

June 20, 1972

W. G. MEDSKER

3,671,208

FLUID MIXING APPARATUS

Filed Oct. 9, 1970

2 Sheets-Sheet 1

FIG. 1

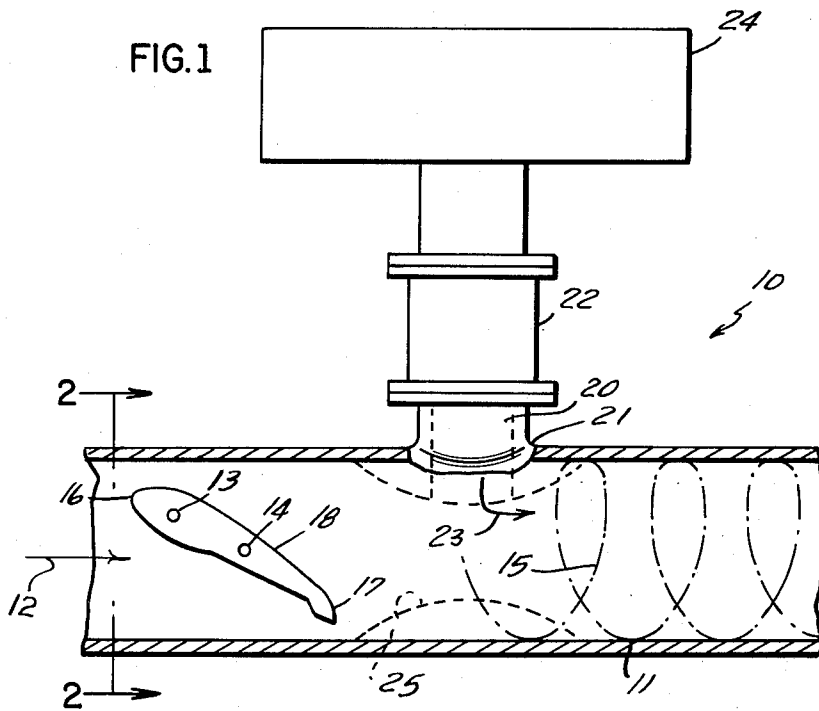


FIG. 2

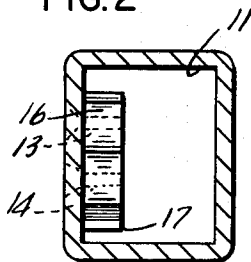


FIG. 3

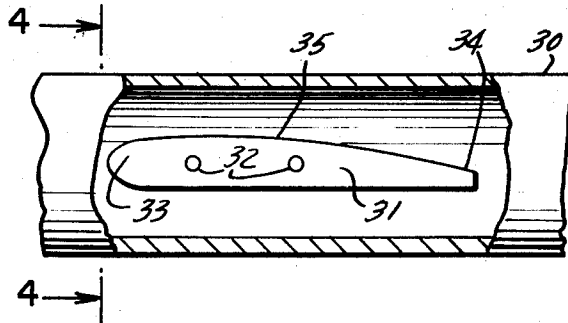


FIG. 5

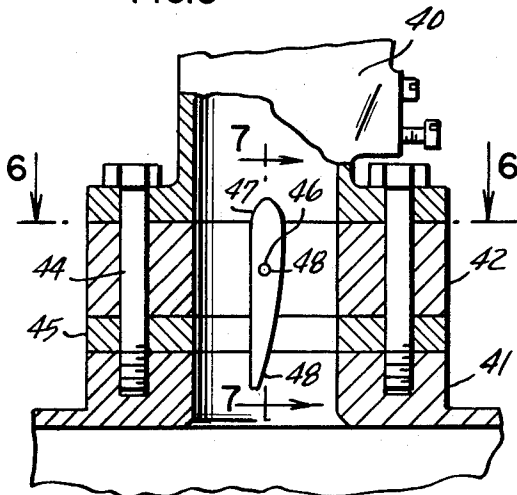
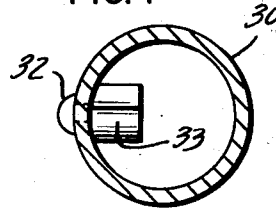


FIG. 4



Wayne G. Medsker  
INVENTOR

By Duckworth & Hobby  
Attorneys

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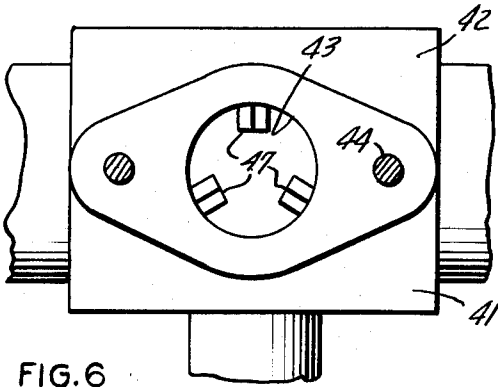


FIG. 6

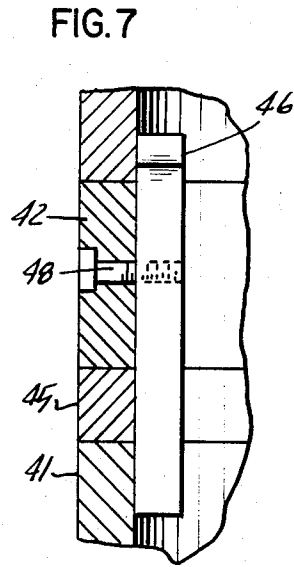


FIG. 7

FIG. 8

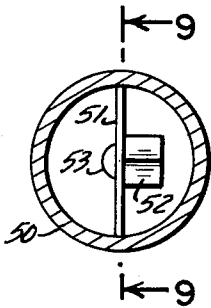


FIG. 9

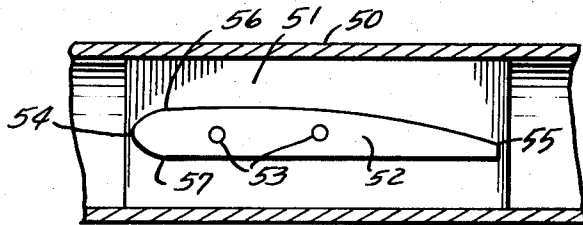


FIG. 10

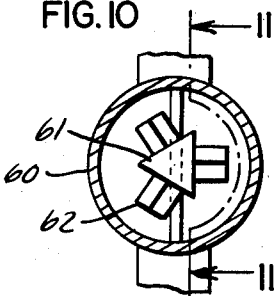
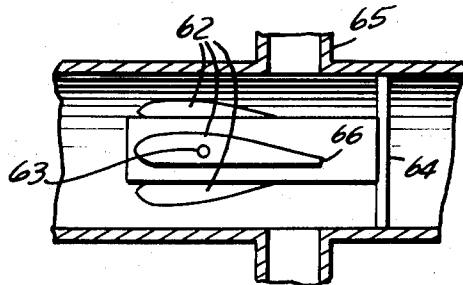


FIG. 11



Wayne G. Medsker  
INVENTOR

By *Duckworth & Hobby*  
Attorneys

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FLUID MIXING APPARATUS

Wayne G. Medsker, Mountain View, Mo. (1321 S. Lakeview, Sturgis, Mich. 49091)

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4 Claims

ABSTRACT OF THE DISCLOSURE

A vortex fluid mixing apparatus is provided for mixing one fluid to another in a conduit or for creating a vortex in fluid passing through a tube breaking up fluid entrained to the sides of the tube. A tube is provided having a fluid vortex mixer attached to the inner surface of the tube for producing a vortex in the fluid passing through the tube. The vortex mixer is an elongated member and is fixedly attached to the inside of a tube either singularly or in plural numbers and may be used in mixing a second fluid with the first by having second fluid enter the tube at the beginning of the vortex being generated and may have a vortex mixer also placed in the feeder tube or may be fed into a venturi in the tube.

BACKGROUND OF THE INVENTION

The present invention relates to fluid mixers and especially to mixers adapted to mix fluids passing through tubes, or the like, and for mixing two or more fluids being combined at junctions in tubes.

In the past it has been conventional practice to produce various circulating, whirling, swirling, or vortexes in fluids passing through conduits passageways such as tubes of all sizes, for mixing the fluids or for generating turbulence in the fluid. One of the most common ways of producing such action in fluid is through movable blades or vanes such as in turbines which may be active by being driven by power source such as an electric motor driving a fan blade, or the like, or which may be passive such as rotating blades or vanes rotated by the fluid passing through the conduit. It has also been suggested to control fluids passing through the tubes with fixed members such as fixed parallel grates or vanes to prevent any swirling motion in the fluid especially in liquids, and it has been common practice to obtain a swirling motion by placing a spiral or twisted member in a tube, dividing the tube into halves or quarters, forcing the liquid to in turn in a circular motion.

The present invention is directed towards a device for mixing gaseous type fluids passing through conduits or tubes in an economical manner utilizing only simple fixed members attached to the inside of the conduit and especially to such a vortex producing device used to mix two or more gaseous fluids by the metering of one of the fluids into the main tube while the main fluid is passing through and which may be used in conjunction with such devices as venturis and aspirators to produce an efficient multiple fluid mixing system.

The present system also have the advantage of breaking up fluids entrained to the inner surface of conduits.

SUMMARY OF THE INVENTION

The present invention relates to a vortex fluid mixing device having a tube, conduit, passageway, or the like, for a fluid to pass through, which tube has a fluid vortex mixing member fixedly attached to the inner surface of the tube, either singularly or in multiples, to produce a vortex in the fluid passing through the tube. Each of the vortex mixers is an elongated member having leading and trailing edges, and having curved portions thereon, and is fixedly attached with a leading edge either directly facing the oncoming fluid or at desired angles for producing a swirling motion in the fluid passing through the tube. One or more additional tubes can be connected to the main tube for metering additional gaseous type fluids into the beginning of the vortex being generated to produce an improved mixing of the fluids being metered into the main tube. The metering can be performed by the venturi appropriately located with or without an aspirator type metering arrangement and can also be improved by having similar vortex mixers placed in the metering tubes so that a pair of vortexes meet at the mixing junction. The present invention is well suited for mixing fluids and for use in devices such as carburetion systems for internal combustion engines, and the like.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features and advantages of this invention will be apparent from a study of the written description of the drawings in which:

FIG. 1 illustrates a preferred embodiment of the present invention;

FIG. 2 is a sectional view taken along line 2-2 of FIG. 1;

FIG. 3 illustrates a second embodiment of the present invention;

FIG. 4 is a sectional view taken along line 4-4 of FIG. 3;

FIG. 5 is a sectional view of an embodiment of the present invention placed in the manifold of an internal combustion engine;

FIG. 6 is a view taken along line 6-6 of FIG. 5;

FIG. 7 is a view taken along line 7-7 of FIG. 5;

FIG. 8 is a cross sectional view of an embodiment placed on a separate holding member;

FIG. 9 is a sectional view taken along line 9-9 of FIG. 8;

FIG. 10 is a cross sectional view of another embodiment; and

FIG. 11 is a sectional view taken along line 11-11 of FIG. 10.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1, the vortex fluid mixing device 10 is illustrated having a main tube or conduit 11 for passage of fluid in the direction of the arrow 12 and having a portion of the passageway 11 removed to show the fluid vortex mixer 13 fixedly attached to the inside of a tube 11 by bolts 14. It will of course be clear that the mixer 13 can be held to the side of tube 11 in any desired manner, such as welding, riveting or bolting, and which member generates a vortex in the fluid passing through the

tube 11, as illustrated by the lines 15. The mixer 13 has a leading edge 16 with a curved surface and trailing edge 17 with a curved surface but with an arced tail and is generally an elongated body with an elongated curved surface 18 between leading edge 16 and trailing edge 17. A metering conduit 20 is connected to tube 11 at 21 and has a metering valve 22 therein for metering a second fluid as illustrated by the arrow 23 into the first fluid at the beginning of the vortex 15. Fluid is fed to valve 22 from a tank 24. It will of course be clear that the liquid could also be metered into the tube 11 by the use of an aspirator designed to meter the fluid at a desired rate, which could be used in conjunction with a venturi illustrated by dotted lines 25, which venturi of course provides increased velocity with reduced pressure of the fluid passing through the tube 11, which by aspiration can draw a fluid from a pipe such as 20 having a nozzle 21 into tube 11 at a predetermined rate.

It should also be pointed out at this point that more than one connecting tube 20 can also be fed into tube 11 simultaneously and that the system has the flexibility to improve mixing by way of a second fluid vortex mixer 13 in the tube 20 just prior to entering tube 11 at 21 to produce a swirling motion in the fluid being metered into tube 11 so that the tube vortexes engage each other at their beginning to produce mixing of the fluids. The present invention is described in connection with fluids in their gaseous state such as air, carbon dioxide or similar type gases, but it is not intended to be limited to fluids in their gaseous state and operated equally well with liquid type fluids.

FIG. 2 shows conduit 11 to be of a rectangular or square variety, but this is not important to the invention which could have a tube of any desired shape. It also illustrates a cross section of the mixing member 13 along with the bolts 14 attaching and mixing member 13 to interior wall to conduit 11.

FIGS. 3 and 4 illustrate a second embodiment of the present invention having a tube 30 with a fluid vortex mixer 31 attached to the interior walls by bolts 32. The tube 30 is a circular passageway as distinguished from the embodiment in FIGS. 1 and 2 and also has a different shape mixer 31 with a leading edge 33 and a trailing edge 34 with a curved surface therebetween 35, having a different shape but still being elongated but without the arced tail illustrated in FIG. 1. This embodiment has mixer 31 aligned in a generally parallel position to the axis of the conduit 30 but it has also been found slight variations in angle will still produce the desired swirling action of fluids passing through the conduit 30.

Turning now to FIGS. 5-7, an embodiment of the present invention is illustrated having a carburetor 40 for an internal combustion type engine connected to the intake manifold 41 with an adapter 42, having a conduit or passageway 43 therein connected between the carburetor 40 and the intake manifold 41 by bolts 44 and having an insulator 45 placed between the adapter 42 and the intake manifold 41 to isolate the heat of the intake manifold from the carburetor and from the adapter 42. The adapter 42 has a plurality for vortex mixers 46 in accordance with the present invention placed therein which may extend into the carburetor and manifold as desired but need not necessarily do so. The vortex mixers have leading edges 47 of a curved nature and are elongated members with trailing edges 48 which are generally narrower than leading edge 47.

FIGS. 6 and 7 will show the fluid mixer in this embodiment to be of the type illustrated in FIGS. 3 and 4 and to use three such vortexes. These mixers reduce the area of the intake manifold at the point they are placed and produce a venturi action if they are of sufficient size and numbers which increases the vortex within the passageways. Each vortex member 46 is held to the adapter 42 by bolts 48, but again it will be clear that other types of attachments could be used for the vortex mixers 46, 75

such as spotwelds or even being cast directly into the adapter 42 or manifold.

Referring now to FIGS. 8 and 9, an embodiment of the present invention is illustrated in a tube 50 having a dividing member 51 passing therethrough with the fluid vortex generator 52 attached thereto by screws 53. Vortex generating member 52 has a curved leading edge 54 and a trailing edge 55 with one side 56 having a generally curved shape of a greater length between the leading edge 54 and the trailing edge 55 than the other side 57.

FIGS. 10 and 11 illustrate an embodiment similar to that in FIGS. 8 and 9 except with a tube 60 having a triangular shaped center member 61 held in the middle of the tube and with three vortex generating members 62 attached to member 61. Each vortex generating member 62 is attached to center member 61 by bolts 63 and is otherwise similar in shape to the previous embodiments. Center member 61 can be held by bars 64 or any similar means and input tubes 65 may enter towards the trailing edge 66 of the vortex generating members 62 from any of the different sides.

The present invention has been demonstrated to be well suited for use in the intake and exhaust systems of internal combustion engines and may be placed in the air filter or in the intake manifolds, and in the tailpipes of the automobile to improve the fluid flow within the systems, and may also be utilized in mixing two or more fluids together for metering one fluid into another. It has also been successfully tested for improving the action of liquid and gaseous fluids and in fire extinguishers utilizing CO<sub>2</sub> for extending the range and spread in these fire extinguishers. It is not intended that the present invention be limited to particular sizes or shapes but for illustrative purposes the vortex mixing members generally produce a low pressure area on one side with the high pressure area on the other to produce the rotation at the opposite end of the mixing members. This requires one surface having more of a curvature than the other and will be varied in size in accordance with the size of the conduit that it is placed in and the number of such mixers placed in the conduit. One such system that I have used successfully in a one inch diameter pipe provided a mixer that extended approximately  $\frac{5}{16}$  of an inch above the wall it was attached to and reached approximately  $\frac{1}{16}$  of an inch at its widest point between the leading and trailing edges with a distance of approximately 2 inches between the leading and trailing edges having a curved leading edge with the other side being a substantially straight line. The curved side rises rapidly to a maximum with a gradually sloping side coming to a point or finish at the trailing edge. This particular mixer was utilized singly and in groups to produce the improved mixing results.

This invention is not to be construed as limited to the particular forms disclosed herein since these are to be regarded as illustrative rather than restrictive.

I claim:

1. A vortex fluid mixing apparatus comprising in combination:

- (a) tubular means adapted for fluid to pass therethrough;
- (b) venturi means for increasing the velocity of fluid passing through said tubular means and being located inside said tubular means;
- (c) fluid vortex mixing means fixedly attached to the inner surface of said tubular means and adapted to produce a vortex in fluid passing through said tubular means;
- (d) said vortex mixing means having at least one elongated member with a leading edge and a trailing edge, said leading edge having a curved portion for facing oncoming fluid in said tubular means and said vortex mixing means having a pair of elongated sides connecting said leading and trailing edges, one side being longer than the other said side, said pair

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of elongated member sides having a substantially uniform depth; and

(e) second tubular means for feeding a second fluid into said tubular means and operatively connected to said tubular means and being downstream from the leading edge of said vortex mixing means whereby fluid fed into said tubular means will be mixed with the fluid passing through said tubular means by the vortex generated by said vortex mixing means.

2. The apparatus according to claim 1 in which said vortex mixing means includes a plurality of elongated members.

3. The apparatus according to claim 2 in which said plurality of elongated members from said venturi in said tubular means.

4. The apparatus in accordance with claim 1 in which each said elongated member is attached to said inner sur-

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face of said tubular means by bracket members holding each said elongated member off the inner surface of said tubular member.

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MORRIS O. WOLK, Primary Examiner

R. E. SERWIN, Assistant Examiner

U.S. Cl. X.R.

48—180 R, M, B; 123—141; 169—15; 259—19; 261—79 R