

Dec. 21, 1965

J. C. H. PARIS  
OIL BURNER APPARATUS

3,224,682

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2 Sheets-Sheet 1

Fig. 1

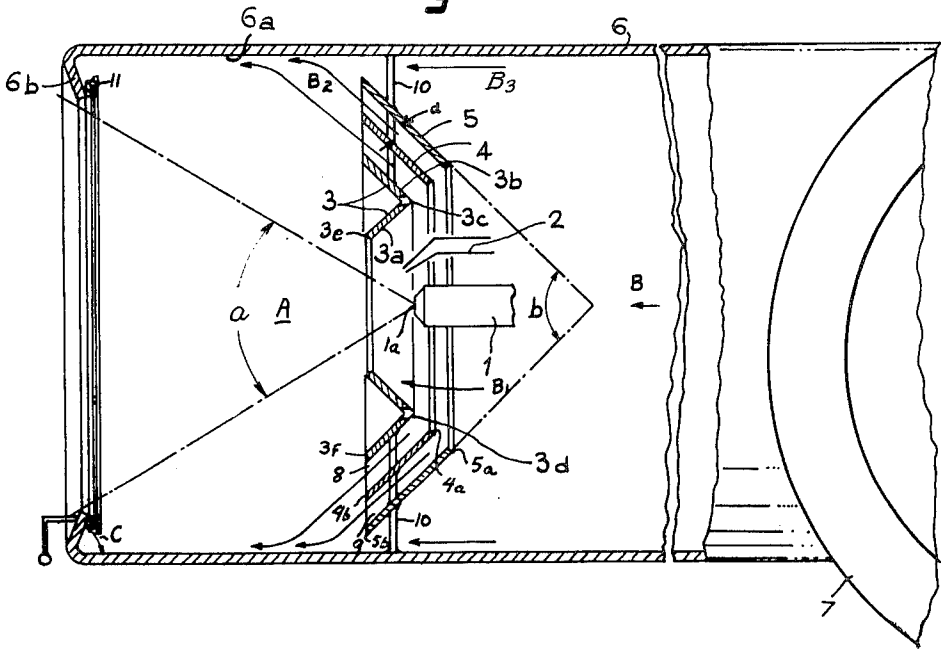
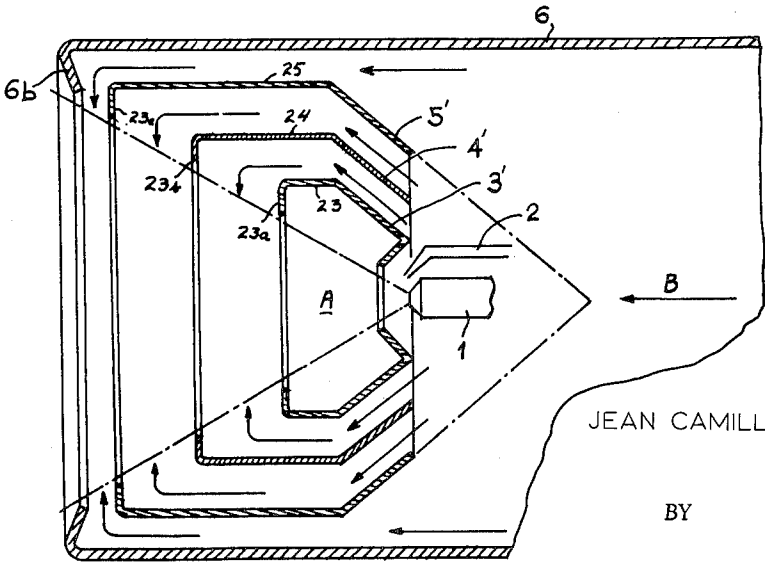


Fig. 2



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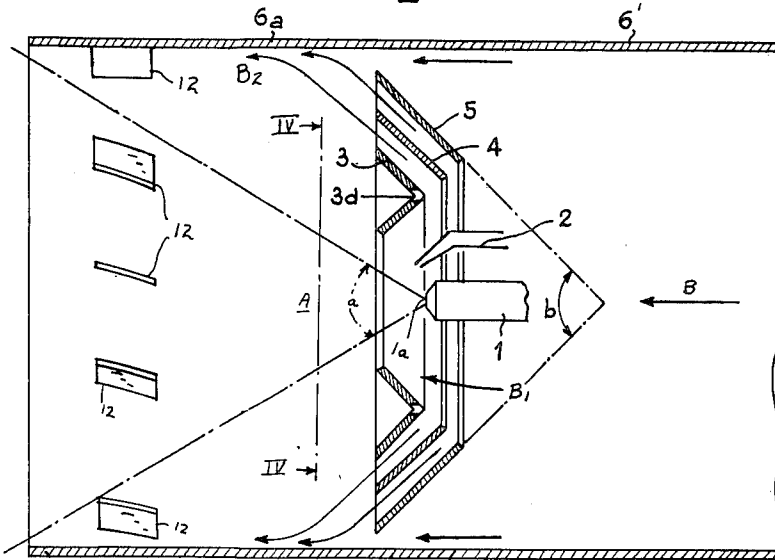
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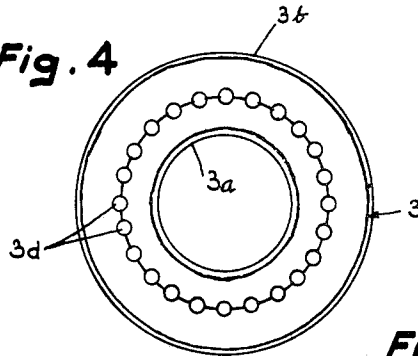
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2 Sheets-Sheet 2

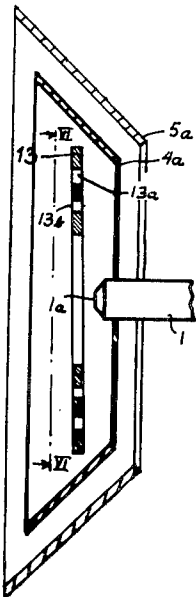
**Fig. 3**



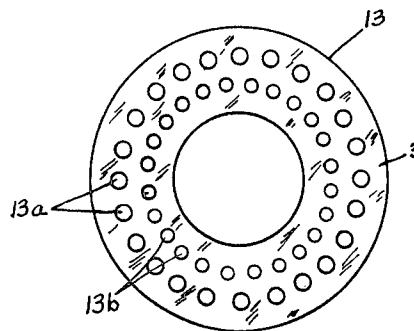
**Fig. 4**



**Fig. 5**



**Fig. 6**



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## OIL BURNER APPARATUS

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860,596; Nov. 17, 1961, 879,264

6 Claims. (Cl. 239—427.3)

My present invention relates to a device, such as an oil burner, in which streams of two fluids are to be intimately commingled within a mixing chamber.

An object of this invention is to provide an improved mixing device of this character adapted to insure a thorough intermingling of the particles, e.g. as required in a burner designed to operate with a silent, substantially soot-free flame.

I have found, in accordance with the instant invention, that this object can be realized in a simple and effective manner by the provision of a set of annular baffles spacedly surrounding the outlet end of a nozzle within a substantially but not necessarily exactly cylindrical shell having an open end beyond the nozzle outlet, these baffles forming one or more outwardly diverging channels for a fluid (such as combustion air) to be admixed with another fluid (e.g. fuel oil) discharged in a substantially conical stream from the nozzle. The baffles, being centrally symmetrical, serve to suppress turbulence at the nozzle by dividing the air flow into a primary branch hugging the nozzle and a secondary branch directed outwardly toward the inner shell wall by way of the aforementioned channel or channels, the latter air flow being ultimately combined with the conical nozzle spray at a location closer to the open end of the shell so that substantially the entire air input is utilized without losses. If the nozzle and the shell are so dimensioned that the conical spray reaches the shell wall ahead of the open end, the outwardly diverted secondary air flow may have sufficient force to penetrate the cone of rarefied fuel in the zone of intersection; otherwise it will be desirable to provide special deflecting means, such as an intumed ledge at the open end of the shell, for directing this secondary air toward the cone axis. The number of baffles may vary with the dimensions of the burner, yet they preferably include an inner baffle and at least two outer baffles with axially and radially staggered edges facing the oncoming air flow.

The invention will be described hereafter with reference to the accompanying drawing in which:

FIG. 1 is a side-elevation view, partly in longitudinal section, of an oil burner embodying the invention;

FIG. 2 is a sectional view similar to that of FIG. 1, illustrating a modification;

FIG. 3 is a view similar to FIG. 2 showing a further modification;

FIG. 4 is a view taken on line IV—IV of FIG. 3;

FIG. 5 is a fragmentary sectional view similar to that of FIG. 3 but showing still another embodiment; and

FIG. 6 is a view taken on line VI—VI of FIG. 5.

In FIG. 1 I have shown an oil burner comprising a conventional nozzle 1 forming the terminal part of a conduit which extends from a controllable source (not shown) of fuel oil under pressure. Nozzle 1 is coaxially surrounded by a cylindrical shell 6 and has an outlet 1a designed to emit a stream of atomized fuel oil A in a conical spray with apex angle  $\alpha$  toward the open end of the shell. An air stream B directed toward that open end is created within the shell 6 by suitable forced-circulation means such as a blower 7.

A set of annular baffles 3, 4 and 5 are coaxially disposed in the path of the air flow B between the nozzle 1

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and the shell 6. The innermost baffle 3 is of V-shaped cross-section so as to form a converging inner surface 3a and a diverging outer surface 3b. The vertex of the V, pointing in the upstream direction of flow, forms a sharp annular ridge 3c substantially in the plane of the nozzle outlet 1a. The baffle 3 is also advantageously provided with peripherally spaced perforations 3d to help create some circulation in the forward space within the V (see also FIGS. 3 and 4). The outer baffles 4 and 5 are of frustoconical shape and lie parallel to the diverging surface 3b of inner baffle 3. Thus there are defined between the baffles 3, 4 and 5 a pair of diverging annular channels 8 and 9, the apex angle of these channels and of the conically diverging surfaces of baffles 3, 4 and 5 having been designated  $b$ . The baffles are fixedly supported from the shell 6 by suitable stays 10 of small air resistance so as to be spaced from the nozzle 1 and the shell 6 to provide additional air passage. A pair of spark electrodes 2, energizable over an ignition circuit not further illustrated, are disposed in the space between nozzle 1a and baffle surface 3a to light the flame of the burner.

The outer baffles 4 and 5 have upstream edges 4a and 5a which are relatively offset in axial and radial direction so that the air layers deviated into the channels 8 and 9 are of substantially constant width  $d$ ; thus, the radial staggering of these edges relatively to each other and to ridge 3c may be such that, as shown, they lie on a rearward extension of the forwardly converging surface 3a. It is not absolutely necessary that the downstream edges 3e, 3f, 4b, 5b of the three baffles terminate all in the same plane as shown in FIG. 1; channels 8 and 9 should, however, be long enough to prevent the flow of any air therethrough in the axial direction.

In operation, the oncoming air divides at ridge 3c substantially without turbulence into a primary flow  $B_1$  deflected inwardly by baffle surface 3a, a secondary flow  $B_2$  directed outwardly by baffles 3b, 4 and 5, and a third flow  $B_3$  passing directly from source 7 through the annular clearance between baffle 5 and shell 6. Whereas the primary flow  $B_1$  joins the fuel spray A in the vicinity of nozzle outlet 1a, the secondary flow  $B_2$  passes together with the third flow  $B_3$  along the inner wall 6a of shell 6 until it strikes an intumed ledge 6b of the shell at the open end thereof and is deflected inwardly and slightly rearwardly toward the axis of cone A. Ledge 6b forms with shell wall 6a a rounded corner whose angle  $c$  may be close to  $90^\circ$ , as shown, though it could also be an obtuse angle.

It will be apparent that the converging surface 3a of baffle 3 promotes the circulation of air in the vicinity of nozzle 3 in a sense counteracting the suction created by air flow  $B_2$  so as to minimize or prevent carbonization of both the nozzle outlet 1a and the baffle surface 3b. The air flow past the baffles 3 to 5 will be substantially laminar since the diversion of the secondary air through channels 8 and 9 reduces the possibility of turbulence within an axial plane. If desired, however, a certain rotary twist may be imparted to the air stream  $B_2$  by means of suitable vanes as described hereinafter with reference to FIG. 3. Substantially all the air delivered by blower 7 will be admixed with the fuel spray A, partly directly via path  $B_1$  and partly over the circuitous path  $B_2$ , so that the burner will operate at maximum efficiency. The flame maintained forwardly of nozzle 1 will be detached from its outlet 1a by the flow-directing action of baffle surface 3a.

The intensity and character of the flame will, of course, be controlled by the rates by which air and fuel are delivered to the interior of shell 6 and nozzle 1, respectively. In many instances it will also be advantageous to be able to control the size of the flame by changing the width of

the discharge end of the shell, e.g. with the aid of a manually controllable iris-type diaphragm 11.

In FIG. 2 I have shown an otherwise identical burner in which the baffles 3', 4', 5' have tubular extensions 23, 24, 25 with inturned ledges 23a, 23b, 23c terminating along the periphery of the cone A to discharge the secondary air substantially radially into the cone.

FIG. 3 illustrates the possibility of omitting the deflecting edge 6b of the previous embodiments, the nozzle outlet 1a being here so designed that the diameter of the cone A at the mouth of shell 6' equals substantially the shell diameter. Thus the axially flowing secondary air B<sub>2</sub> mingles with the fuel spray of cone A at a location where this spray is substantially attenuated so as to be readily penetrated by the air. FIG. 3 also illustrates the provision of vanes 12 for setting the air flow B<sub>2</sub> in rotation about the axis of the cone A.

In certain cases, particularly with a high-power blower, it will be desirable to replace the baffle 3 or 3' of the preceding embodiments by an annular disk 13 positioned forwardly of the upstream edges 4a, 5a of the outer baffles 4 and 5 (or their modifications 4' and 5'). This has been illustrated in FIGS. 5 and 6 which also show two circular arrays of perforations 13a, 13b provided in the baffle plate 13 for the purpose mentioned in connection with perforations 3d. With baffle plate 13 disposed slightly downstream of the nozzle outlet 1a, the flame will again be detached from the nozzle to avoid the deposit of soot thereon. The system operates otherwise in substantially the manner previously described.

Further modifications of the arrangement described and illustrated, including substitutions and combinations of compatible features from different embodiments, are of course possible and are intended to be included in the spirit and scope of the invention as defined in the appended claims.

I claim:

1. In an oil burner, in combination, a substantially cylindrical shell having an open end, a source of axial air flow opening into said shell at a location forwardly of said open end and trained toward the latter, fuel-supply means including a tubular nozzle extending axially within said shell at a location intermediate said source and said open end, said nozzle having an outlet disposed ahead of said open end for discharging a substantially conical stream of atomized fuel toward said open end and centrally symmetrical annular baffle means spacedly surrounding said nozzle in the region of said outlet for intercepting an outer part of said air flow and deflecting it outwardly toward the inner wall of said shell while giving passage to a nonrotating inner part of said air flow through an annular clearance separating said baffle means from said nozzle whereby said inner part mingles with said conical fuel stream just beyond said outlet, said baffle means having a forwardly converging inner frustoconical surface for guiding said inner part toward the nozzle axis and at least one forwardly diverging outer frustoconical surface for directing said outer part as a diverging laminar flow toward said inner wall and thence as a cylindrical flow coaxial with said inner wall toward said conical fuel stream for intermingling therewith at a location close to said open end and substantially beyond its zone of merger with said inner part, said inner and outer frustoconical surfaces meeting at a flow-dividing ridge facing toward said source.

2. The combination defined in claim 1 wherein said baffle means is provided with an annular array of circular openings along said flow-dividing ridge for giving passage to axial streams of supplemental air around said inner part.

3. The combination defined in claim 1 wherein said ridge is located substantially in the plane of said outlet.

4. In an oil burner, in combination, a substantially cylindrical shell having an open end, a source of axial air flow opening into said shell at a location forwardly of said open end and trained toward the latter, fuel-supply means in-

cluding a tubular nozzle extending axially within said shell at a location intermediate said source and said open end, said nozzle having an outlet disposed ahead of said open end for discharging a substantially conical stream of atomized fuel toward said open end, centrally symmetrical annular baffle means spacedly surrounding said nozzle in the region of said outlet for intercepting an outer part of said air flow and deflecting it outwardly toward the inner wall of said shell while giving passage to a nonrotating inner part of said air flow through an annular clearance separating said baffle means from said nozzle whereby said inner part mingles with said conical fuel stream just beyond said outlet, said baffle means having a forwardly converging inner frustoconical surface for guiding said inner part toward the nozzle axis and at least one forwardly diverging outer frustoconical surface for directing said outer part as a diverging laminar flow toward said inner wall and thence as a cylindrical flow coaxial with said inner wall, and annular guide means within said shell close to said end for deflecting said cylindrical flow radially inwardly toward said conical fuel stream for intermingling therewith at a location substantially beyond its zone of merger with said inner part, said inner and outer frustoconical surfaces meeting at a flow-dividing ridge facing toward said source.

5. In an oil burner, in combination, a substantially cylindrical shell having an open end, a source of axial air flow opening into said shell at a location forwardly of said open end and trained toward the latter, fuel-supply means including a tubular nozzle extending axially within said shell at a location intermediate said source and said open end, said nozzle having an outlet disposed ahead of said open end for discharging a substantially conical stream of atomized fuel toward said open end, and a set of coaxial centrally symmetrical annular baffles separated by a first annular clearance from the inner annular wall of said shell and spacedly surrounding said nozzle in the region of said outlet for intercepting an intermediate part of said air flow and deflecting it outwardly toward the inner wall of said shell while giving passage to an outer part of said air flow through said first clearance and to a nonrotating inner part of said air flow through a second annular clearance separating said baffles from said nozzle whereby said inner part mingles with said conical fuel stream just beyond said outlet, said baffles including an inner baffle with a forwardly converging frustoconical surface for guiding said inner part toward the nozzle axis, said baffles further including several concentric outer baffles with parallel frustoconical surfaces defining a plurality of juxtaposed frustoconical channels for directing said intermediate part as a plurality of parallel laminar flows of outwardly diverging shape toward said inner wall, and thence together with said outer part as a cylindrical flow coaxial with said inner wall toward said conical fuel stream for intermingling therewith at a location close to said open end and substantially beyond its zone of merger with said inner part, said inner baffle and the innermost outer baffle meeting at a flow-dividing ridge facing toward said source.

6. In an oil burner, in combination, a substantially cylindrical shell having an open end, a source of axial air flow opening into said shell at a location forwardly of said open end and trained toward the latter, fuel-supply means including a tubular nozzle extending axially within said shell at a location intermediate said source and said open end, said nozzle having an outlet disposed ahead of said open end for discharging a substantially conical stream of atomized fuel toward said open end, a set of coaxial centrally symmetrical annular baffles separated by a first annular clearance from the inner annular wall of said shell and spacedly surrounding said nozzle in the region of said outlet for intercepting an intermediate part of said air flow and deflecting it outwardly toward the inner wall of said shell while giving passage to an outer part of said air flow through said first clearance and to a nonrotating inner

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part of said air flow through a second annular clearance separating said baffles from said nozzles whereby said inner part mingles with said conical fuel stream just beyond said outlet, said baffles including an inner baffle with a forwardly converging frustoconical surface for guiding said inner part toward the nozzle axis, said baffles further including several concentric outer baffles with parallel frustoconical surfaces defining a plurality of juxtaposed frustoconical channels for directing said intermediate part as a plurality of parallel laminar flows of outwardly diverging shape toward said inner wall, and annular guide means within said shell close to said end for deflecting said cylindrical flow radially inwardly and thence together with said outer part as a cylindrical flow coaxial with said inner wall toward said conical fuel stream for intermingling therewith at a location substantially beyond its zone of merger with said inner part, said inner baffle and the innermost outer baffle meeting at a flow-dividing ridge facing toward said source.

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