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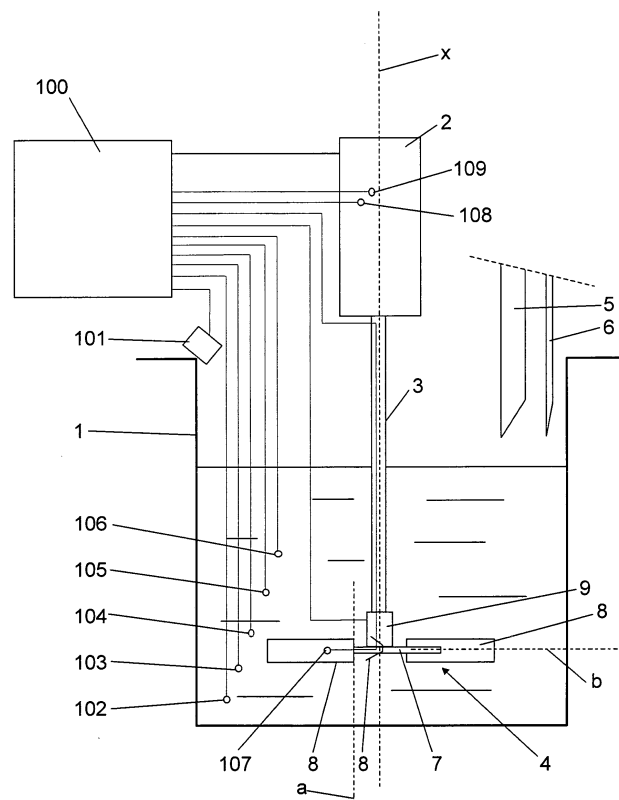
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(54) **A mixing device**

(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 (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. The agitating member

is attached to the shaft to be rotated around the rotary axis (x) by means of the motor and has a given topology determined by a plurality of geometrical parameters. The device comprises adjusting means (9) adapted to permit an adjustment of at least one of the geometrical parameters in order to change the topology of the agitating member and thus influence the mixing.

Fig 1



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 conventionally has a given topology or shape. If different substances, for instance with regard to temperature, viscosity, solid content etc, are to be mixed in different mixing processes, it is frequently necessary to replace the agitating member since the given topology does not result in an optimum mixing process. This is cumbersome and expensive since not only the mixing device and the agitating members are expensive, but also, and more important, the shut-down time during replacement. If we keep the same mixing device and the same agitating member, which is rigid and not deformable, during the entire mixing process, the quality of the product is certainly diminished. In fact, the properties of a mixture are changing during a mixing process, which means that the given topology can be optimised during a part of the mixing process but can be unsuitable during another part of the mixing process.

[0004] US-A-4,150,900 shows a slurry mixer having a tank and a rotating agitating member with blades in the tank. Baffles are provided in the proximity of the inner tank wall. In one embodiment the baffles are floating on the liquid to be mixed.

[0005] DE-A-23 43 011 shows a mixing device comprising three conical shearing elements, which are independently driven and connected to a respective motor by means of a respective tubular shaft. The shafts and the shearing elements are concentrically arranged within each other. One of the shaft and the associated shearing element is axially displaceable.

[0006] DE-A-102 03 005 shows a mixing device for the dissolution of cellulose carbamate. The device comprises a vessel and rotating mixing elements. Probes are provided for continuously measuring a plurality of mixture parameters such as solution concentration, solid content, turbidity, colour, conductivity, refraction of light, molecular weight, particle size, particle count and viscosity. The device also comprises software for analysing result for controlling parameters such as solvent feed, stirrer speed, carbamate addition, removal of carbamate solution and reactor temperature.

[0007] DE-C-44 41 350 shows a mixing device comprising a container, a rotating agitating member arranged in the container and a measuring sensor including a fibre

optic extending down into the mixture in the container. The measuring sensor is adapted to continuously measure the moisture content of the mixture.

[0008] DE-A-40 37 028 shows a process for operating a mixing device comprising a container and a motor-driven rotating agitating member. A number of parameters are continuously sensed, such as temperature, rotating speed, effect of the motor, viscosity (after a set time period). An estimated mixing time is calculated. The rotating speed is regulated in response to the sensed parameters, and can be regulated for the achievement of the estimated mixing time.

SUMMARY OF THE INVENTION

[0009] The object of the present invention is to provide a mixing device that overcomes the problems discussed above. More specifically, the object is to provide a mixing device which is adaptable to varying mixing conditions. This object is achieved by the mixing device defined in claim 1.

[0010] By such adjusting means, adapted to permit an adjustment of at least one of the geometrical parameters in order to change the topology of the agitating member, it is possible to adjust the agitating member to have an optimum shape and dimension for the actual mixing process and the substances to be mixed. One and the same agitating member may thus be used for mixing a variety of different substances. The agitating member may be adjusted to consider such parameters of the mixture as solid content, viscosity, temperature, pH, electrical conductivity, pressure and shear.

[0011] According to an embodiment of the invention, the agitating member has at least one blade extending outside the rotary axis. The blade may thus extend outwardly from the shaft. However, the blade may extend in various directions from the rotary axis. Any configuration of the blade proper is thus possible. It is also to be noted that the agitating member may include an arbitrary number of blades, for instance 1, 2, 3, 4 or more blades.

[0012] According to a further embodiment of the invention, the at least one adjustable geometrical parameter is defined by the at least one blade. Consequently, the topology of the agitating member is changeable by adjusting the position, the shape or the angle of one or several of the blades.

[0013] According to a further embodiment of the invention, the agitating member comprises a base element mounted to the shaft, wherein at least one blade is mounted to the base element. The base element can have any arbitrary shape. The purpose of the base element is to provide an attachment element for the blade or blades. The base element may be an integrated part of the shaft.

[0014] According to a further embodiment of the invention, the at least one blade element is displaceable inwardly and outwardly in order to permit an adjustment of the diameter of the agitating member. The diameter of the agitating member is an important geometrical param-

eter. By changing the diameter D, the effect P of motor is dramatically changed. Approximately the effect $P \approx k \cdot D^5$. The at least one blade may extend along a respective longitudinal blade axis that extends outwardly with respect to the rotary axis. The longitudinal blade axis does not have to be radial with respect to the rotary axis but may also have a tangential component. Furthermore, the longitudinal blade axis may extend somewhat upwardly, perpendicularly, or somewhat downwardly with respect to the rotary axis. Advantageously, the at least one blade is displaceable inwardly and outwardly along the respective longitudinal blade axis.

[0015] According to a further embodiment of the invention, the at least one blade is rotatable around the respective longitudinal blade axis. By means of such an adjustability, the angle of the blade can be changed. The angle of the blade in relation to the rotary direction of the agitating member is a further important geometrical parameter especially with regard to the shear. By adjusting this blade angle the shear can thus be influenced and changed.

[0016] According to a further embodiment of the invention, the at least one blade is rotatable around an attachment axis, which extends through the respective blade. This attachment axis may extend through the blade at an arbitrary position of the blade, for instance at an inner end, at a centre position or at an outer end of the blade. The attachment axis may extend substantially perpendicular to the longitudinal blade axis. Furthermore, the attachment axis may also be substantially parallel to the rotary axis. By means of this adjustability of the blade around the attachment axis, both the diameter of the agitating member and an angle of the blade in relation to the rotary direction of the agitating member may be adjusted, and thus both the shear and the power may be influenced and changed.

[0017] According to a further embodiment of the invention the adjusting means comprises a locking arrangement adapted to permit locking of the at least one blade in a desired position. Such a locking arrangement is advantageous since a desired position can be ensured. Especially, when adjusting one or several geometrical parameters manually, the locking arrangement is important in order to ensure that the desired position is maintained during operation of the device. The adjustment may then be performed by unlocking the locking arrangement, adjusting the position of the blade and finally locking the blade in the adjusted position.

[0018] According to a further embodiment of the invention, the locking arrangement includes at least one first locking member adapted to lock the at least one blade in the desired position with respect to the displacement of the blade inwardly and outwardly. Furthermore, the locking arrangement may comprise at least one second locking member adapted to lock the at least one blade in a desired position with respect to the rotation of the blade around the respective longitudinal blade axis. Still further, the locking arrangement may comprise at least

one third locking member adapted to lock the at least one blade with respect to the rotation of the blade around the attachment axis.

[0019] According to a further embodiment of the invention, the adjusting means comprises a force-generating arrangement adapted to provide the adjustment of at least one of the geometrical parameters. By means of such a force-generating arrangement, it is thus possible to adjust one or several geometrical parameters during operation of the device. The agitating member can thus be adjusted to operate in an optimum manner during the whole mixing process. For instance, the solid content and the viscosity of the mixture can vary during the mixing process. It is therefore advantageous to be able to adapt the agitating member to the instantaneous values of the solid content and the viscosity.

[0020] According to a further embodiment of the invention, the force-generating arrangement includes at least one first force-generating member connected to the at least one blade and adapted to displace the blade inwardly and outwardly. Consequently, the diameter of the agitating member can be changed during operation of the device. The first force-generating member may include a drive member for instance an electrical motor which performs the displacement of the blade inwardly and outwardly. The first force-generating member may also include a spring member which is adapted to displace the blade inwardly and outwardly with regard to the counter-acting forces of the mixture.

[0021] According to a further embodiment of the invention, the force-generating arrangement comprises at least a second force-generating member connected to the at least one blade and adapted to rotate the blade around the attachment axis. Consequently, the blade angle may be adaptable to actual parameters of the mixture, such as the viscosity, the shear, the solid content etc. The second force-generating member may include a drive member, for instance in the form of an electrical motor providing the rotation of the blade around the attachment axis. The second force-generating member may also include a spring member, so that the blade angle and the rotary position of the blade around the attachment axis is self-adapted to the counter-acting forces of the mixture.

[0022] According to a further embodiment of the invention, the force-generating arrangement comprises at least one third force-generating member connected to the at least one blade and adapted to rotate the blade around the longitudinal blade axis. Also the this force-generating member may include a drive member, for instance in the form of an electrical motor, for forcibly adjusting the rotary position of the blade with respect to the longitudinal blade axis during operation of the device. The third force-generating member may also include a spring member, wherein the rotary position of the blade with respect to the longitudinal blade axis is self-adapted to the counter-acting forces of the mixture.

[0023] According to a further embodiment of the inven-

tion, the device comprises a sensor arrangement adapted to sense during operation of the device the value of a mixture parameter related to a quality property of the mixture. Furthermore, the device may comprise a control unit connected to the sensor arrangement and adapted to control the adjusting means during operation of the device in response to the value of the mixture parameter. The control unit also may be connected to the force-generating arrangement, wherein the control unit is arranged to control the force-generating arrangement in response to the value of the mixture parameter sensed by the sensor arrangement. In such away, one or several of the geometrical parameters may be adapted during operation of the device in response to varying parameters of the mixture. For instance the mixture parameter may include at least one of the following mixture parameters: solid content in the mixture, viscosity of the mixture, temperature of the mixture, pH of the mixture, electrical conductivity of the mixture and the pressure in the mixture, and the power consumption of the motor.

[0024] According to a further embodiment of the invention, the sensor arrangement may include a sensor member adapted to sense the solid content in the mixture, a sensor member adapted to sense the viscosity of the mixture, a sensor member adapted to sense the temperature of the mixture, a sensor member adapted to sense the pH of the mixture, a sensor member adapted to sense the electrical conductivity of the mixture and/or a sensor member adapted to sense the pressure in the mixture.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] 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 an agitating member of the mixing device in Fig. 1.
- Fig. 3 shows an agitating member with an adjustable blade according to a first embodiment of the invention.
- Fig. 4 shows a variant of the adjustable blade in Fig. 3.
- Fig. 5 shows another variant of the adjustable blade in Fig. 3.
- Fig. 6 shows an agitating member with an adjustable blade according to a second embodiment of the invention.
- Fig. 7 shows a variant of the adjustable blade in Fig. 6.
- Fig. 8 shows a second variant of the adjustable blade in Fig. 6 in a first position.
- Fig. 9 shows the second variant of the adjustable blade in Fig. 6 in a second position.

- Fig. 10 shows a view of an agitating member having four blades adjustable in accordance with the second variant shown in Figs. 7 to 9.
- Fig. 11 shows an adjustable blade of an agitating member according to a third embodiment of the invention.
- Fig. 12 shows a first variant of the agitating member in Fig. 11.
- Fig. 13 shows a second variant of the adjustable blade in Fig. 11.

DETAILED DESCRIPTION OF VARIOUS EMBODIMENTS OF THE INVENTION

[0026] Fig. 1 shows a device for mixing at least a first substance and a second substance to form a homogeneous 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. The substances are supplied to 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.

[0027] 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 filling materials, chemical products etc.

[0028] 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 by means of the motor 2. The agitating member 4 has a given topology or shape determined by a plurality of geometrical parameters. Furthermore, the agitating member 4, an example of which is disclosed more closely in Fig. 2, 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 1, 2, 3, 4, 5, 6 or more blades 8.

[0029] Furthermore, the device comprises adjusting means, schematically indicated with 9 in Fig. 1. The adjusting means 9 is adapted to permit an adjustment of at least one of the geometrical parameters of the topology of the agitating member 4 in order to change the topology of the agitating member 4 and thus influence the mixing process.

[0030] As appears from the figures, each blade com-

prises two blade wings, an upper blade wing 11 and a lower blade wing 12. The upper blade wing 11 is thinner, or shorter in the rotary direction r of the agitating member 4, than the lower blade wing 12. The blade wings 11 and 12 are connected to a common central portion 13. It is to be noted that the blades 8 can have an arbitrary basic shape, for instance the blade 8 can be provided with only one blade wing.

[0031] In the various embodiments described herein, corresponding elements have been provided with the same reference signs.

[0032] Figs. 3-5 shows a first embodiment of the agitating member 4. According to this embodiment, the blades are displaceable inwardly and outwardly, as indicated by the arrow 14, along the respective longitudinal blade axis b .

[0033] In a first variant disclosed in Fig. 3, the blade 8 is arranged in a slit 15 of the base element 7. The slit 15 is dimensioned to permit a sliding movement of the central portion 13 of the blade 8 therein. In the variant disclosed in Fig. 3, the adjusting means includes a locking arrangement 16 comprising two locking bolts 17. The locking bolts 17 extends through the base element 7 and engages a respective one of four holes 18 through the central portion 13 of the blade 8. In Fig. 3, two of the holes 18 are shown. The two other holes 17 are engaged by the locking bolts 16. When the blade 8 is to be displaced, the locking bolts 17 are released and withdrawn whereafter the blade 8 is displaced to the desired position and the locking bolts 17 are introduced into the holes 18 corresponding to the desired position.

[0034] Fig. 4 shows a second variant of the first embodiment. According to this variant, the adjusting means includes a force-generating arrangement including a first force-generating member 20. The force-generating member 20 includes a drive motor 21 and a force-transferring member 22 connected to the drive motor 21 and the blade 8. The drive motor 21 is thus arranged to displace forcibly the blade 8 along the longitudinal blade axis b inwardly and outwardly on the base element 7.

[0035] Fig. 5 shows a third variant of the first embodiment. According to the third variant the adjusting means comprises a force-generating arrangement with a force-generating member 30 including a spring member 31. The spring member 31 is connected to the blade 8 and an attachment member 32 mounted on the base element 7.

[0036] Fig. 6 shows a first variant of a second embodiment of the agitating member 4. According to this embodiment, the blade 8 is rotatable around a respective attachment axis a , see also Fig. 1. The attachment axis extends through the blade 8. In the embodiment disclosed, the attachment axis a extends through the blade 8 at the inner end of the blade 8. However, it is to be noted that the attachment axis a may extend through the blade 8 at an arbitrary position of the blade 8 or even outside the blade 8 proper, wherein the blade 8 may be connected to a rotatable joint by any connecting member.

However, this connecting joint could in that case also be seen as a part of the blade 8.

[0037] Furthermore, in the embodiment disclosed the attachment axis a is substantially perpendicular to the longitudinal blade axis b and also substantially parallel to the rotary axis x . In the first variant shown in Fig. 6, the adjustment means comprises a locking arrangement 40 including a locking bar 41 extending between the blade 8 and the base element 7. The locking bar 41 may be rotatably connected to the base element 7 and adapted to engage one of several holes or other receiving members provided on the blade 8. It is also possible to let the locking bar 41 be rotatably connected to the blade 8 and adapted to engage one of a plurality of holes 42 or other receiving members provided in different positions on the base element 7, as illustrated in Fig. 6.

[0038] Fig. 7 shows a second variant of the second embodiment. According to this variant the adjusting means includes a force-generating arrangement including a second force-generating member 43 which includes a drive motor 44 directly connected to the blade 8. The drive motor 44 could of course be designed in a variety of different manners. By means of the drive motor 44 the blade 8 is thus arranged to be forcibly rotated around the attachment axis a . In such a way the blade angle in relation to the rotary direction r of the agitating member 4 can be adjusted and thus the shear is influenced. It is to be noted that the blade 8 in the variants disclosed in Figs. 6 and 7 has a slit (not shown) through the central portion 13 so that it can be rotated over the base element 7.

[0039] Figs. 8-10 show a third variant of the second embodiment. In this case the adjusting means comprises a force-generating arrangement with a force-generating member 50 in the form of a spring member 51. The spring member 51 will force the blade 8 to take an appropriate rotary position around the attachment axis a depending on various circumstances. Fig. 7 shows the blade 8 in a first position in which the resistance from the mixture is low. Fig. 8 shows a second position of the blade member wherein the resistance of the mixture is greater. Fig. 9 shows an agitating member 4 having four blades 8, the positions of which are adjusted by means of a respective spring member 51.

[0040] Fig. 11 shows a first variant of a third embodiment of the agitating member. According to this embodiment, the blade 8 is rotatable around the longitudinal blade axis b . More specifically, as appears from Fig. 11, the upper blade wing 11 is rotatable around an upper blade axis b' and the lower blade wing 12 is rotatable around a lower longitudinal blade axis b'' . The blade axes b' and b'' are arranged at an upper edge 13' and a lower edge 13'', respectively, of the central portion 13 of the blade 8. In the first variant, the adjusting means includes a locking arrangement 60 comprising a locking member in the form of a locking rod 61 and a number of grooves 62 extending in parallel with the longitudinal blade axes b' and b'' on the upper blade wing 11 and the lower blade wing 12, respectively. The bar can be moved to engage

different pairs of the grooves 62 and in such a manner the angle of the blade wings 11, 12 can be adjusted.

[0041] Fig. 12 shows a second variant of the third embodiment. According to this variant the device includes a force-generating arrangement including a force-generating member 70 including a respective drive motor 72 for the upper blade wing 11 and the lower blade wing 12. The drive motors 72 are arranged to rotate the respective blade wing 11, 12 around the respective blade axes b', b'', and thus to adjust forcibly the blade angles of the blade wings 11, 12.

[0042] As can be seen in Fig. 12, the force-generating member 70 may also be adapted to rotate the blade 8 around the attachment axis a as is explained in connection with the second variant of the second embodiment disclosed in Fig. 7.

[0043] Fig. 13 shows a third variant of the third embodiment. According to this variant the adjusting means comprises a force-generating arrangement with a force-generating member 80 in the form of a spring member 81. The spring member 81 is connected to the upper blade wing 11 and the lower blade wing 12, and thus arranged to influence and adjust the blade angle of the blade 8 by adapting the angles of the blade wings 11 and 12 to the prevailing circumstances.

[0044] The device also comprises a control unit 100, see Fig. 1 which is arranged to control the motor 2 g i.e. the rotary speed and the effect of the motor 2, and the agitating member 4, i.e. the force-generating members shown 20, 43, 70 in Figs. 4, 7 and 12. Furthermore, the device includes a sensor arrangement adapted to sense, during operation of the device, the value of a plurality of mixture parameters related to the quality property of the mixture. These mixture parameters could, for instance, be the solid content in the mixture, the viscosity of the mixture, the temperature of the mixture, the pH of the mixture, the electrical conductivity of the mixture and the pressure in the mixture. As appears from Fig. 1, the sensor arrangement may include a plurality of sensor members, 101-109. All the sensors 101-109 are connected to the control unit 100. The control unit 100 is then adapted to control the motor 2 and the agitating member 4 in response to the values of parameters sensed by the sensors 101-109. The sensors 101-109 are adapted to sense continuously during operation of the device the values of the parameters. These values are continuously fed to the control unit 100, which by means of software or simulator included therein is adapted provide appropriate control signals for controlling the speed and the effect of the motor 2, and the geometrical parameters of the agitating member 4. When a correct mixture quality has been obtained the device, and thus the mixing process, is automatically stopped. A first sensor member 101 may be adapted to sense the solid content in the mixture. In the embodiment disclosed this sensor member 101 has been exemplified by a video camera receiving an image of the surface of the mixture. This image can be processed and an estimation of the solid content can be made.

[0045] A second sensor member 102 may be adapted to sense the viscosity of the mixture. A third sensor member 103 may be adapted to sense the temperature of the mixture. A fourth sensor member 104 may be adapted to sense the pH of the mixture. A fifth sensor member 105 may be adapted to sense the electrical conductivity of the mixture. A sixth sensor member 106 may be adapted to sense the pressure in the mixture.

[0046] A seventh sensor member 107 may be provided one or several of the blades 8. Such a sensor could also be adapted to sense the viscosity of the mixture.

[0047] An eighth sensor member 108 is adapted to sense the effect or the power consumption, of the motor 2. A ninth sensor member 109 is adapted to sense the rotary speed of the motor 2 and thus of the agitating member 4.

[0048] The present invention is not limited to the embodiments disclosed but may be varied and modified within the scope 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 around the rotary axis (x) by means of the motor and has a given topology determined by a plurality of geometrical parameters, **characterized in that** the device comprises adjusting means (9) adapted to permit an adjustment of at least one of the geometrical parameters in order to change the topology of the agitating member (4) and thus influence the mixing.
2. A device according to claim 1, **characterized in that** the agitating member (4) has at least one blade (8) extending outside the rotary axis (x).
3. A device according to claim 2, **characterized in that** the at least one adjustable geometrical parameter is defined by the at least one blade (8).
4. A device according to any one of claims 2 and 3, **characterized in that** the agitating member (4) comprises a base element (7) mounted to the shaft, wherein the at least one blade (8) is mounted to the base element (7).
5. A device according to any one of claims 3 and 4, **characterized in that** the at least one blade (8) is displaceable inwardly and outwardly in order to permit an adjustment of the diameter of the agitating

- member (4).
6. A device according to any one of claims 3 to 5, **characterized in that** the at least one blade (8) extends along a respective longitudinal blade axis (b) that extends outwardly with respect to the rotary axis (x). 5
 7. A device according to claims 5 and 6, **characterized in that** the at least one blade (8) is displaceable inwardly and outwardly along the respective longitudinal blade axis (b). 10
 8. A device according to any one of claims 6 and 7, **characterized in that** the at least one blade (8) is rotatable around the respective longitudinal blade axis (b). 15
 9. A device according to any one of claims 6 to 8, **characterized in that** the at least one blade (8) is rotatable around an attachment axis (a), which extends through the respective blade (8). 20
 10. A device according to claim 9, **characterized in that** the attachment axis (a) extends substantially perpendicularly to the longitudinal blade axis (b). 25
 11. A device according to any one of claims 9 and 10, **characterized in that** the attachment axis (a) is substantially parallel to the rotary axis (x). 30
 12. A device according to any one of claims 3 to 11, **characterized in that** the adjusting means (9) comprises a locking arrangement (16, 40, 60) adapted to permit locking of the at least one blade in a desired position. 35
 13. A device according to claims 5 and 12, **characterized in that** the locking arrangement (16, 40, 60) includes at least one first locking member (16) adapted to lock the at least one blade (8) in the desired position with respect to the displacement of the blade (8) inwardly and outwardly. 40
 14. A device according to claim 8 and any one of claims 12 and 13, **characterized in that** the locking arrangement (16, 40, 60) comprises at least a second locking member (41) adapted to lock the at least one blade (8) with respect to the rotation of the blade (8) around the attachment axis (a). 45
 15. A device according to claim 9 and any one of claims 12 to 14, **characterized in that** the locking arrangement (16, 40, 60) comprises at least one third locking member (61) adapted to lock the at least one blade (8) in the desired position with respect to the rotation of the blade 8 around the respective longitudinal blade axis (b). 50
 16. A device according to any one of claims 1 to 11, **characterized in that** the adjusting means comprises a force-generating arrangement adapted to provide the adjustment of at least one of the geometrical parameters.
 17. A device according to claims 5 and 16, **characterized in that** the force-generating arrangement includes at least one first force-generating member (20, 30) connected to the at least one blade (8) and adapted to displace the blade (8) inwardly and outwardly.
 18. A device according to claim 17, **characterized in that** the first force-generating member (20) includes a drive member (21).
 19. A device according to claim 17, **characterized in that** the first force-generating member (30) includes a spring member (31).
 20. A device according to claim 8 and any one of claims 16 to 19, **characterized in that** the force-generating arrangement comprises at least a second force-generating member (43) connected to the at least one blade (8) and adapted to rotate the blade (8) around the attachment axis (a).
 21. A device according to claim 20, **characterized in that** the second force-generating member (43) includes a drive member (44).
 22. A device according to claim 20, **characterized in that** the second force-generating member (50) includes a spring member (51).
 23. A device according to claim 9 and any one of claims 16 to 22, **characterized in that** the force-generating arrangement comprises at least one third force-generating member (70, 80) connected to the at least one blade (8) and adapted to rotate the blade around the respective longitudinal blade axis (b', b'').
 24. A device according to claim 23, **characterized in that** the third force-generating member (70) includes a drive member (72).
 25. A device according to claim 23, **characterized in that** the third force-generating member (80) includes a spring member (81).
 26. A device according to any one of the preceding claims, **characterized in that** the device comprises a sensor arrangement adapted to sense during operation of the device the value of a mixture parameter related to a quality property of the mixture.
 27. A device according to claim 26, **characterized in that**

that the device comprises a control unit (100) connected to the sensor arrangement and adapted to control the adjusting means (9) during operation of the device in response to the value of the mixture parameter.

28. A device according to claims 16 and 27, **characterized in that** the control unit (100) is connected to the force-generating arrangement, wherein the control unit (100) is arranged to control the force-generating arrangement in response to the value of the mixture parameter sensed by the sensor arrangement. 10
29. A device according to any one of claims 26 to 28, **characterized in that** the mixture parameter includes at least one of the following mixture parameters: 15
- solid content in the mixture, 20
 - viscosity of the mixture,
 - temperature of the mixture,
 - pH of the mixture,
 - electrical conductivity of the mixture,
 - the pressure in the mixture, and 25
 - the power consumption of the motor.
30. A device according to claim 29, wherein the mixture parameter includes the solid content in the mixture, **characterized in that** the sensor arrangement includes a sensor member (101) adapted to sense the solid content in the mixture. 30
31. A device according to any one of claims 29 and 30, wherein the mixture parameter includes the viscosity of the mixture, **characterized in that** the sensor arrangement includes a sensor member (102) adapted to sense the viscosity of the mixture. 35
32. A device according to any one of claims 29 to 31, wherein the mixture parameter includes the temperature of the mixture, **characterized in that** the sensor arrangement includes a sensor member (103) adapted to sense the temperature of the mixture. 40
33. A device according to any one of claims 29 to 32, wherein the mixture parameter includes the pH of the mixture, **characterized in that** the sensor arrangement includes a sensor member (104) adapted to sense the pH of the mixture. 45
34. A device according to any one of claims 29 to 33, wherein the mixture parameter includes the electrical conductivity of the mixture, **characterized in that** the sensor arrangement includes a sensor member (105) adapted to sense the electrical conductivity of the mixture. 50

35. A device according to any one of claims 29 to 34, wherein the mixture parameter includes the pressure in the mixture, **characterized in that** the sensor arrangement includes a sensor member (106) adapted to sense the pressure in the mixture. 5

36. A device according to anyone of claims 29 to 35, wherein the mixture parameter includes the power consumption of the motor (2), **characterized in that** the sensor arrangement includes a sensor (108) adapted to sense the power consumption of the motor (2). 10

Fig 1

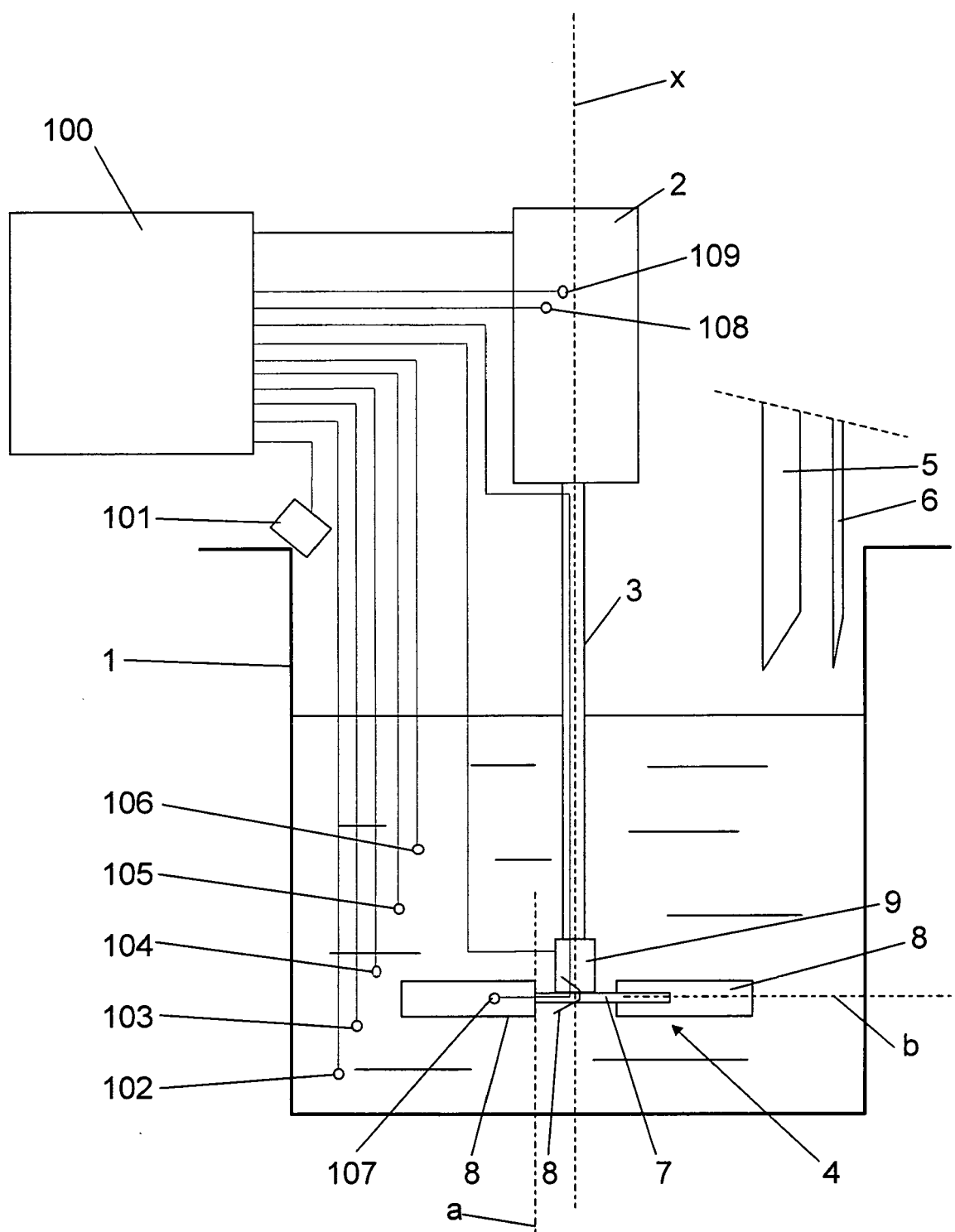


Fig 2

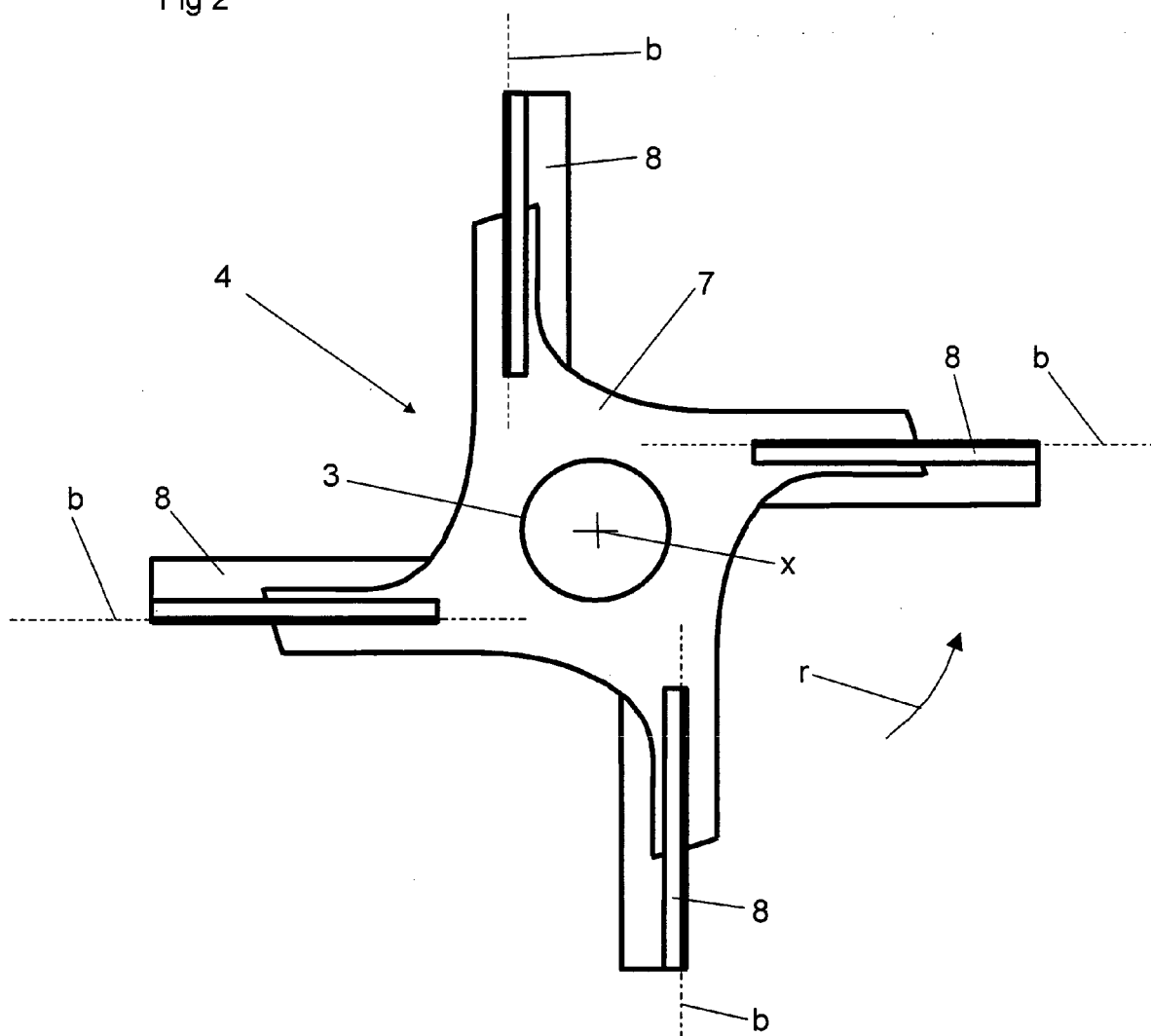


Fig 3

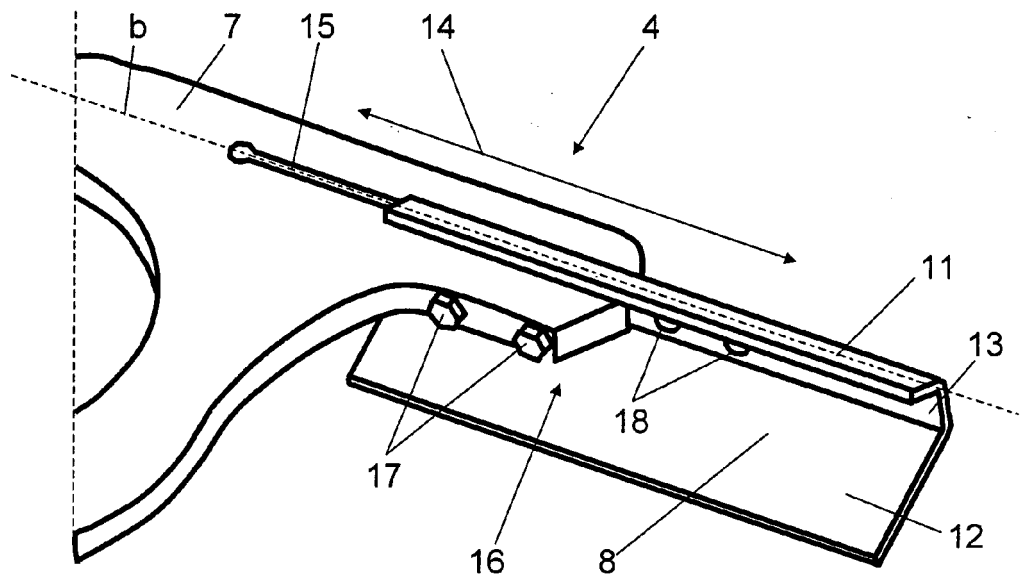


Fig 4

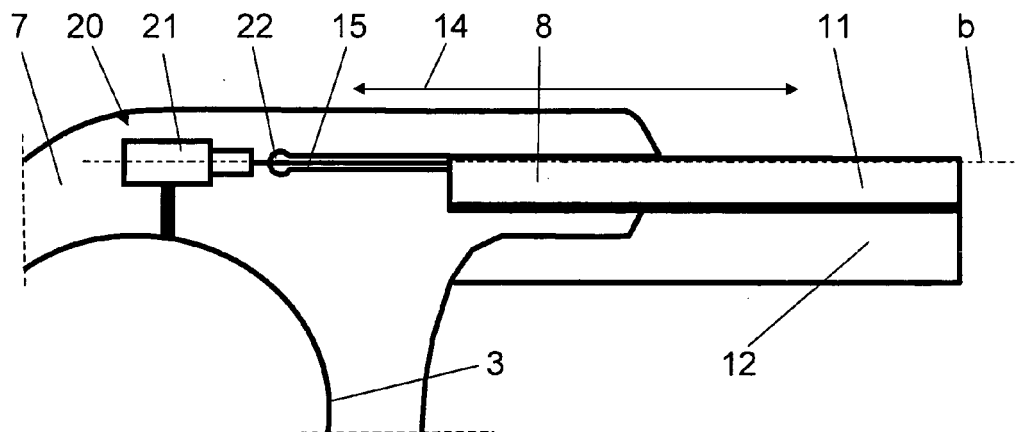


Fig 5

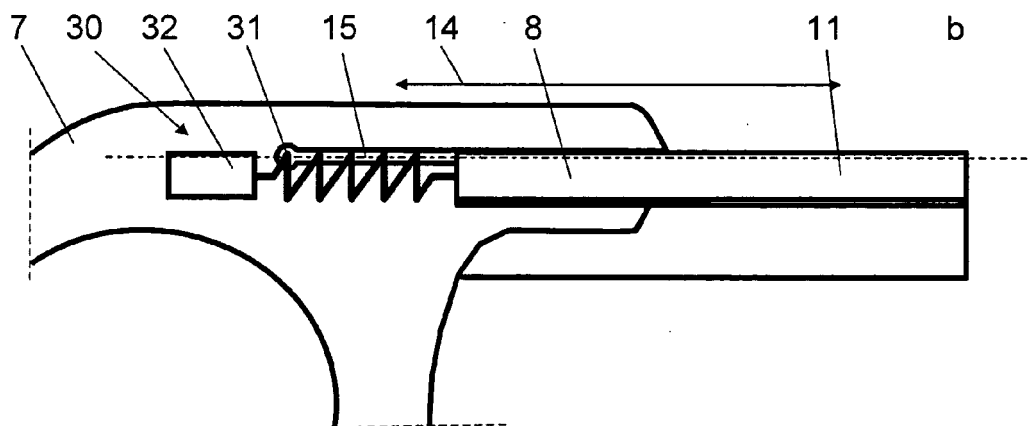


Fig 6

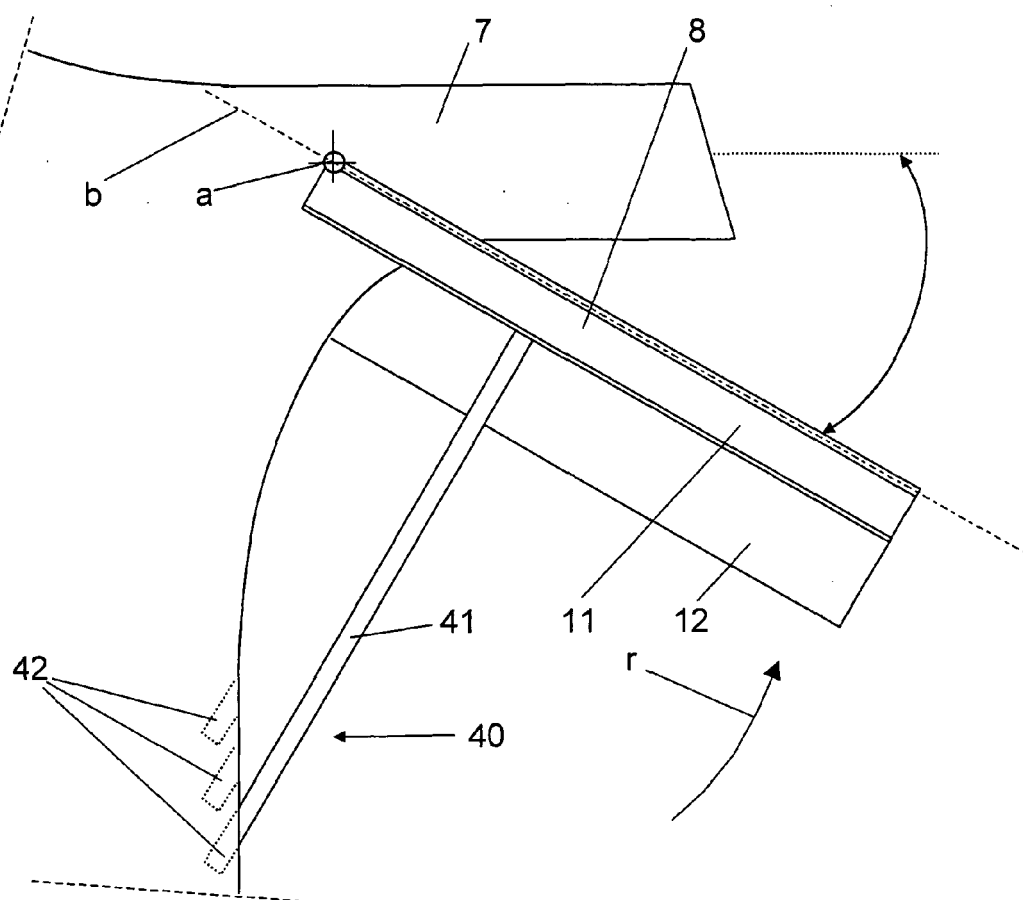


Fig 7

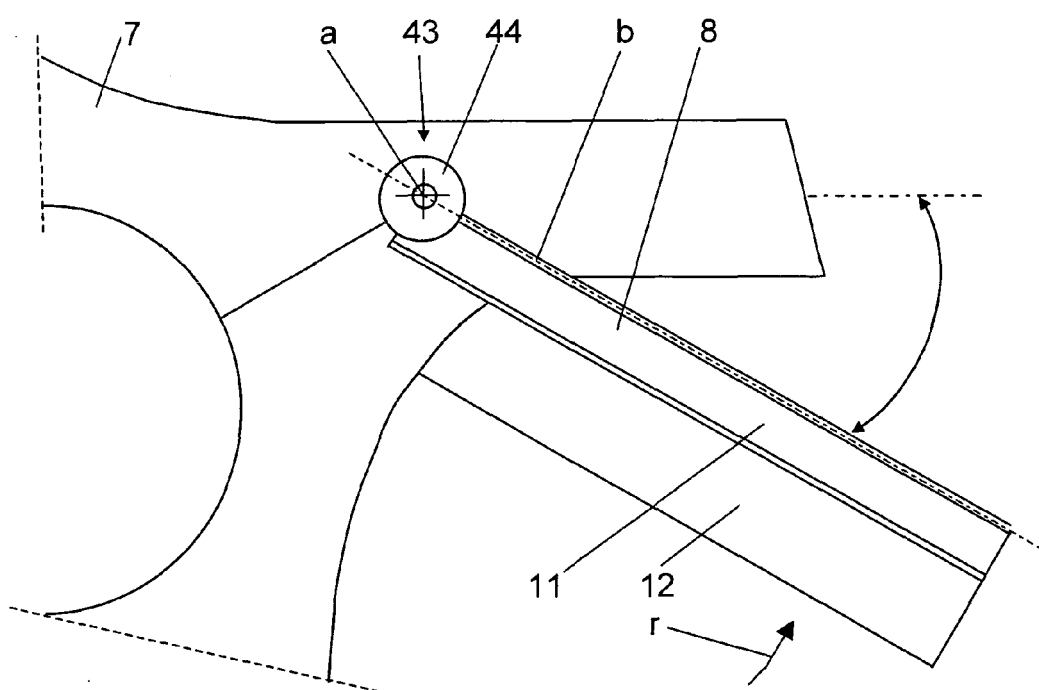


Fig 8

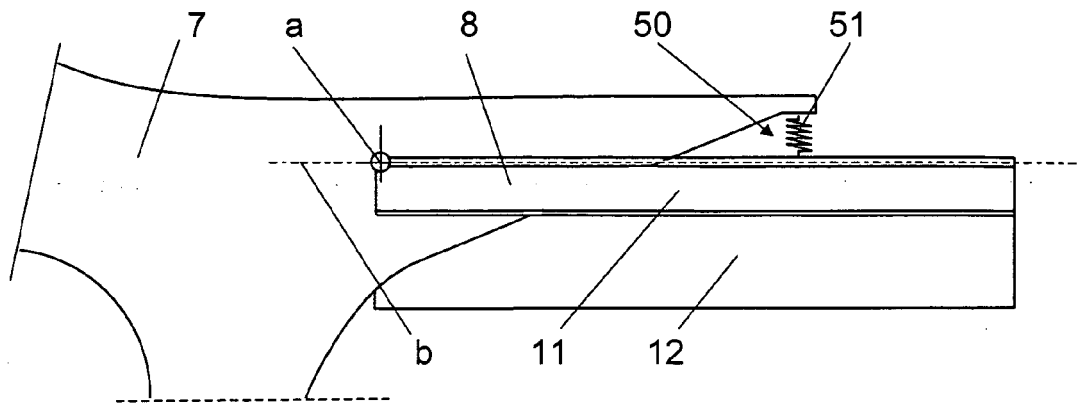


Fig 9

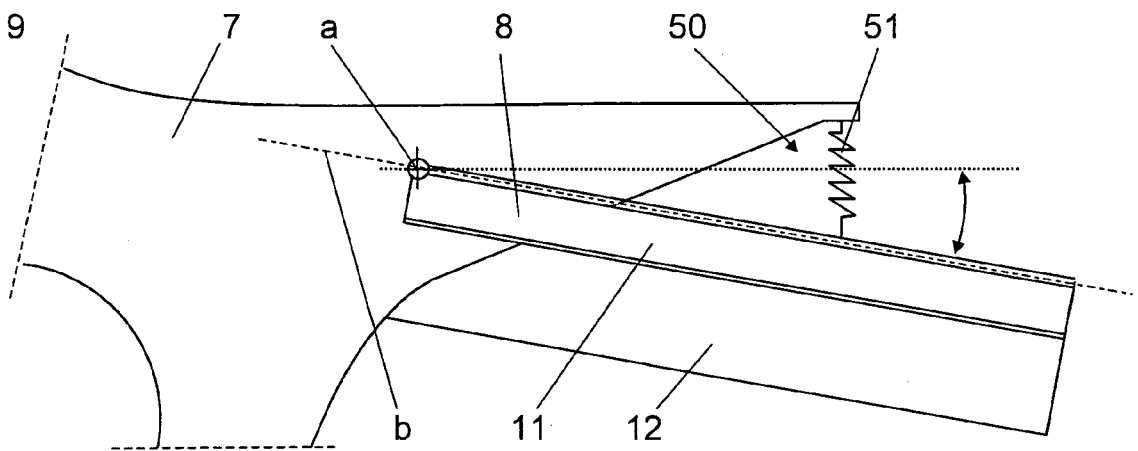


Fig 10

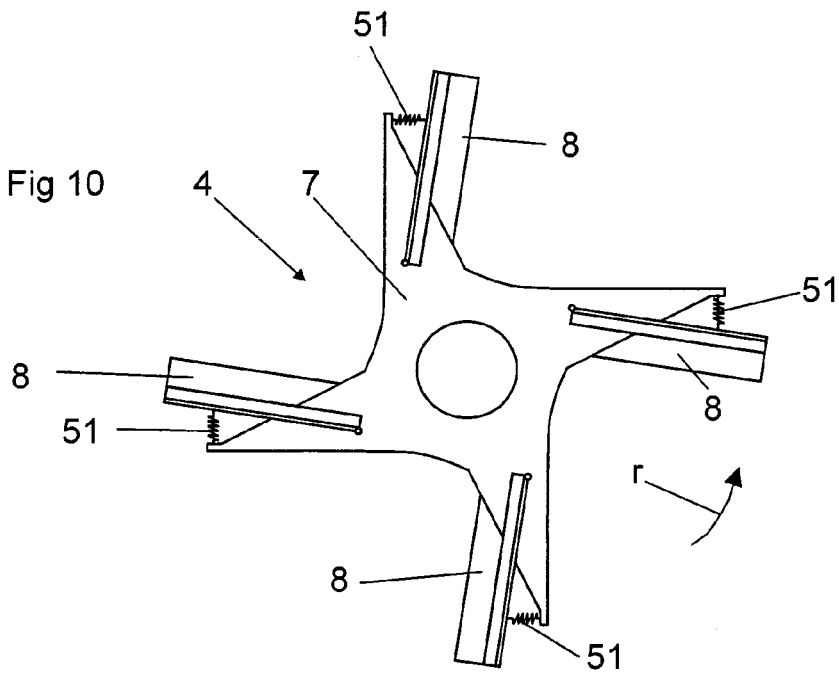


Fig 11

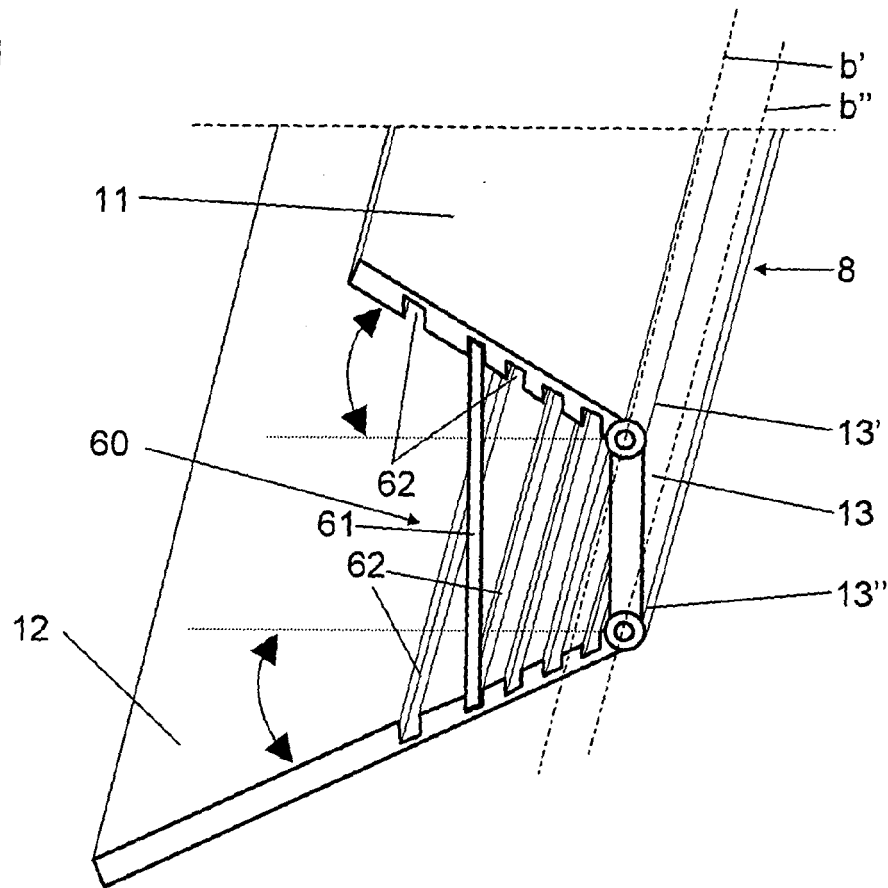


Fig 12

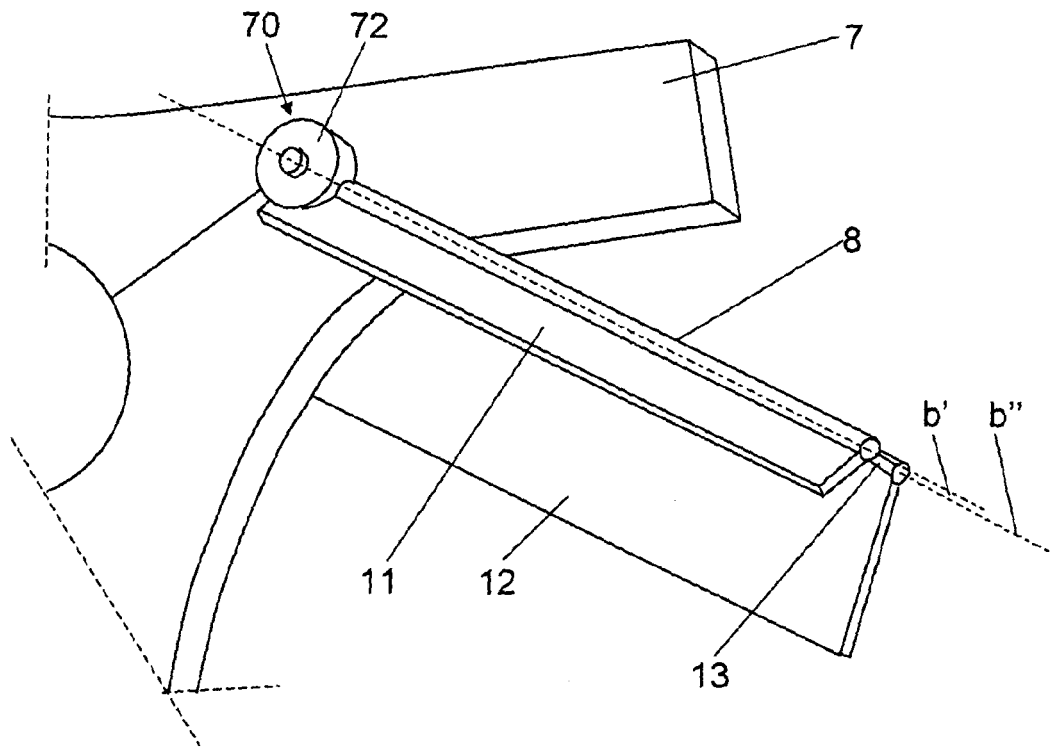
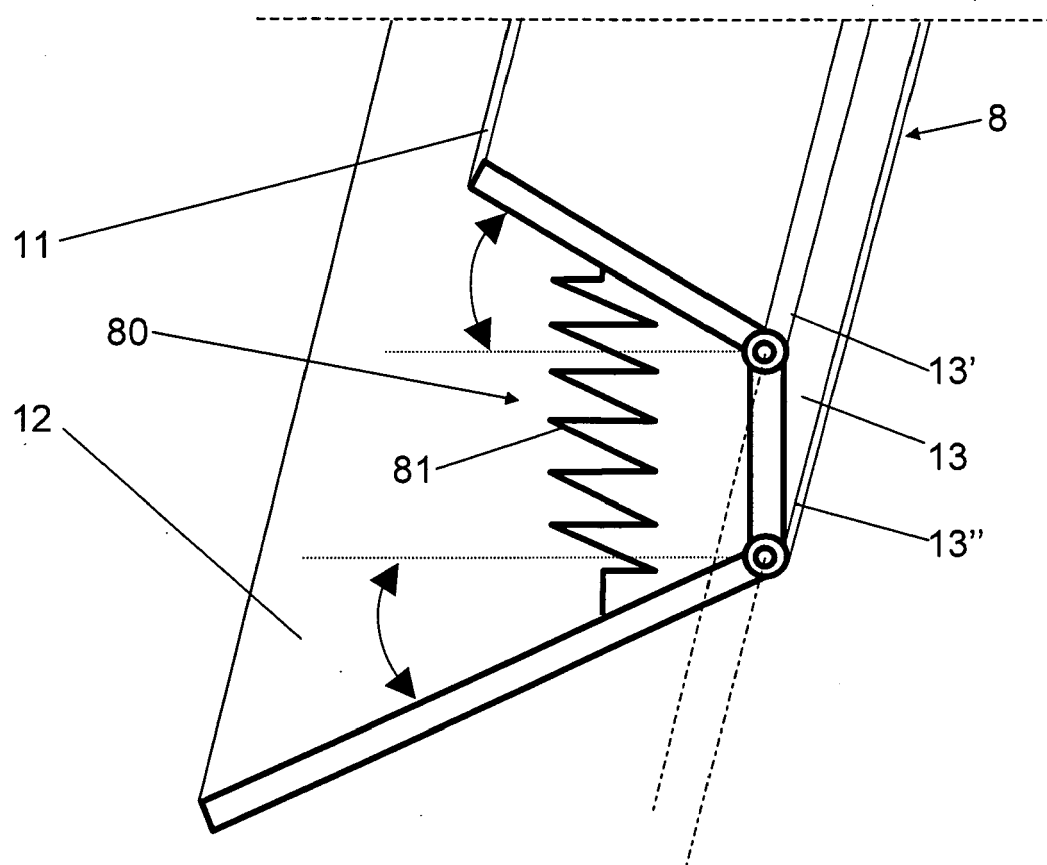


Fig 13





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 44 5080

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	GB 1 271 336 A (COLORTECH S.A) 19 April 1972 (1972-04-19) * page 1, line 55 - page 1, line 76; figures 1,2 *	1-5,9, 10,12,13 26-29, 31,32, 35,36	B01F15/00
Y			
X	----- US 3 326 532 A (LODGE EDMUND R) 20 June 1967 (1967-06-20) * column 3, line 8 - column 6, line 3; figures 6,7 *	1,16	
X	----- US 5 197 803 A (WALL ET AL) 30 March 1993 (1993-03-30) * column 2, line 63 - column 7, line 33; figures 5,6 *	1-3,6,7	
Y	----- FR 2 680 887 A (CAPPELLETTO RENZO) 5 March 1993 (1993-03-05) * abstract; claims 1-4; figures 1,2 *	26-29, 31,32, 35,36	
X	----- EP 0 507 764 A (FA. HELMUT TRAPPL) 7 October 1992 (1992-10-07) * page 3, line 14 - page 3, line 49; figures 1-5 *	1-5,16	TECHNICAL FIELDS SEARCHED (IPC) B01F
X	----- US 3 163 405 A (BALASSA LESLIE L) 29 December 1964 (1964-12-29) * column 2, line 32 - column 4, line 15; figure 5 *	1 2-36	
A	----- US 5 321 974 A (HEMMINGS ET AL) 21 June 1994 (1994-06-21) * abstract; claims 1-4; figures 1,2 *	26-29, 31,32, 35,36	
A	----- -/--		
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 21 March 2006	Examiner Muller, G
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03/82 (P04C01)



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	GB 142 853 A (HERMANN BUECHER)	1-5	
A	2 December 1920 (1920-12-02) * page 1, line 47 - page 2, line 32; figures 1-4 * -----	6-36	
			TECHNICAL FIELDS SEARCHED (IPC)
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 21 March 2006	Examiner Muller, G
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

 2
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 05 44 5080

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

21-03-2006

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
GB 1271336	A	19-04-1972	AT 301500 B	11-09-1972
			CA 923120 A1	20-03-1973
			CH 511634 A	31-08-1971
			DE 2035319 A1	27-05-1971
			ES 382205 A1	16-10-1972
			FR 2056697 A5	14-05-1971
			LU 59222 A1	22-12-1969
			NL 7011492 A	08-02-1971

US 3326532	A	20-06-1967	NONE	

US 5197803	A	30-03-1993	NONE	

FR 2680887	A	05-03-1993	NONE	

EP 0507764	A	07-10-1992	AT 395119 B	25-09-1992
			AT 69691 A	15-02-1992
			HU 63786 A2	28-10-1993

US 3163405	A	29-12-1964	NONE	

US 5321974	A	21-06-1994	AU 7202794 A	03-01-1995
			WO 9429692 A1	22-12-1994

GB 142853	A	02-12-1920	CH 88748 A	16-03-1921
			DE 329434 C	20-11-1920

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 4150900 A [0004]
- DE 2343011 A [0005]
- DE 10203005 A [0006]
- DE 4441350 C [0007]
- DE 4037028 A [0008]