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(54) **Cutter head drive**

(57) Device for the excavation and removal of material from a bottom of a water body, comprising a cutter member (9) for loosening the soil material and a discharge pipe line (7) for the loosened soil material, as well as a support structure, such as a ladder (1), for supporting the discharge pipe line (7), wherein the soil material is transported through the discharge pipe line (7) by means of a pump (15), furthermore provided with rotation means (11,12,...) for rotation of the cutter member, wherein the cutter member (9) has a number of cutting means (33) and defines a space between the cutting means and the entrance of the discharge pipe line, wherein at the entrance of the discharge pipe line a filling piece (8) is arranged, provided with a suction passage (51) between the entrance and the space in order to define a suction mouth, wherein the exit opening of the suction passage to the discharge pipe line contains the centre line (S) of the discharge pipe line and the rotary centre line of the cutter member.

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Description

BACKGROUND OF THE INVENTION

[0001] The invention relates to a dredging device provided with a cutter member for excavating soil material and a suction pipe for transporting excavated soil material away.

[0002] An example of such a dredging device is a cutter (head) suction dredge provided with a rotating or crown-shaped cutter head or with a rotating disk-shaped cutter head.

[0003] The suction pipe, its pump, cutter head and its drive, as well as winch passages, are attached to a ladder that extends downward from a floating body such as a ship. From the engine for the cutter head, a driving shaft extends along the ladder, at the end of which driving shaft the cutter is centrically attached. In case of a crown-shaped cutter head, which comprises a circumferential edge and a hub between which cutting teeth bearing bars extend, the hub is used for that purpose. The suction pipe is adjacent to the driving shaft, and with its entrance extends along the circumferential edge up into the space within the crown, as part of a filling piece for said space.

[0004] In an alternative known embodiment the suction pipe itself is rotatingly driven and at the lower end provided with the cutter head. The suction pipe is then concentric with the crown.

[0005] In another alternative known embodiment the cutter head having a hub situated between the circumferential edge is attached to an end edge of a short bush that is rotatably bearing mounted at the lower end of the suction pipe and at the opposite end edge provided with teeth with which a pinion on a driving shaft extending along the suction pipe, meshes. In another more recent known arrangement the bush is driven by an electromotor of which the stator has been provided at the suction pipe and the rotor in the bush.

[0006] It is an object of the invention to provide a dredging device of the type mentioned in the preamble having a large freedom in design, particularly as regards the cutting means and the suction mouth.

[0007] It is an object of the invention to provide a dredging device of the type mentioned in the preamble with which large efficiency can be achieved.

[0008] It is an object of the invention to provide a dredging device of the type mentioned in the preamble with which the amount of spillage can be kept limited.

[0009] It is an object of the invention to provide a dredging device of the type mentioned in the preamble, which can easily be adapted to the project to be carried out.

SUMMARY OF THE INVENTION

[0010] According to one aspect, the invention provides a device for the excavation and removal of material from a bottom of a water body, comprising a cutter member for loosening the soil material and a discharge pipe line for the loosened soil material, as well as a support structure, such as a ladder, for supporting the discharge pipe line, wherein the soil material is transported through the discharge pipe line by means of a pump, furthermore provided with rotation means for rotation of the cutter member, wherein the cutter member has a number of cutting means and defines a space between the cutting means and the entrance of the discharge pipe line, wherein at the entrance of the discharge pipe line a filling piece is arranged, provided with a suction passage between the entrance and the space in order to define a suction mouth, wherein the exit opening of the suction passage to the discharge pipe line contains the centre line of the discharge pipe line and the rotary centre line of the cutter member.

[0011] Because of the filling piece it is ensured - in a manner known per se - that the rate of flow within the cutter member is not reduced. Due to the more central location of the passage in the filling piece its suction opening can under circumstances, such as a crown-shaped cutter head, and depending on the slope of the ladder, extend closer to the location of excavation, as a result of which the concentration of the mixture can be high.

[0012] The inflow of excavated soil material can be enhanced when the centre line of the suction passage in the entrance opening is at an angle to the centre line of the entrance of the discharge pipe line. The entrance opening can then be oriented more to the position wanted for sucking up the material. The entrance opening of the suction passage then preferably is situated eccentric with respect to the centre line of the discharge pipe line and the rotary centre line of the cutter member.

[0013] In one embodiment the filling piece is arranged substantially around the entrance edge of the discharge pipe line.

[0014] In another embodiment the filling piece is arranged substantially in front of the entrance edge of the discharge pipe line.

[0015] In a further embodiment the filling piece extends radially beyond the drive casing, which may also be advantageous in case of a placement support for a cutter member which support will be mentioned further below and extends beyond the drive casing. In this case there is question of a large freedom in design as regards the filling piece.

[0016] The filling piece may be removed, for instance for inspection of the discharge pipe line, and subsequently be placed back when the filling piece comprises a tightening pipe part that extends fittingly or under narrow tolerances around the discharge pipe line, wherein the tightening pipe part is provided with a circumferential, internal annular chamber that is connected to a connection for liquid, wherein the tightening pipe part is adapted for tightening around the discharge pipe line by filling the annular chamber with a liquid via the connection for liquid.

[0017] The rotation means may comprise a drive casing which is connected to an edge area of the cutter member for subjecting it to a rotary motion, wherein the drive

casing is externally rotatably bearing mounted in the ladder.

[0018] In one embodiment the discharge line has a lowermost suction pipe section that is movable about its centre line and adjustment means are provided for adjusting the angular position of the lowermost suction pipe section about the centre line. When the suction mouth at the lower end of the lowermost suction pipe section is eccentric with respect to the said centre line, the position of the suction mouth with respect to the cutting means at the cutter member can be adjusted by a slight rotation of the lowermost suction pipe section, adapted to the direction of rotation of the cutter member and the hauling direction of the ladder.

[0019] In one embodiment the dredging device according to the invention is provided with adjustment means for adjusting the mutual axial position of the discharge pipe line, optionally including filling piece, and the drive casing including cutter member. In this way an optimal axial position of the suction mouth with respect to the cutter member for a certain work process can be realised, depending on the breach level, step size, etc. In case of for instance a cutter head, the suction mouth can be brought closer to its end (such as where usually the hub will be).

[0020] In a simple embodiment the adjustment means are adapted for axial adjustment of the position of the discharge pipe line with respect to the ladder.

[0021] In a further development of the dredging device according to the invention, the drive casing is provided with a placement support for detachable attachment of the cutter member thereon, particularly its edge area. The cutter member can then easily be replaced, for instance by a comparable cutter member having another diameter. The placement support may extend at radial outward distance from the drive casing, so that the diameter of the drive casing can be relatively small. The filling piece may in that case also extend radially beyond the drive casing. The placement support preferably is continuously circumferential.

[0022] In a further development of this concept the invention provides an assembly of such a device according to the invention and at least two cutter members, wherein the cutter members have edges with diameters that differ from each other, wherein the edges are provided with attachment means for attachment of the cutter member in question on the placement support, wherein the attachment means of the edges of the cutter members define a circumscribed circle of equal diameter.

[0023] The placement support may then be provided with confiners, such as claws, that engage axially and radially externally along and outside over the attachment means.

[0024] In a further development of the dredging device according to the invention the filling piece is detachably attached to the discharge pipe line. The filling piece itself can in that case be fixedly attached to an end section of the discharge pipe line, which end section is then detachably attached to the rest of the discharge pipe line. For replacement said end section can be passed in and out of the drive casing. In that way various embodiments of the filling piece already attached to a discharge pipe section can be kept at the ready to be placed in the dredging device, for instance in adjustment to the replacement of a cutter member by a cutter member of another shape/dimension. The filling piece may be welded to the discharge pipe section so that said connection needs little space.

[0025] With a section extending in the drive casing, the filling piece can be radially externally bearing mounted in the drive casing for supporting radial weight forces and loads as a result of pieces of material that got stuck between filling piece and cutter member.

[0026] In one embodiment the drive casing is tubular and an annular space is formed between the tubular drive casing and the discharge pipe line, which annular space at an end is connected with a pressure source for fluid particularly water, and at the opposite end is connected with one or more nozzles arranged in the inside of the cutter member. The fluid can be used for rinsing the water lubricated bearings, and for help in the excavation, as well as for keeping the cutter member clean/open.

[0027] In the embodiment with the said filling piece the nozzles can be arranged on the filling piece.

[0028] From a further aspect the invention provides a device for the excavation and removal of material from a bottom of a water body, comprising a cutter member for loosening the soil material and a discharge pipe line for the loosened soil material, as well as a support structure, such as a ladder, for supporting the discharge pipe line, wherein the soil material is transported through the discharge pipe line by means of a pump, furthermore provided with means for rotation of the cutter member, wherein the rotation means comprise a drive casing, which is connected to an edge area of the cutter member for subjecting it to a rotary motion, wherein the drive casing is externally rotatably bearing mounted in the ladder.

[0029] The weight of the drive for the cutter member, such as the drive casing, and the cutter member is supported by the ladder. The external forces on the cutter member can also be supported by the ladder. The suction pipe itself can then remain largely free from those forces. The suction pipe can as a result be designed very simple, largely like an ordinary pipe.

[0030] For supporting the weight of the suction pipe itself and the mixture transported therein, the discharge pipe line can be supported in the drive casing, which can be done using simple means, such as a suspension bearing.

[0031] In order to prevent the discharge pipe line from rotating along, means are present for retaining the discharge pipe line against rotation.

[0032] The invention furthermore provides, according to further aspect, a device for the excavation and removal of material from a bottom of a water body, comprising a cutter member for loosening the soil material and a dis-

charge pipe line for the loosened soil material, as well as a support structure, such as a ladder, for supporting the discharge pipe line, wherein the soil material is transported through the discharge pipe line by means of a pump, furthermore provided with rotation means for rotation of the cutter member in an operative rotation direction, wherein the rotation means comprise a drive casing extending in axial direction, which casing is connected to an edge area of the cutter member for subjecting it to a rotary motion, wherein the drive casing is provided with a placement support extending in circumferential direction, such as a circumferential placement edge, for detachable attachment of the cutter member thereon, particularly its edge area.

[0033] The cutter member can be reliably coupled to the rotation means when the rotation means are provided with first engagement cams extending radially with respect to the drive casing, and the cutter member is provided with second engagement cams engaging thereon for in axial direction securing the cutter member with respect to the drive casing.

[0034] The cutter member can then successively by a placement motion and a rotary motion be coupled to the rotation means, wherein the first engagement cams and the second engagement cams in circumferential direction leave recesses free in order to let the first and second engagement cams pass each other in axial direction.

[0035] Play in the coupling in axial direction can be limited or entirely prevented by said rotary motion when the first and second engagement cams are provided with wedge surfaces engaging onto each other and oriented diagonally to the circumferential direction.

[0036] In one embodiment the rotation means are provided with an attachment ring extending around the placement support and rotatable with respect thereto, on which attachment ring the first engagement cams are provided, and the cutter member comprises a cutter head ring on which the second engagement cams are provided, wherein due to rotation of the attachment ring with respect to the placement support the first and the second engagement cams enter into interengagement, preferably due to rotation counter the operative rotation direction.

[0037] The cutter member can be subjected to the rotation of the drive casing when the placement support is provided with third engagement cams extending in axial direction and which engage onto the second engagement cams for in the rotation direction securing the cutter member with respect to the drive casing. The forces arising then can be distributed in circumferential direction when in circumferential direction the second and third engagement cams that engage each other are alternately positioned.

[0038] In an alternative development the first engagement cams are provided at the placement support, and the cutter member comprises a cutter head ring on which the second cams are provided, wherein due to rotation of the cutter head ring with respect to the drive casing the first engagement cams enter into interengagement, preferably due to rotation counter the operative rotation direction.

[0039] The aspects and measures described in this description and claims of the application and/or shown in the drawings of this application may where possible also be used individually. Said individual aspects, such as the filling piece, the exchangeability of the cutter heads, the exchangeability of filling pieces with suction pipe sections, the adjustability of the lowermost section of the suction pipe and other aspects may be the subject of divisional patent applications relating thereto. This particularly applies to the measures and aspects described per se in the sub claims.

SHORT DESCRIPTION OF THE DRAWINGS

[0040] The invention will be elucidated on the basis of a number of exemplary embodiments shown in the attached drawings, in which:

Figure 1 shows a ladder of a dredging tool having a suction pipe arrangement according to the invention;

Figure 2A shows an exploded view of the cutter head arrangement of figure 1;

Figure 2B shows a detail of the cutter head attachment of the arrangement of figure 1;

Figures 2C-E show cross-sections of suction pipe ends each time having a different cutter head;

Figure 2F shows a cross-section of a suction pipe end having an alternative filling piece according to the invention;

Figure 2G shows a cross-section of suction pipe ends having an alternative cutter head attachment according to the invention;

Figure 3 shows a detail of the arrangement of figure 1, with swivel and slide mechanisms;

Figures 4A and 4B show details of the swivel mechanism; and

Figure 5 shows a detail of the arrangement of figure 1 with a jet water inlet.

DETAILED DESCRIPTION OF THE DRAWINGS

[0041] The ladder 1 of the arrangement in figure 1 is rotatably attached - in a vertical plane perpendicular to the plane of the drawing - to a ship, not shown. The ladder 1 supports a hollow shaft or casing 2, which is externally bearing mounted on the ladder 1, with a radial bearing 3 and a combined axial/radial bearing 4. Within the hollow

shaft 2 a suction pipe 7 is accommodated, which at an upper end is connected to a pump 15, and at the lower end is provided with a filling piece or cone 8 extending into cutter head 9. With pipe section 8a the cone 8 is attached to the end of the suction pipe 7 for instance by welding, and is externally bearing mounted within the hollow shaft or casing 2 by means of an axial/radial bearing 5.

[0042] The suction pipe 7 is axially adjustable with respect to the hollow shaft 2 by means of slide mechanism 13. By means of swing or swivel mechanism 14 the suction pipe 7 is tiltable about its centre line S.

[0043] In figure 1 the cone 8 shown has a suction mouth passage 51 having a suction mouth opening or orifice 52 (access opening) on the one side and an suction mouth exit 50 (exit opening) on the other side, as transition to the suction pipe 7 that is situated concentric with respect to the centre line S of the suction pipe 7. The cone 8 shown in figures 2C-E has a passage 51 bending away to the cutter head 9 with respect to the centre line S, so that the opening 52 is situated eccentric with respect to the centre line S.

[0044] The cutter head 9, the teeth contour of which is shown, comprises an edge or cutter head ring 30 and a hub 32, in between which cutting arms 33 extend, which on both ends are fixedly attached thereto. The hub 32 is hollow in order to define a passage 39, through which optionally also soil material and water can flow to the suction mouth. At the outer end the passage may be provided with bars 39a in order to stop large chunks of material.

[0045] As also shown in figure 2A, the cutter head ring 30 at its radial outside is provided with placement cams 31 (second engagement cams), which in circumferential direction are regularly spaced apart. A same cutter head ring 30 is part of the cutter head 9 of figure 2C.

[0046] In the cutter head 109 of figure 2D the cutter head ring 30 has an L-shaped cross-section, and contrary to figure 2C, with its leg 30a it sits for a larger part radially within the ends of the arms 33 situated there. From the radial outside of the leg 30a of the cutter head ring 30 placement cams 31 (second placement cams) project.

[0047] In the cutter head 209 of figure 2E the radial distance between the ends of the arms 33 situated at the cutter head ring 30 and the placement cams 31 (second placement cams) is even larger. Thus the maximum cutter head diameter D3 (figure 2E) exceeds the maximum cutter head diameter D2 (figure 2D) and exceeds the maximum cutter head diameter D1 (figure 2C). Please note that the teeth contours have been left out in the figures 2C-G.

[0048] In the cutter head 309, 409 according to figures 2F and 2G an alternative filling piece or cone 8 has been accommodated. The centre line R of the suction mouth passage 51 and the suction mouth opening 52 is again oriented diagonally to the centre line S of the suction pipe 7. The head 8b of the filling piece 8 in axial direction extends more deeply into the cutter head 9, as a result of which it is at a short distance from the passage 39. The suction mouth opening 52 has a more eccentric position with respect to the centre line S, as a result of which the suction mouth opening 52 is at a short distance from the cutting arms 33 of the cutter head 309, 409.

[0049] The filling piece 8 according to figures 2F and 2G has a two-part structure, wherein the pipe section 8a merges into a radially extending flange 304 that is secured within the filling piece head 8b by means of bolts 305. The axial/radial bearing 5 extends beyond the pipe section 8a of the filling piece 8 between the suction pipe 7 and the casing 2.

[0050] The pipe section 8a comprises an internal annular chamber 301 extending in axial direction within the largest part of the pipe section 8a. The annular chamber 301 is connected to a connecting nipple 303 via a line 302 extending radially in the flange 304. The connecting nipple 303 is situated within the contour of the flange 304. The pipe section 8a is placed around the suction pipe 7 so as to fit, after which via the connecting nipple 303 hydraulic oil up to a pressure of approximately 800 bars is pressed into the annular chamber 301. Due to the volume increase of the annular chamber 301 the pipe section 8a is elastically thickened, as a result of which it is tightened firmly around the suction pipe 7. Alternatively the pipe section 8a can be secured around the suction pipe 7 by driving wedges between the pipe section 8a and the suction pipe 7.

[0051] For attaching the cutter heads 9, 109, 209, 309 a type of clamping table or placement support 10 is attached at the lower end of the hollow shaft 2, for rotation therewith. In the example shown the clamping table 10 comprises two flanges 21 a,b (figure 2B) welded onto the hollow shaft 2, the flanges having a support ring 23 (see figure 2A), provided with radial holes 25a, welded to their radial outer sides. The clamping table or placement support 10 furthermore comprises a claw ring 24, which by means of a flange 22 and bolts 28 is axially, direction cutter head, retained in its place against the support ring 23.

[0052] The claw ring 24 is provided with holes 25b which coincide with the holes 25a in the support ring 23, and which are intended to receive striking pens 26. The claw ring 24 is provided with claws 24a (first engagement cams), which leave recesses 24b free between them. The circumferential length thereof corresponds with said length of the protrusions 23a (third engagement cams) and recesses 23b on the support ring 23.

[0053] When placing the cutter head 9 on the clamping table 10 the placement cams 31 have been passed through the recesses 24b. The cutter head ring 30 then is situated within the claw ring 24. The placement cams 31 are inserted into the recesses 23b and are snugly accommodated therein. Then the claw ring 24 is rotated in the direction E, counter the regular direction of rotation of the cutter head 9, in order to bring the claws 24a axially in front of the recesses 23b and the placement cams 31.

Subsequently the striking pens 26 are introduced, and the cutter head 9 is fixedly attached on the clamping table 10 and thus onto the hollow shaft 2. The cutter head ring 30 then tightly abuts the flange 21 b.

[0054] When replacing a cutter head 9, the striking pens 26 are removed, the claw ring 24 is rotated in opposite direction and the cutter ring head 30 with cutter head 9 is removed. Another cutter head 9 having a cutter head ring 30 with placement cams 31 can then be placed in the said manner. This may for instance be one of the cutter heads 109, 209, 309 shown in figures 2D-F.

[0055] The cutter head 409 according to figure 2G has an alternative cutter head ring 430 with which the cutter head 409 is attached to a clamping table or placement support 410 adapted for that purpose. The cutter head ring 430 is provided with a circulating circumferential groove 429 that is open towards the inside and at the rear side facing the ladder 1 is bounded by claws 424 (second engagement cams) which between them leave recesses free in circumferential direction. The circumferential abutment surface 425 of the circumferential groove 429 extends in a plane transverse to the centre line S. At the opposite side thereof the claws 424 define wedge surfaces 428 which in circumferential direction are at an angle to the circumferential abutment surface 425.

[0056] The adapted placement support 410 comprises a circumferential wall 423 welded against the flanges 21 a,b, which wall at the outer side is provided with placement cams 431 (first placement cams) extending in circumferential direction. The circumferential length thereof corresponds with said length of the claws 424 and the recesses situated in between them. The placement cams 431 are provided with an abutment surface 426 and a wedge surface 427 for cooperation with the circumferential abutment surface 425 and the wedge surfaces 428 of the claws 424, respectively. When installing the cutter head 409 the claws 424 are brought behind the placement cams 431 through the recesses between the placement cams 431. The wedge surfaces 427, 428 are oriented such that when the hollow shaft 2 is rotated in its operation direction they abut each other in order to press the abutment surfaces 425, 426 against each other. Alternatively formulated this is done by rotating the cutter head 9 with respect to the hollow shaft 2 counter its usual operation direction. In the end position the claws 424 and the placement cams 431 are in each others extension in axial direction, after which between two consecutive claws 424 and placement cams 431 a blocking block that is not further shown is mounted on the circumferential wall 423 in order to prevent rotating back.

[0057] It is noted that the cutter heads 309 and 409 according to figures 2F and 2G have a straight hub 32 having a flat front side.

[0058] For driving the hollow shaft 2 and thus the cutter head 9 about centre line S, a gear wheel 18 is attached at the upper end of the hollow shaft 2. The gear wheel 18 is engaged at its circumference by pinions 17, that are driven by electromotors 11 and 12, via reduction gearboxes 16. As a result the hollow shaft 2 is rotated within the ladder 1 and about the suction pipe 7, bearing mounted then in bearings 3 and 4. The electromotors 11 and 1 2 and optionally the reduction gearboxes 16 as well can, by using an intermediate shaft, also be positioned above water on top of the ladder 1.

[0059] There is an annular space 40 between the hollow shaft 2 and the suction pipe 7, which space may be connected to a source of water that is not further shown. The filling piece on the cone 8 is provided with ducts 41, 42 connected to annular space 40 and leading to spray nozzles 43. At the upper end, as can be seen in figure 5, the annular space 40 can be closed off by a bush 44, which at collar 49 thereof is fixedly clamped on the suction pipe by means of a double-conical clamping ring 47 and clamping rings 48a,b that are clamped towards each other thereon, and provided with a sealing towards the hollow shaft 2. Through the bush 44 one or more passages 45 extend, which at their entrance can be connected to a water supply tube or pipe - not shown - which can accommodate optional axial displacement of the bush 44 with respect to the ladder 1. In the annular space pipes that are stationary with the suction pipe can optionally be positioned, which pipes connect the passage 45 with the ducts 41, 42. The supplied water can also be used for rinsing and cooling the support bearing 5.

[0060] In figure 3 the swivel mechanism 14 and the slide mechanism 13 for the suction pipe 7 are further shown. It can be seen that the suction pipe section 7a merges into a wider suction pipe section 7b, wherein at the end of suction pipe section 7b a socket 65 is arranged with sealing ring 66 on the edge of the suction pipe section 7b, along which suction pipe section 7a is able to slide and rotate in a watertight manner.

[0061] In the passage 60 in the ladder 1, a number of supports 61 are provided, on which cylinders 62 are hinged, which cylinders 62 extend in axial direction of the passage 60, and with piston rods 63 are hinged to a ring 67 extending around pipe section 7a. The ring 67 forms an accommodation space 64 in which a ring 68 is fittingly and rotatingly accommodated, wherein the accommodation space is closed by a ring 69. The ring 68 is fixedly attached to the outer surface of a case 76, which by means of a double-conical clamping ring 77 and clamping rings 78a,b (known per se) that are clamped towards each other thereon, is fixedly clamped on pipe section 7a. The ring 68 is rotatable within the rings 67, 69 yet not displaceable in axial direction with respect thereto. Thus by activating the cylinders 62 and retracting/expanding the piston rod 63, the ring 68 and the case 76 and thus pipe section 7a can be slid in the direction A with respect to pipe section 7b. In that way the filling piece/the cone 8 can also be slid within the space between the clamping table 10 and the arms 33 of the cutter head 9 towards the position showed in dashed lines in figure 2E.

[0062] The swivel mechanism 14, also shown in figures 4A and 4B, comprises a cylinder 70 positioned in a radial plane with respect to the suction pipe section 7a,

which cylinder is attached to the ladder 1 by means of a ball hinge 71. With the end at the location of 73, the piston rod 72 is attached with a ball hinge to a rod 75, which extends in an axial plane of suction pipe section 7a, and at the ends is rigidly attached to flat rings 74a, 74b that are fixedly attached to case 76 and thus on suction pipe section 7a, which not far away therefrom is supported in bearing 6. By activating the cylinder 70, the piston rod 72 will expand or retract in the direction B. Because of the hinge 73 the rings 74 will rotate in the direction C, and thus the case 76 and the pipe section 7a. The hinge 73 ensures that also an axial sliding in the direction A can be followed, because the cylinder 70 can swivel along (figure 4A). Due to this swivel possibility the suction opening in the cone 8 can be given an optimum position, depending on the swaying direction of the ladder, flow rate, soil type, etcetera. If so desired this can take place continuously during the dredging process.

[0063] The above description is included to illustrate the operation of preferred embodiments of the invention and not to limit the scope of the invention. Starting from the above explanation many variations that fall within the spirit and scope of the present invention will be evident to an expert.

Claims

1. Device for the excavation and removal of material from a bottom of a water body, comprising a cutter member for loosening the soil material and a discharge pipe line for the loosened soil material, as well as a support structure, such as a ladder, for supporting the discharge pipe line, wherein the soil material is transported through the discharge pipe line by means of a pump, furthermore provided with rotation means for rotation of the cutter member, wherein the cutter member has a number of cutting means and defines a space between the cutting means and the entrance of the discharge pipe line, wherein at the entrance of the discharge pipe line a filling piece is arranged, provided with a suction passage between the entrance and the space in order to define a suction mouth or orifice, wherein the exit opening of the suction passage to the discharge pipe line contains the centre line of the discharge pipe line and the rotary centre line of the cutter member.

2. Device according to claim 1, wherein the entrance opening of the suction passage is situated eccentric with respect to the centre line of the discharge pipe line and the rotary centre line of the cutter member.

3. Device according to claim 1 or 2, wherein the entrance opening of the suction passage contains the centre line of the discharge pipe line and the rotary centre line of the cutter member.

4. Device according to any one of the preceding claims, wherein the centre line of the suction passage in the entrance opening is at an angle to the centre line of the entrance of the discharge pipe line.

5. Device according to any one of the preceding claims, wherein the filling piece is arranged substantially around the entrance edge of the discharge pipe line.

6. Device according to any one of the preceding claims, wherein the filling piece is arranged substantially in front of the entrance edge of the discharge pipe line.

7. Device according to claim 5 or 6, wherein the filling piece comprises a tightening pipe part that extends fittingly or under narrow tolerances around the discharge pipe line, wherein the tightening pipe part is provided with a circumferential, internal annular chamber that is connected to a connection for liquid, wherein the tightening pipe part is adapted for tightening around the discharge pipe line by filling the annular chamber with a liquid via the connection for liquid.

8. Device according to any one of the preceding claims, wherein the rotation means comprise a drive casing which is connected to an edge area of the cutter member for subjecting it to a rotary motion, wherein the drive casing is externally rotatably bearing mounted in the ladder, wherein the discharge pipe line preferably is supported in the drive casing, preferably bearing mounted so as to be rotatable.

9. Device according to claim 8, provided with retaining means for retaining the discharge pipe line against rotation.

10. Device according to claim 8 or 9, wherein the drive casing is provided with a placement support, such as a circumferential placement edge, for detachable attachment of the cutter member thereon, particularly its edge area, wherein the placement support preferably extends at radial outward distance from the drive casing, wherein the placement support preferably is continuously circumferential.

11. Assembly of a device according to claim 10, and at least two cutter members, wherein the cutter members have edges with diameters that differ from each other, wherein the edges are provided with attachment means for attachment of the cutter member in question on the placement support, wherein the attachment means of the edges of the cutter members define a circumscribed circle of equal diameter, wherein the placement support preferably is provided with confiners that engage axially and radially externally along or outside over the attachment means.

12. Device according to any one of the preceding claims, wherein the discharge pipe line has a lowermost suction pipe section that is movable about its centre line and adjustment means are provided for adjusting the angular position of the lowermost suction pipe section about the centre line.

13. Device according to any one of the preceding claims, provided with adjustment means for adjusting the mutual axial position of the discharge pipe line and the drive casing, wherein the adjustment means preferably are adapted for axial adjustment of the position of the discharge pipe line with respect to the ladder.

14. Device according to any one of the preceding claims, wherein the filling piece is detachably attached to the discharge pipe line, wherein the filling piece itself preferably is fixedly attached to an end section of the discharge pipe line, which end section is detachably attached to the rest of the discharge pipe line and for replacement can be passed in and out of the casing.

15. Device according to claim 14, wherein with a section extending in the casing the filling piece is radially externally bearing mounted.

16. Device according to any one of the preceding claims, wherein the drive casing is tubular and an annular space is formed between the tubular drive casing and the discharge pipe line, which annular space at an end is connected with a pressure source for fluid particularly water, and at the opposite end is connected with one or more nozzles arranged in the inside of the cutter member, wherein the nozzles preferably are arranged on the filling piece.

17. Device for the excavation and removal of material from a bottom of a water body, comprising a cutter member for loosening the soil material and a discharge pipe line for the loosened soil material, as well as a support structure, such as a ladder, for supporting the discharge pipe line, wherein the soil material is transported through the discharge pipe line by means of a pump, furthermore provided with means for rotation of the cutter member, wherein the rotation means comprise a drive casing, which is connected to an edge area of the cutter member for subjecting it to a rotary motion, wherein the drive casing is externally rotatably bearing mounted in the ladder, wherein the discharge pipe line preferably is supported in the drive casing, preferably bearing mounted so as to be rotatable.

18. Device according to claim 17, provided with retaining means for retaining the discharge pipe line against rotation.

19. Device for the excavation and removal of material from a bottom of a water body, comprising a cutter member for loosening the soil material and a discharge pipe line for the loosened soil material, as well as a support structure, such as a ladder, for supporting the discharge pipe line, wherein the soil material is transported through the discharge pipe line by means of a pump, furthermore provided with rotation means for rotation of the cutter member in an operative rotation direction, wherein the rotation means comprise a drive casing extending in axial direction, which casing is connected to an edge area of the cutter member for subjecting it to a rotary motion, wherein the drive casing is provided with a placement support extending in circumferential direction, such as a circumferential placement edge, for detachable attachment of the cutter member thereon, particularly its edge area, wherein the placement support preferably extends at radial outward distance from the drive casing, wherein the placement support preferably is continuously circumferential.

20. Device according to claim 19, wherein the drive casing is externally rotatably bearing mounted in the ladder.

21. Device according to claim 19 or 20, wherein the rotation means are provided with first engagement cams extending radially with respect to the drive casing, and the cutter member is provided with second engagement cams engaging thereon for in axial direction securing the cutter member with respect to the drive casing, wherein the first engagement cams and the second engagement cams in circumferential direction preferably leave recesses free in order to let the first and second engagement cams pass each other in axial direction.

22. Device according to claim 21, wherein the first and second engagement cams are provided with wedge surfaces engaging onto each other and oriented diagonally to the circumferential direction.

23. Device according to claim 21 or 22, wherein the rotation means are provided with an attachment ring extending around the placement support and rotatable with respect thereto, on which attachment ring the first engagement cams are provided, and the cutter member comprises a cutter head ring on which the second engagement cams are provided, wherein due to rotation of the attachment ring with respect to the placement support the first and the second engagement cams enter into interengagement, preferably due to rotation counter the operative rotation direction, wherein the placement support preferably is provided with third engagement cams extending in axial direction and which engage onto the second

engagement cams for in the rotation direction securing the cutter member with respect to the drive casing, wherein in circumferential direction the second and third engagement cams that engage each other preferably are alternately positioned.

24. Device according to claim 21 or 22, wherein the first engagement cams are provided at the placement support, and the cutter member comprises a cutter head ring on which the second cams are provided, wherein due to rotation of the cutter head ring with respect to the drive casing the first engagement cams enter into interengagement, preferably due to rotation counter the operative rotation direction.

25. Assembly of a device according to any one of the claims 19-24, and at least two cutter members, wherein the cutter members have edges with diameters that differ from each other, wherein the edges are provided with attachment means for attachment of the cutter member in question on the placement support, wherein the attachment means of the edges of the cutter members define a circumscribed circle of equal diameter, wherein the placement support preferably is provided with confiners that engage axially and radially externally along or outside over the attachment means.

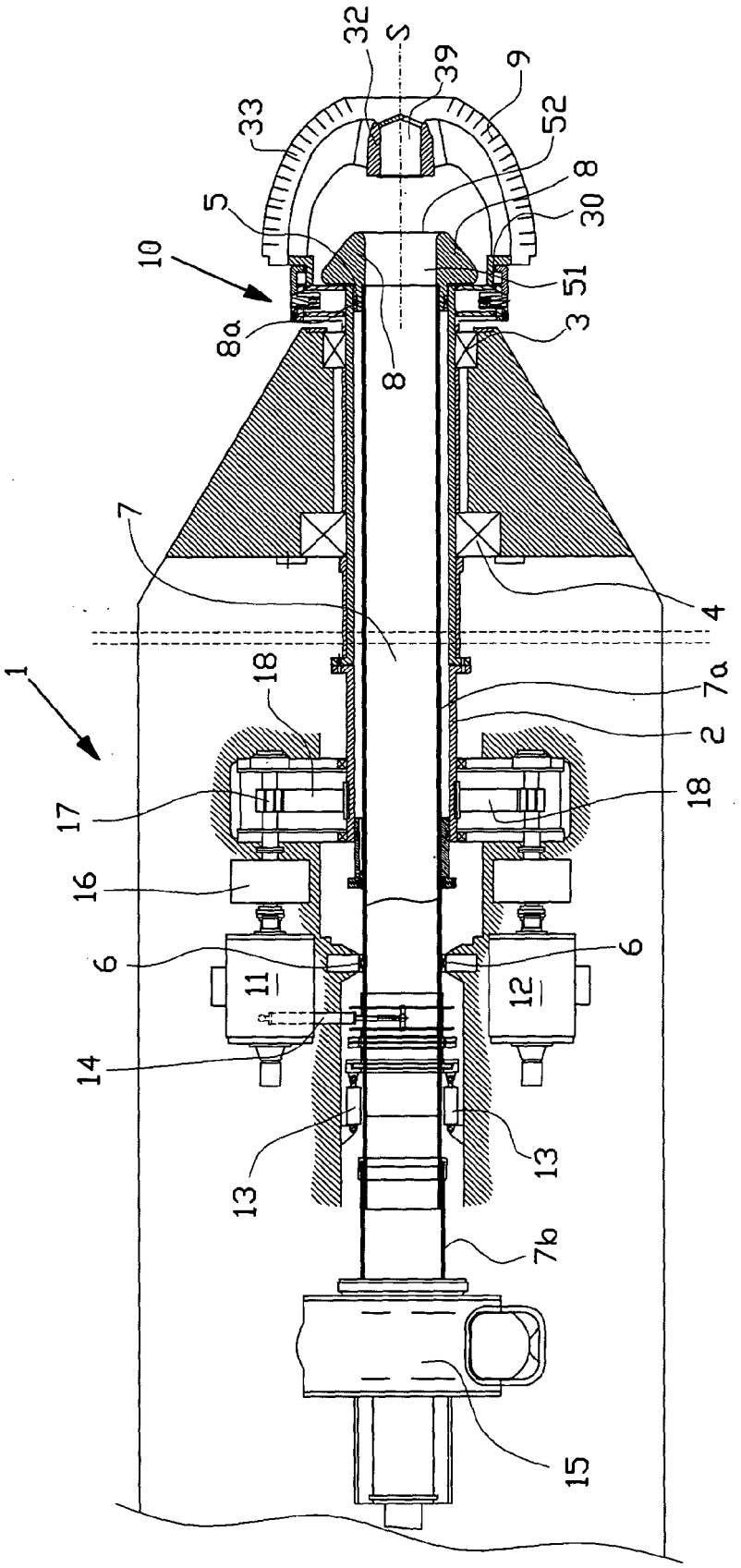
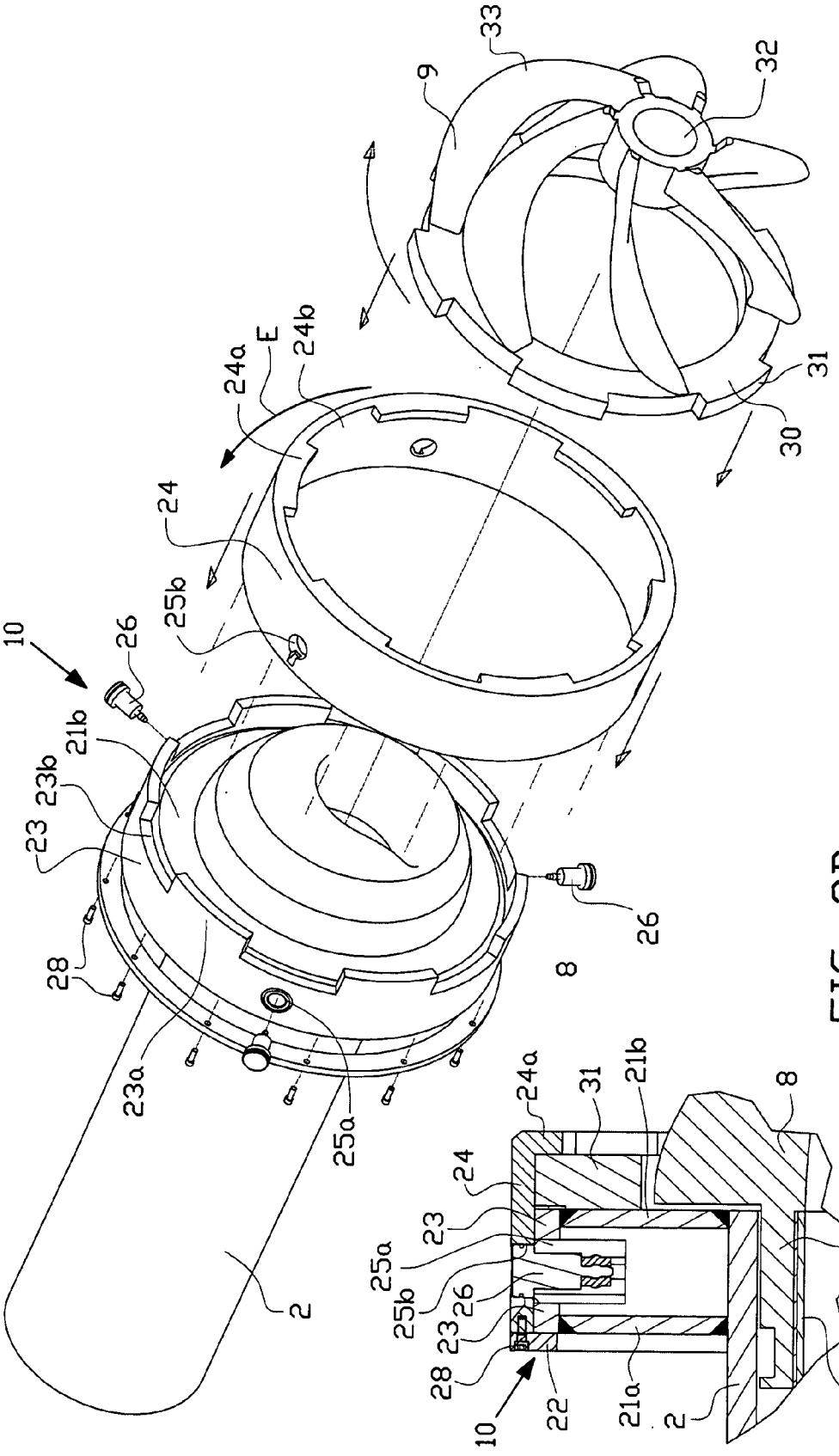

32
S
39
9
33
52
8
5
30
10
51
3
8a
8
7
4
1
18
7a
2
17
18
16
6
6
11
12
14
13
13
7b
15

FIG. 1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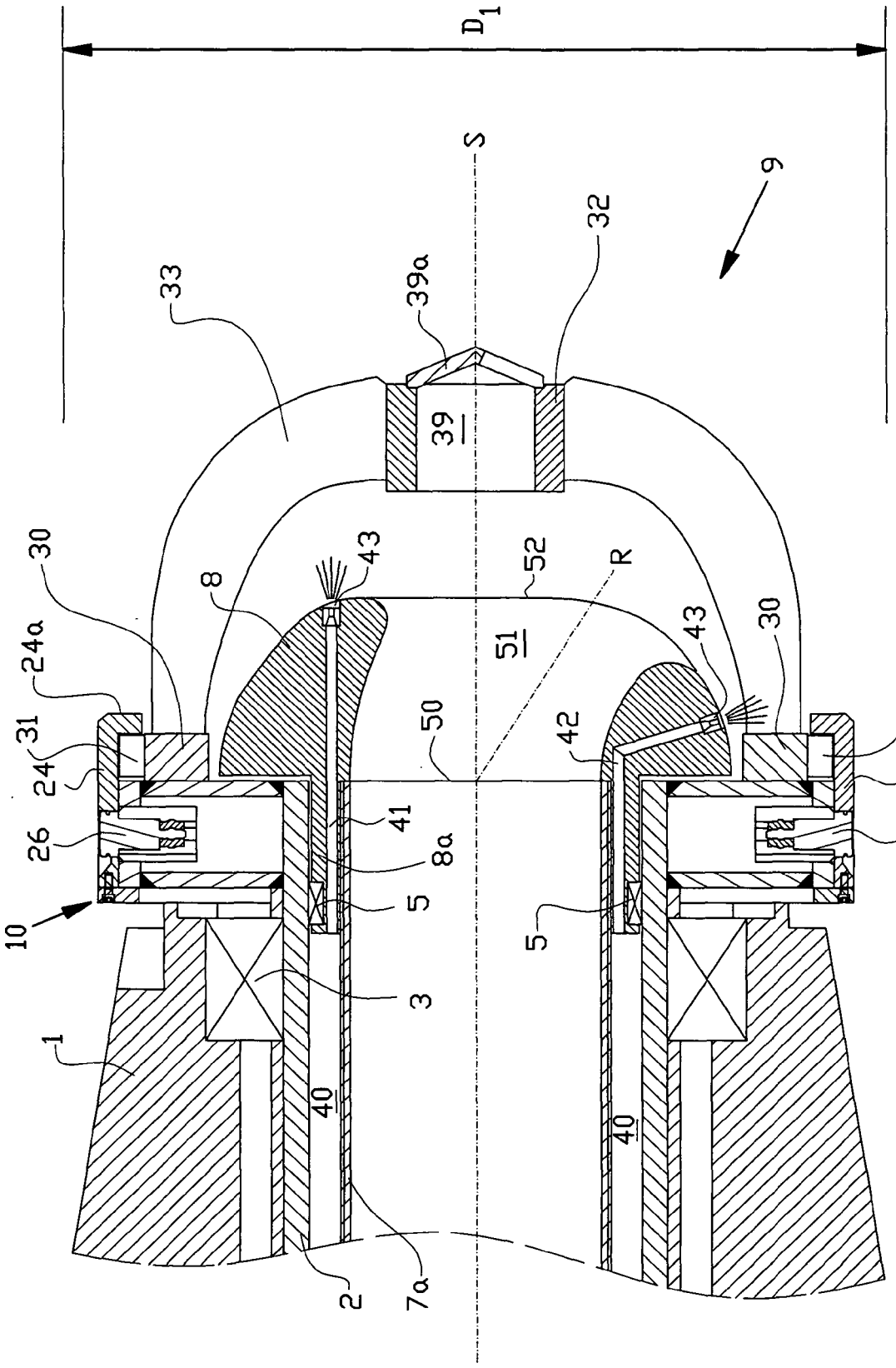
9
32
24a
E
24b
31
30
24
25b
10
26
21b
23b
23
28
23a
25a
2
8
26

FIG. 2A

24a
31
21b
8
24
23
8a
25a
25b
26
23
28
22
21a
2
10
7

FIG. 2B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9
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33
39a
39
30
43
8
52
R
24a
51
43
30
31
24
50
42
31
24
41
26
8a
26
5
10
5
3
1
40
40
2
7a

FIG. 2C

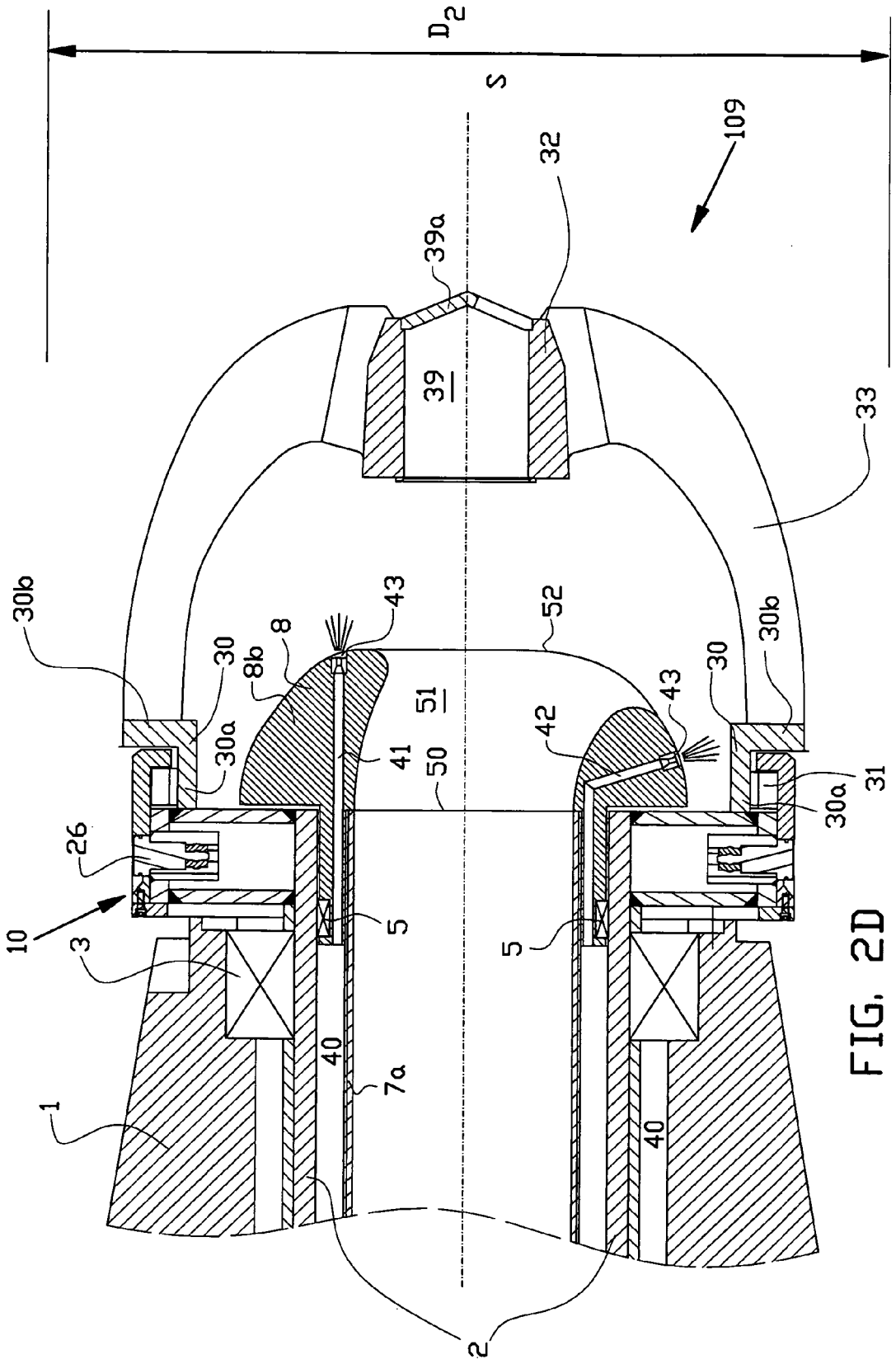
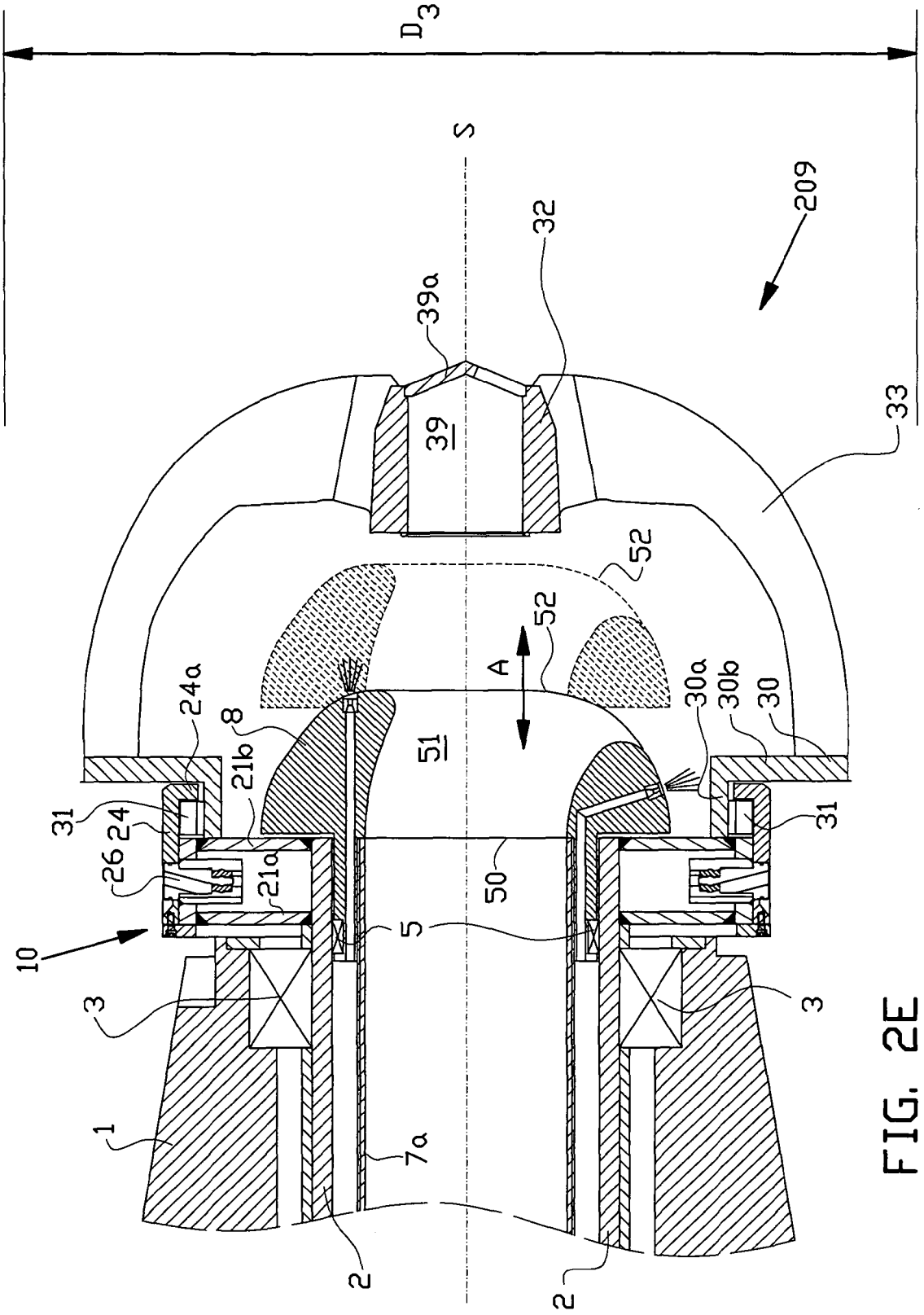

D2
S
109
32
39a
39
33
30b
30
8b
8
43
52
51
41
50
42
43
30
30b
30a
31
26
10
3
5
5
40
7a
40
1
2

FIG. 2D


D3
S
209
32
39a
39
33
52
52
A
24a
8
51
30a
30b
30
21b
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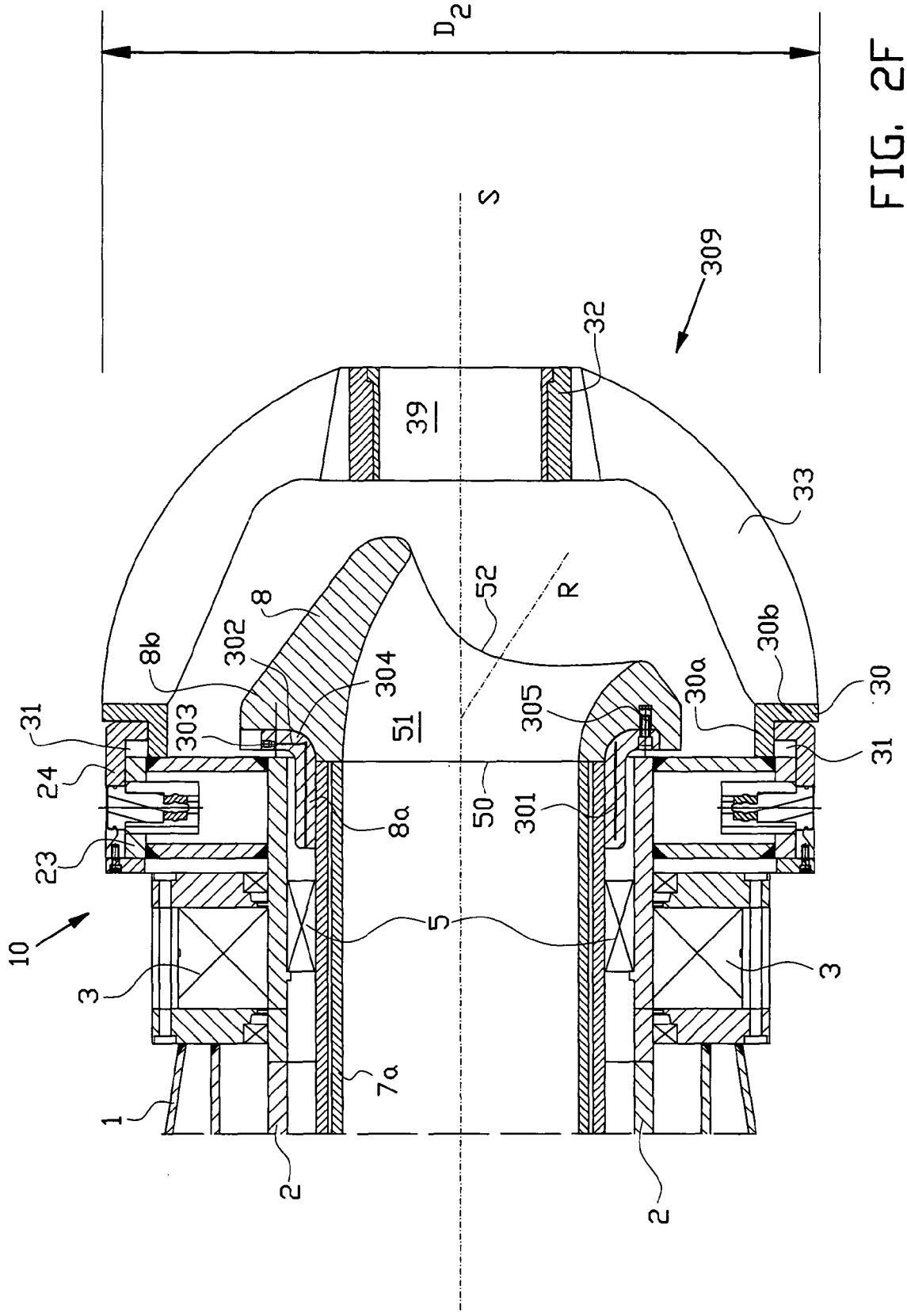
24
26
21a
50
31
10
5
3
3
1
7a
2
2

FIG. 2E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S
309
32
39
33
52
R
8b
302
8
304
30b
30a
30
305
303
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31
24
23
10
3
5
8a
50
301
7a
1
2

FIG. 2F

FIG. 2G

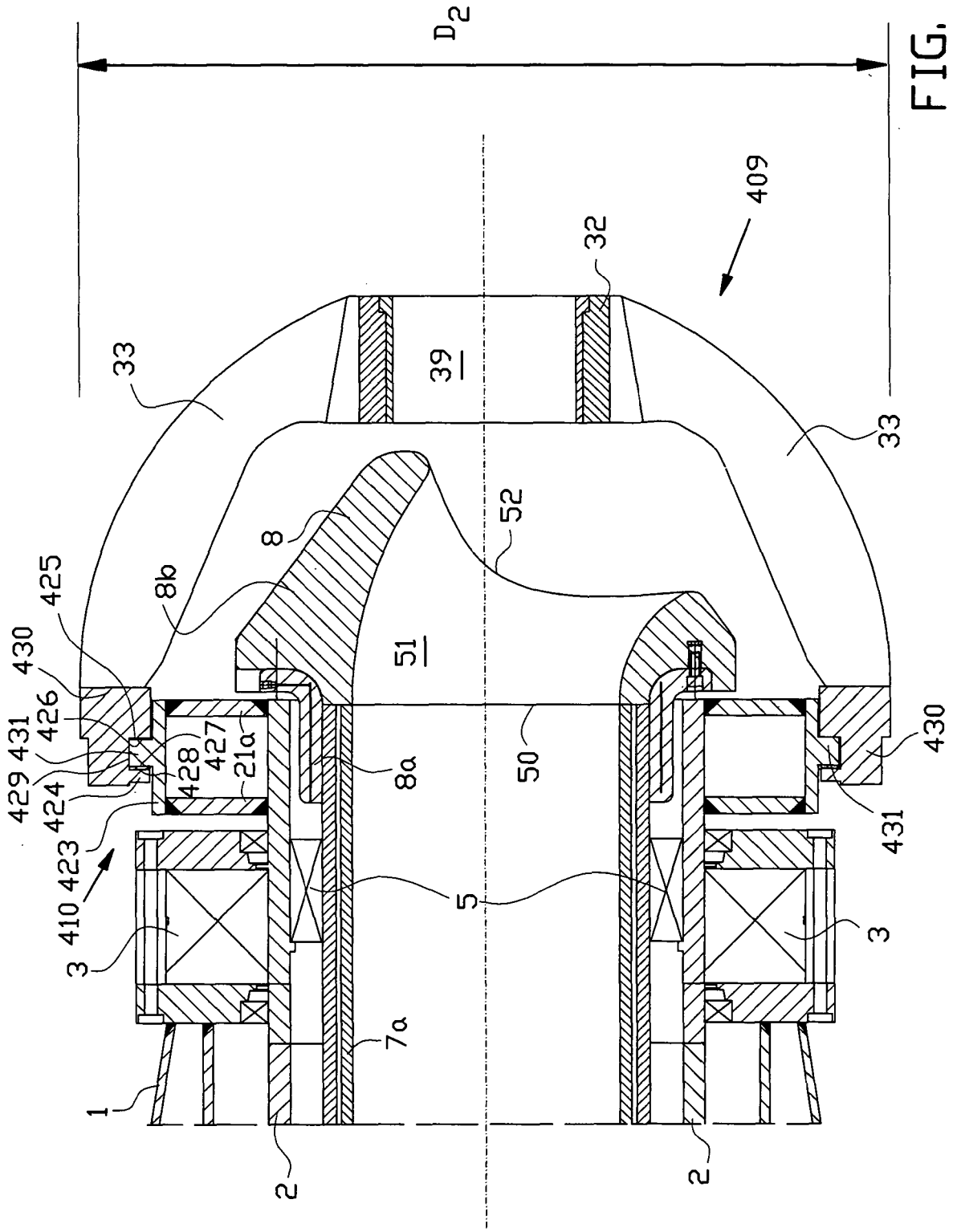
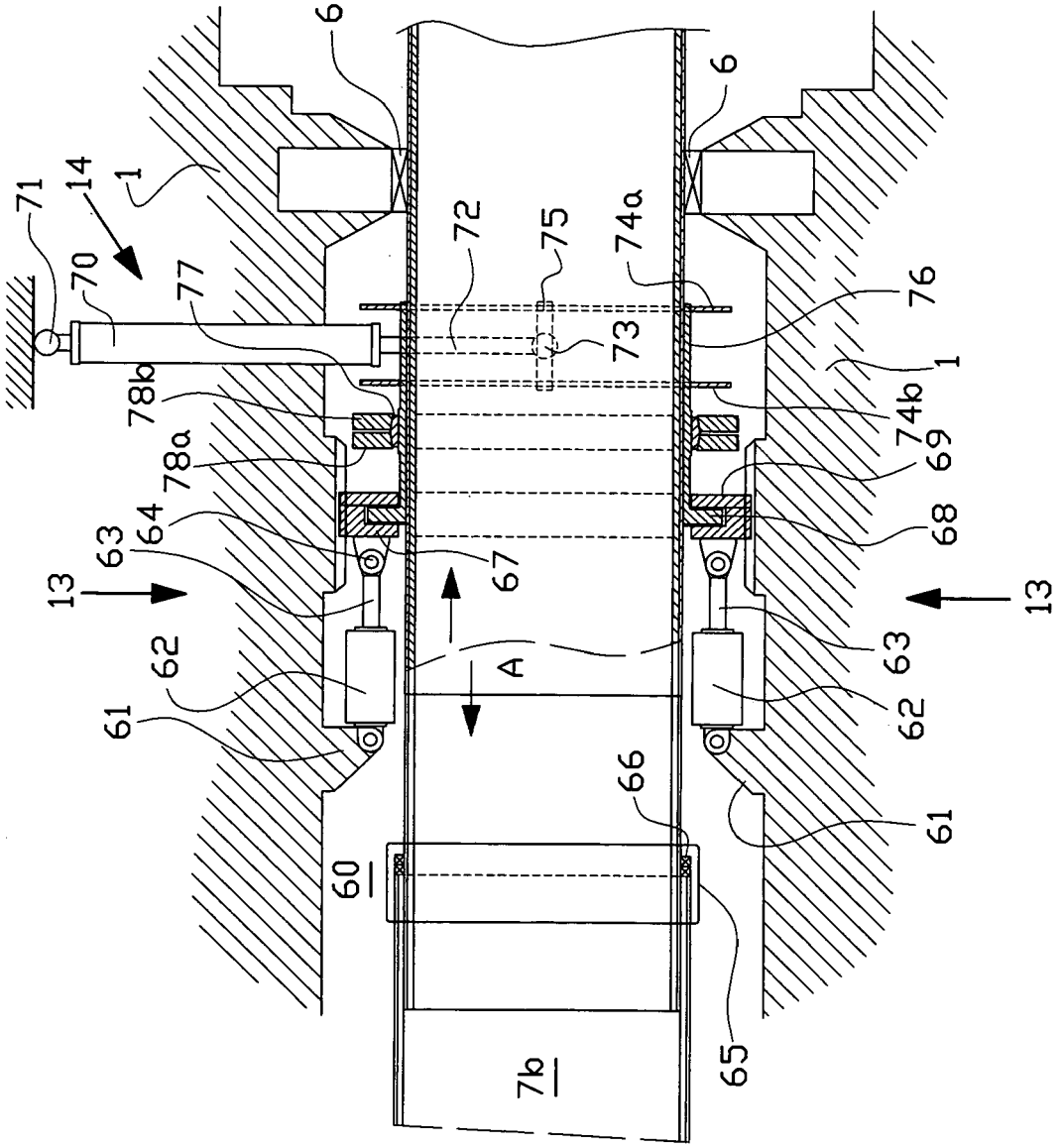

D2
409
32
33
39
33
8
52
8b
425
430
426
431
429
424
423
410
427
428
21a
51
8a
50
430
431
5
3
3
7a
1
2
2

FIG. 3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14
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77
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74a
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73
1
78b
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78a
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A
63
61
62
66
61
60
65
7b

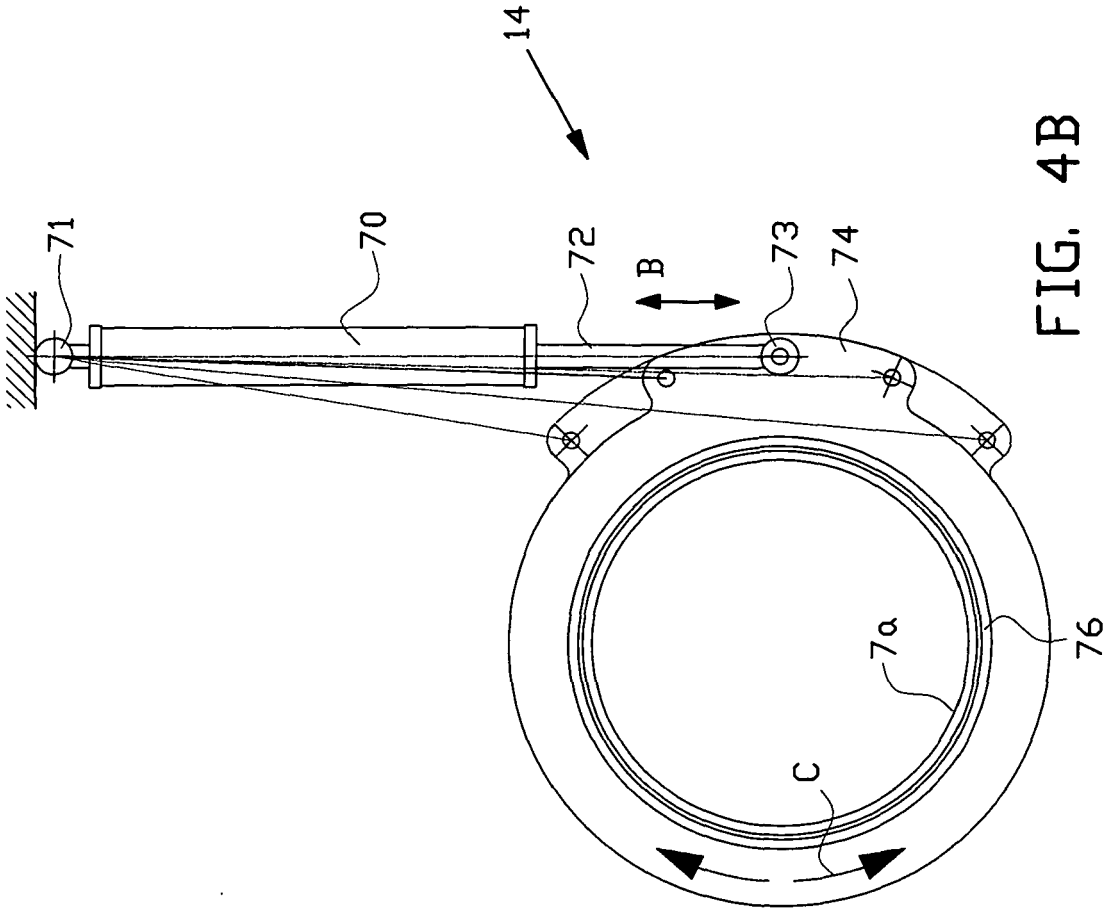

FIG. 4B

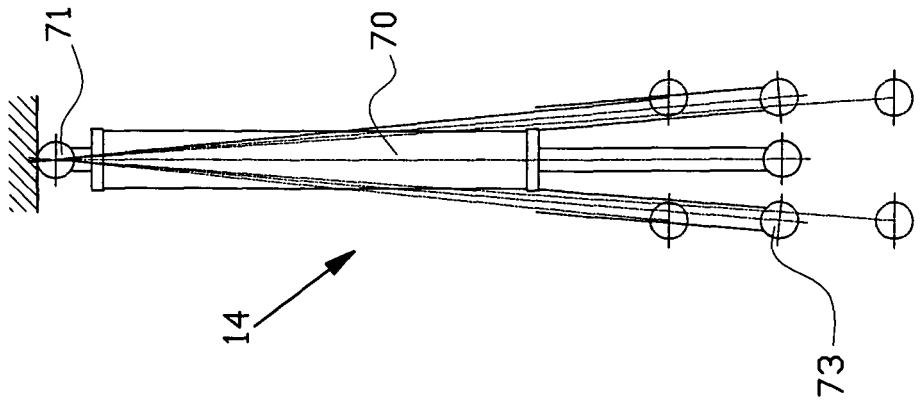

FIG. 4A

FIG. 5