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(54) **APPARATUS FOR MIXING A FIRST FLUID INTO A SECOND FLUID**

VORRICHTUNG ZUM MISCHEN EINER ERSTEN FLÜSSIGKEIT IN EINE ZWEITE FLÜSSIGKEIT

APPAREIL DESTINE A MELANGER UN PREMIER FLUIDE AVEC UN SECOND FLUIDE

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(73) Proprietor: **KVAERNER PULPING AB**
651 15 Karlstad (SE)

(72) Inventors:
- **EKHOLM, Rolf**
  653 50 Karlstad (SE)
- **JANSSON, Ulf**
  653 46 Karlstad (SE)

(74) Representative: **Hynell, Magnus**
Hynell Patenttjänst AB,
Patron Carls väg 2
683 40 Hagfors/Uddeholm (SE)

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SE-B- 468 341

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Description

TECHNICAL FIELD

The present invention relates to an apparatus for mixing a first fluid into a second fluid, which apparatus comprises:

- a housing having a flow chamber for the said second fluid,
- a flow restrictor member in the flow chamber, and
- means for introducing the said first fluid into at least one gap between the flow restrictor member and those walls of the chamber facing towards the flow restrictor member. The invention relates, in particular, to an apparatus for mixing a fluid, preferably a gaseous fluid such as, for example, steam, ozone or oxygen gas, into a cellulose pulp suspension.

PRIOR ART

The heating of liquids and suspensions by means of direct steam can be difficult to carry out for a large number of reasons. One is the difficulty of atomizing the steam and simultaneously keeping the suspension in such motion that a smooth and continuous condensation takes place, which requires, namely, that the steam is evenly atomized in the liquid or suspension. This is especially difficult when a large quantity of steam is supplied. When steam is added, it occurs, moreover, that the volume of the steam bubbles can be so great that the convection of heat between the steam and the liquid is insufficient for the desired continuous condensation. Because of this, intermittent, violent steam implosions arise, causing shocks and vibrations. These can be so violent that mechanical damage is incurred, which is accentuated the greater the quantity of steam to be added.

In general, a number of requirements can be placed upon a steam mixer. The steam should be added such that local surpluses do not occur during passage through the mixer. The degradation or so-called fluidization must take place in such a way that local pressure variations are minimized. Any implosions which occur because of steam bubbles should take place in a section in which the components or the construction material cannot suffer damage resulting from the cavitation-like phenomena. The mixer should have some form of in-built elasticity to enable it to absorb pressure and shocks caused by possible momentary disturbances in the steam and pulp flows up to and through the mixer.

A large number of apparatuses for mixing a gaseous fluid into a pulp suspension are known. The Swedish Patent No. 468 341 describes an apparatus for mixing a suspension of a cellulose-containing fibre material and a fluid such as, for example, gases in the form of ozone, oxygen and chlorine and liquids containing various active substances, e.g. chlorine dioxide. In its basic principle, this mixer comprises a funnel-shaped part and, in this, a conical moving part. Between the funnel-shaped part and the conical part there is formed an adjustable gap through which the pulp passes. In the walls of the funnel-shaped part there are located a number of openings for the fluid which is to be mixed into the passing pulp. Drawbacks with this apparatus are that it is relatively large, that its installation, especially in existing pipe systems, is complicated, since the flow direction of the pulp alters in the mixer, requiring that the pipe system to which the mixer is to be connected has to be redirected, and that the mixer requires some form of stand or base on which to be mounted.

Also common are mixer devices having a rotary part for mixing fluid into the pulp. A problem in these devices is that the rotation gives rise to large pressure variations, which create local zones of very low pressure to which the steam makes its way, resulting in implosions as described above. A further problem is to distribute the steam evenly in the pulp suspension, especially when large quantities of steam are to be supplied, as a result of which capacity problems can also arise.

BRIEF DISCLOSURE OF THE INVENTION

The object of the present invention is to remedy the said problems. There is therefore proposed, according to the invention, a blending or mixer apparatus which does not have any rotary parts, which does not presuppose that the said second fluid, which can consist, for example, of a pulp suspension, does not require that the flow alters its principal flow direction, thereby making the apparatus suitable for installation in existing pipe systems, which is compact in its construction and which does not require a stand or base for its mounting.

These and other objects and advantages of the invention can be achieved by virtue of the characteristics of the invention which are specified in the subsequent patent claims. Further characteristics and aspects and advantages of the invention can be derived from the following description of a preferred embodiment.

BRIEF DESCRIPTION OF DRAWINGS

In the following description of a preferred embodiment, reference will be made to the appended drawings, in which:

Fig. 1 is a partially cut-through end view of the apparatus according to the present invention.

Fig. 2 is a side view in section taken along the line II-II in Figure 1.

Fig. 3 is a part view in section taken from Figure 2, showing the embodiment of the distribution members, and

Fig. 4 is a perspective view of a flow restrictor member forming part of the apparatus.

Fig. 5 is a side view in section of an apparatus according to a modified embodiment of the invention taken along the corresponding section shown in Fig. 2,

Fig. 6 is a perspective view of a flow restrictor member included in an apparatus according to a modified embodiment of the invention, and

Fig. 7 is a perspective view of a flow restrictor member included in an apparatus according to yet another embodiment of the invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

The apparatus A comprises, according to the embodiment, a main body 1 - hereinafter referred to as the housing - which in turn exhibits a tubular or sleeve-shaped outer wall 36, a first, plane end wall 37, a second end wall 38, which can also be plane but which, according to the embodiment, is inwardly conical, and between the said first and second end walls a continuous elongated opening 39 - hereinafter referred to as the flow chamber - which is limited to the sides by a pair of plane chamber walls 5, 10. The shape of the flow chamber 39 will be described in greater detail below.

The flow chamber 39 divides the first, plane end wall into two circular-segment-shaped portions 37a and 37b and the second end wall 38 is also correspondingly divided into two portions 38a and 38b, which can be described as conical segments or plane, circular segments in the event of the end wall 38 being plane. Between the outer wall 36 and the walls 5, 37a and 38a there is formed a first outer space 40a and at the other side of the housing 1 there is correspondingly formed a second outer space 40b. Leading to these two first and second outer spaces 40a, 40b are supply lines 41a, 41b for the fluid which has been referred to above as the first fluid and which is to be mixed into the said second fluid. According to the embodiment, the said first fluid is intended to consist of steam, but can also, in other applications of the apparatus, consist of other gaseous fluids, e.g. oxygen, ozone, chlorine dioxide and/or by a liquid.

The apparatus A is fastened, by means of the housing 1, between two pipelines 32, 33, which, according to the embodiment, have the same diameter as the outer wall 36 of the housing 1. A different diameter is also, however, conceivable. The fastening can be realized in a conventional manner by a flange joint. A pair of flanges on the housing 1 are denoted by 34, 35. The apparatus A having the housing 1 is herein facing such that the said second fluid flows from the line 32 up through the flow chamber 39 and onward up through the pipeline 33, the housing 1 facing with the plane, first end wall 37 towards the incoming pipeline 32 for the said second fluid and with the inwardly conical, second end wall 38 facing towards the outgoing line 33.

At both ends of the flow chamber, the outer wall of the housing 1 is breached, thereby forming lateral openings 43 and 44. Through these openings 43, 44, the flow chamber 39 communicates with a pair of first and second cylinder spaces 45 and 46 respectively, disposed outside the housing 1. The associated first and second cylinders 27 and 28 are welded to the outer wall 36 of the housing 1. In the cylinders 27, 28 there are located a first and a second piston 25 and 26, respectively. The said first piston 25 is further connected by a piston rod 23 to a hydraulic piston 21 in a hydraulic cylinder 20. A pair of supply lines for hydraulic oil have been denoted by 20a, 20b. Instead of hydraulic operation, pneumatic operation can also be envisaged. The cylinder 20 consists in this case of a pneumatic cylinder and the lines 20a, 20b are air lines.

In the flow chamber 39 there is disposed a flow restrictor member 6, which extends from the first cylinder space 45, through the first lateral opening 43, onward through the whole of the chamber 39 and, via the second lateral opening 44, into the second cylinder space 46. At the same time as the flow restrictor member 6 constitutes a restrictor member in the flow chamber 6, it also constitutes a connecting element between the two pistons 25 and 26, which are connected up to both ends of the flow restrictor member 6.

The appearance of the integrated member, which consists of the flow restrictor member 6, the said first and second pistons 25, 26, the piston rod 23 and the hydraulic or pneumatic piston 21, is shown in Fig. 4. The longitudinal axis of the flow restrictor member 6, also the centre axis for the pistons 25 and 26, has been denoted by 24. This is perpendicular to the centre line 31 of the housing 1, which at the same time is the principal flow direction for the second fluid which is transported through the pipelines 32 and 33 and into which the said first fluid is to be blended.

As can be seen from Figs. 1, 2 and 4, the flow restrictor member 6 has the general shape of a six-sided polyhedron limited by a pair of side walls 7, 8, a bottom wall 48, a top wall 49, a rear end wall 50, which is joined to the first piston 25, and a front end wall 51, which is joined to the second piston 26. More specifically, the flow restrictor member 6 is double wedge-shaped in that it is wedge-shaped both in its longitudinal direction, i.e. in the direction of the axis 24, by virtue of the two side walls 7, 8 converging towards each other in a wedge shape, in the direction of the axis 24, from the rear end wall 50 towards the front end wall 51, and in the transverse direction, by virtue of the same end walls 7, 8 also converging towards each other in a wedge shape, in the direction of the axis 31, from the top wall 49 towards the bottom wall 48 facing towards the inflowing second fluid.

The flow chamber 39 has a shape which is approximately uniform with the shape of the flow restrictor member 6. When the flow restrictor member 6 is sym-

metrically placed in the flow chamber 39, the side walls 7, 8 of the flow restrictor member, however, form a small angle with the side walls 5 and 10, respectively, of the chamber 39. There is thus formed between the said walls 5, 7 and 8, 10, respectively, a gap 15 and 16, respectively, which widens somewhat in the flow direction. These two gaps 15, 16 constitute passages for the second fluid which is to pass from the pipeline 32, through the apparatus A according to the invention, to the second line 33. In principle, the walls which define the gaps 15, 16 can be parallel in the position of symmetry, but the small deviation from parallelism and hence the widening gap shape is to be preferred.

The apparatus A further comprises means for introducing the said first fluid, which in the envisaged application should be constituted by steam, into the gaps 15, 16. These means comprise, on the one hand, the two outer spaces 40a and 40b and the supply lines 41a, 41b to these spaces and, on the other hand, holes 18 in the side walls 5 and 10 of the flow chambers 39. These holes 18 are distributed along the length of the side walls 5, 10 and are preferably disposed closer to the inlet openings 11 and 12, respectively, of the two gaps 15 and 16 than their outlet openings 13 and 14, respectively. The holes 18 can be configured, for example, as circular holes or as gaps or slots. The term "hole" should therefore not be given any restrictive meaning, but should cover all through openings, slots, etc., regardless of shape. In axial section, the holes have a shape which widens from the outer spaces 40a, 40b to the gaps 15, 16. This shape is particularly suitable where the second fluid, which flows up through the gaps 15, 16, is a fibre-containing suspension. If the supply of the said first fluid - the mix-in fluid - through the supply lines 41a, 41b were interrupted, whilst cellulose-containing fibre material continues to flow through the apparatus A, then the holes 18 are blocked by the fibre material and do not penetrate into the outer spaces 40a, 40b. When steam or a different blend-in fluid is turned on again through the lines 41a and 41b into the spaces 40a and 40b, respectively, this fluid will blow away the fibre plugs in the holes 18, so that these again become ready for use.

As a variant or improvement, the holes, slots or equivalent 18 can be disposed in separate exchangeable plates, which can be screw-fastened and can fill a larger opening in the side walls 5, 10. By having access to a number of such exchangeable plates, which can be provided with a different number of holes 18 or with holes 18 of different shape, location, size etc., the user can acquire increased opportunities to adapt the inflow of the first fluid, in the present case steam, to other conditions. If for example, the production conditions should alter in the larger installation of which the apparatus according to the invention constitutes a part, an exchangeable plate can be replaced so that a plate is obtained having holes matched to the altered production conditions.

It is also in fact possible to supply the steam or other first fluid via the flow restrictor member 6, in which case openings are correspondingly disposed in the side walls 7, 8 of the said flow restrictor member, preferably close to the inlet openings 11, 12 of the gaps 15, 16.

Also forming part of the equipment are pressure-detecting sensors, mounted upstream and downstream of the apparatus, and governor devices (these parts not shown) for controlling the piston 21 by influencing the flow in the lines 20a, 20b in order thereby to control the movements of the wedge-shaped flow restrictor member 6, in the longitudinal direction of the flow restrictor member, transversely to the principal flow direction for the pulp suspension or equivalent other fluid through the apparatus A, thereby enabling the width of the gaps 15, 16 and hence also the flow through the apparatus to be regulated.

In the following description of how the apparatus functions, it is presupposed that the fluid which flows up through the pipelines 33, 34 and which in the patent claims and in the preceding text is referred to as the second fluid is a suspension of cellulose fibre pulp in water, and that the said first fluid, which is to be introduced into this suspension, is steam.

The pressure-detecting sensors (not shown) and the said governor devices measure or receive the measurement values of the pressures in the fibre pulp suspension upstream and downstream of the apparatus A in order to register a pressure differential. The governor devices compare the registered pressure differential with a predefined desired value, which is set in dependence upon prevailing production conditions such as temperature, consistency, pulp type and capacity. This setting is preferably made automatically.

The governor device activates the control cylinder 20 by regulating the pressure and/or flow through the hydraulic lines 20a and 20b, so that the flow restrictor member 6 is shifted forwards or backwards in the direction of the axis 24, i.e. transversely to the principal flow direction coinciding with the axis 31, in order to set the gaps 15, 16 to the desired width.

If for example, the pressure increases on the inlet side, i.e. in the pipeline 32, this is registered by the said sensors and governor devices, so that the control cylinder 20 is activated and moves the flow restrictor member 6 transversely to the principal flow direction 31, so that the width of the gaps 15, 16 increases. The thereby increased flow area makes it possible for the blockage to be dispersed and for a greater pulp flow to be obtained until the pressure on the inlet side drops and the pressure differential returns to normal. The control cylinder 20 is then re-activated, so that the gap widths diminish, this continuing to be repeated until a stable state is achieved.

The flow restrictor member 6 is controlled in its axial movements by the pistons 25, 26 in the cylinders 27, 28, so that the longitudinal axis 24 of the flow restrictor member 6, the longitudinal axis of which at the same

time constitutes the centre axis for the pistons 25, 26, will always coincide with the plane of symmetry of the flow chamber 39, this plane of symmetry coinciding with the principal flow direction 31 in the apparatus A. The flow restrictor member 6 is nevertheless able to wobble, by small rotational movements, about its centre axis 24, due to the fact that the bearing pistons 25, 26 are cylindrical. This means that if one of the gaps 15, 16 begins to be blocked, the pressure in the other gap will increase and preferably in the region of the outlet passages 13 or 14. This unbalanced pressure on the one or other of the side walls 7 or 8 generates a torque which turns the restrictor member 6 about its centre axis 24, thereby increasing the gap width where the gap is in the process of being blocked. By increasing the gap width in the critical blockage region, the blockage or "plugging" can be made to work loose. Above all, however, blockage of the gaps by the mounting of the flow restrictor member 6 in the cylinders 27, 28 is avoided due to the fact that the constant pressure variations which arise in the two gaps 15, 16 generate constant, small rotational movements of the flow restrictor member 26, which inhibits blockage.

The pressure from the fluid flowing in the gaps 15, 16 acts upon the inner sides 29, 30 of the bearing pistons 25, 26 via the lateral openings 43, 44. The first piston 25, which is placed closest to the control cylinder 20, has an inner surface 29 which is larger than the surface 30 belonging to the other piston 27, which means that the pressure from the flowing fluid endeavours to press the flow restrictor member 6 in the direction of the control cylinder 20. This means that the control cylinder 20 operates for the most part with a counter-pressure in order, so to speak, to resist the pressure from the flowing medium. Where appropriate, a damping in the form of a pressure can be imposed upon the other side of the control cylinder 20 so as to dampen the movements from the flow restrictor member 6. A certain freedom of movement in the longitudinal direction 24 of the flow restrictor member 6 is nevertheless desirable since pressure variations in the said second fluid, which flows up through the apparatus A, and the counter-pressure from the control cylinder 20 can generate oscillating longitudinal movements of the flow restrictor member 6, which also counteract blockage or "plugging" of the gaps 15, 16. Where appropriate, the apparatus A may also be provided with a vibrator, which is connected up to the bearing piston 26 and acts in the longitudinal direction of the flow restrictor member 6.

In order to control the flow of the said second fluid, i.e. the pulp suspension according to the embodiment, the narrower surface 48, facing towards the flowing medium, of the wedge-shaped flow restrictor member 6 can be extended by a projecting guiding body.

Modified embodiments of the apparatus according to the invention will be described below with reference to Figs. 5-7. In Figs. 5 and 6, details which have a direct correspondence in Figs. 1-4 have the same reference numbers with the addition of', and in Fig. 7 with the addition of x.

The apparatus A' comprises a main body or housing 1', with a first flat end wall 37' and a second flat end wall 38' and between said first and second end walls 37', 38' a flow chamber 39' with the same general form as the flow chamber 39 in the previous embodiment. The apparatus A' is mounted between the two pipelines 32' and 33' by means of flange connections analogous with the previous embodiment.

In the flow chamber 39' there is disposed a flow restrictor member 6' which is essentially formed as a six-sided polyhedron limited by a pair of side walls 7', 8', a curved bottom wall 48' and a curved upper wall 49'. Otherwise, the flow restrictor member 6' may be designed in analogy with the flow restrictor member 6 in the previous embodiment. However, it might be suitable to displace the centre axis 24' for those pistons (corresponding to pistons 26, 27 in the previous embodiment, which control the movements of the flow restrictor member 6') closer to the bottom wall 48' in order to center the flow restrictor member 6' under influence of the fluid flowing through the flow chamber 39'.

According to the embodiment, the two side walls 5' and 10' of the flow chamber 39' consist of a pair of double plates, namely an outer plate 5A', 10A' which is securely welded to the end walls 37', 38', and an inner plate 5B', 10B' which is detachably attached to the respective outer plate 5A', 10A' by means of bolts 60. Between on one hand the two inner plates 5B' and 10B' and on the other hand the side walls 7' and 8' of the flow restrictor member 6', a gap 15' and 16' respectively is provided in the same manner as for the previous embodiment.

According to the embodiment, the sides of the walls 5B' and 10B' facing the gaps 15' and 16', are provided with elongated recesses or grooves 61 in order to increase the turbulence of the fluid flowing through the gaps 15', 16' and thereby further improve the mixing of the second fluid which is to be mixed with said first fluid in the gaps 15', 16'. In the lower part of each inner side plate 5B' 10B',a series of holes 18' are provided for introducing the said first fluid into the gaps 15', 16'. Behind these holes, an elongated opening 18A' is provided in the respective outer side wall 5A', 10A'.

Outside the elongated openings 18A', an outer space 40a' and 40b', respectively, is provided. Supply lines 41a' and 41b' are connected to these outer spaces 40a' and 40b', respectively, for said first fluid.

In the preamble to this patent specification is mentioned that intermittent, violent steam implosions may arise when steam is mixed into a fluid, causing chocks and vibrations. In order to attenuate such chocks and to prevent or reduce any vibrations of the flow restrictor member 6', the following provisions are made. Each of the two side walls 7', 8' of member 6' is provided with a recess 62 on the side of the wall facing the gap 15' or 16'. The recesses 62 take up the major part of the said

wall sides and are covered by a thin sheet 63 of stainless steel. The covered recesses 62 may be filled with sand, lead or steel shots, rubber or any other chock dampening material in a manner which may be known per se.

The operation of the apparatus shown in Fig. 5 corresponds to the above described operation of the apparatus A according to the previous embodiment. Therefor, reference is made to the previous description regarding the operation.

In the above description of the embodiment according to Fig. 5, it was mentioned that the axis 24' preferably is displaced towards the front end wall 48' of the flow restrictor member 6' in order to counteract tilting of the flow restrictor member 6' in the flow chamber 39'. The embodiment according to Fig. 6 shows another way of efficiently preventing such tilting. According to this embodiment, the two centre axis 24' and 24" of pistons 25' and 26', respectively, are parallel and displaced relative each other. Preferably, they are displaced in such a way that the axis 24' and 24" are in a vertical plane coinciding with the plane of symmetry of the flow restrictor member 6'.

In the embodiment of Fig. 7, a guide pin 50, 51 is used on each of the pistons 25x and 26x, or optionally only on one of these in order to prevent tilting of the flow restrictor member 6x. The guide pins 60, 61 are parallel with the piston axis and housed in the respective cylinder house, not shown.

The above-described apparatus A according to the invention exhibits a large number of advantages over apparatuses according to the prior art. It has a substantially simpler design, is very compact and is simple to install in existing pipe systems. This can be achieved by the fact that a pipe, in which the apparatus A is to be mounted, only needs to be cut off in two places in order to accommodate the apparatus, after which the apparatus is suitably connected, e.g. by a flange joint, to the thus cut-off pipe, with the pipelines 32 and 33 above corresponding to the cut-off parts of the pipe. No stand or base is needed to support the apparatus A, which also facilitates installation. A further advantage is that the principal flow, i.e. the flow of the pulp suspension (the said second fluid), does not need to alter its principal flow direction through the apparatus A, which means that a high velocity of the fluid through the gaps 15, 16 can be maintained, which means, in turn, that the added steam or other first fluid is well distributed in the second fluid (pulp suspension), thereby also reducing the risk of implosions. If such implosions should nevertheless occur, they will occur downstream and will not therefore cause any serious problems. Another advantage of the apparatus A is that, as a result of its design, inter alia its mounting, it effectively inhibits blockage due to the fact that the flow restrictor member has a certain freedom of movement both in its longitudinal direction and about its longitudinal axis.

Claims

1. Apparatus for mixing a first fluid into a second fluid, which apparatus (A) comprises:

   - a housing (1) having a flow chamber (39) for the said second fluid,
   - a flow restrictor member (6) in the flow chamber, and
   - means (18) for introducing the said first fluid into at least one gap (15, 16) between the flow restrictor member and those walls (5, 10) of the flow chamber (39) facing towards the flow restrictor member,

   characterized

   - in that the flow restrictor member, in a plane transversely to the principal flow direction (31) of the second fluid, as well as the said flow chamber in the same plane, has the essential shape of a wedge,
   - in that between each of those two sides of the flow restrictor member which converge in a wedge shape and those walls of the wedge-shaped chamber which face towards the flow restrictor member there is a gap (15, 16), and
   - in that the said means (18) for introducing the said first fluid are disposed in the region of these two gaps.

2. Apparatus according to Claim 1, characterized in that the flow restrictor member (6) tapers in a wedge shape, both in its longitudinal direction at right-angles to that of the second fluid in the principal flow direction and in a direction which coincides linearly with but is aimed directly counter to the said principal flow direction.

3. Apparatus according to Claim 1 or 2, characterized in that the wedge-shaped flow restrictor member (6) is arranged to be moveable along its longitudinal axis (24), i.e. transversely to the principal flow direction, relative to the said housing (1) and hence relative to the walls (5, 10) facing towards the flow restrictor member, thereby altering the width of the said gaps (15, 16).

4. Apparatus according to any one of Claims 1-3, characterized in that the wedge-shaped flow restrictor member is mounted in bearing members (27, 28) on either side of the flow restrictor member.

5. Apparatus according to Claim 4, characterized in that the bearing members (27, 28) comprise cylinders in which cylindrical pistons (25, 26) are mounted, which pistons are joined to both ends of the flow restrictor member, enabling the flow restrictor member to be rotated about its longitudinal axis (24).

6. Apparatus according to any one of Claims 1-4, characterized in that those inner sides (29, 30) of the bearing pistons (25, 26) facing towards the flow restrictor member are in contact with the fluid which flows through the apparatus A.

7. Apparatus according to any one of Claims 1-6, characterized by a control cylinder (20) arranged to be able to move the wedge-shaped restrictor member (6) for regulating the width of the said gaps (15, 16).

8. Apparatus according to Claim 7, characterized in that the bearing piston (25) which is placed closest to the control cylinder (20) exhibits an inner surface (29) which is larger than the inner surface belonging to the bearing piston (26) which is placed on the other side of the restrictor member.

9. Apparatus according to any one of Claims 1-8, characterized in that those walls (5, 10) of the housing (1) facing towards the flow restrictor member exhibit holes (18), slots or equivalent for introducing the said first fluid into the said gaps (15, 16).

10. Apparatus according to Claim 9, characterized in that the said holes (18) are located closer to the inlet openings (11, 12) than to the outlet openings (13, 14) of the gaps (15,16).

11. Apparatus according to Claim 9 or 10, characterized in that the said holes, in the axial direction, have a conically tapered shape, calculated from the gaps.

12. Apparatus according to any one of Claims 1-11, characterized in that the said gaps (15, 16) widen in the flow direction when the flow restrictor member is disposed symmetrically in the flow chamber.

13. Apparatus according to any one of the preceding claims, characterized in that it also comprises governor devices arranged to measure the differential between the pressures downstream and upstream of the inlet and outlet openings of the apparatus (A) and to bring about a displacement of the wedge-shaped flow restrictor member (6) in its longitudinal direction transversely to the principal flow direction of the second fluid through the apparatus, in dependence upon a measured pressure differential relative to a predefined value.

14. Apparatus according to one of the claims 1-13, characterized in that at least one of the surfaces, which between them define the gap (15', 16'), is uneven.

15. Apparatus according to claim 14, characterized in that the unevenness comprises longitudinal grooves or recesses (61) in one of said surfaces.

16. Apparatus according to claim 15, characterized in that said recesses or grooves extend along the longitudinal direction of the wall, i.e. transversal to the main flow direction of the fluid flowing through the gap.

17. Apparatus according to one of the claims 14-16, characterized in that the surfaces of the flow chamber (39') as well as of the flow restrictor member (6') facing the gap are uneven, preferably provided with longitudinal recesses or grooves transversal to the flow direction of the fluid.

18. Apparatus according to one of the claims 1-17, characterized by means to prevent tilting of the flow restrictor member in the flow chamber.

19. Apparatus according to one of the claims 1-18, characterized in that the flow restrictor member (6') is provided with chock dampening means (62, 63) on the sides of the walls (7', 8') of the flow restrictor member facing said gaps (15', 16').

Patentansprüche

1. Vorrichtung zum Zumischen eines ersten Fluids zu einem zweiten Fluid, wobei diese Vorrichtung (A) folgende Elemente umfaßt:

   - ein Gehäuse (1) mit einer Strömungskammer (39) für das zweite Fluid,
   - ein Strömungsbegrenzungsglied (6) in der Strömungskammer, und
   - Mittel (18) zur Einleitung des ersten Fluids in mindestens einen Zwischenraum (15, 16) zwischen dem Strömungsbegrenzungsglied und den dem Strömungsbegrenzungsglied zugewandten Wänden (5, 10) der Strömungskammer (39),

   dadurch gekennzeichnet,

   - daß das Strömungsbegrenzungsglied, in einer Ebene quer zu der Hauptströmungsrichtung (31) des zweiten Fluids betrachtet, sowie die Strömungskammer, in derselben Ebene betrachtet, im wesentlichen die Form eines Keils aufweisen,
   - daß zwischen einer jeden der beiden in Keilform aufeinander zulaufenden Seiten des Strömungsbegrenzungsgliedes und jenen Wänden der keilförmigen Kammer, die dem Strömungsbegrenzungsglied zugewandt sind, ein Zwischenraum (15, 16) vorhanden ist, und
   - daß die Mittel (18) zur Einleitung des ersten Fluids im Bereich dieser beiden Zwischenräume angeordnet sind.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß das Strömungsbegrenzungsglied (6) sich keilförmig verjüngt, und zwar sowohl in seiner Längsrichtung, welche im rechten Winkel zu der Hauptströmungsrichtung des zweiten Fluids angeordnet ist, als auch in einer Richtung, welche linear der Hauptströmungsrichtung entspricht, jedoch gegenläufig zu dieser verläuft.

3. Vorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß das keilförmige Strömungsbegrenzungsglied (6) entlang seiner Längsachse (24), d.h. quer zu der Hauptströmungsrichtung, in bezug auf das Gehäuse (1) und folglich in bezug auf die dem Strömungsbegrenzungsglied zugewandten Wände (5, 10) beweglich angebracht ist, wodurch eine Veränderung der Breite der Zwischenräume (15, 16) ermöglicht wird.

4. Vorrichtung nach einem der Ansprüche 1 - 3, dadurch gekennzeichnet, daß das keilförmige Strömungsbegrenzungsglied in zu beiden Seiten des Strömungsbegrenzungsgliedes angeordneten Lagerelementen (27, 28) montiert ist.

5. Vorrichtung nach Anspruch 4, dadurch gekennzeichnet, daß die Lagerelemente (27, 28) Zylinder umfassen, in denen zylinderförmige Kolben (25, 26) montiert sind, welche mit beiden Enden des Strömungsbegrenzungsgliedes verbunden sind und eine Drehung des Strömungsbegrenzungsgliedes um seine Längsachse (24) ermöglichen.

6. Vorrichtung nach einem der Ansprüche 1 - 4, dadurch gekennzeichnet, daß die dem Strömungsbegrenzungsglied zugewandten Innenseiten (29, 30) der Lagerkolben (25, 26) mit dem durch die Vorrichtung (A) fließenden Fluid in Berührung stehen.

7. Vorrichtung nach einem der Ansprüche 1 - 6, gekennzeichnet durch einen derart angeordneten Steuerzylinder (20), daß damit das keilförmige Begrenzungsglied (6) bewegt werden kann, um so die Breite der Zwischenräume (15, 16) einzustellen.

8. Vorrichtung nach Anspruch 7, dadurch gekennzeichnet, daß der dem Steuerzylinder (20) nächstgelegene Lagerkolben (25) eine Innenoberfläche (29) aufweist, welche größer ist als die Innenoberfläche des Lagerkolbens (26), welcher auf der anderen Seite des Begrenzungsgliedes angeordnet ist.

9. Vorrichtung nach einem der Ansprüche 1 - 8, dadurch gekennzeichnet, daß die dem Strömungsbegrenzungsglied zugewandten Wände (5, 10) des Gehäuses (1) über Löcher (18), Schlitze oder äquivalente Elemente zur Einleitung des ersten Fluids in die Zwischenräume (15, 16) verfügen.

10. Vorrichtung nach Anspruch 9, dadurch gekennzeichnet, daß die Löcher (18) näher an den Eingangsöffnungen (11, 12) als an den Ausgangsöffnungen (13, 14) der Zwischenräume (15, 16) angeordnet sind.

11. Vorrichtung nach Anspruch 9 oder 10, dadurch gekennzeichnet, daß die Löcher von den Zwischenräumen aus gerechnet in Axialrichtung eine sich konisch verjüngende Form aufweisen.

12. Vorrichtung nach einem der Ansprüche 1 - 11, dadurch gekennzeichnet, daß die Zwischenräume (15, 16) sich in Strömungsrichtung verbreitern, wenn das Strömungsbegrenzungsglied symmetrisch in die Strömungskammer eingesetzt ist.

13. Vorrichtung nach einem der vorangegangenen Ansprüche, dadurch gekennzeichnet, daß sie auch Steuereinrichtungen umfaßt, welche dazu dienen, das Differential zwischen den Druckverhältnissen abströmseits der Ausgangsöffnung und zuströmseits der Eingangsöffnung der Vorrichtung (A) zu messen und in Abhängigkeit zu einem gemessenen Druckdifferential in bezug auf einen Vorgabewert eine Verschiebung des keilförmigen Strömungsbegrenzungsgliedes (6) in Längsrichtung, d.h. quer zu der Hauptströmungsrichtung des zweiten Fluids durch die Vorrichtung, herbeizuführen.

14. Vorrichtung nach einem der Ansprüche 1 - 13, dadurch gekennzeichnet, daß zumindest eine der Oberflächen, welche die Begrenzungsflächen des Zwischenraums (15', 16') darstellen, uneben ist.

15. Vorrichtung nach Anspruch 14, dadurch gekennzeichnet, daß die Unebenheit Längsrillen bzw. Vertiefungen (61) in einer der Oberflächen umfaßt.

16. Vorrichtung nach Anspruch 15, dadurch gekennzeichnet, daß die Vertiefungen bzw. die Rillen sich entlang der Längsrichtung der Wand, d.h. quer zu der Hauptströmungsrichtung des durch den Zwischenraum durchströmenden Fluids, erstrecken.

17. Vorrichtung nach einem der Ansprüche 14 - 16, dadurch gekennzeichnet, daß die dem Zwischenraum zugewandten Oberflächen der Strömungskammer (39') sowie des Strömungsbegrenzungsgliedes (6') uneben sind und bevorzugterweise in Längsrichtung mit Vertiefungen bzw. Rillen versehen sind, welche quer zu der Strömungsrichtung des Fluids verlaufen.

18. Vorrichtung nach einem der Ansprüche 1 - 17,

gekennzeichnet durch Mittel zum Verhindern eines Umkippens des Strömungsbegrenzungsgliedes in der Strömungskammer.

19. Vorrichtung nach einem der Ansprüche 1 - 18, dadurch gekennzeichnet, daß das Strömungsbegrenzungsglied (6') an jenen Seiten seiner Wände (7', 8'), welche den Zwischenräumen (15', 16') zugewandt sind, mit stoßdämpfenden Mitteln (62, 63) ausgestattet ist.

Revendications

1. Appareil pour mélanger un premier fluide avec un second fluide, cet appareil (A) comprenant :

- un boîtier (1) pourvu d'une chambre d'écoulement (39) pour le second fluide,
- un organe restricteur d'écoulement (6) dans la chambre d'écoulement, et
- des moyens (18) pour introduire ledit premier fluide dans au moins un intervalle (15, 16) entre l'organe restricteur d'écoulement et les parois (5, 10) de la chambre d'écoulement (39) qui font face à l'organe restricteur d'écoulement,
  caractérisé
- en ce que l'organe restricteur d'écoulement, dans un plan transversal à la direction principale d'écoulement (31) du second fluide, ainsi que ladite chambre d'écoulement dans le même plan, a substantiellement le profil d'un coin,
- en ce qu'entre chacun des deux côtés de l'organe restricteur de flux et qui converge suivant un profil en coin et les parois de la chambre conformée en coins qui font face à l'organe restricteur de flux, il est prévu un intervalle (15, 16) et
- en ce que lesdits moyens (18) pour introduire le premier fluide sont disposés dans la région de ces deux intervalles.

2. Appareil selon la revendication 1, caractérisé en ce que l'organe restricteur d'écoulement (6) s'amincit suivant une conformation en coin, à la fois dans sa direction longitudinale à angles droits avec celle du second fluide dans la direction d'écoulement principal et dans une direction qui coïncide linéairement avec mais est orientée directement en sens contraire de la direction d'écoulement principal.

3. Appareil selon la revendication 1 ou 2, caractérisé en ce que l'organe restricteur d'écoulement (6) en forme de coin est disposé pour être déplaçable suivant son axe longitudinal (24), c'est-à-dire transversalement à la direction d'écoulement principal, par rapport audit boîtier (1) et par conséquent par rapport aux parois (5, 10) faisant face à l'organe restricteur d'écoulement, en modifiant ainsi la largeur desdits intervalles (15, 16).

4. Appareil selon l'une quelconque des revendications 1 à 3, caractérisé en ce que l'organe restricteur d'écoulement conformé en coin est disposé dans des organes de paliers (27, 28) de chaque côté de l'organe restricteur d'écoulement.

5. Appareil selon la revendication 4, caractérisé en ce que les organes de paliers (27, 28) comprennent des cylindres dans lesquels des pistons (25, 26) sont montés, ces pistons étant reliés aux deux extrémités de l'organe restricteur d'écoulement, et permettant à ce dernier d'être mis en rotation autour de son axe longitudinal (24).

6. Appareil selon l'une quelconque des revendications 1 à 4, caractérisé en ce que les côtés intérieurs (29, 30) des pistons (25,2 6) de paliers, faisant face à l'organe restricteur d'écoulement, sont en contact avec le fluide qui s'écoule à travers l'appareil (A).

7. Appareil selon l'une quelconque des revendications 1 à 6, caractérisé par un cylindre de commande (20) disposé pour pouvoir déplacer l'organe restricteur (6) en forme de coin pour réguler la largeur des intervalles (15, 16).

8. Appareil selon la revendication 7, caractérisé en ce que le piston de palier (25) disposé le plus prés du cylindre de commande (20) présente une surface intérieure (29) plus grande que la surface intérieure appartenant au piston de palier (26) qui est placé sur l'autre côté de l'organe restricteur.

9. Appareil selon l'une quelconque des revendications 1 à 8, caractérisé en ce que les parois (5, 10) du boîtier (1) qui font face à l'organe restricteur d'écoulement présentent des trous (18), des fentes ou équivalents pour introduire ledit premier fluide dans lesdits intervalles (15, 16).

10. Appareil selon la revendication 9, caractérisé en ce que les trous (18) sont situés plus près des ouvertures d'entrée (11, 12) que des ouvertures de sortie (13, 14) des intervalles (15, 16).

11. Appareil selon la revendication 9 ou 10, caractérisé en ce que les dits trous, dans la direction axiale, présentent un profil en forme de tronc de cône, dimensionné à partir des intervalles.

12. Appareil selon l'une quelconque des revendications 1 à 11, caractérisé en ce que lesdits intervalles (15, 16) s'élargissent dans la direction d'écoulement lorsque l'organe restricteur d'écoulement est dis-

posé symétriquement dans la chambre d'écoulement.

13. Appareil selon l'une quelconque des revendications précédentes, caractérisé en ce qu'il comprend également des dispositifs régulateurs centrifuges prévus pour mesurer le différentiel entre les pressions en aval et en amont des ouvertures d'entrée et de sortie de l'appareil (A), et pour provoquer un déplacement de l'organe restricteur d'écoulement (6) conformé en coin dans sa direction longitudinale transversalement à la direction principale d'écoulement du second fluide à travers l'appareil, en fonction d'un différentiel de pression mesuré par rapport à une valeur prédéfinie.

14. Appareil selon l'une quelconque des revendications 1 à 13, caractérisé en ce qu'au moins l'une des surfaces, qui entre elles délimitent l'intervalle (15', 16'), est irrégulière.

15. Appareil selon la revendication 14, caractérisé en ce que l'irrégularité comprend des rainures ou cavités longitudinales (61) dans l'une desdites surfaces.

16. Appareil selon la revendication 15, caractérisé en ce que les dites cavités ou rainures s'étendent suivant la direction longitudinale de la paroi, c'est-à-dire transversalement à la direction d'écoulement principal du fluide s'écoulant à travers l'intervalle.

17. Appareil selon l'une quelconque des revendications 14 à 16, caractérisé en ce que les surfaces de la chambre d'écoulement (39') ainsi que celles de l'organe restricteur d'écoulement (6) faisant face à l'intervalle, sont irrégulières, de préférence munies de cavités ou rainures longitudinales, disposées transversalement à la direction d'écoulement du fluide.

18. Appareil selon l'une des revendications 1 à 17, caractérisé par des moyens pour empêcher un basculement de l'organe restricteur d'écoulement dans la chambre d'écoulement.

19. Appareil selon l'une quelconque des revendications 1 à 18, caractérisé en ce que l'organe restricteur d'écoulement (6') est muni d'un dispositif amortisseur à cale (62, 63) sur les côtés des parois (7', 8') de l'organe restricteur d'écoulement faisant face auxdits intervalles (15', 16').

Fig. 1

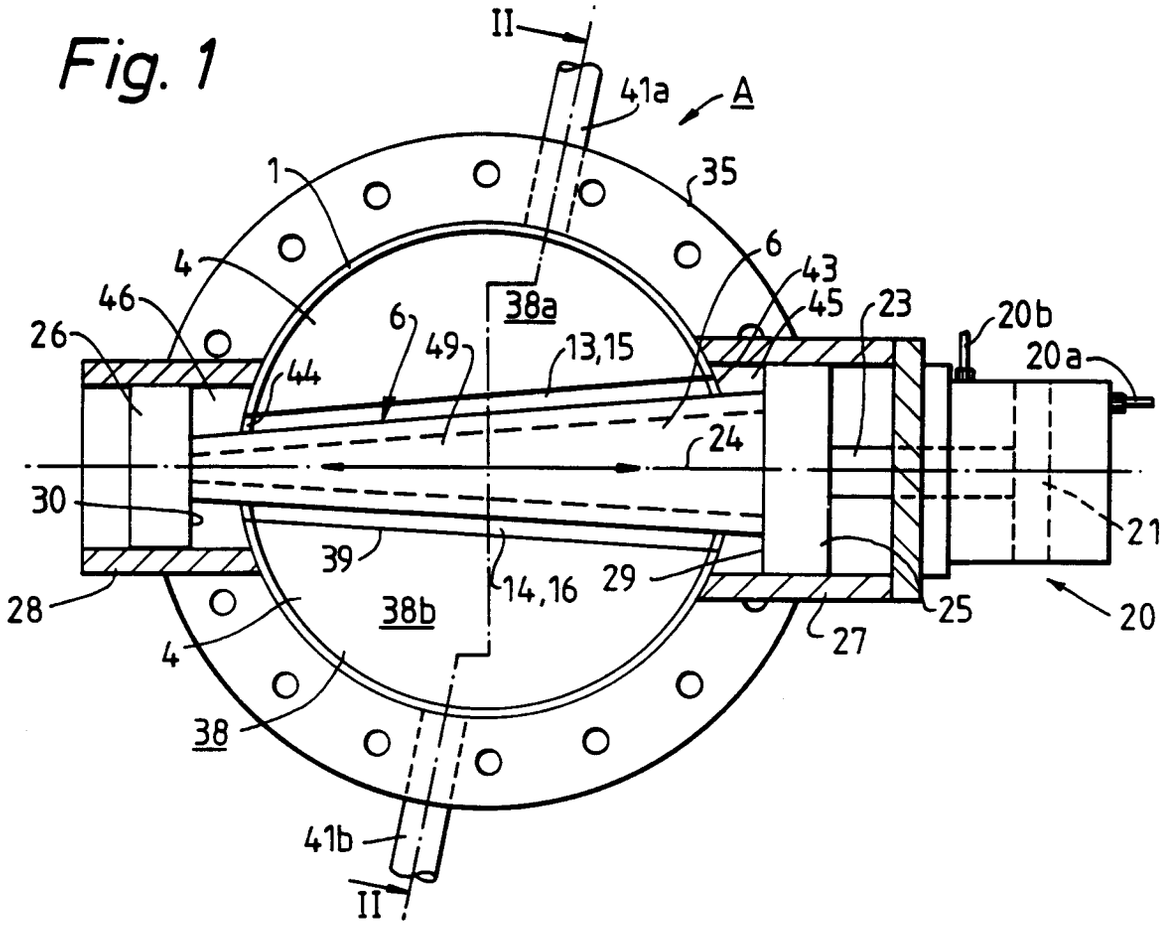

II
41a
A
1
35
4
6
43
46
38a
45
23
20b
26
6
49
13,15
20a
44
24
30
21
39
14,16
29
28
38b
25
20
4
27
38
41b
II

Fig. 2

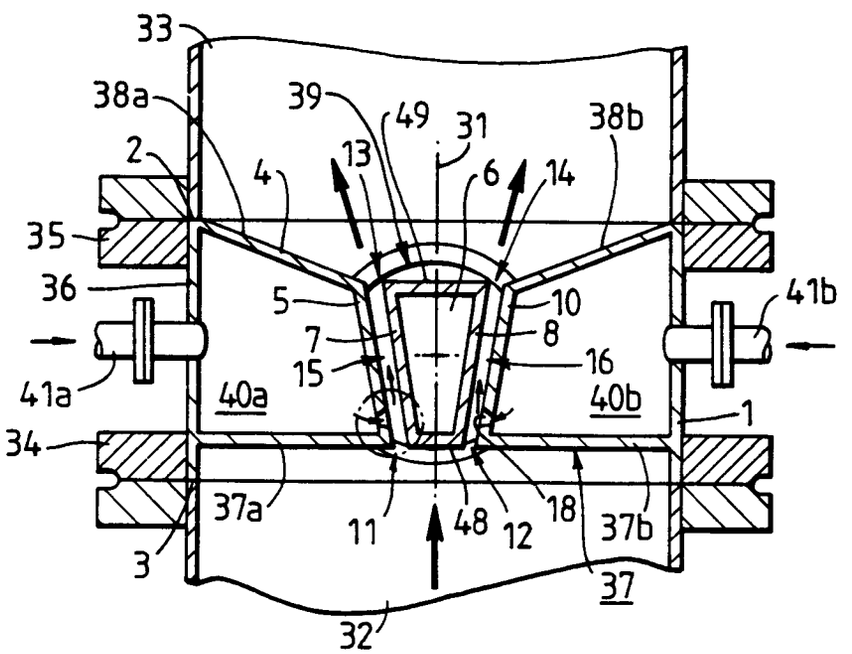

33
38a
39
49
31
38b
2
13
4
6
14
35
36
5
10
41b
7
8
15
16
41a
40a
40b
1
34
37a
11
48
12
18
37b
3
37
32

Fig.3

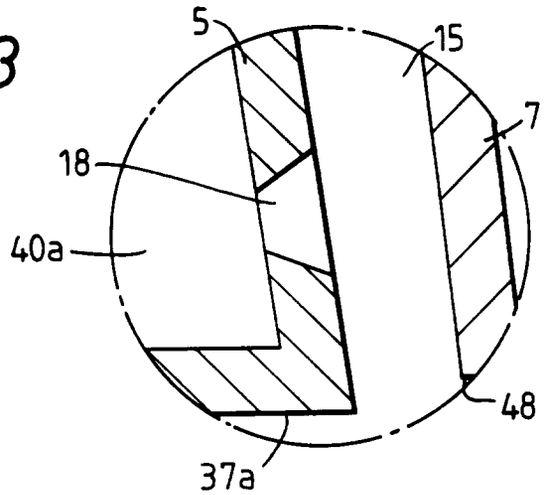


Fig.4

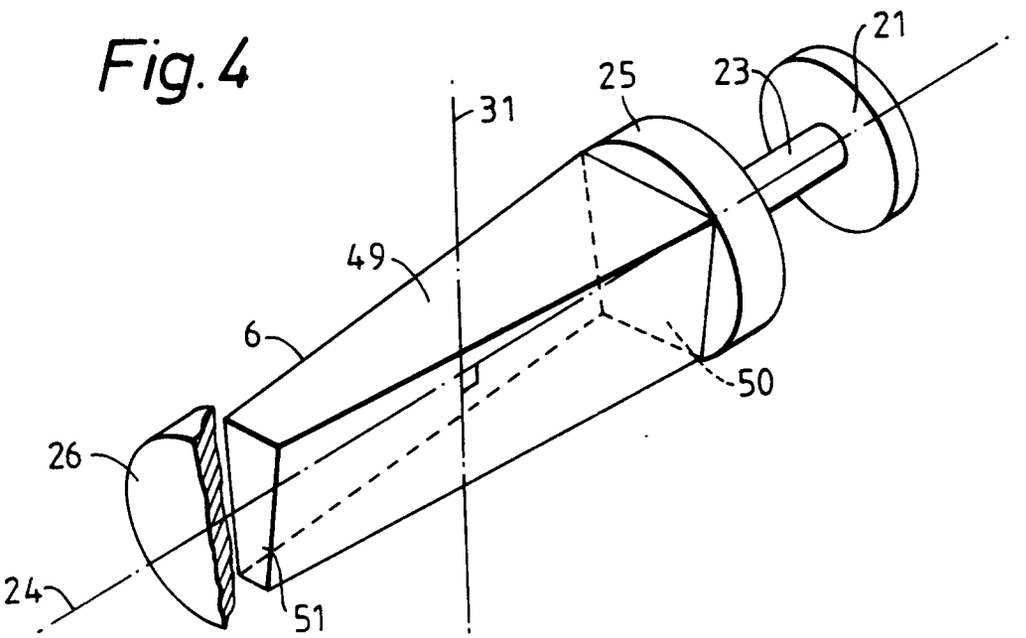


Fig. 5

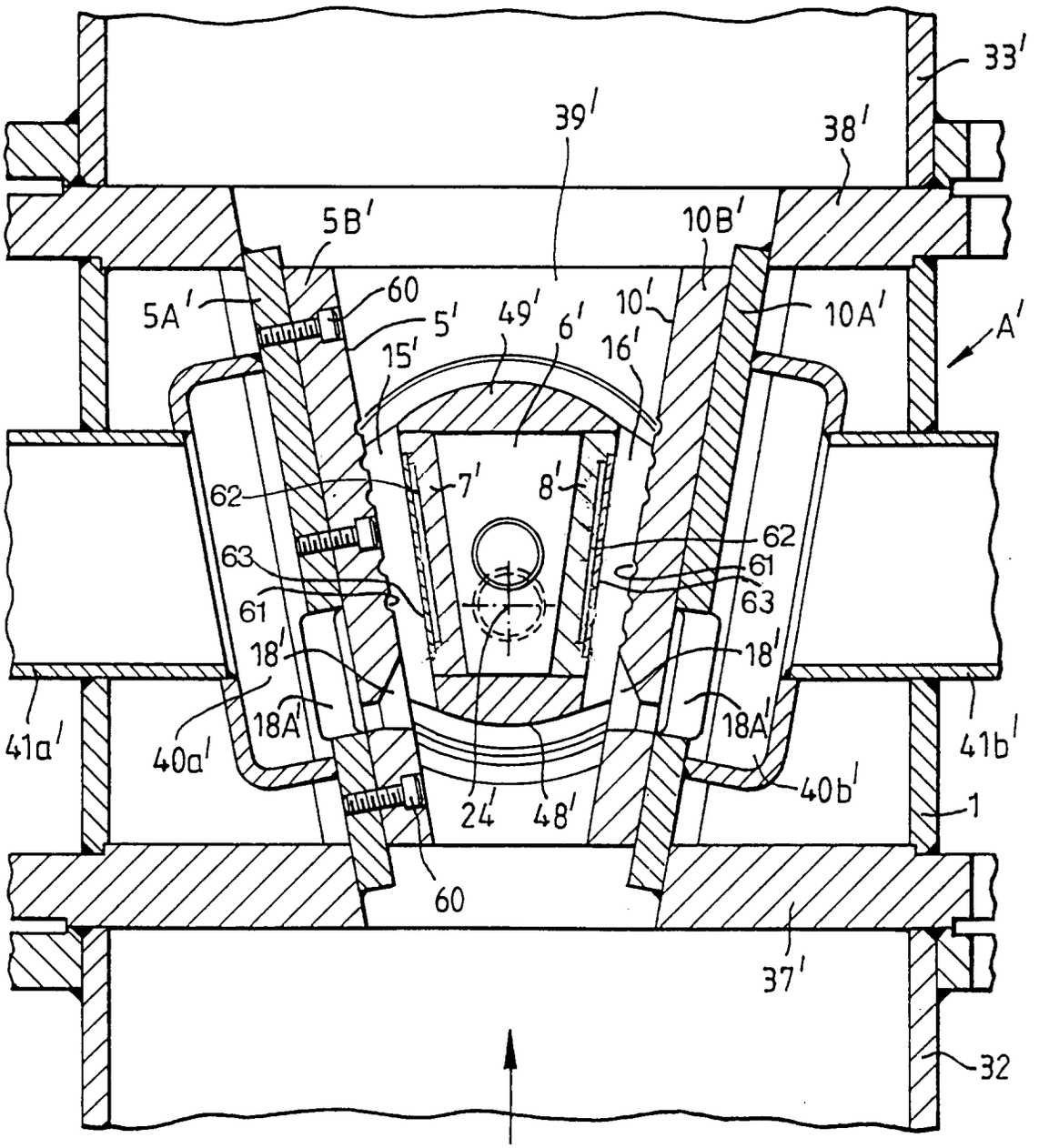

33'
39'
38'
5B'
10B'
5A'
60
5'
49'
6'
10'
10A'
A'
15'
16'
62
7'
8'
62
63
61
61
63
18'
18'
41a'
18A'
18A'
41b'
40a'
40b'
24'
48'
1
60
37'
32

Fig. 6

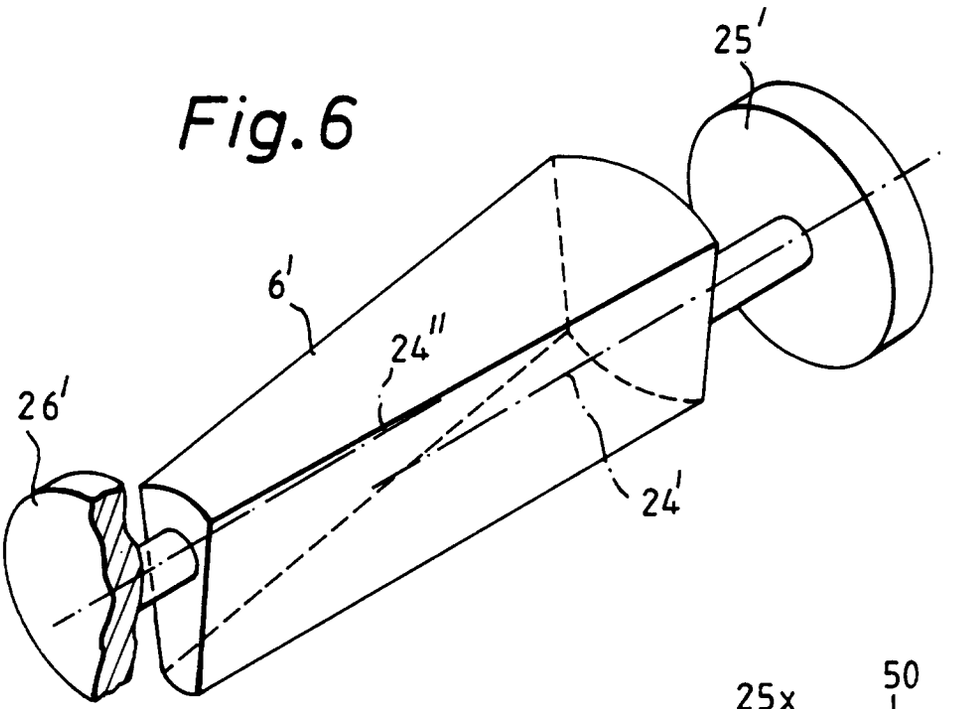


Fig. 7

