Jan. 5, 1937. J. SMITH ET AL 2,066,806

OIL BURNER

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Fig. 1.

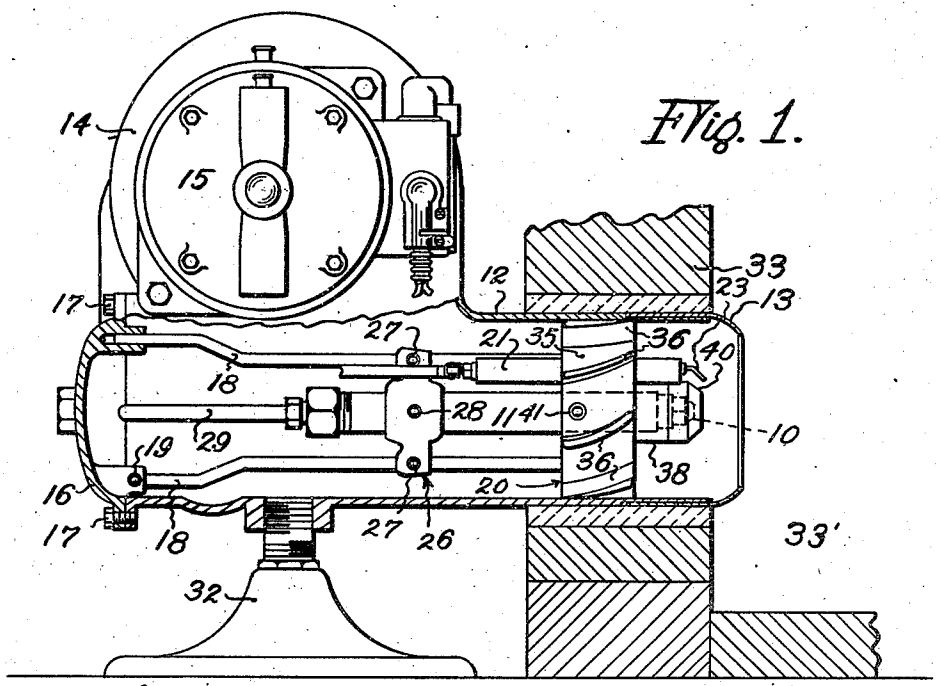
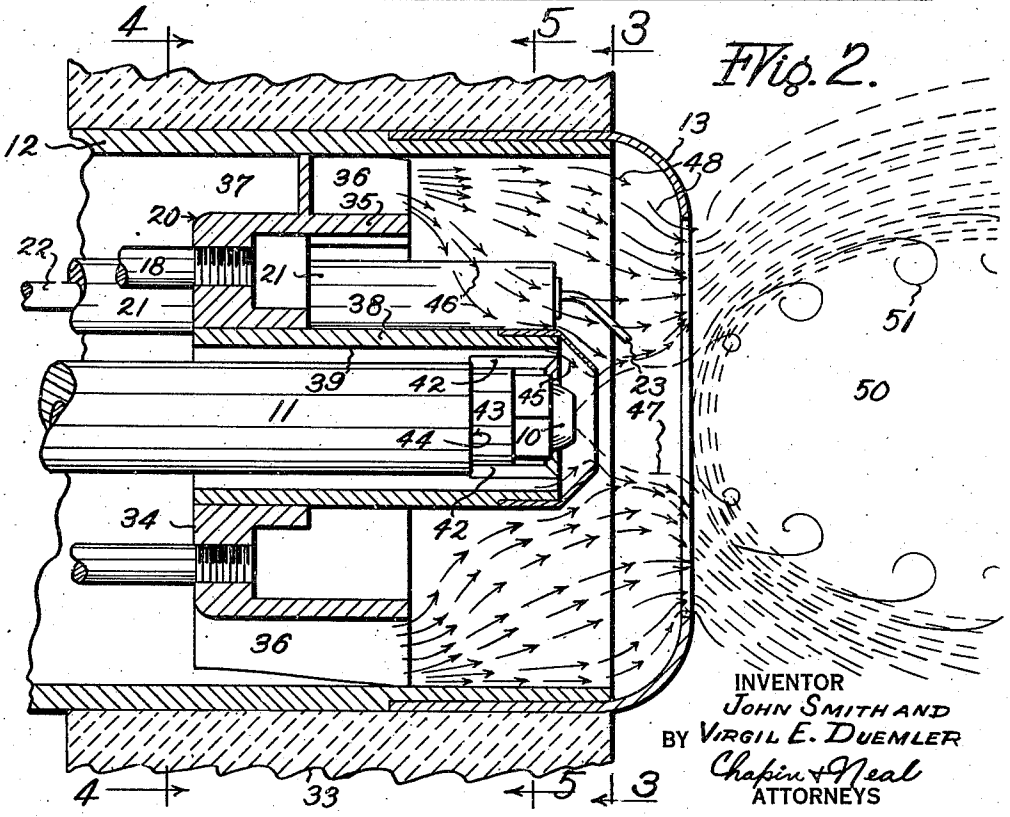


Fig. 2.



INVENTOR
JOHN SMITH AND
BY VIRGIL E. DUEMLER
Chapin & Neal
ATTORNEYS

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Fig. 3.

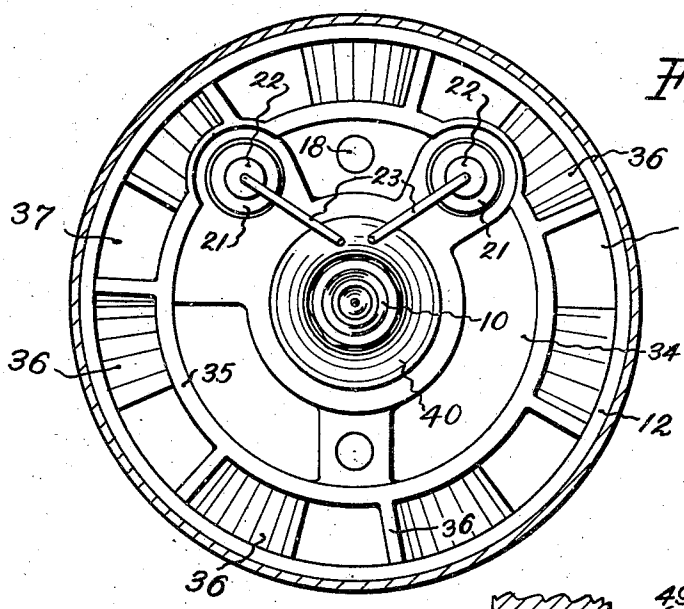


Fig. 6.

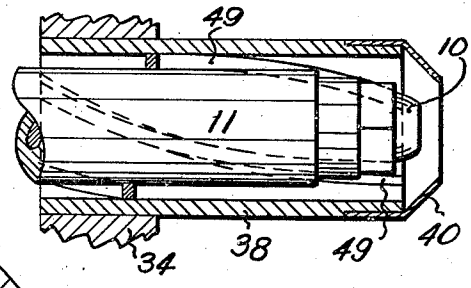


Fig. 4.

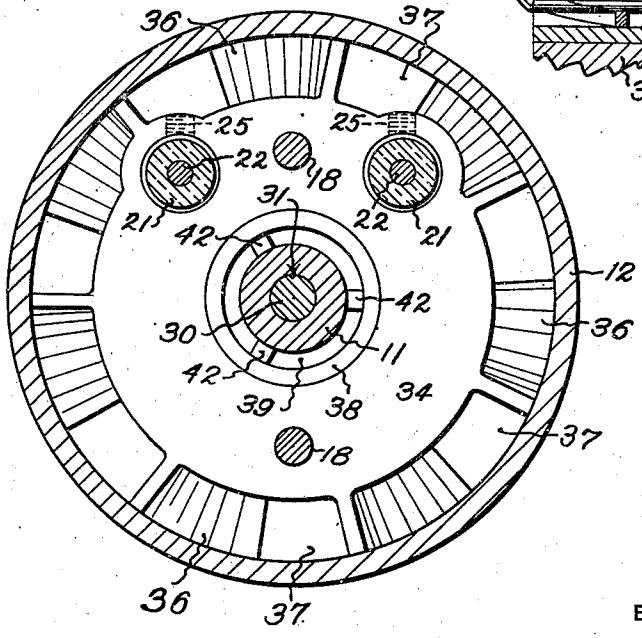
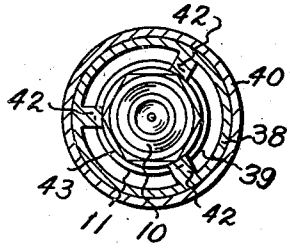


Fig. 5.



INVENTOR
JOHN SMITH AND
BY VIRGIL E. DUEMLER
Chapin & Neal
ATTORNEYS

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2,066,806

OIL BURNER

John Smith, Southwick, and Virgil E. Duemler, West Springfield, Mass., assignors to Gilbert & Barker Manufacturing Company, West Springfield, Mass., a corporation of Massachusetts

Application December 2, 1935, Serial No. 52,482

4 Claims. (Cl. 158—76)

This invention relates to improvements in oil burners.

The invention has for an object the provision in a gun type burner of improved means for directing air to the oil, characterized by the production of a steady, stable and quiet flame of high temperature and by improved efficiency of combustion.

More particularly, it is an object of the invention to provide in a burner wherein the air is fed to the oil in a plurality of generally concentric, annular streams, a novel form of spacing of the outlets, through which said streams issue, whereby an annular area of low pressure is created between said streams into which one of them may in part expand and form, in effect, an intervening stream of lessened velocity, thereby securing an improved and graded distribution of the air along the flame to effect progressive combustion.

Another object of the invention is to provide in a burner of the class described, means for causing the outer air stream to whirl around the axis of the oil nozzle, and an arrangement whereby an inner portion of the outer air stream is enabled to expand radially inward and envelop the oil stream at a point close to but slightly beyond the location where the inner air stream meets the oil stream, and in the zone of gasification of the oil,—said inner portion of the whirling air stream acting to whirl the gasified oil in a zone between the oil nozzle and the normal zone of application of the outer air stream to the oil.

These and other objects will more particularly appear as the detailed description proceeds and will be pointed out in the appended claims.

The invention will be disclosed with reference to the accompanying drawings, in which:

Fig. 1 is a side elevational view, partly in section of an oil burner embodying the invention;

Fig. 2 is a fragmentary sectional elevational view, taken similarly to Fig. 1 but showing only the outlet end of the burner and drawn to a larger scale;

Figs. 3, 4 and 5 are cross sectional views taken on the lines 3—3, 4—4 and 5—5, respectively, of Fig. 2; and

Fig. 6 is a fragmentary sectional elevational view showing a modification.

Referring to these drawings; the burner is of the pressure atomizing type, having a nozzle 10 to which oil is supplied under relatively high pressure and from which the oil is emitted in a substantially hollow conical spray of finely divided particles and practically in the form of a mist or fog. This nozzle is secured to one end of a cylindrical support 11 and located near the open outlet end of an air tube 12, having at such end a deflector 13 to direct air inwardly toward the oil spray. Air at relatively low pressure is supplied to tube 12, near its other end, by a fan 14 driven by a motor 15,—the fan casing being located above tube 12 and formed as an integral part thereof.

The fan end of tube 12 is closed by a head 16 held in place by cap screws 17 and capable of being easily removed to enable servicing of the nozzle 10 and associated parts. A pair of rods 18 fixed in head 16 by set screws 19 in a manner to enable adjustment of the rods in a direction longitudinally of the tube 12, extend forwardly in said tube and are suitably fixed, as by the screw threads shown in Fig. 2, to an air dividing and directing member 20 which is slidable in the tube. This member 20 supports a pair of insulators 21, carrying the ignition electrode rods 22 which terminate in electrodes 23 positioned in igniting relation with the spray from nozzle 10. The insulators 21 pass through and are slidably adjustable in a longitudinal direction in member 20 and are fixed in their positions of adjustment by set screws 25 in member 20. A bracket 26 interconnects the two rods 18 and is adjustably fixed to each by a set screw 27. The nozzle support 11 passes through bracket 26 and is fixed thereto by a set screw 28. Thus, by removing head 16, the nozzle 10, air director 20 and spark electrodes may be withdrawn as one unit, without disturbing the relationship of these parts.

Oil is supplied to the nozzle by any suitable means, usually a pump (not shown) driven by motor 15, and passes through piping, indicated in part in Fig. 1 at 29, to the nozzle support 11. The piping 29 enters the air tube through a radial slot in the inner face of head 16, as indicated in Fig. 1. The support 11 is also an oil conductor. It is bored out, as shown in Fig. 4, to receive a rod 30 which has a longitudinal groove 31 in its periphery and which fills the bore and closes it except for the groove 31. This groove interconnects the piping 29 and nozzle 10. The nozzle support is or may be constructed as and for the purposes disclosed in U. S. Patent No. 2,015,572, granted September 24, 1935, on an invention of L. F. Spear.

The burner is supported, preferably in a manner to enable vertical adjustment, by a standard 32 connected at its upper end to the air tube 12. The outlet end of this tube passes through the

furnace wall 33 and opens into the combustion chamber 33' thereof.

The burner, as thus far described, is of a generally old and well known type and it is thought unnecessary to a proper understanding of the present invention to describe it in further detail. It will be understood that the burner illustrated is given merely as one example of many burners of the pressure atomizing type, in which the invention may be embodied. The invention does not depend on the constructional details described in connection with the burner and is independent of them.

The invention features a special construction of the air-directing member 20. This member, in the form shown, is roughly cup-shaped, having an annular rear wall 34 disposed transversely of tube 12 and an integral and forwardly projecting annular flange or outer tubular part 35, mounted in spaced coaxial relation with tube 12 and forming an outer annular air pasage 37 of relatively large area. The indenting of the front face of this member is largely for the purpose of saving metal and except for the undesirable bulk, the member could be truly cylindrical. Integral vanes 36 project radially outward from the outer periphery of flange 35 at suitably spaced angular intervals and these vanes engage the inner wall of tube 12. These vanes are inclined to the direction of the air flow in tube 12 and substantially of spiral form. They operate, as is well understood in the art, to whirl the air passing through the passage 37. The wall 34 is bored out to receive a tube 38 having an internal diameter greater than the support 11, which passes through it in coaxial relation, whereby an inner air passage 39 of annular form is provided. This passage 39 is relatively small in cross sectional area as compared to passage 37 and only a small portion of the air supply passes through it. The outlet end of the inner air tube 38 has fixed thereto a deflector or nozzle 40 to direct the inner annular air stream toward the oil spray. The tube 38 is adjustable longitudinally in the air director and is held in adjusted position by a set screw 41 (Fig. 1). The nozzle support 11 is supported at its forward and nozzle-bearing end and centered in the tube 38 by three fins 42 which extend radially inward from the tube and engage the cylindrical part 43 of the support 11. The shoulder 44 on support 11 is adapted to abut the ends of vanes 42 as shown. The vanes 42, as herein shown, are straight and parallel to the direction of air flow in tube 12.

In operation, the oil supplied under high pressure to nozzle 10 is emitted from the latter in the form of a spray of very finely divided particles and in substantially the shape of a hollow cone. Actually, the spray is almost like a mist or fog. Surrounding that portion of the spray which is visible, is a zone of invisible spray and the spark from the ignition electrodes usually extends only into the zone of this halo-like invisible spray. Ignition occurs initially in this zone rather than in the visible part of the spray. The arc-like spark from the electrodes is distended by the outer air stream and blown into the invisible oil spray. The latter ignites in a flash which is almost instantaneously transmitted to the visible spray to ignite the latter. The oil issuing from nozzle 10 rapidly expands and would spread out radially to a large extent except for the action of the two air streams. The oil spray, initially in the form of a hollow cone, is subjected first to the action of the inner air stream which envelops it at a location very close to the tip of nozzle 10. This inner stream initially is of relatively high velocity and acts to shape the oil spray and prevent undue radial spreading thereof. The forward course of the inner air stream is shown by the arrows 45 in Fig. 2. Some mixing of air and oil occurs here but the mixture is necessarily rich because the air supply is small. The inner air stream, after it leaves the air nozzle 40, rapidly expands and is soon dissipated so that its effectiveness in holding the flame within bounds is very soon lost. The outer air stream is then made to act on the flame and confine it within bounds in a novel manner.

The outer stream is caused by the vanes 36 to whirl or rotate and envelop the flame. The outer and whirling air stream at the point of its emission (at the forward end face of tubular part 35) is spaced radially a substantial distance from the inner air stream, and there is a substantial space between these streams. Therefore, the outer air stream, in part, expands radially inward toward tube 38 and flows forwardly along the same (as indicated in Fig. 2 by the arrows 46) and then inwardly along the outer surface of nozzle 40 to meet the flame at a point close to the outlet of nozzle 40, or at about the point where the inner air stream loses its effectiveness on the flame. This action is, we believe, a very important factor contributing to the exceptional results in combustion which are secured from this burner. A portion of the whirling outer air stream is made to act on the flame in a zone intermediate the two zones where the inner and outer air streams would act in a burner of conventional form. This portion of the outer air stream is made to whirl the gasified oil in the zone where the whirling has heretofore been effected by vanes in the inner air passage. Thus, one set of vanes accomplishes the work of the two sets often used. The result is a necking down of the flame into more or less cylindrical form for a short distance, as illustrated at 47,—say a little beyond the outlet end of deflector 13. The zone between the latter and the nozzle is one of ignition and gasification. Here, the oil is gasified, as it must be in order to burn, and combustion for the most part occurs beyond the deflector 13. Therefore, the part of the outer air stream which expands as described, acts on the gasified oil in the gas zone, whirling it around and around to improve the mixture and hold the flame confined in the shape shown. Necessarily, this air has relatively low velocity in a forward direction because it is travelling in a spiral path and because it has expanded in a radial direction. (The arrows show simply the general forward direction of the air and no attempt has been made to show the actual spiral path of the outer air.) It thus tends to hold the oil longer in the zone of gasification and thereby much better and more thorough gasification and mixture occur, as is evidenced by the bluish color of the flame in this zone. The oil is slowed up in its forward travel long enough to enable thorough gasification to occur. Naturally a condition of partial vacuum exists in the space between the outlets of the two air streams and this has a retarding effect on the flame and also tends to prevent it from drifting away from the nozzle 10, thus resulting in a very quiet and stable flame. The outer portion of the outer air stream follows the usual course (indicated roughly by the arrows 48) and meets and envelops the flame out-

side the nozzle 13, supplying the air to support combustion of the gasified oil. In the zone outside the nozzle 13, which is the primary combustion zone, the flame is whitish and it terminates in the secondary combustion zone (not shown) with orange colored tips,—an indication of the proper amount of air supply. The flame has a hollow center 50 in which there is some recycling of the products of combustion and here there is also a certain amount of turbulence indicated at 51.

It is to be particularly noted that the arrangement described results in a very effective and graded air distribution. Instead of concentrating the air supply at two fixed zones, some of the air of the outer air stream is fed to the flame at various points between these zones, thus distributing the air along the flame to secure progressive combustion.

The air directing means also is effective over a wide range. Its construction is such that the results described are obtained with such means independently of the amount of oil burned and the velocity of the air, over a considerable range.

The arrangement also results in better combustion due to a more thorough gasification and a more thorough and uniform mixing of the air and oil. A flame of higher temperature is secured,—a highly radiant one and one of short bushy character. The flame is exceedingly stable and quiet. Ignition is sure and carbonization is reduced to a degree where it is practically negligible. Efficiency of combustion is very much improved as proved by actual tests.

The relative longitudinal positions of the nozzle 10, cone 40, air director 20 and deflector 13 may be varied within limits and, by so doing, variations can be effected in the shape of the flame. The illustrated relationship between these parts is what we consider to be the best and most effective. The assembly of nozzle 10, cone 40 and air director 20 may be moved longitudinally relatively to deflector 13, as by loosening screws 19 (Fig. 1) and pushing rods 18 more deeply into their sockets in head 16 or pulling them out farther in such sockets. If such assembly is moved toward deflector 13, the flame is widened very decidedly and if moved backwardly, the flame is narrowed slightly. The cone 40 and nozzle 10 may be moved relatively to the air director 20 and deflector 13. To do this, screws 28 and 41 are loosened, tube 40 is pushed back or pulled out to the desired degree in member 20, and support 11 is moved until the shoulder 44 abuts the ends of vanes 42, when the nozzle 10 and cone 40 will be in the same relationship as formerly. The effect of such movement, if backward, is to narrow the flame and, if forward, to broaden the flame. The nozzle 10 may be adjusted longitudinally without moving the parts 13, 20 and 40, by loosening the screw 28 and moving the nozzle support 11. The nozzle should not be moved rearwardly from the illustrated position. It might be moved forwardly provided that the locating plan described, involving abutment of shoulder 44 with the ends of vanes 42 were dispensed with. The effect would be to broaden out the flame. Other adjustments may be made, if desired. For example, the element 20 may be moved toward or away from the deflector 13 leaving the cone 40 and nozzle 10 positioned as shown, but the ones above enumerated are the most desirable ones and those usually used.

It should be particularly noted that the means used to space the inner and outer air streams so that part of the outer stream can expand and form an intervening stream of less velocity, enable another desirable result to be obtained. The electrodes and their insulators can be passed through the annular wall 34 and thus kept out of the air passages. Necessarily, if these elements were inserted in air passage 37, they would interfere with the equal distribution of air flow to the flame. By the present arrangement, the electrodes and their insulators are kept out of the way where they have no deleterious effect on the air streams.

The inner air stream may be whirled, as by the vanes 49 shown in Fig. 6. The ordinary advantage of whirling this stream has been secured by the arrangement described, whereby the whirling effect of the outer stream is transmitted to a location close to the nozzle where it can do much of the work which would ordinarily be expected of the whirling inner stream. The inner vanes 49 are, therefore, only necessary where a whirling effect of increased intensity is desired. In most cases, we find it preferable to omit vanes 49 because their use results in expanding the flame into saucer-like form, which in most cases is not desired. Where conditions are such as to make a flame of this shape desirable, the vanes 49 can be used to advantage.

The invention provides an improved form of air dividing and directing means in cooperative relation with the oil nozzle and results in a better mixing of the air and oil with resulting greatly improved combustion, and in the production of a flame which is short and bushy in form, consistently steady and stable, quiet, and of excellent quality.

What we claim is:

1. In an oil burner, a tube through which air is supplied and having a contracted outlet end, a nozzle for emitting a substantially conical spray of oil, said nozzle located in said tube near the outlet end thereof, an inner tubular member surrounding said nozzle in spaced relation forming an annular passage through which air flows and from which it is directed to the sprayed oil in a zone near the nozzle, an outer member spaced inwardly from said tube to form an outer annular passage through which air flows to said contracted outlet and is directed to the sprayed oil beyond said zone, a partition connecting said members and blocking flow of air except through said passages, and means for whirling the outer air stream, said passages being radially spaced sufficiently to create a substantial annular space between them into which the inner part of the outer air stream may expand and form an intervening annular air stream of less velocity than the outer part of the outer air stream.

2. In an oil burner, a tube through which air is supplied and having a contracted outlet end, a nozzle for emitting a substantially conical spray of oil, said nozzle located in said tube near the outlet end thereof, an inner tubular member surrounding said nozzle in spaced relation forming an annular passage through which air flows and from which it is directed to the sprayed oil in a zone near the nozzle, an outer member spaced inwardly from said tube to form an outer annular passage through which air flows to said contracted outlet and is directed to the sprayed oil beyond said zone, a partition connecting said members and blocking flow of air except through said passages, and means for whirling the outer air stream, the outlet end of the outer air passage being substantially separated in a radial direc-

tion and spaced rearwardly in the tube from the outlet end of the inner passage, whereby the whirling outer air stream as it leaves the outlet of the outer air passage may in part expand radially inward and mix with the sprayed oil in a zone adjacent the outlet of the inner air passage.

3. In an oil burner, a tube through which air is supplied and having a contracted outlet end, a nozzle for emitting a substantially conical spray of oil, said nozzle located in said tube near the outlet end thereof, an inner tubular member surrounding said nozzle in spaced relation forming an annular passage through which air flows and from which it is directed to the sprayed oil in a zone near the nozzle, an outer member spaced inwardly from said tube to form an outer annular passage through which air flows to said contracted outlet and is directed to the sprayed oil beyond said zone, and a partition connecting said members and blocking flow of air except through said passages, said passages being radially spaced sufficiently to create a substantial annular space between them into which the inner part of the outer air stream may expand and form an intervening annular air stream of less velocity than the outer part of the outer air stream.

4. In an oil burner, a tube through which air is supplied and having a contracted outlet end, a nozzle for emitting a substantially conical spray of oil, said nozzle located in said tube near the outlet end thereof, an inner tubular member surrounding said nozzle in spaced relation forming an annular passage through which air flows and from which it is directed to the sprayed oil in a zone near the nozzle, an outer member spaced inwardly from said tube to form an outer annular passage through which air flows to said contracted outlet and is directed to the sprayed oil beyond said zone, and a partition connecting said members and blocking flow of air except through said passages, the outlet end of the outer air passage being substantially separated in a radial direction and spaced rearwardly in the tube from the outlet end of the inner passage, whereby the outer air stream as it leaves the outlet of the outer air passage may in part expand radially inward and mix with the sprayed oil in a zone adjacent the outlet of the inner air passage.

JOHN SMITH.
VIRGIL E. DUEMLER.