annular chambers one for fuel and the other one for air, said fuel chamber having a wall provided with holes of a diameter less than 0,3 millimeters and directed into the passage provided between the valve cone and its seat and the air chamber having its wall separating the same from the fuel chamber provided with holes opening into said fuel chamber and in alignment with said holes of the fuel chamber, and means to supply liquid fuel and air under pressure respectively to said chambers.

FRITZ EGERSDÖRFER.