(19) Europäisches Patentamt
European Patent Office
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(11) **EP 1 776 999 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
25.04.2007 Bulletin 2007/17

(51) Int Cl.:
B01F 15/00 *(2006.01)*

(21) Application number: **05445081.2**

(22) Date of filing: **21.10.2005**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

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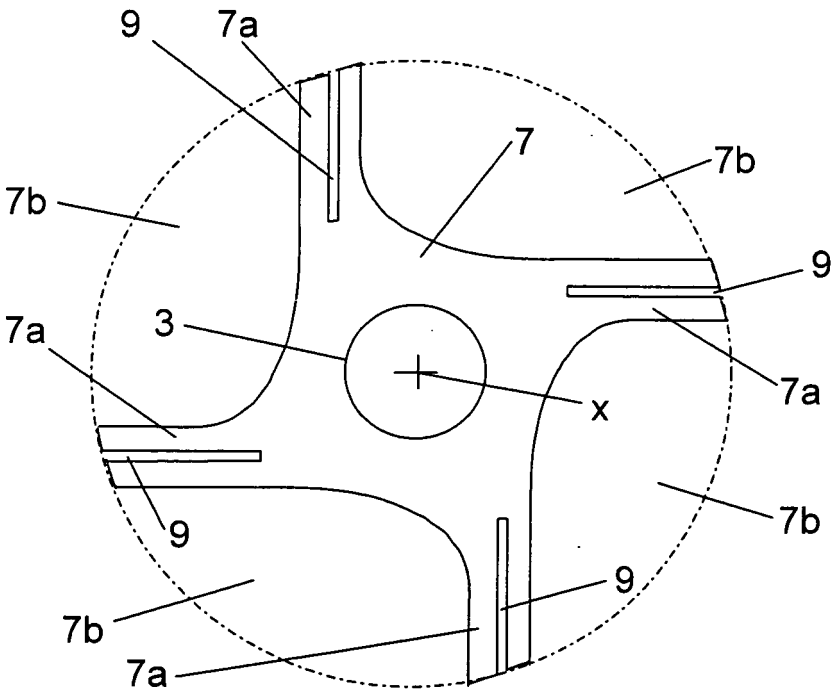
(54) **A mixing device**

(57) The present invention refers to a device for mixing at least a first substance and a second substance to form a homogenous mixture. The device comprises a motor, a shaft extending from the motor and being rotatable around a rotary axis (x), and an agitating member (4) for mixing the substances. The agitating member (4) is attached to the shaft to be rotated in a rotary direction (r) around the rotary axis (x) by means of the motor and includes at least two blades (8) extending outside the rotary axis (x). The blades (8) extend along a respective longitudinal blade axis (b). The agitating member (4) comprises a base element (7) mounted to the shaft (3) and having a thin, disc-like shape. The blades are mounted to the base element.

Fig 3



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Description

BACKGROUND OF THE INVENTION AND PRIOR ART

[0001] The present invention refers generally to mixing of at least a first substance and a second substance. The first substance is typically a liquid and the second substance one or several additives to be added to the liquid. The additives can include a liquid or a solid, for instance a powder material.

[0002] More specifically, the present invention refers to a device for mixing at least a first substance and a second substance to form a homogenous mixture according to the precharacterizing portion of claim 1.

[0003] In a mixing process, especially a wet mixing process, the agitating member has a given topology or shape. The topology or shape is very important for the mixing result of the mixing process and the efficiency of the mixing device. Various shapes and topologies for the agitating member of mixing devices have been proposed in the past. Disadvantages of previous agitating members are that they either have a complicated shape, at least from a manufacturing point of view, or have a simple design providing a poor mixing result and mixing efficiency.

[0004] US-A-4,150,900 shows a slurry mixer having a tank and a rotating agitating member with four blades extending radially outwardly from the rotary axis. Each blade has one blade wing which is inclined with respect to the rotary axis.

[0005] SU-997770 discloses an agitating member for a mixing device. The agitating member has four blades extending radially outwardly with respect to the rotary axis. The blade wings are inclined with respect to the rotary axis. Each blade has a radially inner blade wing and a radially outer blade wing. The inner blade wing is inclined in an opposite direction in comparison with the outer blade wing.

SUMMARY OF THE INVENTION

[0006] The object of the present invention is to provide a mixing device, which can be manufactured in any easy and cost-efficient manner and which permits a high mixing efficiency and a proper mixing result.

[0007] This object is achieved by the mixing device initially defined, which is characterized in that the agitating member comprises a base element mounted to the shaft and having a thin, disc-like shape, wherein the blades are mounted to the base element. By means of such a thin, disc-like shape, the base element may be manufactured in an easy manner, for instance through cutting or punching from a metal sheet. The base element may have any suitable shape, for instance a conical shape or a substantially plane shape. The base element is suitable for receiving blades of varying configuration, i.e. blades of any desired shape may easily be attached to the base element. The blades may extend outwardly from the base element.

[0008] According to an embodiment of the invention, the base element includes at least two outwardly extending portions, wherein the blades are mounted to a respective one of the outwardly extending portions. Advantageously, each outwardly extending portion may include a longitudinal slit into which the respective blade is introduced. The slit may preferably extend in parallel to the respective blade axis. Cutout portions are formed between the outwardly extending portions in order to permit mixing in an axial direction being parallel to the rotary axis, i.e. the substances on one side of the disc-like base element may be efficiently mixed with substances on the other side of the disc-like base element.

[0009] According to a further embodiment invention, each blade comprises a first blade wing being inclined with respect to the rotary surface. Furthermore, each blade may also comprise a second blade wing arranged axially beside the first blade wing, wherein the first blade wing is inclined towards the motor and away from the longitudinal blade axis, and the second blade wing is inclined away from the motor and away from the longitudinal blade axis. An agitating member, and thus a mixing device, having one or a plurality of such blades provides a very efficient mixing. One of the two blade wings will provide a flow of the substances to be mixed in a radially outward and upward direction, whereas the other blade wing will provide a flow of the substances to be mixed in a radially outward and downward direction. In such a way, an upper circulating flow path and a lower circulating flow path will be created so that all of the substances to be mixed in a vessel will be influenced by the agitating member.

[0010] According to an embodiment of the invention, each blade includes a sheet-like element forming the first blade wing and the second blade wing. In such a way, the blade according to this invention can be manufactured in an easy and cost efficient manner. A substantially plane sheet of any suitable material may be bent to form the two blade wings, along one or two lines, for instance.

[0011] According to a further embodiment of the invention, one of the blade wings is shorter than the other blade wing along the rotary direction of the agitating member. The mixing force exerted by the shorter blade wing will be smaller than the mixing force of the other blade wing. By designing the blade wings in this way, an advantageous flow pattern can be obtained in the substances to be mixed in the container.

[0012] According to a further embodiment of the invention, the first blade wing extends substantially in parallel to a first extension plane and the second blade wing extends substantially in parallel to a second extension plane, wherein the first extension plane forms an angle of inclination to the second extension plane and wherein the first extension plane and the second extension plane are substantially parallel to the longitudinal blade axis.

[0013] According to a further embodiment of the invention, the first blade wing is substantially plane. Advanta-

geously also the second blade wing may be substantially plane. Such a design of the blade wings enables an easy and cost efficient manufacturing of the blade.

[0014] According to a further embodiment of the invention, the blade includes a central portion, wherein the first blade wing and the second blade wing are connected to the common central portion. Such a common central portion may be designed to permit mounting of the blade to the agitating member. The base element may be adapted to permit mounting of the common central portion of the blade. The common central portion may also be formed by the sheet-like element.

[0015] According to a further embodiment of the invention, each blade has a curved shape seen in a cross-section perpendicular to the blade axis.

[0016] According to a further embodiment of the invention, the longitudinal blade axis extends outwardly with respect to the rotary axis. It is possible to let the longitudinal blade axis extend substantially radially , but the longitudinal blade axis may also have a tangential component with respect to the rotary axis. Furthermore, the longitudinal blade axis may be inclined upwardly or downwardly with respect to the rotary axis.

[0017] According to a further embodiment of the invention the agitating member includes at least three such blades uniformly distributed around the rotary axis. Advantageously, the at least three blades may be attached to the base element and extend outwardly with respect to the rotary axis.

[0018] According to a further embodiment of the invention, the device comprises a vessel adapted to receive the substances to be mixed, wherein the agitating member is provided in an inner space of the vessel.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The present invention is now to be explained more closely by means of the description of preferred embodiments and with reference to the drawings attached hereto.

Fig. 1 shows schematically a side view of a mixing device according to the present invention.

Fig. 2 shows schematically a view from above of the first embodiment of an agitating member of the mixing device in Fig. 1.

Fig. 3 shows a base element of the agitating member in Fig. 2.

Fig. 4 shows a part of the agitating member in Fig. 2.

Fig. 5 shows a side view of a blade of the agitating member in Fig. 2.

Fig. 6 shows schematically a view from above of a second embodiment of an agitating member of the mixing device in Fig. 1.

Fig. 7 shows a part of an agitating member having a blade according to a third embodiment.

Fig. 8 shows a part of an agitating member having a blade according to a fourth embodiment.

Fig. 9 shows a part of an agitating member having a blade according to a fifth embodiment.

Fig. 10 shows a part of an agitating member having a blade according to a sixth embodiment.

Fig. 11 shows a part of an agitating member having a blade according to a seventh embodiment.

DETAILED DESCRIPTION OF VARIOUS EMBODIMENTS OF THE INVENTION

[0020] Fig. 1 shows a device for mixing at least a first substance and a second substance to form a homogenous mixture. The device comprises a vessel 1 adapted to receive the substances to be mixed. The device also comprises a motor 2, a shaft 3 extending from the motor 2 and being rotatable around a rotary axis x, and an agitating member 4 for mixing the substances. In the embodiment disclosed, the motor 2 is mounted to the vessel 1 via a number of mounting members 1 a. The vessel 1 has an opening 1b through which the shaft 3 extends into an inner space 1 c of the vessel 1. The vessel 1 is adapted to be positioned so that the opening 1b is turned upwards.

[0021] The substances are supplied to the inner space 1 c of the vessel 1 via supply members, schematically indicated with reference signs 5 and 6. The supply member 5 is adapted for the supply of the first substance which can be a liquid. The supply member 6 is adapted for the supply of the second substance which can be one or several additives to be added to the liquid. The additives can include a liquid, or a solid product, for instance a powder material. In case several additives are to be added to the first substance, several supply members 6 can be provided. The device is suitable for mixing substances, such as paint, lubricants, paper coating and filing materials, chemical products etc.

[0022] The agitating member 4 is attached to the shaft 3 so that the agitating member 4 will be rotated together with the shaft 3 around the rotary axis x in a rotary direction r by means of the motor 2, see Fig. 2. The agitating member 4 has a given topology or shape determined by a plurality of geometrical parameters.

[0023] The agitating member 4 is disclosed more closely in Fig. 2. The agitating member 4 comprises a base element 7, which is mounted to the shaft 3, and four blades 8, which are mounted to the base element 7. Each blade 8 extends along a respective longitudinal blade axis b. The longitudinal blade axis b extends outwardly with respect to the rotary axis x. Although the agitating member 4 is shown with four blades 8 in Fig. 2, it is to be noted that the agitating 4 can include a different number of blades 8, for instance three blades 8 as shown in Fig. 6, or 1, 2, 5, 6 or more blades 8. The base element 7, disclosed separately in Fig. 3, has a plane, disc-like shape. The base element 7 is relatively thin, i.e. in relation to the plane disc-like extension of the base element 7. It is to be noted that the disc-like base element 7 also can have a slightly conical shape and be upwardly or downwardly inclined.

[0024] Furthermore, the base element 7 has four outwardly extending portions 7a. Each portion 7a may be formed, starting from a circular disc, see Figs. 3 and 6, by removing intermediate cutout portions 7b between the outwardly extending portions 7a. In such away, the base element 7 will have a reduced size and the flow of the mixture between the blades 8 will not be negatively influenced. In particular, the cutout portions 7b permit a flow of substances to be mixed from one side of the disc-like base element 7 to the other side of the disc-like base element 7. It should be noted that the base element 7 also could have a circular shape, i.e. an outer contour along the circular dash-dotted lines in Figs. 3 and 6.

[0025] Each outwardly extending portion may have a slit 9 for receiving a respective one of the blades 8. Consequently, in the embodiment disclosed, the base element 7 has four slits 9. The four blades 8 are introduced in a respective one of the slits 9, see also Figs. 4 and 5.

[0026] As can be seen, especially in Figs. 4 and 5, each blade comprises a first blade wing 11 and a second blade wing 12. The first blade wing 11 forms an upper blade wing and the second blade wing 12 forms a lower blade wing. Each blade also comprises a common central portion 13. The blade wings 11 and 12 are connected to the common central portion 13. It is to be noted that the blades 8 can have an arbitrary basic shape, for instance with respect to the size and the inclination of the blade wings 11, 12.

[0027] The first blade wing 11 and the second blade wing 12 are thus arranged axially beside each other. The first blade wing 11 is inclined upwardly, towards the motor 2 and away from the longitudinal blade axis b. The second blade wing 12 is inclined downwardly away from the motor 2 and away from the longitudinal blade axis b. As can be seen in Fig 5, the first blade wing 11 extends substantially in parallel to a first extension plane p,q and the second blade wing 12 extends substantially in parallel to a second extension plane p',q'. The first extension plane p,q and the second extension plane p',q' are substantially parallel to the longitudinal blade axis b. Moreover, in the embodiment disclosed, the extension planes p,q and p', q' are substantially plane. It is to be noted, however, that the blade wings 11 and 12 may have a somewhat curved extension.

[0028] In other words, the first blade wing 11 is inclined upwardly with respect to a rotary surface s defined by the rotary axis x and the blade axis b. The second blade wing is inclined downwardly with respect to the rotary surface s. The absolute value of the angle α of inclination of the first blade wing 11 and the angle β of inclination of the second blade wing 12 with respect to the rotary surface s may be equal, but the angle α of inclination of the first blade wing 11 may also differ from the angle β of inclination of the second blade wing. In the embodiments disclosed, the central portion 13 extends substantially perpendicularly to the rotary surface s. Moreover, the central portion 13 is substantially plane and extends in a plane that is substantially perpendicular to the rotary surface s.

[0029] In the embodiments disclosed, the rotary surface s is substantially plane. It is to be noted however that the rotary surfaces may have another shape, for instance a conical shape.

[0030] In the embodiments disclosed, the first blade wing 11 is shorter than the second blade wing 12 along the rotary direction r of the agitating member 4. However, it is also possible to let the blade wings 11, 12 have the same length or to let the second blade wing 12 be shorter than the first blade wing 11.

[0031] Each blade 8 includes a sheet-like element forming the two blade wings 11, 12. More specifically, each blade 8 may be manufactured from a sheet material, for instance a metal sheet. The blade 8 may then be bent along a bending line to form the two blade wings 11, 12. In case the blade 8, as in the embodiment disclosed, also includes a central portion 13, the upper blade wing 11 is bent along a first bending line and the lower blade wing 12 is bent along a second bending line. The manufacturing of the blade 8 may thus be obtained in an easy manner.

[0032] Fig. 7 shows a part of an agitating member 4 having a blade 8 according to a third embodiment. In this case the blade 8 has a curved shape seen in a cross-section perpendicular to the blade axis b. The blade 8 still exhibits a first upper blade wing 11 and a second lower blade wing 12 connected to each other by a curved central portion 13. In order to improve the attachment of the blade 8 to the base element 7, the slit 9 may have a curvature corresponding to the curvature of the central portion 13 seen in a cross-section transversally to the blade axis b.

[0033] Fig. 8 shows an agitating member having a blade 8 according to a fourth embodiment. In this case the blade 8 has a first upper blade wing 11 and a second lower blade wing 12, which are directly connected to each other. Consequently, the blade 8 has no central portion. As can be seen from Fig. 8, the blade 8 is attached to the base element 7 in a slit 9 gripping the first blade wing 11. The slit 9 has an inclination determining the inclination of the first blade wing 8.

[0034] Fig. 9 shows an agitating member 4 having a blade 8 according to a fifth embodiment. In this case the blade 8 merely has a lower blade portion 11 extending into the slit 9 and downwardly beneath the base element 7. The inclination of the blade 8, i.e. the blade wing 12, is determined by the inclination of the slit 9.

[0035] Fig. 10 shows an agitating member 4 having a blade 8 according to a sixth embodiment. In this case, the blade 8 has a central portion 13 and a lower blade wing 12. The central portion 13 is slightly curved as the blade disclosed in Fig. 7. The slit 9, which preferably has the same curvature as the central portion 13, engages the blade 8.

[0036] Fig. 11 shows an agitating member 4 having a blade 8 according to a seventh embodiment. In this case, the blade 8 has an upper blade wing 11 and a central

portion 13. The central portion 13 is substantially plain whereas the upper blade wing 11 is slightly curved.

[0037] A plurality of different shapes of the blades 8 is thus shown in the figures. It should be noted, however, that the variety of different blade shapes are possible within the scope of the following claims. The blades 8 disclosed in the application should be seen as advantageous examples.

[0038] The blades 8 can be attached to the base element 7 in many various ways. In Figs. 4 and 7 attachment screws 20 are indicated. The screws 20 are threadly engaged in holes in the base element 7 and secure the blades 8 in the slits 9. The screws 20 may extend through corresponding holes in the blades 8.

[0039] In the embodiments disclosed, the blade axis b extends at a distance from and in parallel to a radial direction. It is to be noted that this distance can be varied or changed, and that the blade axis b could coincide with a radial direction.

[0040] The present invention is not limited to the embodiments disclosed but may be varied and modified within the scoop of the following claims.

Claims

1. A device for mixing at least a first substance and a second substance to form a homogenous mixture, the device comprising
a motor (2),
a shaft (3) extending from the motor and being rotatable around a rotary axis (x), and
an agitating member (4) for mixing the substances, wherein the agitating member (4) is attached to the shaft to be rotated in a rotary direction (r) around the rotary axis (x) by means of the motor and includes at least two blades (8) extending outside the rotary axis (x), wherein the blades extend along a respective longitudinal blade axis (b) and wherein the blade axis (b) defines a rotary surface (s) when the agitating member (4) rotates around the rotary axis (x), **characterized in that** agitating member (4) comprises a base element (7) mounted to the shaft and having a thin, disc-like shape, wherein the blades (8) are mounted to the base element (7).

2. A device according to claim1, **characterized in that** the blades (8) extend outwardly from the base element (7).

3. A device according to any one of claims 1 and 2, **characterized in that** the base element (7) includes at least two outwardly extending portions (7a), wherein the blades (8) are mounted to a respective one of the outwardly extending portions (7a).

4. A device according to claim 3, **characterized in that** cutout portions (7b) are formed between the outwardly extending portions (7a) in order to permitting mixing in an axial direction being parallel to the rotary axis (x).

5. A device according to any one of claims 1 to 4, **characterized in that** the base element (7) has substantially plane shape.

6. A device according to any of claims 1 to 4, **characterized in that** the base element (7) has a slightly conical shape.

7. A device according to any one of the preceding claims, **characterized in that** each blade (8) comprises a first blade wing (11) being inclined with respect to the rotary surface (s).

8. A device according to claim 7, **characterized in that** each blade (8) also comprises a second blade wing (12) arranged axially beside the first blade wing (11), wherein the first blade wing (11) is inclined towards the motor and away from the longitudinal blade axis (b), and the second blade wing (12) is inclined away from the motor and away from the longitudinal blade axis (b).

9. A device according to claim 8, **characterized in that** each blade (8) includes a sheet-like element forming the first blade wing (11) and the second blade wing (12).

10. A device according to any one of claims 8 and 9, **characterized in that** one of the blade wings (11, 12) is shorter than the other blade wing (11, 12) along the rotary direction (r) of the agitating member (4).

11. A device according to any one of claims 7 to 10, **characterized in that** the first blade wing (11) extends substantially in parallel to a first extension plane (p,q) and that the second blade wing (12) extends substantially in parallel to a second extension plane (p',q'), wherein the first extension plane (p,q) forms an angle ($\alpha+\beta$) of inclination to the second extension plane (p',q') and wherein the first extension plane (p,q) and the second extension plane (p', q') are substantially parallel to the longitudinal blade axis (b).

12. A device according to any one of claims 7 to 11, **characterized in that** the first blade wing (11) is substantially plane.

13. A device according to any one of claims 7 to 12, **characterized in that** the second blade wing (12) is substantially plane.

14. A device according to any one of claims 7 to 13, **characterized in that** the blade (8) includes a cen-

tral portion (13), wherein the first blade wing (11) and the second blade wing (12) are connected to the common central portion (13).

15. A device according to claims 9 and 14, **characterized in that** also the common central portion (13) is formed by the sheet-like element.

16. A device according to any one of the preceding claims, **characterized in that** each blade (8) has a curved shape seen in a cross-section perpendicular to the blade axis (b).

17. A device according to any one of the preceding claims, **characterized in that** the longitudinal blade axis (b) extends outwardly with respect to the rotary axis (x).

18. A device according to any one of the preceding claims, **characterized in that** the agitating member (4) includes at least three such blades (8) uniformly distributed around the rotary axis (x).

19. A device according to claim 18, **characterized in that** the at least three blades (8) are attached to the base element (7) and extend outwardly with respect to the rotary axis (x).

20. A device according to any one of the preceding claims, **characterized in that** the device comprises a vessel (1) adapted to receive the substances to be mixed, wherein the agitating member (4) is provided in an inner space of the vessel (1).

Fig 1

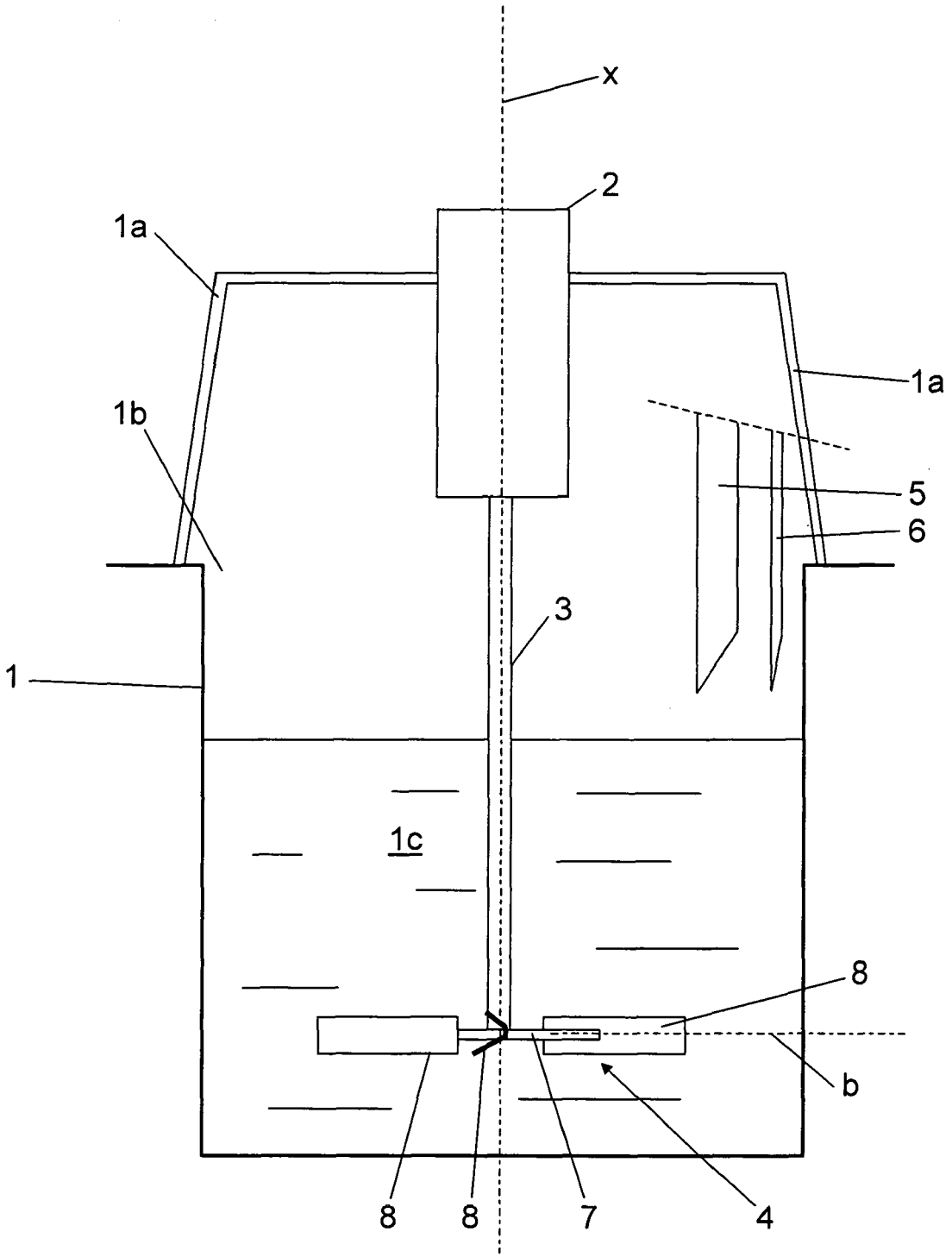


Fig 2

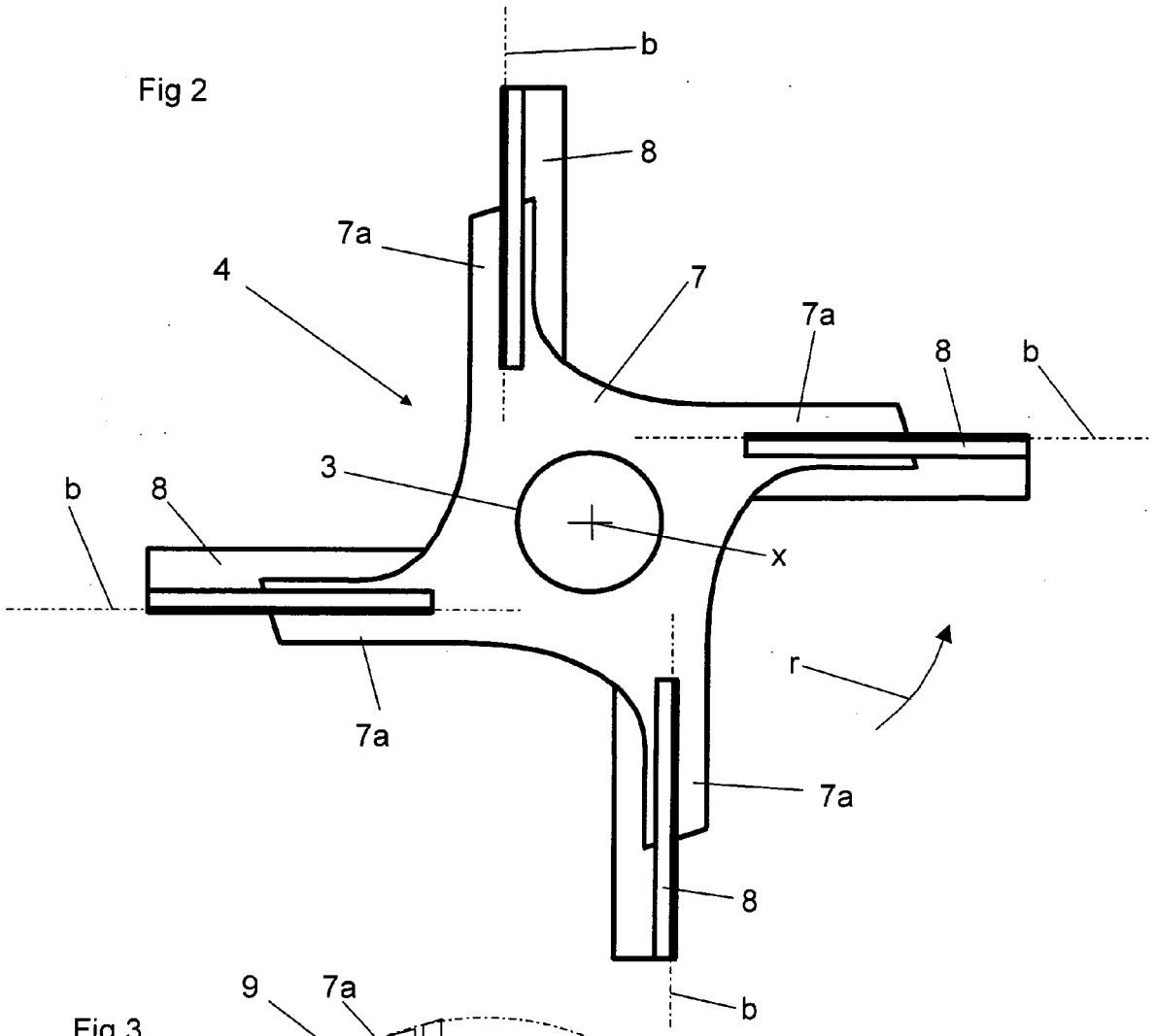


Fig 3

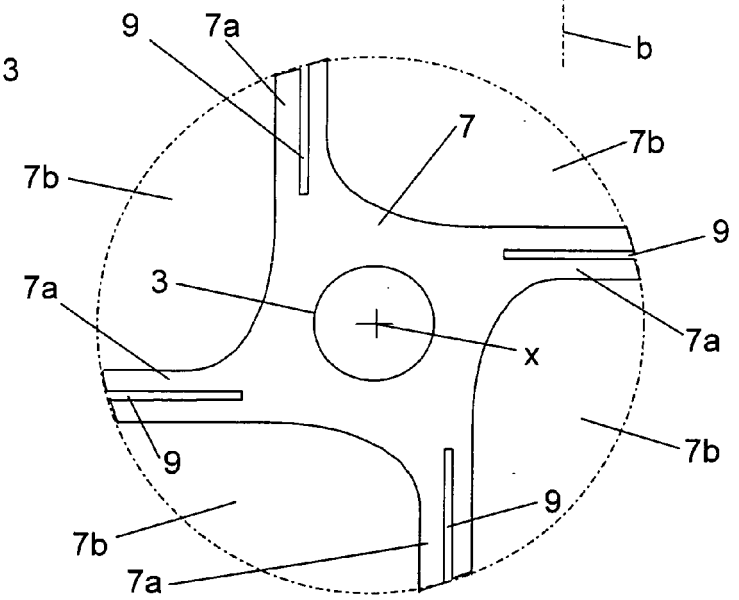


Fig 4

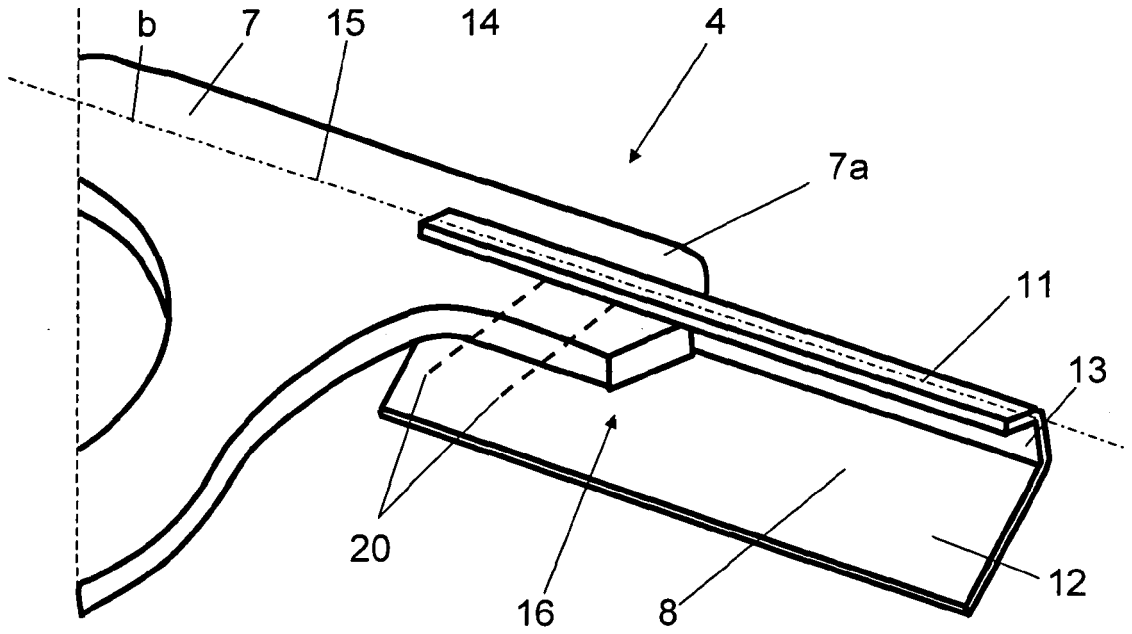


Fig 5

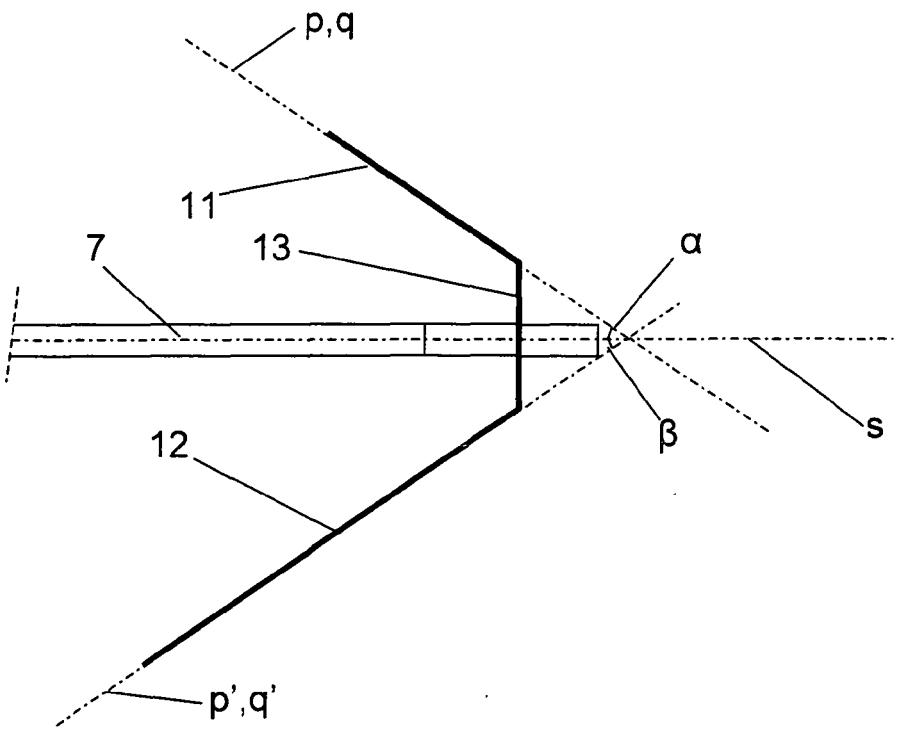


Fig 6

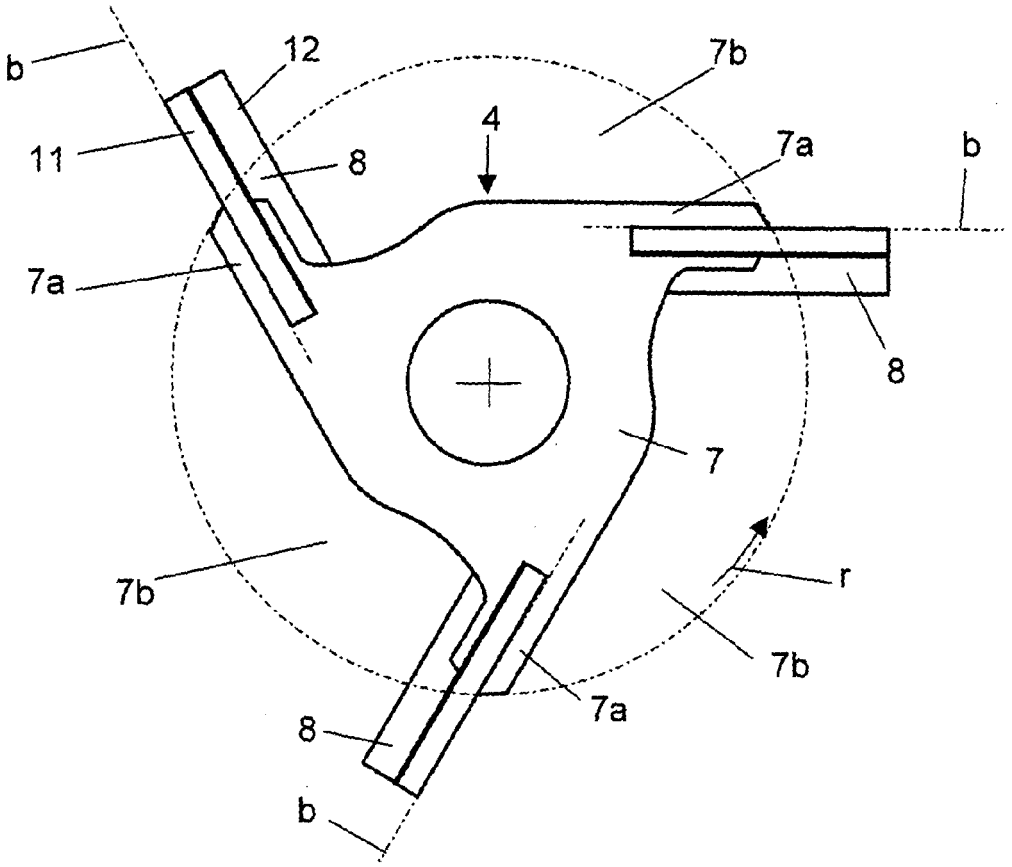


Fig 7

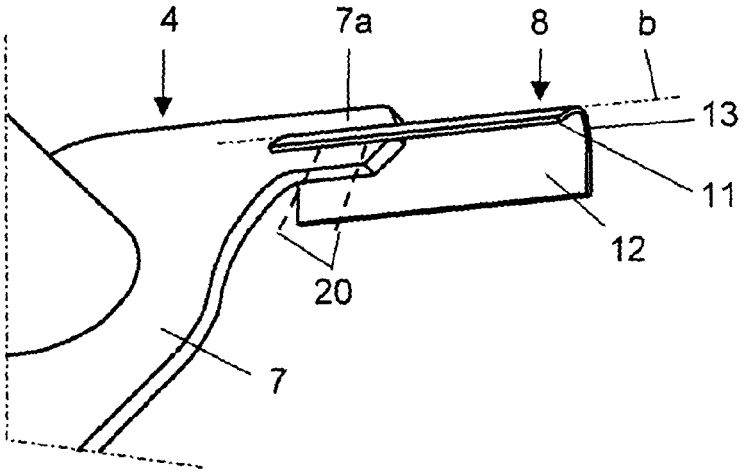


Fig 8

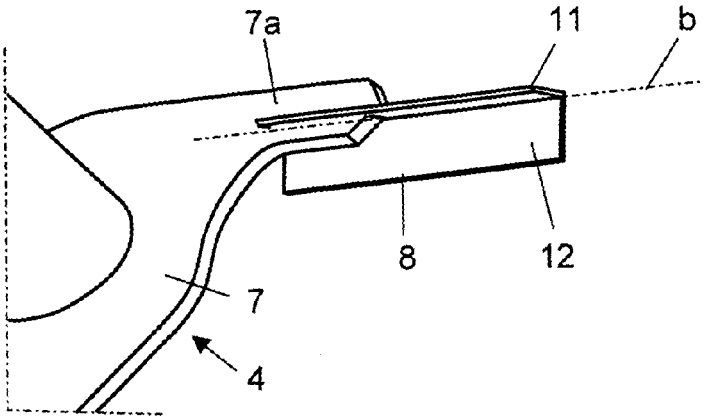


Fig 9

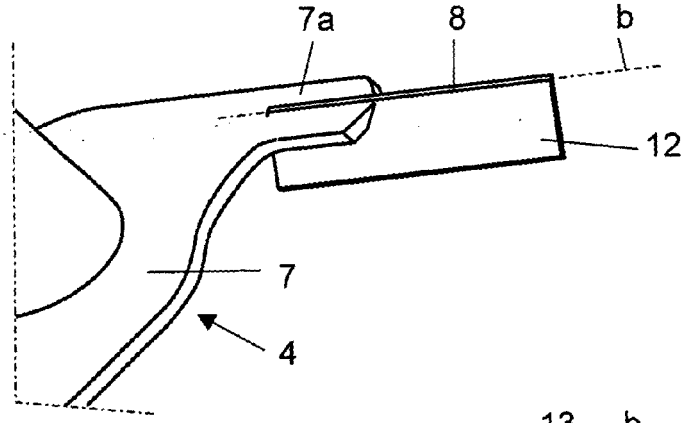


Fig 10

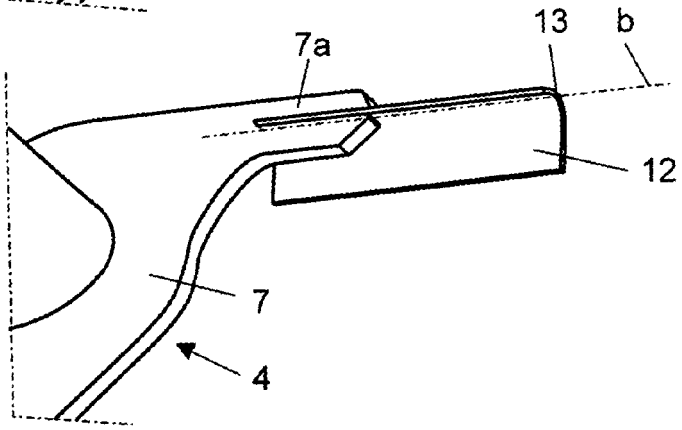
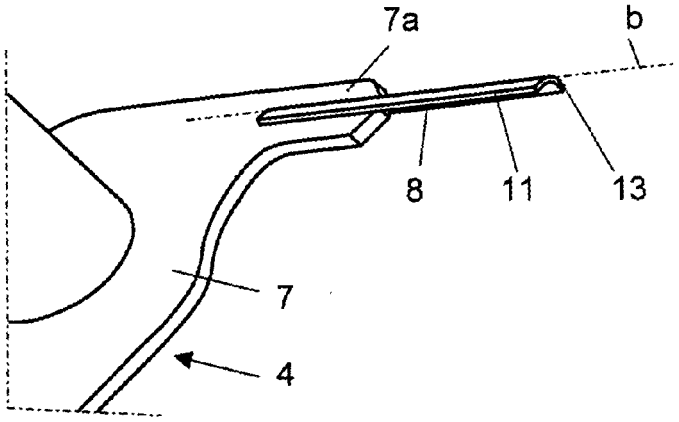


Fig 11



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EUROPEAN SEARCH REPORT

Application Number
EP 05 44 5081

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 791 780 A (BAKKER ET AL) 11 August 1998 (1998-08-11) * column 2, line 61 - column 3, line 65; figures 1-3 *	1,2, 5-10, 16-20	B01F15/00
X	US 5 904 423 A (FORSCHNER ET AL) 18 May 1999 (1999-05-18) * column 2, line 27 - column 3, line 35; figures 1-4 *	1-4, 6-10, 16-20	
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X	US 2 384 952 A (MILLER FRANK D) 18 September 1945 (1945-09-18) * claim 1; figures 1-3 *	1,2,5, 7-10	TECHNICAL FIELDS SEARCHED (IPC)
X	FR 2 763 867 A (GRANDE PAROISSE SA) 4 December 1998 (1998-12-04) * abstract; claim 1; figures 1,2,4,5 *	1,2, 18-20	B01F
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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
Munich	17 March 2006	Muller, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 44 5081

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17-03-2006

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