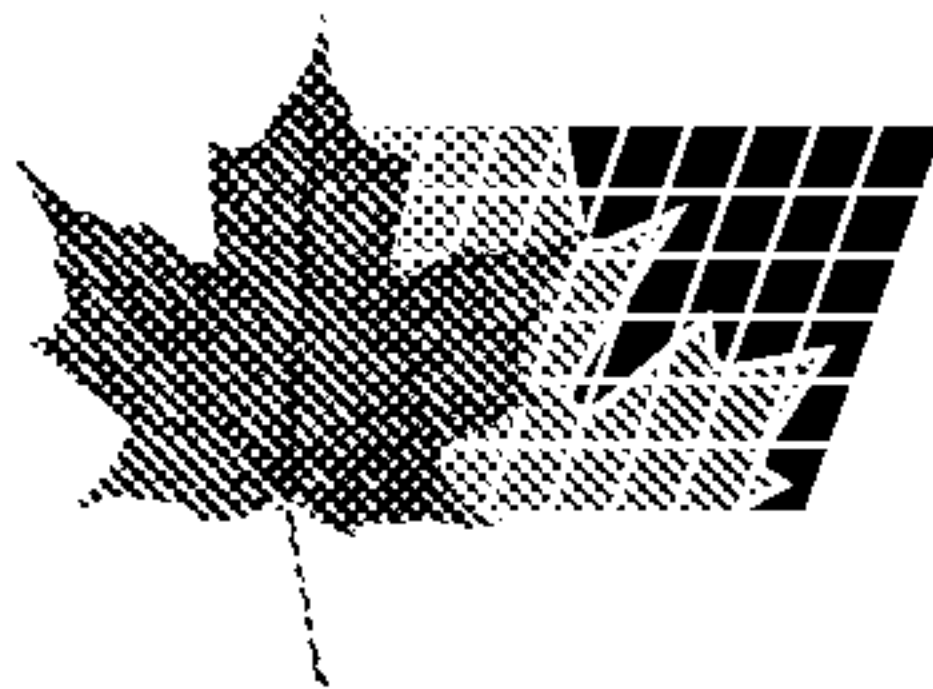




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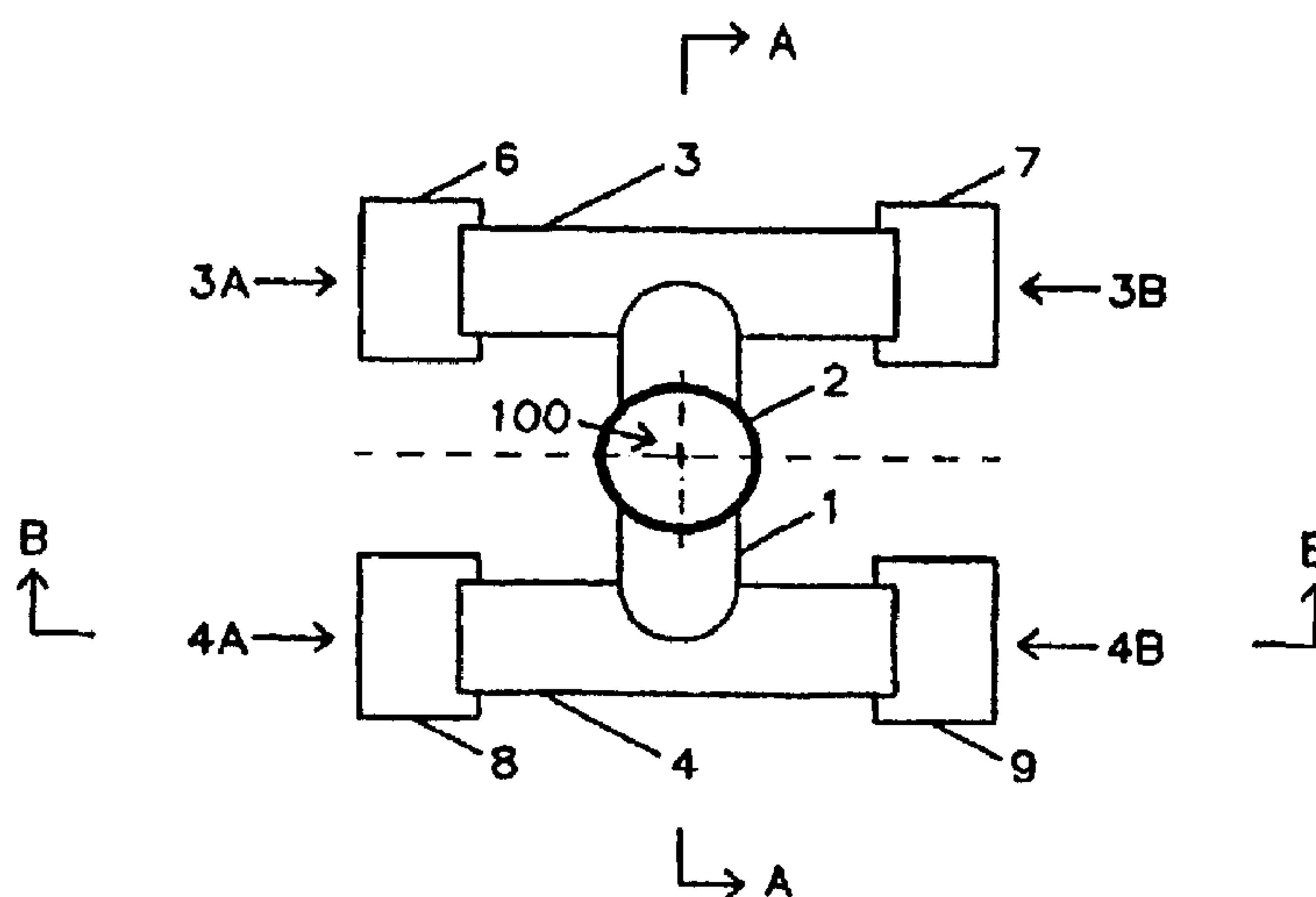
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(54) **APPAREIL EN TUBE D'EVACUATION DE LIQUIDE D'UN
RECIPIENT**

(54) **TUBE APPARATUS FOR OUTLET OF LIQUID FROM A
CONTAINER**



(57) L'invention concerne un appareil en tube permettant d'évacuer un liquide d'un récipient, notamment d'un réservoir de séparation, adapté pour recevoir au moins deux fluides différents à interface immédiate, les ouvertures d'évacuation du liquide dans le récipient étant disposées au-dessus et/ou au-dessous de l'interface. Au moins un élément de tube (3, 4) est adapté de manière à adopter une position horizontale dans le récipient et comprend au moins deux ouvertures d'évacuation de liquide (3A, B, 4A, B). Un tube collecteur (2) communique avec chaque élément de tube (3, 4) et permet d'évacuer un liquide du récipient. Immédiatement au-dessous et/ou au-dessus de chaque ouverture d'évacuation de liquide (3A, B, 4A, B), se trouve un élément de régulation de débit (6, 7, 8, 9) généralement sous forme de plaque qui s'étend généralement à l'horizontale dans toutes les directions par rapport à l'ouverture d'évacuation de liquide concernée.

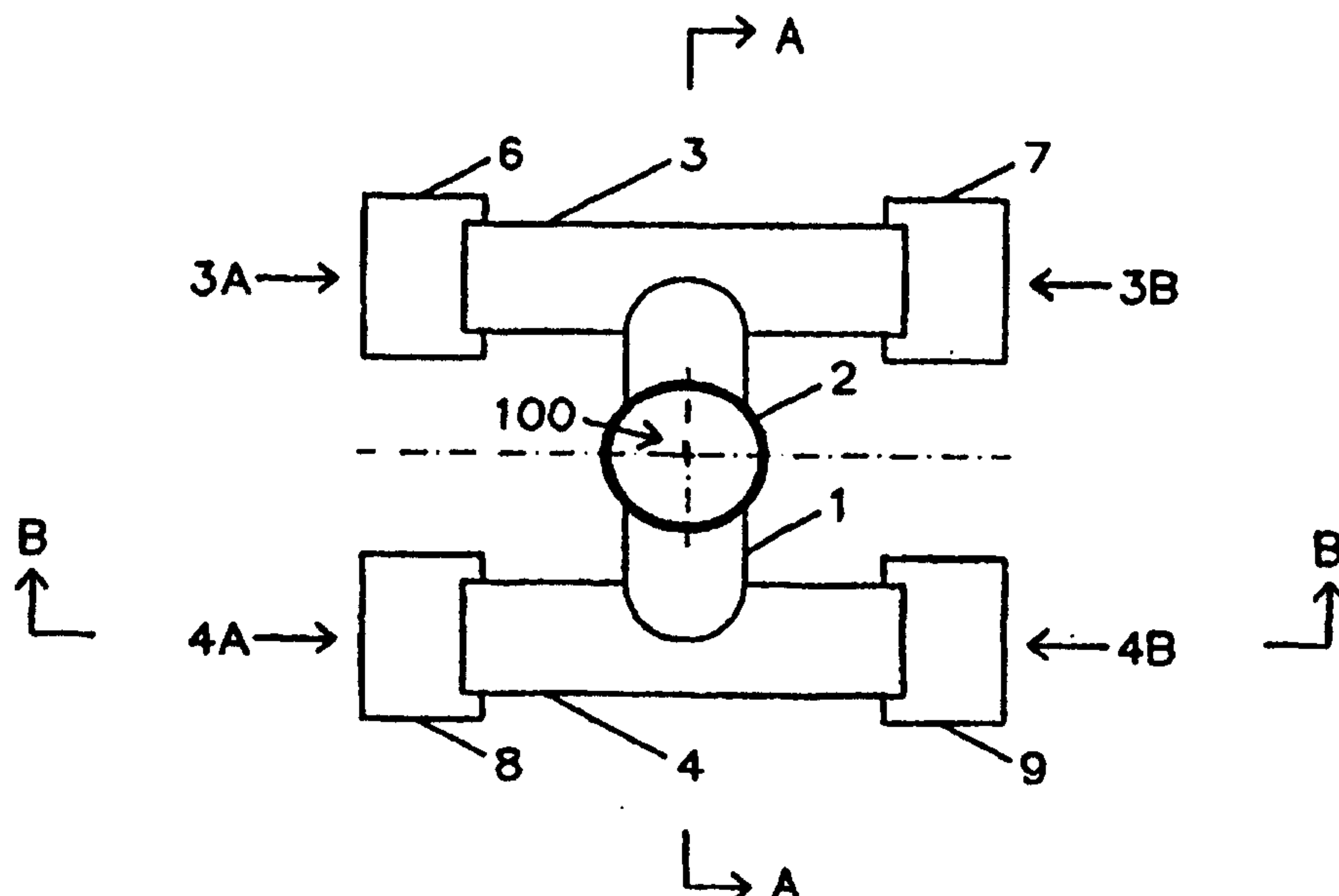
(57) Tube apparatus for outlet of liquid from a container, in particular a separation tank, adapted to receive at least two different fluids with intermediate interface (s), where liquid outlet openings are located above and/or underneath the interface (s). At least one tube member (3, 4) is adapted to have a substantially horizontal position in the container and is provided with at least two liquid outlet openings (3A, B, 4A, B). A collecting tube (2) communicates with each tube member (3, 4) as serves to lead liquid out of the container. Immediately under and/or over each liquid outlet opening (3A, B, 4A, B) there is provided a generally plate-shaped flow control element (6, 7, 8, 9) which extends in general horizontally in all directions with respect to the liquid outlet opening concerned.

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(21) International Application Number: PCT/NO99/00201 (22) International Filing Date: 17 June 1999 (17.06.99) (30) Priority Data: 19983018 29 June 1998 (29.06.98) NO (71) Applicant (for all designated States except US): DEN NORSKE STATS OLJESELSKAP A.S [NO/NO]; N-4035 Stavanger (NO). (72) Inventors; and (75) Inventors/Applicants (for US only): HØYDAL, Jan [NO/NO]; Skolebakken 10B, N-4100 Jørpeland (NO). FARSTAD, Per [NO/NO]; Sildaberget 2, N-5071 Loddefjord (NO). (74) Agent: ABC-PATENT, SIVILING. ROLF CHR. B. LARSEN A.S; Brynsveien 5, N-0667 OSLO (NO).	(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the</i> <i>claims and to be republished in the event of the receipt of</i> <i>amendments.</i>	

(54) Title: TUBE APPARATUS FOR OUTLET OF LIQUID FROM A CONTAINER



(57) Abstract

Tube apparatus for outlet of liquid from a container, in particular a separation tank, adapted to receive at least two different fluids with intermediate interface (s), where liquid outlet openings are located above and/or underneath the interface (s). At least one tube member (3, 4) is adapted to have a substantially horizontal position in the container and is provided with at least two liquid outlet openings (3A, B, 4A, B). A collecting tube (2) communicates with each tube member (3, 4) as serves to lead liquid out of the container. Immediately under and/or over each liquid outlet opening (3A, B, 4A, B) there is provided a generally plate-shaped flow control element (6, 7, 8, 9) which extends in general horizontally in all directions with respect to the liquid outlet opening concerned.

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TUBE APPARATUS FOR OUTLET OF LIQUID FROM A CONTAINER

This invention relates to a tube apparatus for discharge of liquid from a container, in particular a separation tank, adapted to receive at least to different
5 fluids with one or more intermediate boundary layers, where liquid outlet openings are located above and/or under the boundary layer(s).

A common use for such a liquid outlet is for draining at the bottom of a container. The tube apparatus according
10 to the invention has primarily been developed for draining the water phase in an oil-water separator. However the apparatus is also well suited for use in two-phase separators with low liquid levels. As already indicated above there can in this connection generally be the question
15 of more than two different liquids or fluid phases, since it can also be contemplated to employ the tube apparatus between two boundary layers in such a case with three or (more) different liquids, or the more interesting case of two liquids and a gas phase.

20 Conventional designs of outlet arrangements for liquid from containers and tanks are as a rule based on a single outlet at one point. This involves drawbacks related to strong local draining effects in the vicinity of the outlet opening. Thus entraining of liquid from surrounding portions
25 of the container will very easily occur, so that outflow and mixing of different liquids or phases in the boundary layer will result. The invention aims at substantial improvements in this respect.

In practical cases of mounting of a tube apparatus
30 according to the invention in a container, the outlet openings will normally be well elevated above the bottom of the container. A result of this is that entraining of particles and bottom deposits such as sand, from the region at the bottom will be prevented, which apparently is an
35 advantage compared to an outlet opening located close to or flush with the bottom of the container.

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According to the invention the novel and specific features of a tube apparatus as stated above, in the first place consist therein that there is provided at least one tube member adapted to have a substantially horizontal position in the container and provided with at least two liquid outlet openings, and a collecting tube that communicates with each tube member and serves to lead liquid out of the container, whereby immediately underneath and/or above each liquid outlet opening there is disposed a generally plate-shaped flow control element that extends in general horizontally in all directions with respect to the liquid outlet opening concerned.

The arrangement of one or more tube members and two or more liquid outlet openings can in central embodiments according to the invention, comprise tube members having each two liquid outlet openings. Within the framework of the invention, however, there may also be contemplated embodiments with two or more tube members each having only one liquid outlet opening, for example a configuration with three tube members extending each in its direction from a common collecting tube and having an associated liquid outlet opening at the outer free end of each tube member.

With a tube apparatus according to the invention mounted in a container or separator tank particularly good draining properties are obtained. By distributing a number of liquid outlet openings, for example 3, 4 or more openings, over larger area or portions of the container, combined with associated flow control elements, one (or two) adjacent boundary layers between two different liquids will be influenced to a negligible degree during operation. In the typical case of a boundary surface lying somewhat above the outlet openings, it is more specifically liquid flow directed downwards from the region at the boundary surface that is prevented. In actual practice this involves that for example in an oil-water separator the boundary surface or interface between oil and water can be positioned very close to the outlet openings without any risk of entraining of oil with the water during outflow. In a corresponding manner entraining of gas is prevented when a two-phase separator is concerned.

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In the following description the invention will be explained more closely with reference to the drawings where:

- Fig. 1 schematically and in top view shows a configuration of the tube apparatus with an H-shape,
- 5 fig. 2 shows the apparatus of fig. 1 in cross-sectional view according to the line B-B in fig. 1,
- fig. 3 shows a cross section according to line A-A in fig. 1,
- 10 fig. 4 in contrast to the symmetrical configuration in fig. 1-3, shows an asymmetric tube apparatus in top view,
- fig. 5 in a cross-sectional view corresponding to fig. 2, shows an embodiment of the tube apparatus intended for positioning the liquid outlet openings above liquid interface,
- 15 fig. 6 in a similar manner as in fig. 5, shows a tube apparatus intended for positioning the liquid outlet openings between two interfaces in a container, and
- 20 fig. 7 shows a configuration somewhat similar to the one in fig. 1, but with a specific embodiment of plate-shaped flow control elements.

In the exemplary embodiment of the tube apparatus according to the invention, as seen from fig. 1, 2 and 3, there are incorporated two tube members 3 and 4, each of which has two liquid outlet openings, namely 3A and 3B as well as 4A and 4B, respectively. There is here the question of a symmetrical arrangement where four liquid outlet

30 openings are located at the same distance from a central, vertical axis 100, and have the same orientation with respect thereto. An intermediate portion of each tube member 3 and 4 is connected to a transverse tube 1 which in turn communicates with a collecting tube 2 adapted to carry

35 liquid out of the container concerned. In this example the collecting tube 2 stands vertically and has a flange connection at its lower end, for transfer or connection out through a bottom (not shown) of the container. An interface between two different fluids is shown at 10 in figures 2 and

40 3.

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The tube member 3 has an outlet opening 3A at one end and a second outlet opening 3B at the other end. In a corresponding way tube member 4 has two liquid outlet openings 4A and 4B. This is a case of circular tube cross section in tube members 3 and 4, as will appear in particular from fig. 3. As illustrated in this figure outlet openings 3A and 4A constitute a lower part of the complete tube cross section, as corresponding upper parts 3C and 4C of the cross section are closed with a plate. The limiting edge is illustrated at 4D for opening 4A. Preferably flush with the lower limiting edge of plate parts 3C and 4D there are shown flow control elements 6 and 8, respectively. The shape and position of a total of four such flow control elements 6, 7, 8 and 9 is seen more fully from figures 1 and 2. These flow control elements have a substantially rectangular plate shape, possibly with rounded corners.

At this point it is obvious that the rectangular shape can be modified very much, for example to a rather oval or possibly circular shape. As to the extension of plate elements 6, 7, 8 and 9 in relation to the associated liquid outlet openings 3A, 3B, 4A and 4B, there may also be quite large variations, but it is considered to be advantageous that the flow control elements have their largest dimensions horizontally or straight ahead of the opening concerned.

Based on an apparatus as explained above, it will be realized that this is to be located in the container concerned so that the liquid outlet openings 3A, 3B, 4A and 4B are positioned underneath the interface 10. Accordingly the plate elements 6, 7, 8 and 9 lie between interface 10 and the respective openings, so that these in terms of liquid flow will be screened in relation to the interface. The arrows towards openings 4A and 4B in fig. 2 thus illustrate how outflow through these openings will influence the liquid layers up towards interface 10 only to a small degree.

In the symmetrical H-configuration according to fig. 1, the four outlet openings 3A, 3B, 4A and 4B are of equal dimensions, so that the liquid volume discharged through each of these openings will be the same. This of course is related to the flow path further on from the respective

openings through tube members 3 and 4 as well as the transverse tube 1 to collecting tube 2.

Unlike the symmetrical tube apparatus of fig. 1, 2 and 3 as just explained, fig. 4 shows an example of an asymmetrical embodiment. Also here there are provided two tube members 13 and 14 with associated liquid outlet openings 13A, 13B, 14A, 14B, respectively. There is also provided a transverse tube 11 connecting the two tube members to a collecting tube 12. At each of the outlet openings there is shown a flow control element, as indicated at 16, 17, 18 and 19. These elements here have a rectangular plate shape resembling the flow control elements in figures 1-3.

It appears from fig. 4 that tube members 13 and 14 with their associated outlet openings are somewhat skewed in relation to collection tube 12. The explanation of this asymmetrical arrangement is in the first place that collecting tube 12 penetrates the bottom of the container concerned, somewhat inclined with respect to the central line 110 along the bottom of the container. It is desirable however, that the four liquid outlet openings are positioned in pairs symmetrically in relation to the bottom of the container and thus to the central line 110. It is of course the question here of a horizontal cylindrical container the axis of which extends in parallel to the central line 110 mentioned above. From the geometrical relationships described here, it is seen that tube members 13 and 14 are adapted to lie substantially horizontally in the mounted position of the tube apparatus. In this configuration of the apparatus the flow paths from openings 13B and 14B will be shorter than the flow paths from openings 13A and 14A, and consequentially the size of the openings is adjusted in order to compensate for this. Thus liquid outlet openings 13A and 14A must be larger than openings 13B and 14B in order that the flow contribution from each of opening shall be equal magnitude.

In the preceding figures of drawings it has been a precondition that the interface (10 in fig. 2 and 3) lies higher than the outlet apparatus. Fig. 5 shows a case of the opposite arrangement, namely with an interface 20 at a lower level than a tube member 24 with associated liquid outlet openings 24A and 24B with their flow control elements 28 and 29. Therefore, these elements here have a screening effect with respect to fluid flow from the region at interface 20. Otherwise the embodiment of fig. 5 can correspond to the one in fig. 1-3. Thus, there is shown a vertical collecting tube 22 corresponding to collecting tube 2 in fig. 1-3.

A further possible modification is illustrated in fig. 6, where there is the case of two interfaces 30A and 30B, whereby fluids above interface 30B as an alternative can be a gas phase. A collecting tube 32 here penetrates interface 30A and carries a tube member 34 so that this is localized between the interfaces 30A and 30B. Liquid outlet openings 34A and 34B in this embodiment have flow control elements both at the upper side and at the underside, as shown at 36 and 38 for opening 34A and at 37 and 39 for opening 34B. Thereby the openings will be screened with respect to both interfaces 30A and 30B, so that outflow of liquid will take place substantially from the liquid layers between interfaces 30A and 30B.

The cross-sectional shape of tube member 34 in fig. 6 advantageously can be rectangular, so that plate elements 36-39 can be located and attached substantially flush with the upper and lower wall respectively of the rectangular tube member 34. Based on a symmetrical H-configuration as in fig. 1, the outlet openings according to fig. 6 with advantage can comprise the full rectangular cross section of tube member 34. In other words all the liquid outlet openings can be of the same shape and size.

Irrespective of the cross-sectional shape it is also within the framework of the invention that the plane of the outlet openings can deviate from the vertical plane. A more or less downwards or upwards inclined orientation of the openings is also possible.

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Finally fig. 7 also shows an essentially symmetrical H-configuration with collecting tube 42, transverse tube 41 and two tube members 43 and 44. Associated outlet openings are indicated with arrows at 43A, 43B and 44A, 44B, respectively. What is specific in the embodiment of fig. 7 is that there is provided a common flow control element 46 for the openings 43A and 44A at one side and at the other side a common plate element 47 for the openings 43B and 44B. In certain respects such an embodiment can be advantageous among other things for the purpose of an extended area of the flow control elements as a whole. A large extension in this respect will be obtained by having a common plate element extending between and out from all outlet openings in the tube apparatus.

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1. Tube apparatus for outlet of liquid from a container, in particular a separation tank, adapted to receive at least two different fluids with intermediate interface(s), where
5 liquid outlet openings are located above and/or under the interface(s),
characterized by at least one tube member (3,4,13,14,24,34,43,44) adapted to have a substantially horizontal position in the container and provided with at
10 least two liquid outlet openings (3A,B,4A,B,13A,B,14,A,B, 24A,B,34A,B,43A,B,44A,B), and a collecting tube (2,12,22,32,42) that communicates with each tube member (3,4,13,14,24,34,43,44) and serves to lead liquid out of the container, whereby immediately under and/or over each liquid
15 outlet opening (3A,B,4A,B,13A,B,14A,B,24A,B, 34A,B,43A,B,44A,B) there is provided a substantially plate-shaped flow control element (6,7,8,9,16,17,18,19,28,29, 36,37,38,39,46,47) which extends in general horizontally in all directions in relation to the liquid outlet opening
20 concerned.
2. Apparatus according to claim 1,
characterized in that the flow control elements (6,7,8,9,16,17,18,19,28,29,36,37,38,39) have their largest extension out from the associated liquid outlet
25 opening (3A,B,4A,B,13A,B,14,A,B, 24A,B,34A,B) straight forwardly thereof.
3. Apparatus according to claim 1 or 2,
characterized in at that each tube member (3,4,13,14,24,43,44) has round cross section, that each
30 liquid outlet opening (3A,B,4A,B,13A,B,14A,B,24A,B,34A,B, 43A,B,44A,B) is formed as a part of the round cross section and is delimited partially by a preferably rectilinear edge (4D) which is adapted to extend horizontally, and that the flow control elements (6,7,8,9,16,17,18,19,28,29,46,47) are
35 disposed generally flush with each limiting edge (4D) concerned.

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4. Apparatus according to claim 1 or 2,
c h a r a c t e r i z e d in that each tube member (34)
has a rectangular cross section with a corresponding full
liquid outlet opening (34A,34B) and that the flow control
5 elements (36,37,38,39) are positioned flush with an upper
and/or lower wall of each tube member (34).

5. Apparatus according to any one of the claims 1-4,
c h a r a c t e r i z e d in that it is in the principle
symmetrical about a vertical axis (100) and that all liquid
10 outlet openings (3A,B,4A,B,24A,B,34A,B,43A,B,44A,B) are of
equal dimensions.

6. Apparatus according to claim 5,
c h a r a c t e r i z e d in that as seen in the
horizontal plane it has an H-configuration with a transverse
15 tube (1,41) which connects a middle portion of two tube
members (3,4,43,44) to the collecting tube (2,42).

7. Apparatus according to any one of claims 1-4,
c h a r a c t e r i z e d by an asymmetrical configuration
as seen in the horizontal plane and adjustment of the size
20 of the liquid outlet openings (13A,B,14A,B) so that all the
openings will have approximately the same liquid flow
volume.

8. Apparatus according to any one of claims 1-7,
c h a r a c t e r i z e d in that the collecting tube
25 (2,22,32,43) is adapted to stand substantially vertically in
the mounted position in the container.

9. Apparatus according to any one of claims 1-8,
c h a r a c t e r i z e d in that at least one flow
control element (46,47) is common to two or more liquid
30 outlet openings (43A,44A,resp. 43B,44B).

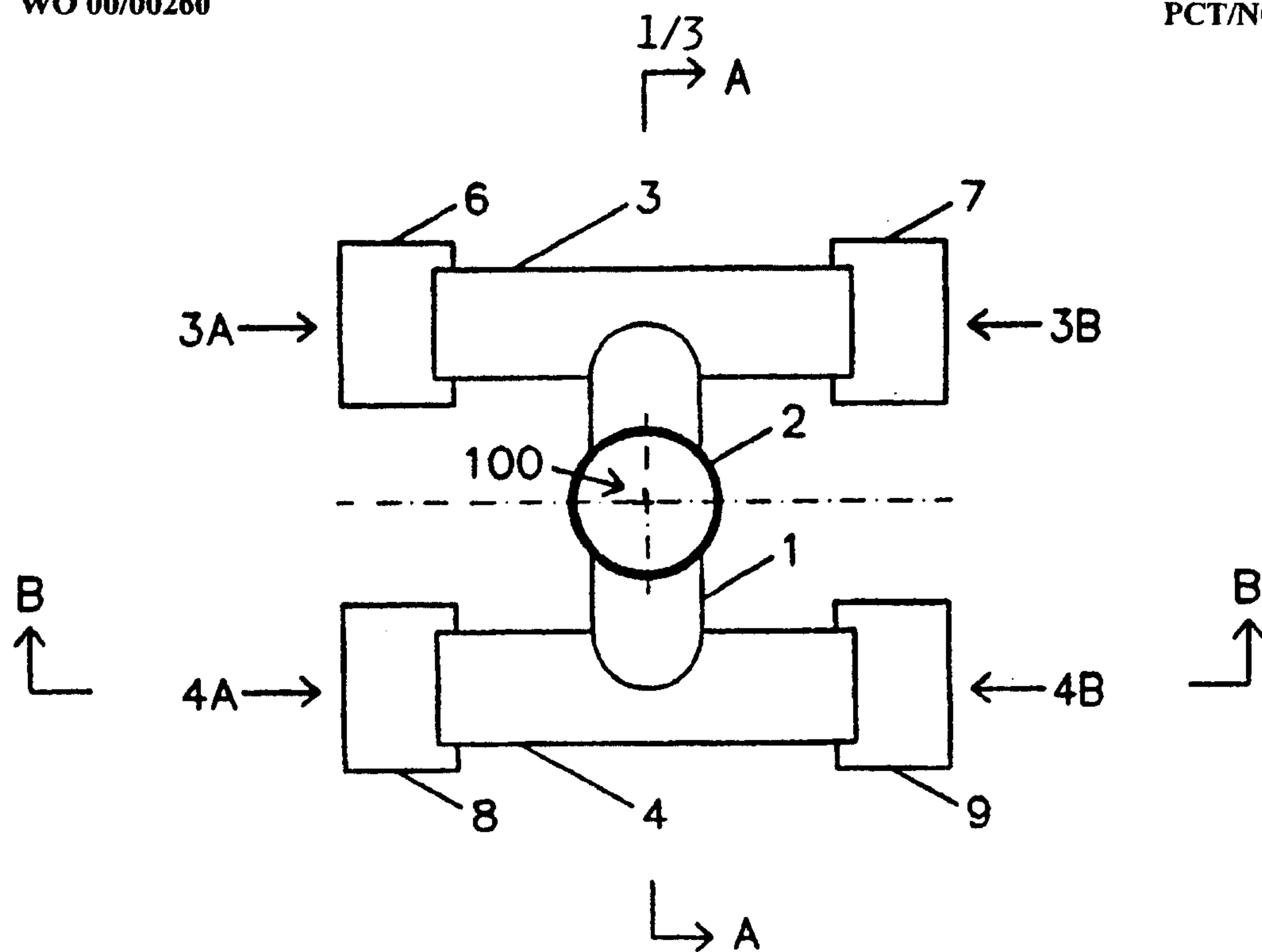


FIG. 1

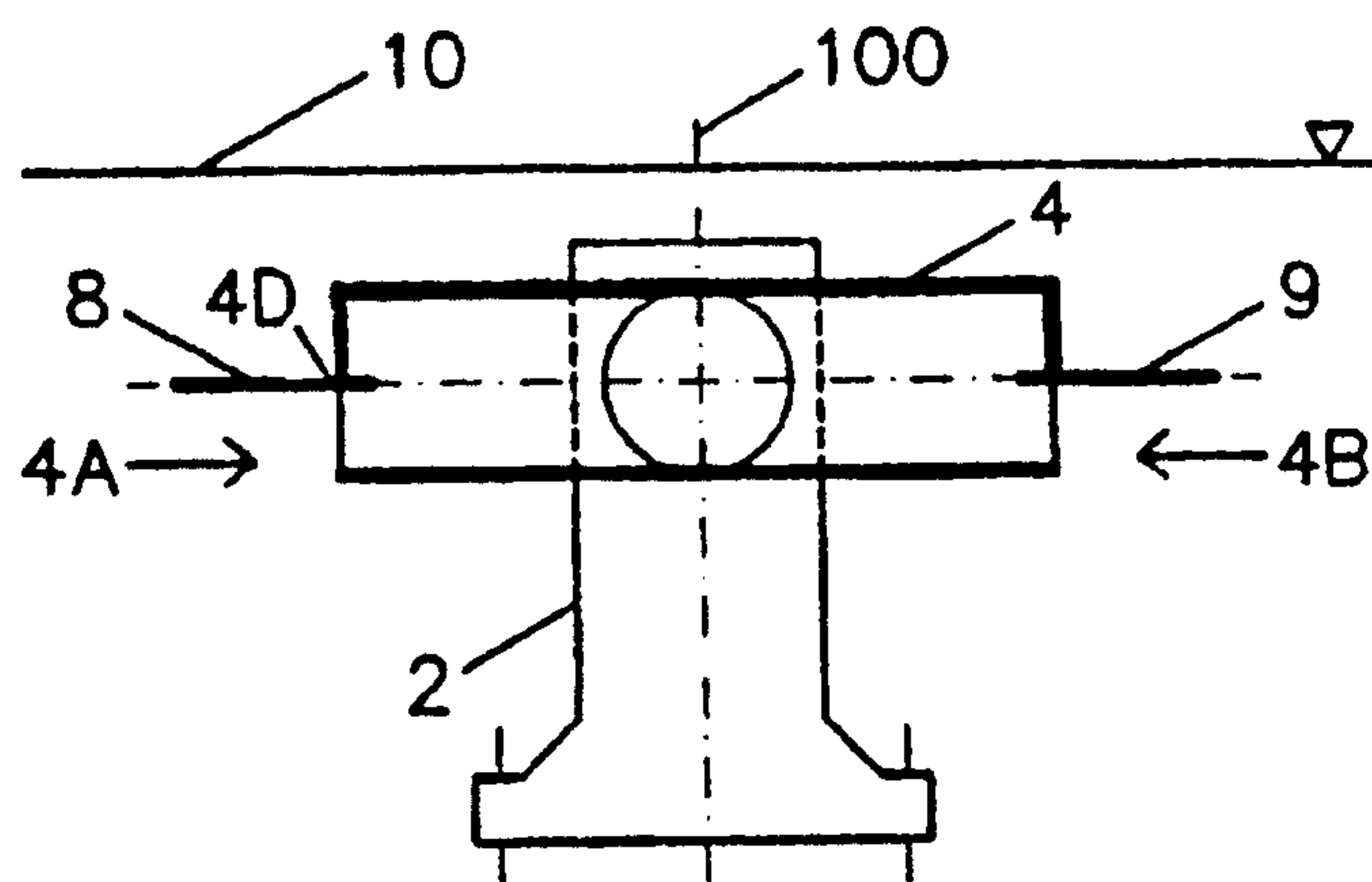


FIG. 2

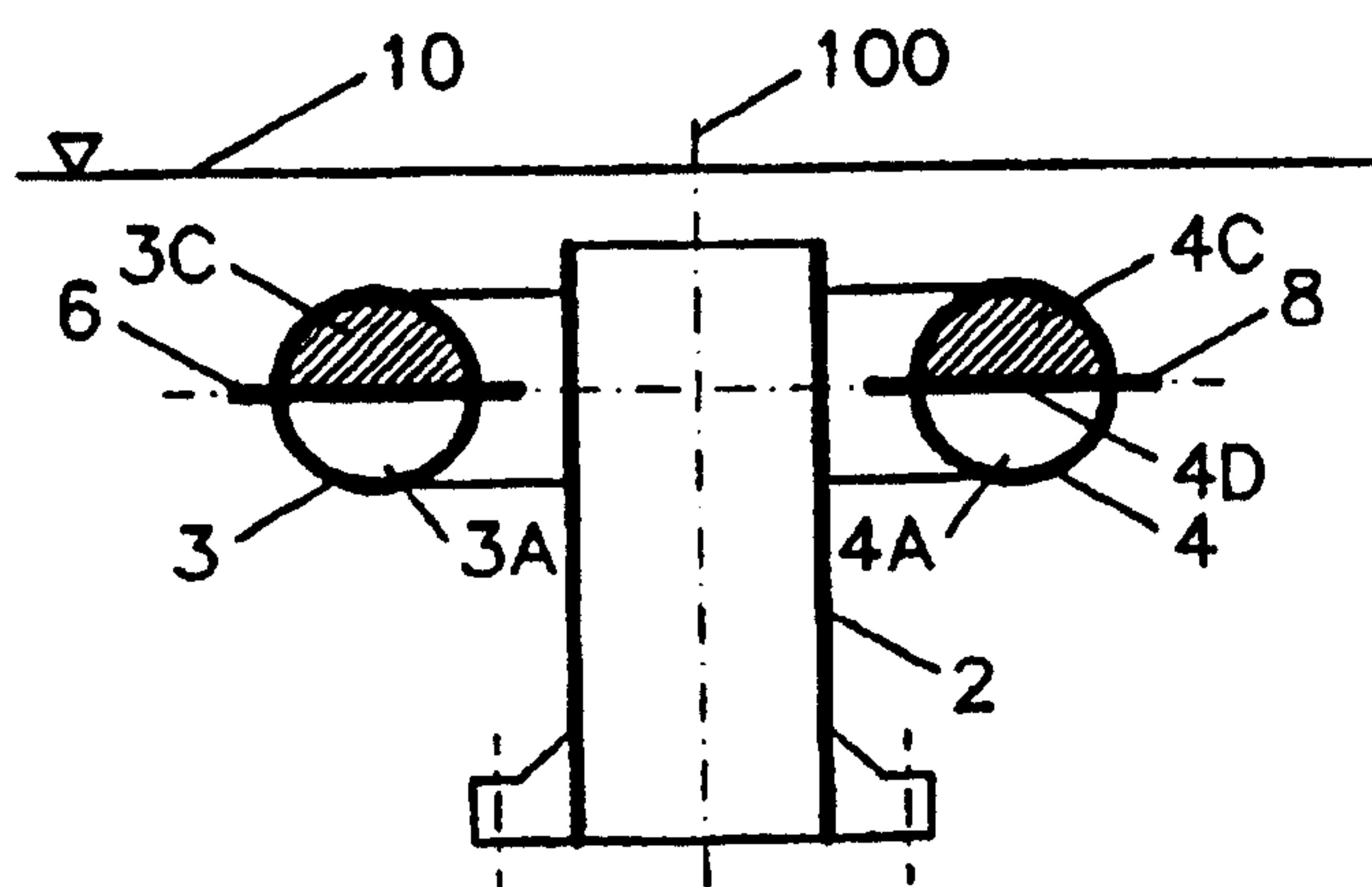


FIG. 3

James G. Clark

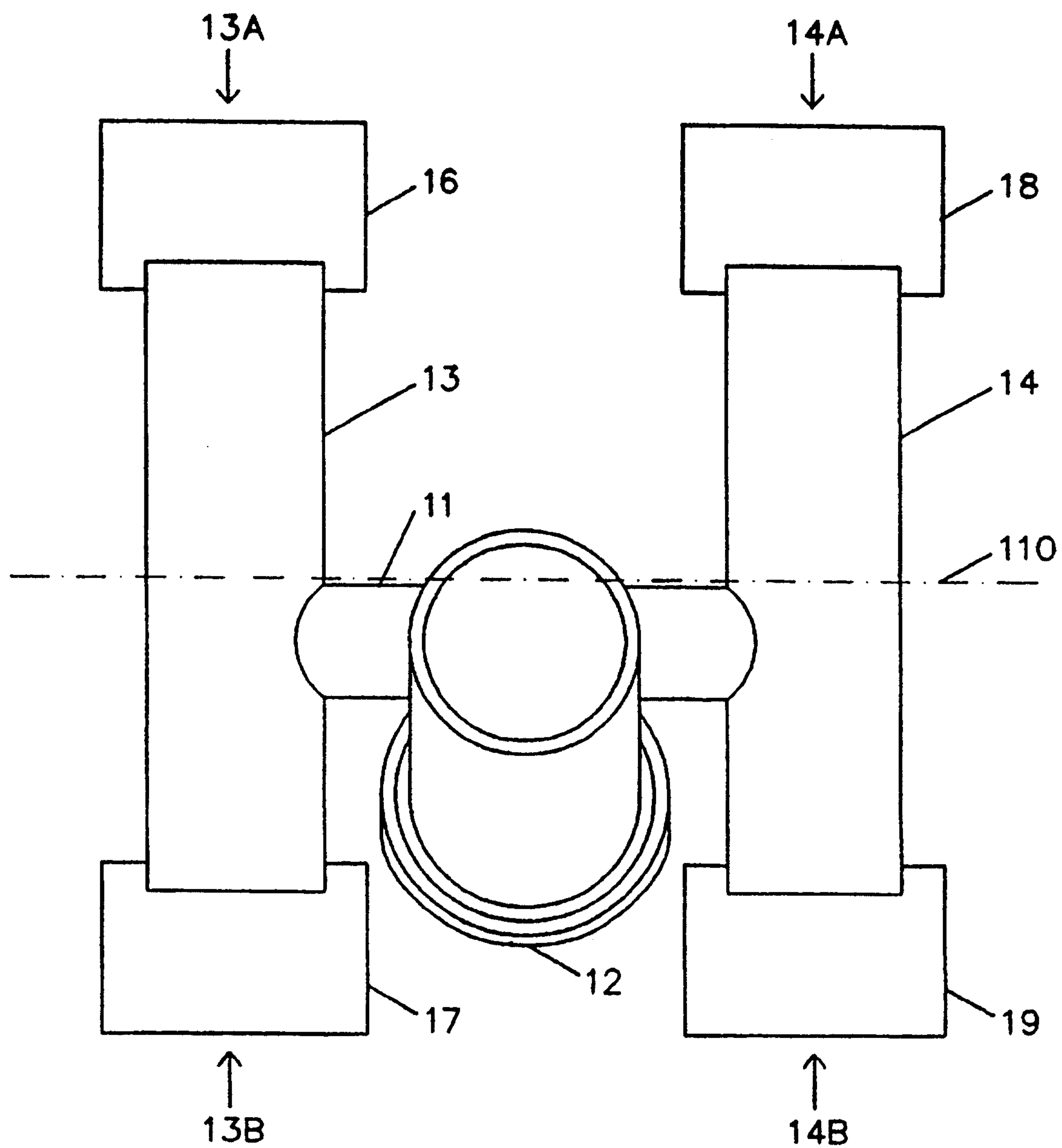


FIG. 4

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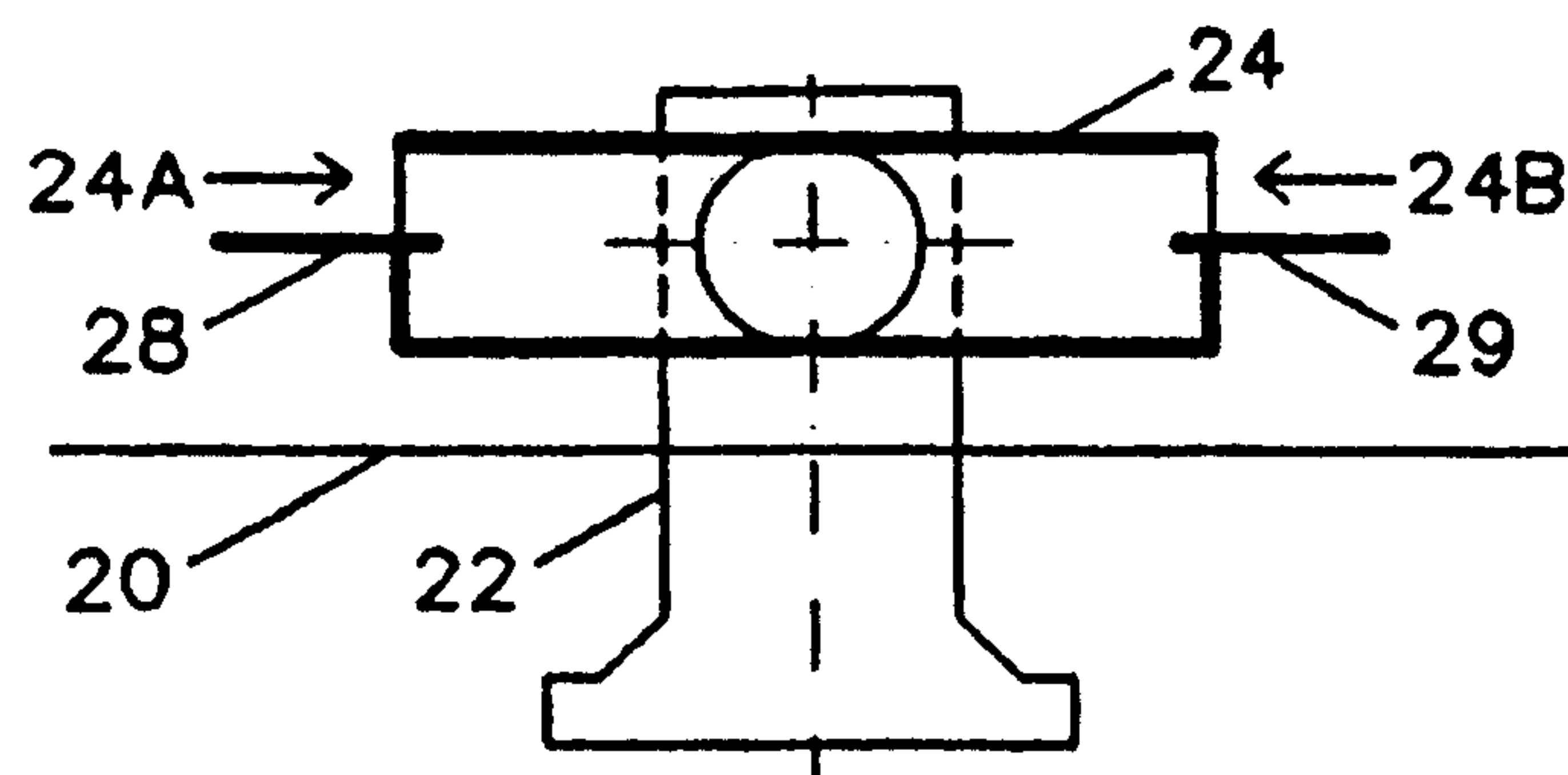


FIG. 5

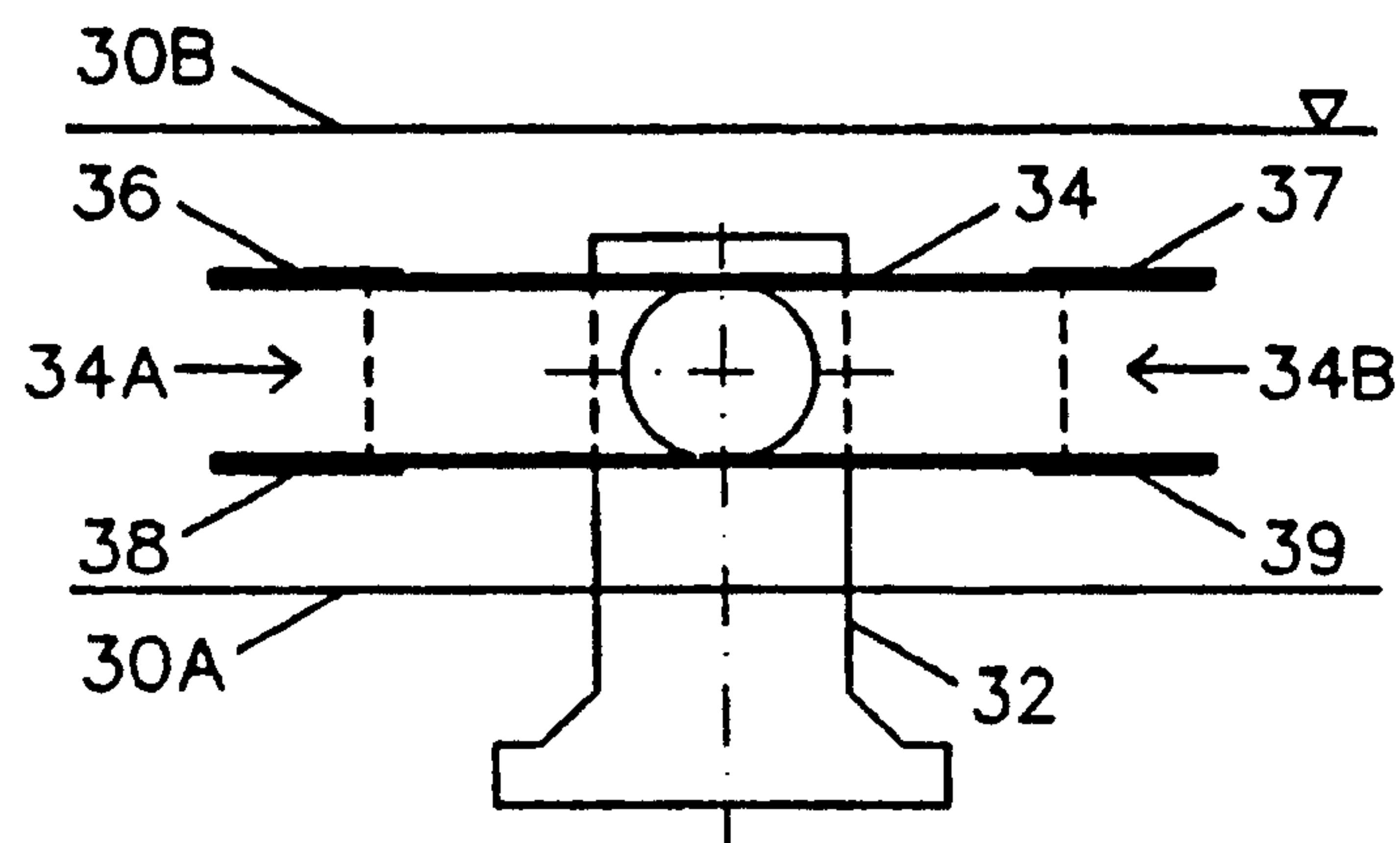


FIG. 6

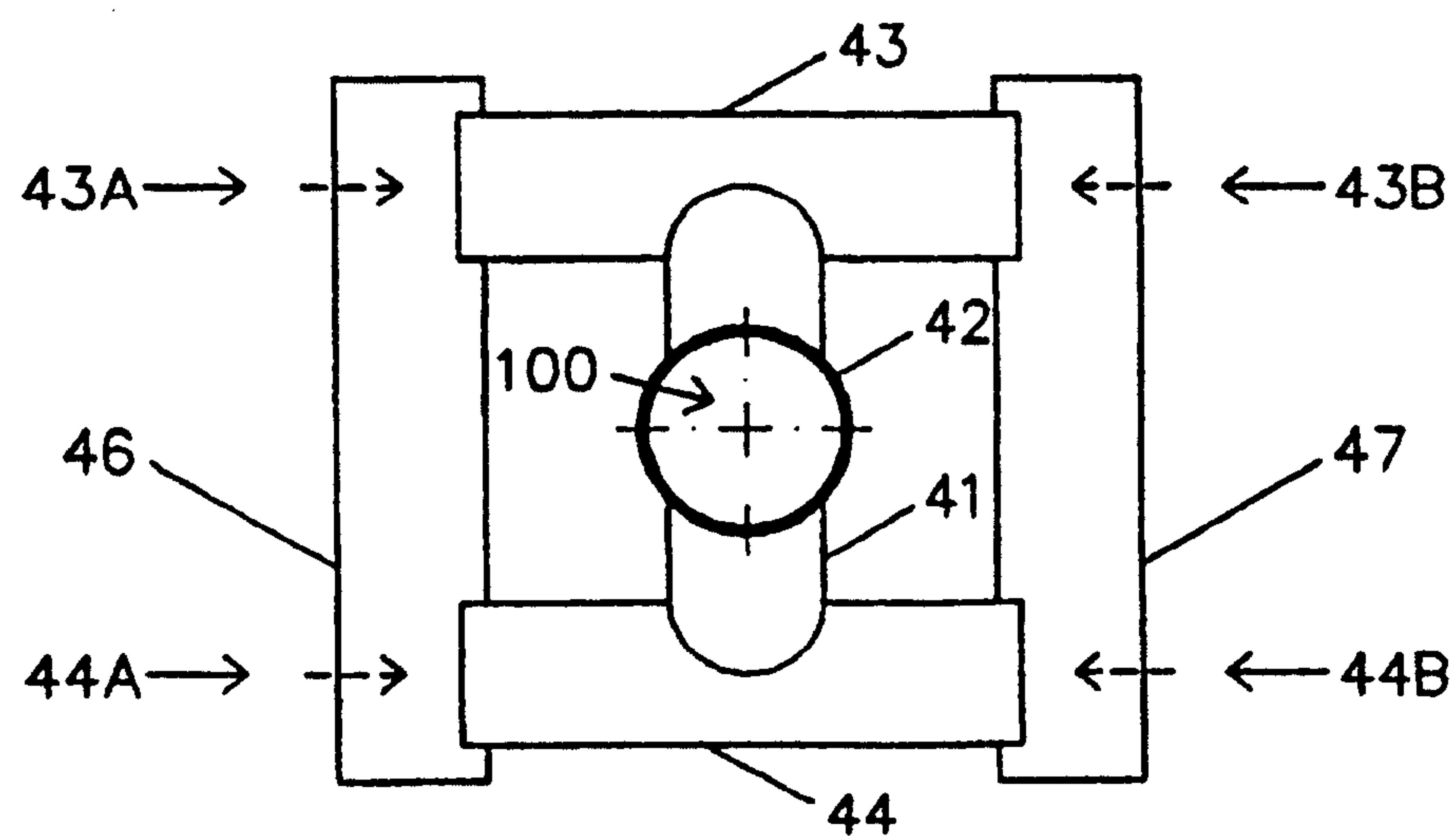


FIG. 7

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