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(54) Mixer

(57) A mixer (1) e.g. for use in the food or chemical industry comprises a vessel (2) having a base portion (3) and an upper portion (4) whose interiors have rotational symmetry about an axis (S), and blades (6) carried by arms (7) which are rotatable about an axis (R) so that an edge (9) of each blade (6) sweeps across the interior surface of at least the base portion (3) of the vessel (2). The base portion (3) of the vessel (2) is hemispherical, the axis of rotation (R) of said arms (7) is obliquely inclined to the axis of symmetry (S) of said vessel (3), and the blades (6) are carried by three arms (7) and are spaced apart along each arm (7) and staggered as between one arm and the next thereby to allow sweeping of substantially the full extent of the interior surface of the base portion (3) of the mixing vessel (2).

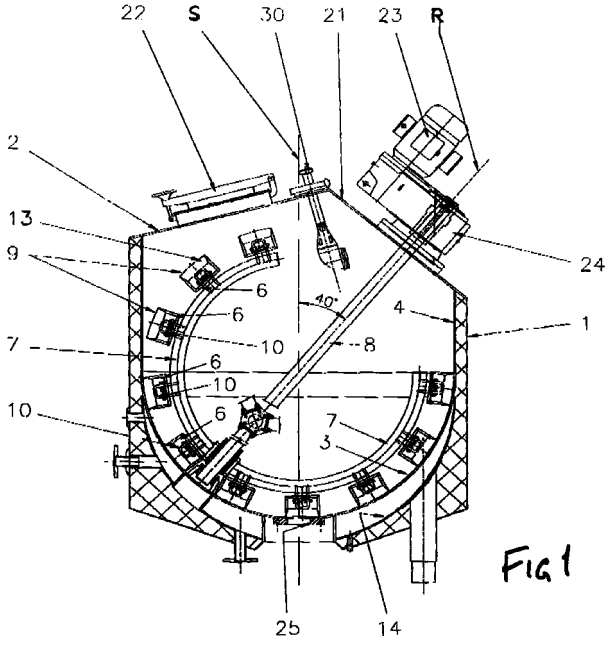

Fig 1

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Description

[0001] This invention relates to mixers and has particular but not exclusive reference to mixers for use in the food industry and in the pharmaceutical and chemical industries.

[0002] Mixers used in the food industry typically have a capacity of between 600 and 1,500 kg. Such mixers are typically used in production of syrups and sauces and they may incorporate a heat exchange jacket should it be required to chill or cook the syrup or sauce. Such mixers usually include a mixing vessel which has a hemispherical base and a cylindrical upper portion. The food to be processed is contained within the hemispherical base portion of the vessel and is stirred by blades. It is also known in the food processing industry to make use of vessels having a conical base portion or torispherical (hemi-ellipsoidal) base portion and to use vessels which are plain cylindrical and in which the contents of the vessel are also stirred by blades. Such mixers may also be used in the pharmaceutical industry and the chemical industry generally.

[0003] In the case of conical or cylindrical or torispherical vessels the blades are generally rotated about a vertical axis. See for example German Patent Specification DE 2815946A and European Patent Specification EP0046477.

[0004] When the base of the vessel is hemispherical other options are available and such a vertical-axis arrangement is in fact not preferred because it tends to lead to mass rotation of the contents of the vessel and very inefficient mixing.

[0005] Proposals have been made to mount blades on a member which is rotated about a horizontal axis, see for example US Patent Specification No. 4818116, but again there is a tendency towards mass rotation of the vessel's contents and when the vessel has a hemispherical base it is preferred to mount the mixing blades on arms which are arranged at the end of the spindle somewhat like the flukes of an anchor, and to rotate the spindle carrying these arms about an axis which is offset by ten or more degrees from the vertical in order to impart a degree of oblique lift to the contents of the vessel and thus promote efficient mixing. Such an arrangement is shown in US Patent Specification No. US 3752057.

[0006] When the blades are rotated about an offset axis in this way it is surprisingly difficult in practice to ensure that the interior surface of the lower portion of the vessel is fully swept so that the latter is scraped clean while the blades rotate. This gives rise to various difficulties. In particular when a heating jacket is placed around the vessel for cooking of the vessel's contents, any material left on the surface of the vessel for an excessive period can burn and discolour. This is obviously a particular problem in the preparation of light coloured sauces since portions of burnt material could then become incorporated in the sauce and discolour it, and thus render it unfit for sale even if there was no significant effect on flavour.

[0007] It is a principal object of the present invention to provide a new form of mixer which, at least in its most preferred embodiments, goes at least some way towards alleviating this problem.

[0008] According to the present invention there is provided a mixer comprising a vessel having a base portion and an upper portion whose interiors have rotational symmetry about an axis, and blades carried by arms which are rotatable about an axis so that an edge of each blade sweeps across the interior surface of at least the base portion of the vessel, **characterised in that** said base portion of the vessel is hemispherical, the axis of rotation of said arms is obliquely inclined to the axis of symmetry of said vessel, and in that said blades are carried by three said arms and are spaced apart along each arm and staggered as between one arm and the next thereby to allow sweeping of substantially the full extent of the interior surface of the base portion of the mixing vessel.

[0009] We have found that it is in practice very much simpler and more convenient to form a staggered arrangement of mixer blade which will sweep the entire area of the base of the mixing vessel when those blades are staggered along three arms than when they are staggered along only two. Thus it is easier to ensure that no area of the base of the mixing vessel will remain unswept by at least one blade, even after a considerable service life of the mixer. It may be noted that providing a facility for adjusting blade positions is not really a practical proposition since such blades could easily become mis-adjusted.

[0010] It is surprising that such a simple solution to this problem has not previously been proposed, particularly in view of the length of time over which this problem has been known and in view of its practical significance.

[0011] The three blade carrying arms are suitably disposed at 180° to each other and mounted towards a lower end of a spindle. The spindle arm arrangement thus resembles a three-flunked anchor or a "treble" fish-hook.

[0012] It is noted that the axis of rotation of the arms bearing the mixing blades should be inclined to the axis of symmetry of the mixing vessel. This affords great advantages in the even mixing of the contents of the vessel. The angle between the two axes is preferably greater than 10° and is suitably between 20° and 50°. This gives a very good lifting and turning action which promotes efficient and even mixing.

[0013] Hitherto, in one commercially available form of mixer, the mixer blades have been mounted to their arms by hairpin clips threaded between pairs of spaced flanges located on the arm and a blade carrier respectively. This allows the blade carrier to rotate about the pivot axis defined by the hairpin clip, which, in the usual arrangement, is substantially parallel to a plane which is tangent to the surface of the mixing vessel at the instan-

taneous location of that blade carrier, and is also parallel to the leading edge of the blade. A similar effect is given by the blade mountings illustrated in US 3752057.

[0014] The commercially known blade carrier comprises a backing plate whose side margins are bent up and over to form lips which define grooves into which a blade proper may be slid and where it is held in position by a hook. Such a conventional blade may also pivot about that hook, that is, about an axis which may be considered as being effectively normal to the (moving) tangent plane referred to. There is however very little freedom of movement allowed in the third orthogonal direction namely that which allows pivotal movement of the leading edge of the blade about an axis which corresponds with the direction of advance of that leading edge. Accordingly, while the leading edge of such a blade may be moved towards or away from the interior surface of the mixing vessel of a known mixer, and while the angle such leading edge makes with its direction of advance may also be varied, there is no possibility of self-adjustment of the leading edge of the blade in cases where only one leading corner of the blade makes contact with the mixing vessel.

[0015] A similar problem arises when the blade mounting construction of US 4818116 is adopted.

[0016] It will be appreciated that it is desirable that not only should the entire area of the base of the mixing vessel be swept, but also that such area should be swept clean.

[0017] In order to solve this problem, DE 2815946A proposes mounting its blades on posts provided on stirrer arms. The posts, like the blades themselves, extend normally to the local surface of the mixer vessel (that is radially of the spindle) and the blades are spring-biassed radially outwardly. Such an arrangement allows a clean sweeping of the area swept by each blade, so that material being mixed is substantially prevented from sticking to the interior surface of the base of the mixing vessel, where it could burn if the vessel was heated, and/or give rise to hygiene problems.

[0018] However, the blade mounting proposed in DE 2815946A is rather complicated, and the springs required may need to be formed from special material so that they will not contaminate food products and so that they themselves can resist corrosion, for example by sauces containing vinegar.

[0019] The present invention therefore also includes in its most preferred embodiments the features that said blades are loosely mounted on said arms so that the blades are freely movable in relation to the arms with sufficient freedom of movement about each of three orthogonal axes that their sweeping edges can maintain contact with said interior surface as they sweep across it.

[0020] We have found that clean sweeping by the mixer blades can be achieved simply and reliably by an appropriate loose mounting which can be of very simple construction and which does not require any spring biasing of the blades. The apparatus is accordingly simpler to construct and to assemble than the apparatus proposed by DE 2815946A. Such apparatus can also have a further and very important advantage due to is simple construction; it can contain fewer small interstices in which material being processed can lodge. We have found that by appropriate design of the blades and their mountings, it is possible to construct an apparatus which can be cleaned easily and thoroughly by using an internal spray head. Previously known mixing apparatus, on the other hand, has required dismounting of the mixing blades for a thorough cleaning and sterilisation of the mixing equipment.

[0021] Because the blades of a mixer according to the invention are carried by the arms with a sufficient degree of freedom of movement, setting up and fitting out of the mixer are very much simplified, each such blade can self-adjust to that portion of the surface of the mixing vessel against which it bears, and a thorough scraping of the interior of the vessel during mixing can more easily be achieved. Thus the mixing blades can adapt to irregularities in the vessel or in setting up, and also to any tendency for the spindle to run out of true.

[0022] In order to promote this end it is preferred that the blades should have a freedom of movement of at least 2° and preferably at least 5° about each of three orthogonal axes.

[0023] In preferred embodiments of the invention, contact between the base portion of the mixing vessel and the blades takes place at a leading edge of each said blade, and preferably, the blade leading edges are biassed into contact with the mixing vessel base portion by forces exerted on the blades by any contents of the mixing vessel. Advancing the blade in such a way that their leading edges make contact and they are thus inclined at an acute angle to their direction of advance promotes a lifting of the material away from the interior surface of the vessel and thus contributes towards good mixing. The blades may be, and preferably are, chamfered at their leading edges in order to promote these advantages, and also to help ensure that the leading edges of the blades are pressed into contact with the interior walls of the mixing vessel by forces exerted by the material being processed, this further promoting clean sweeping of the vessel.

[0024] In the most preferred embodiments of the invention said blades are constituted as substantially rectangular plates of synthetic resin material. These are particularly simple to form. Suitable synthetic resins include PTFE and nylon.

[0025] Advantageously said arms are provided with blade carriers formed as curved loops.

[0026] The blades are preferably provided with slots which are a loose fit over said curved loops.

[0027] We have found that a suitable design of curved loop holder on the arm and of the blades is sufficient to ensure that the blades do not come loose from the holder during use. Retention of the blades is pro-

moted in embodiments in which each loop is arrange to sweep across the interior surface of the base portion of the mixer vessel while its distal end is spaced from the surface of that base portion by less than the thickness of the blade which it carries. Clearly the blade cannot separate from its loop while sweeping that base portion.

[0028] However, in the case of a hemispherical mixer having an offset-axis blade system it will be appreciated that the blades will periodically lift out of the base portion and thus away from the wall of the vessel and in such cases it is suitable to provide some means for retaining the blade onto its loop carrier. It is preferred therefore that at least some of said blades are each provided with a retaining pin which is insertable across a said slot within a said loop to retain the blade on the carrier.

[0029] This system of blades and loop carriers is of particular advantage because it is very easily cleanable. The system may be constructed with a minimum of crevices in which food particles could lodge and in fact in the most preferred embodiments, the system is so simple to clean that proper hygiene may be maintained simply by hosing the interior of the vessel down between charges. Spray heads may be provided in the vessel for spraying cleaning fluids, for example a pre-rinse with water, a caustic wash and a following rinse. In the most preferred embodiments of the invention, the mixer is connected to a CIP (Clean-In-Place) cleaning system.

[0030] The invention will now be described by way of example only with reference to the accompanying diagrammatic drawings in which:

Figure 1 is a vertical cross sectional view of an embodiment of mixer in accordance with this invention;

Figure 2 is a diagrammatic view of an arrangement of mixer blades

Figure 3 is a detail sectional view of a mixer blade on its curved carrier loop.

[0031] In Figure 1, a mixer 1 comprises a mixing vessel 2 having a base portion 3 which is hemispherical in shape and a cylindrical upper portion 4. The vessel 2 has a roof 21 in which there is a charging hatch 22. The roof 21 also supports a motor 23 which drives a shaft 8 via a gearbox 24. and The shaft 8 carries by arms 7 on which are mounted blades 6 for mixing the contents of the vessel. The blades 6 are suitably constituted as substantially rectangular plates of synthetic resin material.

[0032] The blades 6 and arms 7 are rotated about the rotational axis R of the shaft 8 which in this embodiment is arranged at an angle of 40° to the axis S of rotational symmetry of the mixing vessel 2.

[0033] The blades 6 are driven in rotation by the motor 23 so that their leading edges 9 sweep across the interior surface of at least the base portion 3 of the vessel 2. The blades 6 are carried by the arms 7 on carriers 10 in the form of curved loops. The positions of the blades 6 are staggered along the different arms 7 to allow sweeping of substantially the full extent of the interior surface of the base portion 3 of the mixing vessel 2, as is most clearly shown in Figure 2. In fact as shown in Figure 2, the blades are carried by three arms 7.

[0034] As shown in Figures 2 and 3 the blades are held by the curved loops 10 simply by the latter's projection through slots 11 formed in the blades. As shown in Figure 3, the slots are a loose fit around the curved loop carriers 10 and it is found that this itself provides sufficient play to give the required freedom of movement to the blades 6 that their leading sweeping edges 9 can self-adjust to maintain contact with the interior surface of the base portion 3 of the vessel 2 as they sweep across it.

[0035] As shown in Figures 1 and 2, the blades are provided with a chamfer 13 leading towards their leading, sweeping edges 9. In use this chamfer tends to urge the leading edge 9 of the blade 6 against the interior surface of the base portion 3 of the mixing vessel 2 to ensure thorough sweeping. Also due to this chamfer, though the blades 6 are initially formed with straight leading edges 9, in practice these may quite soon wear away, especially at the ends of those edges, to leave curved leading edges 9a which correspond with the curvature of the hemispherical base portion of the mixing vessel.

[0036] The slope and curvature of the blade retaining loops 10 combined with the slope 11 of the slot in the blades 6 tends to cause those blades to ride up the loops 10 so that they retain the blades without any further means being required.

[0037] Such retention is ensured if each said loop 10 is arranged to sweep across the interior surface of the hemispherical base portion 3 while its distal end 10a is spaced therefrom by a distance which is less than the thickness T of the blade 6 which it carries.

[0038] If required, at least some of said blades 6 are each provided with a retaining pin 12 insertable across a said slot 11 within a said loop 10 to retain the blade 6 on the carrier 10. Such an arrangement is shown in Figure 3.

[0039] The hemispherical base portion 3 of the mixing vessel 2 is provided with a drain opening 25 at its lowest point, and it is enclosed within a heat-exchange jacket 14 through which may be circulated steam or hot water or a coolant fluid as desired.

[0040] A spray head 30 is provided as part of a cleaning system for directing jets of appropriate cleaning fluids to the interior of the mixing vessel. Such fluids may include water, cold or hot, steam, or caustic or other washing solutions.

Claims

1. A mixer (1) comprising a vessel (2) having a base portion (3) and an upper portion (4) whose interiors have rotational symmetry about an axis (S), and blades (6) carried by arms (7) which are rotatable about an axis (R) so that an edge (9) of each blade (6) sweeps across the interior surface of at least the base portion (3) of the vessel (2), **characterised in that** said base portion (3) of the vessel (2) is hemispherical, the axis of rotation (R) of said arms (7) is obliquely inclined to the axis of symmetry (S) of said vessel (3), and in that said blades (6) are carried by three said arms (7) and are spaced apart along each arm (7) and staggered as between one arm and the next thereby to allow sweeping of substantially the full extent of the interior surface of the base portion (3) of the mixing vessel (2).

2. A mixer according to claim 1, wherein the axis of rotation (R) of said arms (7) is inclined to the axis of symmetry (S) of said vessel (3) by between 10° and 50°.

3. A mixer according to Claim 1 or 2, wherein said blades (6) are loosely mounted on said arms (7) so that the blades (6) are freely movable in relation to the arms with sufficient freedom of movement about each of three orthogonal axes that their sweeping edges (9) can maintain contact with said interior surface as they sweep across it.

4. A mixer according to claim 3, wherein said blades (6) have freedom of movement of at least 5° about each of three orthogonal axes.

5. A mixer according to any preceding claim, wherein contact between the base portion (3) of the mixing vessel (2) and the blades (6) takes place at a leading edge (9) of each said blade (6).

6. A mixer according to claim 5, wherein the blade leading edges (9) are biased into contact with the mixing vessel base portion (3) by forces exerted on the blades (6) by any contents of the mixing vessel (2).

7. A mixer according to any preceding claim wherein said blades (6) are constituted as substantially rectangular plates of synthetic resin material.

8. A mixer according to any preceding claim wherein said arms (7) are provided with blade carriers (10) formed as curved loops.

9. A mixer according to claims 7 and 8, wherein said blades (6) are provided with slots (11) which are a loose fit over said curved loops (10).

10. A mixer according to claim 9, wherein at least some of said blades (6) are each provided with a retaining pin (12) insertable across a said slot (11) within a said loop (10) to retain the blade (6) on the carrier (10).

11. A mixer according to any of claims 8 to 10, wherein each said loop (10) is arranged to sweep across the interior surface of said base portion (3) while its distal end (10a) is spaced therefrom by less than the thickness (T) of the blade (6) which it carries.

12. A mixer according to any preceding claim, wherein said vessel (2) is provided with a heat-exchange jacket (14).

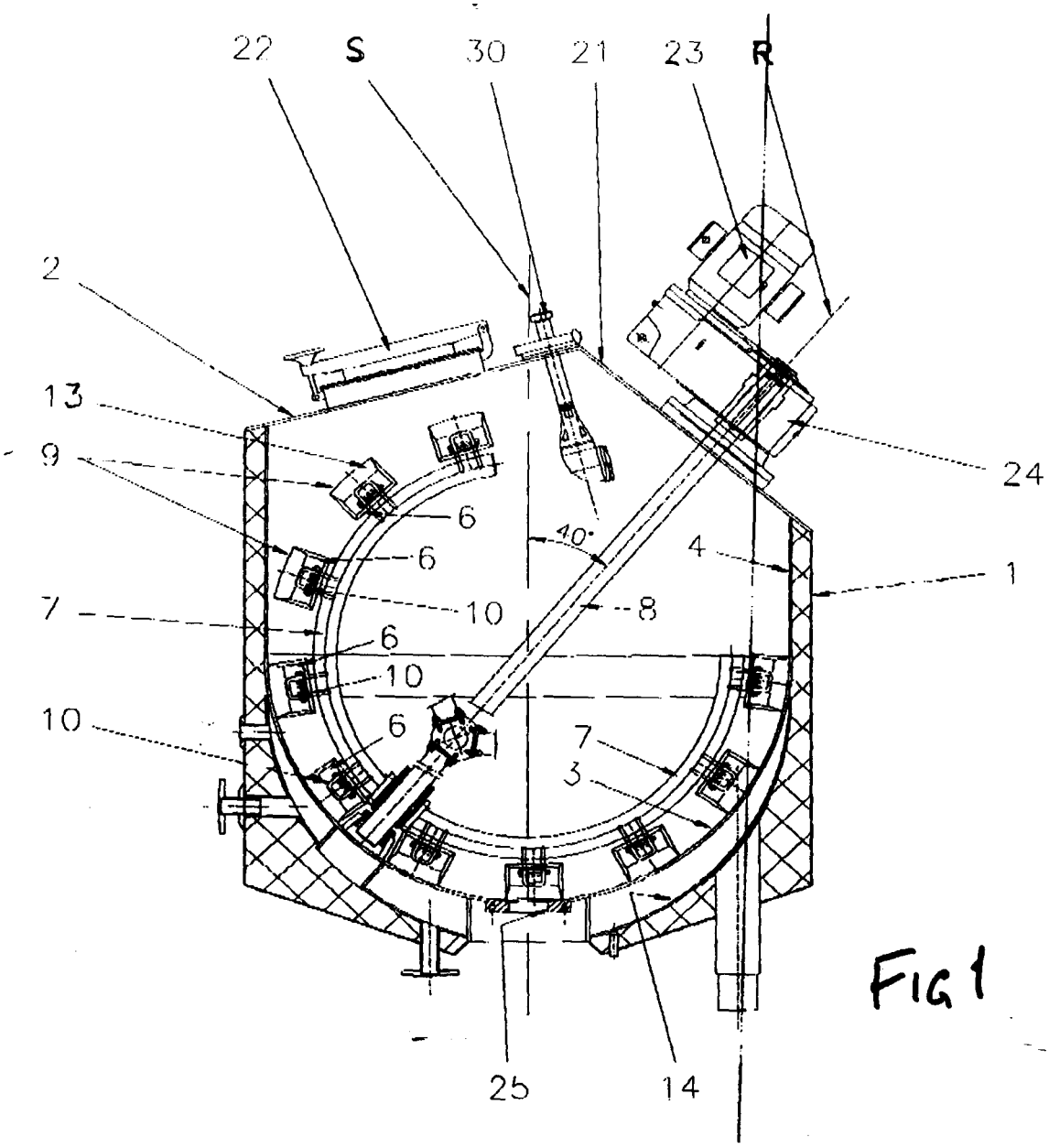

Fig 1

Fig 2

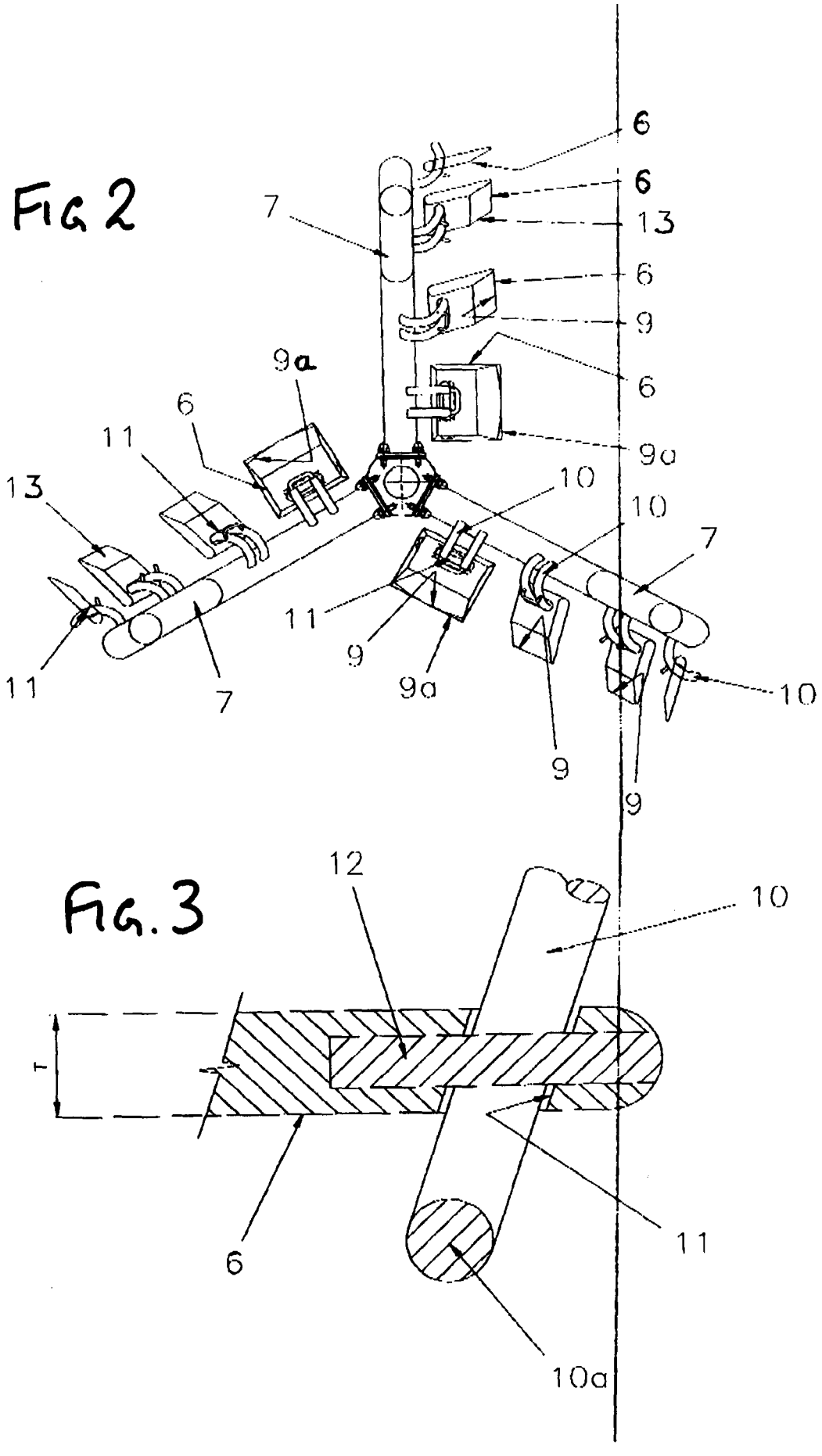

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 00 30 0399

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	7 April 2000	Belibel, C

CATEGORY OF CITED DOCUMENTS

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