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(71) Applicant and

(72) Inventor: ELLAM, Donovan, Graham [GB/GB]; 58
Monkway Brow, Whitehaven, Cumbria CA28 9DT (GB).

(74) Agents: CHUGG, David, John et al.; Appleyard Lees, 15
Clare Road, Halifax, West Yorkshire HX1 2HY (GB).

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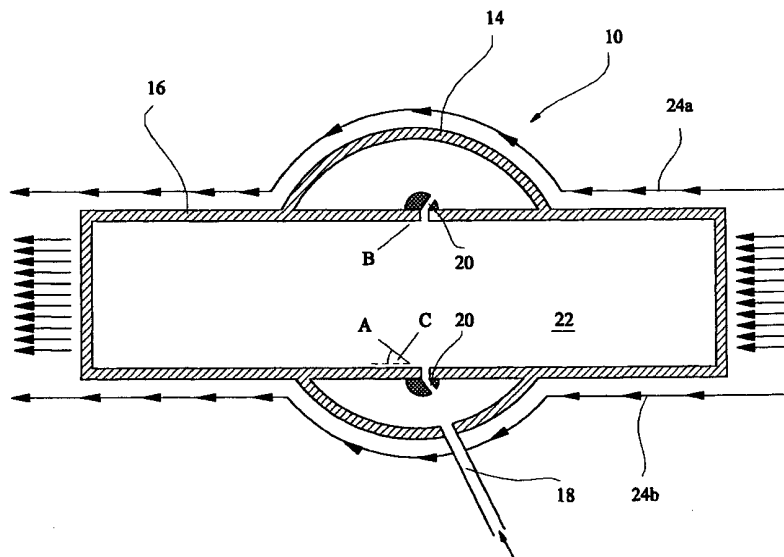
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(54) Title: FLUID DRIVEN MIXERS



(57) Abstract: A fluid driven mixer (10) comprises a tubular inlet portion (12), a body portion (14) and a tubular outlet portion (16). Gas is supplied to the body portion (14) by a supply line (18) which is fed by an external source (not shown). The gas is ejected from an annular exhaust section (20) into a central cavity (22) of the mixer (10). The gas is directed out of the outlet portion (16), which results in a flow of material in which the mixer is placed being entrained with the flow of gas. Material is drawn into the tubular inlet portion (12) and forced out of the tubular outlet portion (16). A sympathetic flow, shown by lines (24a) and (24b), is induced around the exterior of the mixer (10) from the inlet portion (12) to the outlet portion (16).



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FLUID DRIVEN MIXERS

This invention relates to a fluid driven mixer and to a method of mixing material with a fluid driven mixer.

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An existing fluid driven mixer (shown in Figure 3) comprises a central tubular conduit 22 into which air is pumped and injected from within the tube to cause a flow of material for mixing to be entrained and sucked into the tube. Problems arise with this type of device because turbulence can be created in the material for mixing and also pieces of solid matter within the material for mixing become trapped on the mixer, eventually reducing the efficiency due to potential partial blockage, because of a build-up of material around the originally trapped piece.

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It is an object of the present invention to address the above-mentioned disadvantages.

According to one aspect of the present invention a fluid powered mixer comprises an inlet portion, a body portion and an outlet portion which define a conduit, in which the body portion is operable to direct a pressurised driving fluid into the conduit towards the outlet portion to thereby entrain a flow of material to be mixed through the conduit, wherein the exterior of the mixer is shaped to enhance a sympathetic flow of material to be mixed around the exterior of the mixer from the inlet portion, over the body portion and to the outlet portion.

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Preferably the sympathetic flow is smooth, non-turbulent flow.

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The angle made between exterior surfaces of adjacent portions of the mixer may be greater than 120° , preferably greater than 130° , most preferably 135° or greater.

5 The mixer may have a tubular lateral cross-section.

The body portion may have an exterior surface that curves between the inlet and outlet portions, preferably with a convex curve. The body portion may have an exterior
10 surface with a diameter which increases from a first diameter to a second diameter and decreases to the first diameter along its length. The first diameter may be a diameter of the inlet and/or the outlet portion. The second diameter may be the maximum diameter of the mixer.

15

The exterior surface of the body portion may have a constant radius of curvature. The exterior surface may have a radius of curvature that is greater than a maximum diameter of the mixer.

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The mixer may have an exterior surface which is substantially free of projections on which solid material for mixing could snag. The mixer may have a welded construction.

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The inlet, body and outlet portions may be welded together.

The pressurised driving fluid may be steam, preferably for
30 pasteurisation of sewage for mixing.

The mixer may also be a pump.

According to another aspect of the present invention a method of mixing material with a fluid driven mixer comprises directing pressurised fluid into a conduit formed by inlet, body and outlet portions of a mixer, said
5 fluid being directed towards the outlet portion to thereby entrain a flow of material in which the mixer is located through the conduit, wherein the mixer is shaped to enhance a sympathetic flow of the material along the exterior of the mixer, from the inlet portion, over the
10 body portion and to the outlet portion.

The pressurised fluid may be steam, preferably for pasteurising the material as well as mixing the material. The material may be sewage, for pasteurisation and
15 subsequent use as fertiliser.

All of the above aspects may be combined with any of the features disclosed herein, in any combination.

20 A specific embodiment of the present invention will now be described, by way of example, and with reference to the accompanying drawings, in which:

Figure 1 is a schematic cross-sectional view of a fluid
25 driven mixer;

Figure 2 is a partial schematic cross section of the mixer shown in figure 1; and

30 Figure 3 is a schematic cross sectional view of a prior art fluid driven mixer.

Figure 1 shows a fluid driven mixer 10 comprises a tubular inlet portion 12 a body portion 14 and a tubular outlet portion 16. Gas is supplied to the body portion 14 by a supply line 18 which is fed by an external source (not shown). Alternatively other fluids such as liquids may be used to drive the mixer. The gas is ejected from an annular exhaust section 20 into a central cavity 22 of the mixer 10. The gas is directed out of the outlet portion 16, which results in a flow of material in which the mixer is placed being entrained with the flow of gas. Material is drawn into the tubular inlet portion 12 and forced out of the tubular outlet portion 16. A sympathetic flow, shown by lines 24a and 24b, is induced around the exterior of the mixer 10 from the inlet portion 12 to the outlet portion 16.

In more detail, the mixer 10 has a steel outer casing, with the inlet and outlet portions 12 and 16 and body portion 14 together having a smooth outer surface. The body portion 14 forms a bulbous central portion with a surface which curves between the inlet and outlet portions. The body portion 14 is generally circular in lateral cross section, as shown in figure 2. The central cavity 22 also has a smooth surface.

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The exterior surface of the body portion makes an angle of approximately 135° with the inlet and outlet portion, where they join.

Both the exterior and interior surfaces are designed to offer a minimum amount of resistance, or surface features on which solid material can snag.

In particular, when the mixer described herein is used in the treatment of waste water and sewage, the problem of plastic bags, and other solid non biodegradable items snagging on the mixer, as frequently occurs, is significantly reduced.

The general features of the mixer 10 are also present in the prior art device shown in Figure 3, like numerals denote like parts. As mentioned above, gas is supplied to the body portion 14. The gas is then distributed around the body portion 14 and exits via the exhaust section 20 into the central cavity 22. The gas is ejected in the direction shown by arrows A and B in figure 1, towards the outlet portion 16.

The outlets in the exhaust section 20 take the form of openings which extend from the hollow body portion to the central cavity 22. The outlets make an angle C (see figure 1) to the longitudinal axis of the pump. Also, as shown in figure 2, the openings make an angle D with a radius of the body portion 14. With the gas forced out of the exhaust section 20 in the directions mentioned above, a spiral flow of material in which the mixer 10 is placed will be caused.

The internal constructional details of the fluid driven mixer 10 described herein have already been described in UK patent applications GB 2,242,370 and GB 2,313,410, both in the name of D G Ellam. However, those documents do not disclose a fluid driven mixer which has the characteristic of requiring considerably less maintenance due to snagging of materials on the mixer, due to the construction of its external parts.

The fluid driven mixer 10 described herein can also be used in applications other than waste water/sewage treatment mentioned above, such as mixing or driving
5 liquids or powders from one location to another through conduits. The mixer 10 may also be a pump. Also, the mixer can be used for mixing dry materials such as grain and the like.

10 A further use for the mixer described herein is in the field of pasteurisation. Waste water and sewage must be treated to kill bacteria before it can be used as a fertiliser. At present, one way can be to treat sewage by introducing lime into the sewage to kill the bacteria.

15 In order to treat sewage so that it can be used as a fertiliser, the mixer described herein can be driven by steam, which has the effect of both mixing the material and also pasteurising the sewage and thereby killing
20 bacteria, as required. More generally, the mixer can be driven by steam, hot fluid, or hot gas to effect a heat treatment of the material to be mixed.

The fluid driven mixer described herein has significant
25 advantages over previous fluid driven mixers in that the period of time over which a mixer can be run without maintenance is considerable increased, because there is a much reduced risk of the mixer reducing in efficiency due to partial blocking when material is snagged on the mixer.

30 The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and

which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

- 5 All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features
10 and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same,
15 equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

- 20 The invention is not restricted to the details of the foregoing embodiment(s). The invention extend to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel
25 combination, of the steps of any method or process so disclosed.

CLAIMS

1. A fluid powered mixer comprises an inlet portion, a body portion and an outlet portion which define a conduit, in which the body portion is operable to direct a pressurised driving fluid into the conduit towards the outlet portion to thereby entrain a flow of material to be mixed through the conduit, wherein the exterior of the mixer is shaped to enhance a sympathetic flow of material to be mixed around the exterior of the mixer from the inlet portion, over the body portion and to the outlet portion.
2. A fluid powered mixer as claimed in claim 1, wherein the sympathetic flow is smooth, non-turbulent flow.
3. A fluid powered mixer as claimed in either claim 1 or claim 2, in which the angle made between exterior surfaces of adjacent portions of the mixer is greater than 120° .
4. A fluid powered mixer as claimed in any preceding claims, in which the body portion has an exterior surface that curves between the inlet and outlet portions.
5. A fluid powered mixer as claimed in any preceding claim in which the exterior surface of the body portion has a radius of curvature that is greater than a maximum diameter of the mixer.
6. A fluid powered mixer as claimed in any preceding claim, which has an exterior surface that is substantially free of projections on which solid material for mixing could snag.

7. A fluid powered mixer as claimed in any preceding claim, in which the pressurised driving is steam.
- 5 8. A fluid powered mixer as claimed in claim 7, in which the steam is for the pasteurising of sewage for mixing.
9. A method of mixing material with a fluid driven mixer comprises directing pressurised fluid into a conduit
10 formed by inlet, body and outlet portions of a mixer, said fluid being directed towards the outlet portion to thereby entrain a flow of material in which the mixer is located through the conduit, wherein the mixer is shaped to enhance a sympathetic flow of the material along the
15 exterior of the mixer, from the inlet portion, over the body portion and to the outlet portion.
10. A method of mixing material with a fluid driven mixer as claimed in claim 9, in which the pressurised fluid is
20 steam.

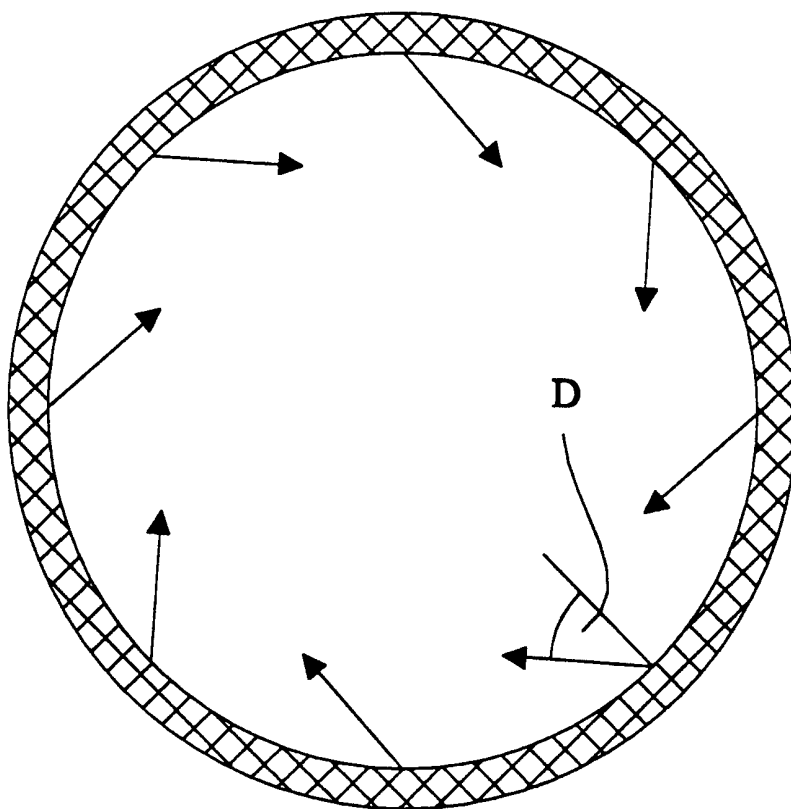


FIG. 2

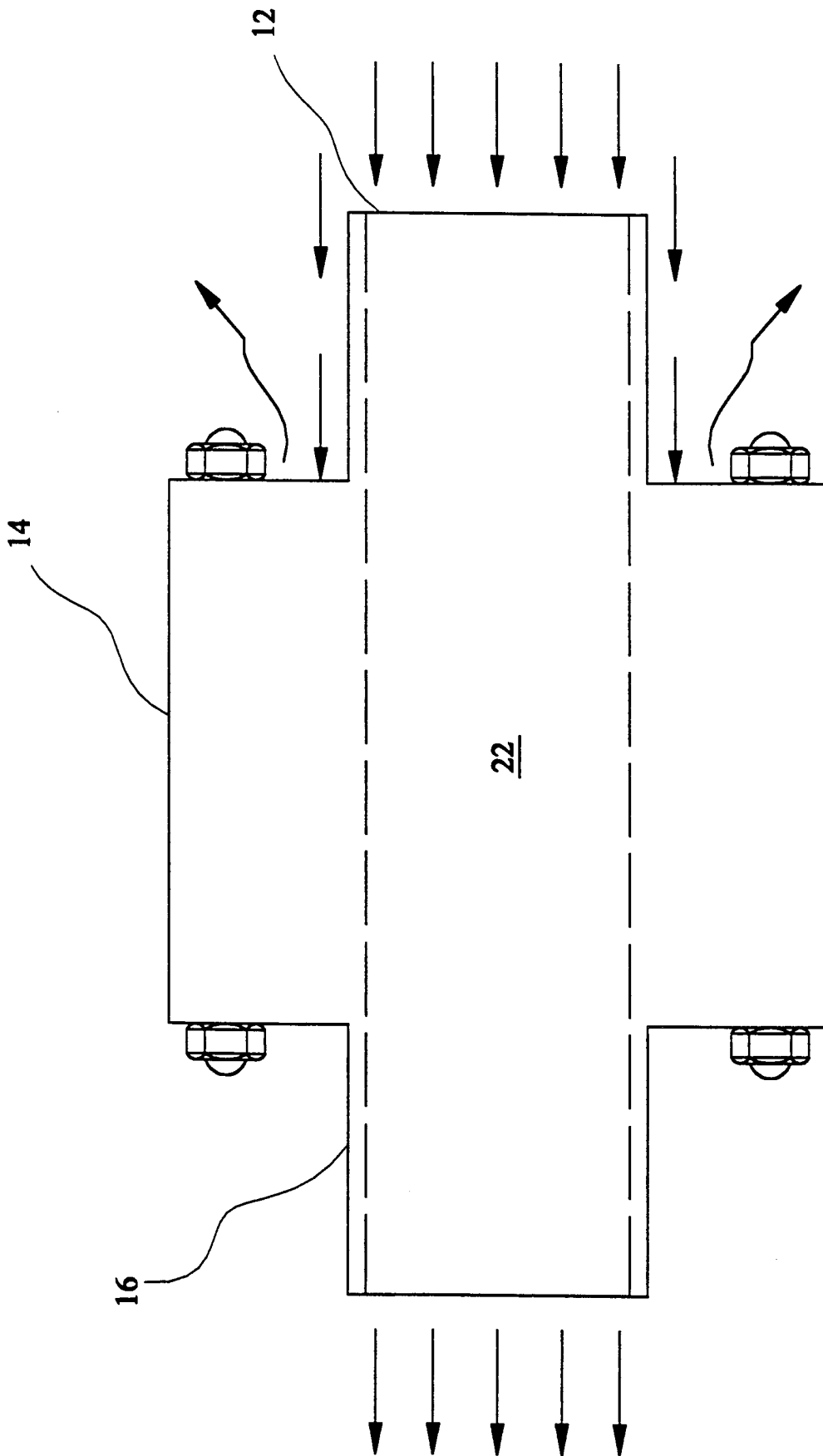


FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 99/01538

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 B01F5/04 B01F3/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 IPC 7 B01F F04F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	EP 0 854 295 A (MARINE TECHNO RESEARCH INC) 22 July 1998 (1998-07-22) the whole document ---	1, 2, 4, 6, 9
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Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search

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Name and mailing address of the ISA
 European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
 Fax: (+31-70) 340-3016

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Gourier, P

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INTERNATIONAL SEARCH REPORT

Internal Application No
PCT/GB 99/01538

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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International Application No

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