

July 10, 1951

W. J. BLOOMER

2,560,069

MIXER

Filed Feb. 21, 1946

2 Sheets-Sheet 1

Fig. 1.

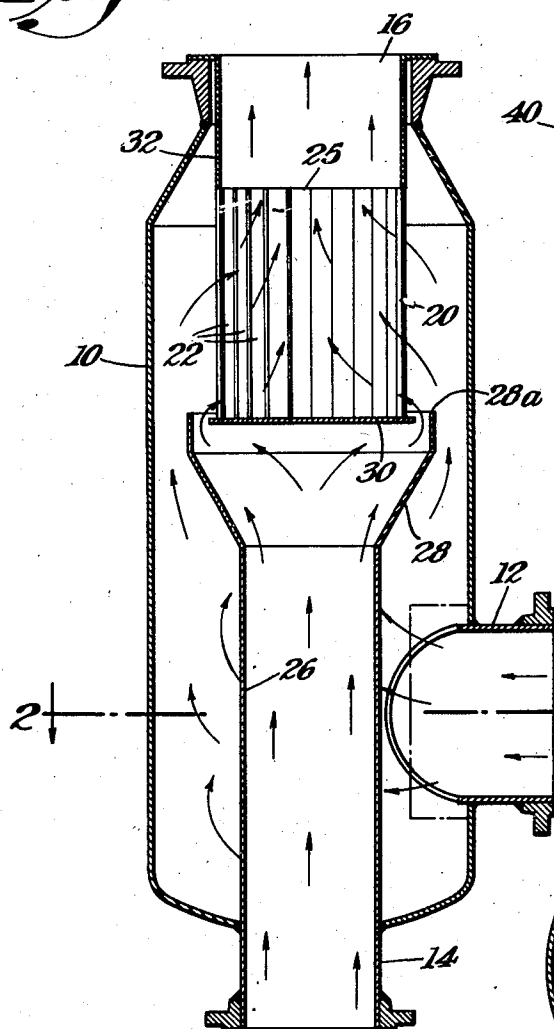


Fig. 3.

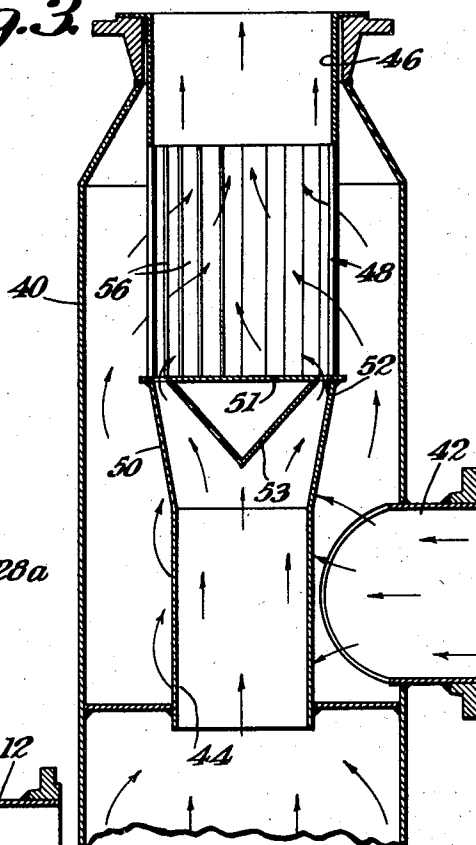
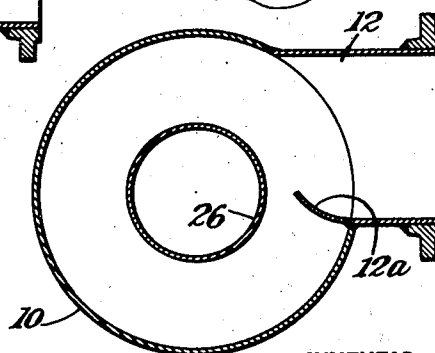


Fig. 2.



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Fig. 4.

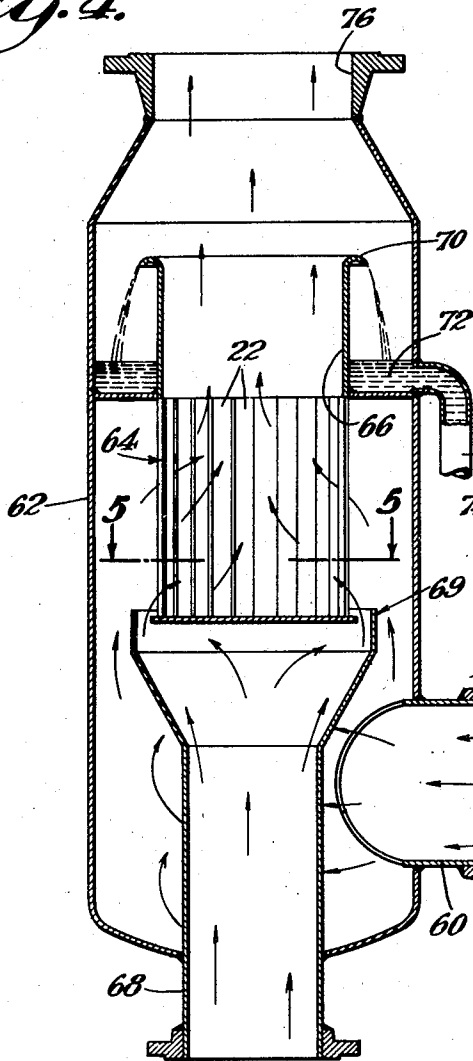


Fig. 6.

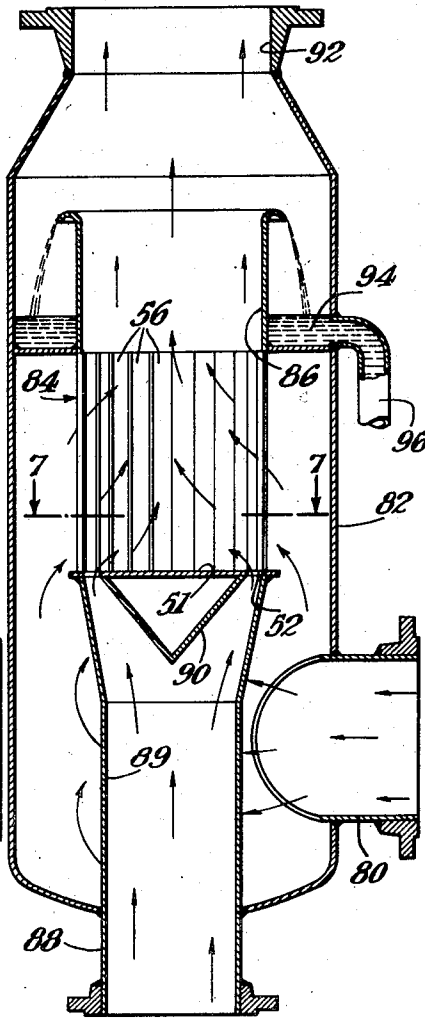


Fig. 5.

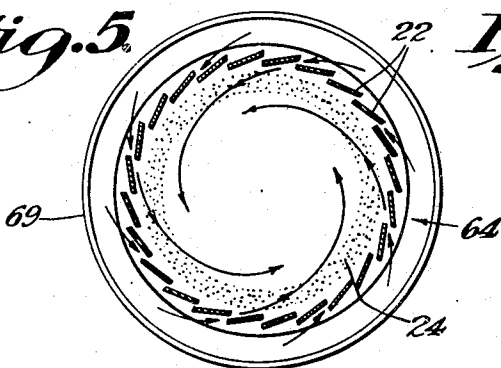
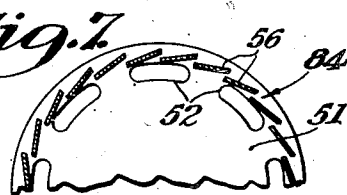


Fig. 7.



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UNITED STATES PATENT OFFICE

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Application February 21, 1946, Serial No. 649,203

3 Claims. (Cl. 48—180)

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This invention relates to the contacting of various fluid materials one with another and more particularly to the provision of a new and improved apparatus for accomplishing such contact or mixing.

In my co-pending application, Serial No. 550,933, filed August 24, 1944, and abandoned on February 3, 1949, in favor of Serial No. 66,445, filed December 21, 1948, I have disclosed a novel form of mixer or contact device which is particularly adapted for the burning of fuel. By the provision of a suitable tuyère I have found it possible to obtain extremely intimate and complete mixing of liquids and fluids with air to provide a combustible mixture.

My present invention applies the principles therein disclosed to the broader field of mixing which is most effectively accomplished by a somewhat similar type of tuyère when fed with a fluid mass substantially in accordance with the broad principles described in my prior application.

One of the principal objects of the present invention is to provide a fluid mixing apparatus which is adapted to intimately mix two or more fluid materials, one or more of which may be gaseous, liquid or a fluidized solid.

Another object of the invention is to provide a highly intimate mixing of fluid materials in which proportionate amounts of the various materials may be carefully controlled with a resulting intimacy of mixing or chemical reaction as may be required.

More specifically, my invention relates to the mixing of air and naphthalene mixtures in predetermined proportions and with a relative economy of operation otherwise not obtainable.

Further objects and advantages of the invention will clearly appear from the following description of a preferred form of embodiment thereof taken in connection with the attached drawing in which:

Fig. 1 is a substantially central vertical section of one form of contacting apparatus particularly adapted for air naphthalene mixing and contacting.

Fig. 2 is a horizontal section taken substantially on the line 2—2 of Fig. 1.

Fig. 3 is a central vertical section of a modified form of contacting apparatus.

Fig. 4 is a central vertical section of a different form of contacting apparatus in which a liquid is separately drawn off.

Fig. 5 is a horizontal section taken substantially along the line 5—5 of Fig. 4.

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Fig. 6 is a substantially vertical central section of a modified form of construction of the general type shown in Fig. 4.

Fig. 7 is a partially horizontal section taken substantially on the line 7—7 of Fig. 6.

In accordance with the preferred form of embodiment of my invention, the apparatus shown in Fig. 1 is preferably a contact or mixing apparatus adapted to bring together in most intimate relation one or more fluid or fluidized substances. Generally, the apparatus includes a casing 10 which is conveniently cylindrical and preferably vertical, which has a first fluid inlet at 12 and a second inlet at 14. The outlet nozzle is indicated at 16.

The principal element within the casing 10 is a tuyère, generally indicated at 20, and consisting mainly of a cylindrical cage of spaced and similarly inclined, angularly arranged, vertical blades 22 forming inwardly convergent gas paths, as more generally shown in Fig. 5. These form a hollow cylindrical element which is conveniently spaced within the casing 10 in such a manner that a fluid entering at 12 must pass through the tuyère blades on the way to the outlet at 16.

This arrangement is such that a highly developed envelope of rotation of the fluid results from the centrifugal effect of the blades, and as shown in Fig. 5, this envelope 24 is hollow. I also find that this envelope appears to be of generally parabolic shape, having the vertex below the bottom of the tuyère and having a central zone of reduced pressure with a resulting somewhat dense inner surface or wall.

The combined rotation and continued feeding of the fluid through the inlet 12 thus forces the fluid in a helical path out of the tuyère and through the outlet 16.

In accordance with my discovery of this extremely dense inner envelope surface, I find it essential in mixing a second fluid with the first fluid to introduce the second fluid to the envelope at a relatively less dense portion within the inner wall.

As shown in Fig. 1, for example, I provide what I term an "outside" feed, in that I direct the second fluid from inlet 14 through an internal conduit 26 having a bell mouth 28 to a zone adjacent, but overlapping, the bottom edge of tuyère 20. As noted, the edge 28a of the bell mouth 28 longitudinally extends to the closed bottom 30 of the tuyère but is radially spaced therefrom. The secondary fluid, therefore, reaches the lower portion of the tuyère 20 and enters the outer wall of the envelope, passing between the tuyère blades 22

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and immediately becoming a part of the rotating envelope. Preferably the second fluid is under a slight pressure to force it continuously into the envelope, thus preventing any interruption to the rotation of the envelope of fluid.

The continued rotation of the envelope within the tuyère, as previously mentioned, is accomplished mainly by the continuous feed of the first fluid through the inlet 12 and into the tuyère, the outer wall being limited by the inflow of the fluid and thus establishing an equilibrium of envelope which is hollow and shallow. The second fluid which enters the envelope also, soon reaches an equilibrium stage, becoming intermixed with the first fluid. The rate of longitudinal movement of the envelope depends, of course, upon the amount of fluids and the volumetric displacement and can be varied in accordance with the desired time of contact.

If desired, the time of contact may be increased by the use of a chimney section 32 between the end of the tuyère and the outlet 16, or, as will be apparent, the tuyère may extend directly to the top of the outlet, as is more clearly shown in my co-pending application above mentioned.

It may also be desirable to aid the rotatory effect of the first fluid 12 by using a suitable baffle 12a adjacent the inlet nozzle 12 to give the fluid some initial direction of flow.

I find that this type of apparatus is of particular benefit in the mixing of air and naphthalene, and in order to accomplish an intimate mixing of approximately 40,000 lbs. per hour of water saturated air, with approximately 3,000 lbs. of water saturated air entraining approximately 1,500 lbs. per hour of naphthalene, it is estimated that there is approximately 500,000 cubic feet per hour of vapor passing through the blades. Assuming a maximum pressure drop of .25 lb. per square inch and a velocity of 70 feet per second, it will require approximately 103 blades with an 18" tuyère diameter, and the feed pan 28a is approximately 20" in diameter. The casing 10 in such a circumstance would be approximately 24" in diameter.

It is, of course, to be understood that the mixing or contact materials may include liquids, gases, or fluidized solids, and the mixing may be such as above mentioned or it may result in a chemical reaction in which the products are chemically different from those introduced.

A slightly modified form of embodiment of my invention is shown in Fig. 3 in which the casing 40 is provided with a first fluid inlet at 42 substantially as in the prior case, and a second fluid inlet is shown at 44. The outlet is indicated at 46 and the tuyère is generally indicated at 48.

In this case, however, the second feed conduit 50 extends to the bottom of the tuyère, the base 51 of which has a series of annular openings 52, as generally shown in Fig. 7. A baffle 53 placed in the center of the conduit 50 serves to channel the second fluid to these openings. As in the embodiment of Fig. 1, the opening means 52 are in close proximity to the lower inner edges of the blades 56 and form an inside feed to a portion of the envelope which is of low density.

It will be appreciated that the swirling hollow envelope will thus pick up the second fluid which enters at the zone not nearly as dense as the inner surface of the hollow envelope, so that there can be the same continuous rotary helical motion of the two fluids which discharge from the outlet at 46.

A still further modified form of construction is shown in Figs. 4 and 6 which are more particular-

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ly adapted to an adsorption process wherein a gas supplied through the inlet 60 to the casing 62, passes upwardly through the blades of the tuyère generally indicated at 64, and through the chimney 66.

A fluidized solid, such as activated carbon, for example, may enter the second fluid inlet 68, and by the outside feed means generally indicated at 69, will be picked up by the swirling hollow envelope established by the passage of the first fluid through the tuyère, as in the prior case.

If naphthalene be introduced at 60 with the activated carbon suspended in air entering at 68, there will be such an intimate mixing in the tuyère that the naphthalene will be adsorbed in the activated carbon and the fine solids with the adsorbed material will pass over the upper lip 70 of the tuyère chimney 66 and will be collected in the pump 72, where it can be drawn off through the outlet 74. At the same time the dried gas will be discharged through the outlet 76.

In a slightly modified form of construction, as shown in Fig. 6, one fluid introduced through the inlet 80 and to the casing 82, will pass through the tuyère 84 through the chimney portion 86 and will cause the desired intimate mixing with a second fluid entering at 88 and passing through the conduit 89 around the baffle 90 through the openings 92 into the hollow swirling envelope of the first fluid. As in the prior case, the dried material may discharge through the outlet 92 with the liquid portion collected in the sump 94 and drawn off as desired at 96.

It will be apparent that I have provided an improved form of apparatus for the intimate mixing of fluid materials which may or may not be accompanied by the separation of a liquid portion. I find that with a curved lip a liquid portion may be withdrawn without disturbance of continuity of the upward flowing envelope, thereby avoiding forming or other interference.

I therefore consider the apparatus suitable for many uses, of which only a few are described as illustrative.

I claim:

1. A mixer for diluting a first fluid stream with a second fluid stream, which comprises a generally cylindrical casing having an opening at one end; a cylindrical tuyère enclosed by said casing in spaced relation and having an open outer end closely fitting into said casing opening, the inner end of said tuyère being substantially closed, and the lateral wall of said tuyère being formed as a cage of spaced, similarly inclined blades extending longitudinally from said closed inner end and defining inwardly convergent fluid paths, said casing being formed with a first fluid inlet opening positioned inwardly of the inner closed end of said tuyère; and a tubular conduit extending into the other end portion of said casing, said tubular conduit having a circular inner end terminating closely adjacent to and forming with the closed inner end of said tuyère annular opening means extending in close proximity to the adjacent inner ends of said blades to supply a second fluid thereto.

2. A mixer for diluting a first fluid stream with a second fluid stream, which comprises a generally cylindrical casing having an opening at one end; a cylindrical tuyère enclosed by said casing in spaced relation and having an open outer end terminating in a nozzle closely fitting into said casing opening, the inner end of said tuyère being closed, and the lateral wall of said tuyère inward of the nozzle being formed as a cage of

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spaced, similarly inclined blades extending longitudinally from said closed inner end and defining inwardly convergent fluid paths, said casing being formed with a first fluid inlet opening positioned inwardly of the inner closed end of said tuyère; and a tubular conduit extending into the other end portion of said casing, said tubular conduit having a circular inner end extending around the periphery of the closed inner end of said tuyère and forming therewith an annular opening in close proximity to the adjacent inner ends of said blades to supply a second fluid thereto.

3. A mixer for diluting a first fluid stream with a second fluid stream, which comprises a generally cylindrical casing having an opening at one end; a cylindrical tuyère enclosed by said casing in spaced relation and having an open outer end terminating in a nozzle closely fitting into said casing opening, the inner end of said tuyère being closed and formed with an annular series of openings communicating with the inside of the tuyère, and the lateral wall of said tuyère inward of the nozzle being formed as a cage of spaced, similarly inclined blades extending longitudinally from said closed inner end and de-

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fining inwardly convergent fluid paths, said casing being formed with a first fluid inlet opening positioned inwardly of the inner closed end of said tuyère; and a tubular conduit extending into the other end portion of said casing, said tubular conduit having a circular inner end closed by the inner end of said tuyère and surrounding said series of openings to supply a second fluid in close proximity to the adjacent inner ends of said blades.

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