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(54) **IMPROVEMENTS IN AN UNLOADING PUMP WHICH IS SUBMERSIBLE IN THE CARGO OF A SHIP'S CARGO TANK**

IN DER LADUNG EINES SCHIFFSLADERAUMES EINTAUCHBARE ENTLADEPUMPE

AMELIORATIONS APPORTEES A UNE POMPE DE DECHARGEMENT SUBMERSIBLE DANS LA CARGAISON D'UNE CITERNE A CARGAISONS D'UN BATEAU

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(56) References cited:
NO-B- 178 244 **US-A- 3 904 306**

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Description

[0001] The present invention relates to an unloading pump arrangement, which is suitable for submersion in the cargo of a ship's cargo tank and which has a pump inlet which is suitable for arrangement in or by a well at the bottom of the tank, where the pump arrangement comprises a main pump and an auxiliary pump which is drive connected through a vertical axis with impeller of the main pump and which has a lower inlet end which is suitable for arrangement at a level between the bottom of the well and the under side of the blades of the impeller and an upper discharge end at a level above the under side of the blades of the main pump, and where the unloading pump a discharge pipe which is suitable for discharging cargo at a delivery location via deck of the ship.

[0002] By means of an unloading pump submerged in the cargo it is possible to unload cargo in a controlled manner by stepless capacity control in all manner of types of cargo (fluid). It is possible, especially in relatively small ships, to employ pump arrangements where the pump is connected to the drive motor via a relatively long shaft, so that the drive motor for example can be placed on deck, while remaining parts of the pump arrangement can be submerged in the cargo. In other instances, and especially in relatively large ships, there is employed for practical reasons an unloading pump in the form of an elongate, means of separate suction arrangements having separate drive means, but this requires extra piping, extra drive medium and extra cleaning of the associated additional equipment, something which creates extra complications. In practice such suction arrangements are placed on the outer side of the pump arrangement, as a separate unit, but can also be arranged, as in NO Patent 300 964, internally in the pump arrangement.

[0003] Alternatively there have been employed in practice so-called stripping arrangements for collecting such residues of cargo, that is to say stripping arrangements, which operate together with and partially independently of the unloading pump. With such stripping arrangements it has been possible, with an emptied loading tank, to undertake cleaning in a controlled accurate and effective manner, together with cleaning of the unloading pump itself. By means of such stripping arrangements it has been usual - while the impeller of the unloading pump is kept in operation with a certain pump pressure against the residual cargo in the pump - with an extra supplied counterpressure, produced by compressed air or compressed gas, to blow the residues of the cargo from the pump pipe via a connected stripping conduit to a suitable delivery location via the deck of the ship.

[0004] In NO Patent 178 244 it is proposed to suck inwardly into the pump the largest possible quantity of the cargo residue which otherwise is retained in the tank well, by arranging an extra pump (auxiliary pump) in

drive connection with the impeller of the main pump, but then placed a considerable distance forwards, that is to say upstream of the impeller of the main pump. With such a solution one has indeed been able to fetch up portions of the cargo residue from the tank well, but a considerable problem is however that the stripping equipment has produced at the same time an undesired reduced capacity of the unloading pump during remaining working conditions, that is to say during normal unloading operations. It can rigid pump arrangement, which is readily dismountable, that is to say *inter alia* easily immersible or hoistable relative to the well at the bottom of the cargo tank. Then there is employed a pump impeller which is driven by a motor via a short drive shaft, the pump impeller and the pump motor being adapted to be located just by the bottom of the ship's cargo tank, submerged in the cargo. In such a case the pump motor is preferably enclosed in a protective housing.

[0005] In a practical embodiment the inlet for the unloading pump is defined between the bottom of a well in the tank and the impeller of the unloading pump. The distance between the impeller of the unloading pump and the bottom of the well of the cargo tank is *inter alia* adapted according to the cross-sectional flow through the pump. Normally the unloading pump can empty cargo to a level substantially flush with the under side of the unloading pump. Consequently there remains behind a first residue of cargo in the well at the level below the impeller of the main pump. In addition there remains behind a second residue of cargo within the pump itself. The second cargo residue is emptied most often back to the well by a stopping of the unloading operation or the stripping operation. The portions of the cargo, which pass the unloading pump, can be removed in a known manner via the associated discharge pipe in the stripping operation.

[0006] In practice special problems are presented in getting emptied out the last residues of the cargo, which are collected in the well of the tank, that is to say in the region between the under side of the unloading pump and the bottom of the tank well, in the concluded unloading operation. As is shown for example in NO Patent 174 460 separate suction arrangements have hitherto been employed for collecting up such residues of cargo, that is to say special suction arrangements, which operate independently of the unloading pump itself. Consequently it is possible to suck up the residues by be a question of a reduction of a couple of per cent of the usual unloading capacity. In order to avoid this problem the distance between the bottom of the tank well and the inlet of the unloading pump has had to be increased and the effect of the solution has therefore not been satisfactory for all purposes.

[0007] Furthermore various proposals are known for feeding extra pump medium via an extra pump to the impeller of the main pump. More specifically it is proposed to locate a feeding pump upstream of the impeller

of the main pump, which induces an extra flow of pump medium to the impeller of the main pump. Such known proposals are evident from DE 1 045 237, DE 2 037 785, DE 2 545 736, US 3 304 877 and US 3 588 280. In all the said publications the flow of pump medium first passes the feeding pump and immediately thereafter the impeller of the main pump in a continuous course in a coherent flow path. The placement and the design of the said feeding pumps cause however an interruption in the passage of the pump with a significant reduction of the unloading capacity of the pump as the end result.

[0008] The aim of the present invention is to ensure the largest possible removal of the residues of cargo from the bottom of the tank including feeding of such residues in the impeller of the main pump. This is sought to be solved by a favourable design of the auxiliary pump.

[0009] According to NO 178 244 an auxiliary pump is known which is formed of a substantially cylindrical casing portion, which is supported via a middle anchor pin which is fastened to the under side of the impeller of the main pump. The casing portion is carried on the anchor pin via one or more supporting ribs, which maintain the casing portion on the anchor pin and which can form lifting blades of the auxiliary pump.

[0010] Substantially the same flow through cross-section is employed at the upper end of the main pump as at its lower end.

[0011] According to US 3 904 306 an auxiliary pump is known which is formed of a double-conical bell portion, that is to say with a lower skirt portion, which extends conically upwards converging from its lower portion towards the middle of the bell portion, and an upper portion, which extends conically upwards diverging from the middle of the bell portion obliquely upwards and outwards in the flow through passage in the impeller of the main pump. In this instance the bell portion is carried via sideways directed support ribs in a common hub fastened to the under side of the main impeller. In this case also the support ribs can form blades of the auxiliary pump.

[0012] With the present invention the aim inter alia is to be to design the auxiliary pump in a constructionally and operatively simpler, and more effective manner. More specifically the aim is to adjust the conditions, so that the largest possible quantity of the cargo residues can be removed, which had to be retained in the pump arrangement after the concluded usual unloading operation, in a flow favourable manner.

[0013] This is solved according to the invention in that the auxiliary pump which has the form of a part conical sleeve portion or bell portion provided with an internal flow passage, has the maximum radial internal and external dimensions at the discharge end of the auxiliary pump and the minimum radial internal and external dimensions at the lower inlet end of the auxiliary pump, and the auxiliary pump at the discharge end thereof has a discharge chamber communicating with the impeller

of the main pump through discharge openings, which empty directly out from the periphery of the discharge chamber at the height of the flow-through passage and being arranged between a conical internal guide surface and a conical external guide surface of said sleeve formed auxiliary pump.

[0014] With the afore-mentioned solution an extra pumping effect can be obtained with the auxiliary pump without reducing the pumping effect of the main pump. A first significant result is that the auxiliary pump can be active in the whole pumping phase, that is to say both in the unloading phase and in the concluding stripping phase, without damaging effects on the normal unloading operation. More specifically, by means of the part conical sleeve portion of the auxiliary pump and the upper discharge chamber defined thereby, there can be ensured in a controlled manner an effective flow of pump medium to the upper portion of the discharge chamber with the possibility of uniform emptying from the discharge chamber to the flow-through passage in the impeller of the main pump. In this connection it is important that an active guide face is obtained for the pump medium both on the upwardly diverging, conical inner side of the sleeve portion and on the upwardly diverging, conical outer side of the sleeve portion. It is correspondingly important to arrange the sleeve portion with a restricted inlet in the centre of the rotation zone of the pump medium and with equivalent outlet passages to the flow-through passages of the main pump, at the same time as the conically upwardly diverging discharge chamber gives the possibility for effective outflow of pump medium via outlet passages arranged at the radially outermost peripheral portion of the auxiliary pump. By means of the portion of the pump medium, which flows on the outer side of the sleeve portion, a hand can be lent during the normal unloading operation with bringing the pump medium in the intended rotating flow path now in front of the inlet to the main pump. In addition by said rotating flow path an equivalent rotating flow path can be ensured branched off inwardly into and further upwardly through the sleeve portion along its inner side.

[0015] It will also be possible to continue the course of the said part-flows in a coinciding manner in a common flow path through the main pump. In this connection one or more outlets from the auxiliary pump can empty out into a region, which is defined by the pump space of the main pump and a region just downstream of said pump space.

[0016] It is aimed to be able to conduct the flow of pressure medium from outlet(s) of the auxiliary pump directly into the flow path of the flow of medium through the pump space of the main pump.

[0017] In practice the outlets from the auxiliary pump empty out into the pump space of the main pump just downstream of the inlets to the impeller of the main pump, that is to say at the level of or above the radially inner portion of the impeller blades of the main pump in a lower portion of the impeller of the main pump.

[0018] Practical trials have shown that a surprisingly good result is achieved with the pump arrangement according to the invention, having an especially simple design of the auxiliary pump, by means equivalent inner and outer outwardly and upwardly diverging guide faces in the sleeve portion of the auxiliary pump.

[0019] This good result is obtained by relatively smooth and uniform guide faces in the sleeve portion itself without special projections. Particularly favourable conditions are obtained by designing the sleeve portion with uniformly deflected guide faces, which extend curved from below from an essentially vertical path to a more or less radially outwardly directed path above.

[0020] Without significantly influencing the course of the flow via the main impeller of the pump and without reducing the capacity and efficiency of the unloading pump, there is achieved according to the invention an increased suction effect via the auxiliary pump towards the cargo residue in the tank well and. in addition it is made possible to ensure an effective sucking up and removal of the cargo residue which necessarily finds itself in the unloading pump and its cargo discharge pipe.

[0021] According to the invention it is preferred that the auxiliary pump is formed from a sleeve of relatively thin-walled material diverging from below obliquely upwards and outwards, and that the sleeve is secured via its upper peripheral edge portion at a guide portion in the impeller of the main pump, the outlet openings being designed just by, that is to say immediately below the fastening of the sleeve to the impeller of the main pump.

[0022] By means of a constructionally simple, separately produced sleeve of thin-walled material, the sleeve can be fastened according to the invention by simple means, such as a welding operation, to the impeller of the main pump in a ready manner.

[0023] Further features will be evident from the following description having regard to the accompanying drawings, in which:

[0024] Fig. 1 shows a schematic cross-section of a tanker equipped with the pump arrangement according to the invention.

[0025] Fig. 2 shows schematically the pump arrangement according to Fig. 1 illustrated in side view and in segment.

[0026] Fig. 3 shows, in a segment of Fig. 2, a vertical section of a lower portion of the pump arrangement according to a first embodiment.

[0027] Fig. 4 shows a plan view of the impeller of the main pump of the pump arrangement together with in part the discharges from the auxiliary pump to the main pump.

[0028] Fig. 5 shows in segment the auxiliary pump illustrated as a separate unit segregated from the main pump according to a second embodiment.

[0029] Fig. 6 shows in segment a vertical section of the impeller of the main pump and an associated auxiliary pump according to a third embodiment.

[0030] By way of introduction there will be described

with reference to Figures 1,2 and 3, plus parts of Fig. 4, known components which for a part of a pump arrangement according to the invention.

[0031] In Fig. 1 an unloading tank 10a in a tanker 10 is shown, where bottom 11 of the tanker 10 is illustrated, which is provided with a locally defined tank well 12. In the tank well 12 a lower end of an unloading pump is submerged, that is to say an inlet end 13 to a pump arrangement 14. The pump arrangement 14 is adapted to operate submerged in the cargo in the tank 10a in a relatively free downwardly hanging condition, with local, centering side support not shown further arranged at suitable height levels in the cargo tank, for example along the one tank wall.

[0032] The tank well 12 is, as clearly shown in fig. 2, given an optimal design with respect to the collection and flow of cargo to the unloading pump and is in this connection given a concavely rounded form.

[0033] The pump arrangement 14 according to the present invention is of a corresponding submersible type and has corresponding sealing and a corresponding mode of operation to that which is shown and described in NO 123 115.

[0034] In Fig. 2 there is shown a pump structure comprising a pump impeller 15, which is received in a snail house-like pump housing 16. During mounting and dismounting the pump housing 16 is freely axially moveable relative to the well 12 and is centered relative to this by means of a combined support/control ring and spurt screen 16a, which is fastened with paws 16b to the bottom 11 of the tank 10a in or by the tank well 12. At 16c (Fig. 3) there is shown an inverted funnel-shaped guide shield fastened to the pump housing 16 just below the lower edge 15a of the impeller 15. The impeller 15 is driven via a short drive shaft 17 by a drive motor, for example such as shown in NO 123 115, submerged in the cargo.

[0035] From two diametrically opposite sides of the pump housing 16 a respective branch pipe 25a converges, of which only the one is shown herein, upwardly towards a transition portion 26a to a common cargo discharge pipe 26. The discharge pipe 26 and protective pipe 23 of the hydraulic supply and discharge conduits extend in parallel upwards and pass individually through a cover 10b on a hatchway 10c on the deck of the ship. The discharge pipe 26 extends further to a suitable discharge location, as shown by an arrow C just above deck 10d of the ship.

Stripping operation known per se

[0036] After terminating the normal unloading operation the residue of cargo, which remains behind in the discharge pipe 26 and the branch pipes 25a and in the pump housing 16, and the residue of cargo, which remains behind in the tank well 12, are removed by means of a stripping operation, in which the pump impeller 15 continues to be kept working. One can continue hereby

without a break from the normal unloading operation to the subsequent stripping operation, without delay.

[0037] According to the invention importance is attached on being able to conduct normal unloading operations under optimum conditions and having to adapt the remaining, subsequent functions according to existing unloading equipment. The stripping operation is consequently undertaken in a manner which is adapted according to the equipment and the arrangement, which is used in the preceding unloading operation.

[0038] In Fig. 1 and 2 a stripping pipe 28 is shown, which has an intake opening 29 connected to a discharge pipe 26 at the transition portion 26a. In the illustrated embodiment the opening 29 is connected to the transition portion 26a, that is to say connected downstream of the adjacent discharge branch conduits 25a. By means of the stripping pipe 28 the cargo residue in the discharge pipe 26 and at least parts of the discharge branch conduits 25a can be emptied.

[0039] In a typical cargo tank of a ship the pump arrangement has a height from the bottom 11 of the tank 10a to just above the hatch cover on the deck 10d of the tank 10a, of 25 - 30 metres, while the remaining unloading equipment at the unloading location requires an additional lifting height of the order of magnitude of 10 metres. With submersible pump arrangements of known construction it is usual, that at pump pressures of said order of magnitude a significant out flow (leakage) of pump medium takes place via upper and lower fissures in the pump housing 16 of the pump arrangement between the impeller 15 and certain sealing arrangements in the pump housing 16.

[0040] The afore-mentioned stripping operation removes in practice the major portion of the cargo, which has reached into the discharge pipe, but hitherto it has been difficult to get rid of the last residues of cargo in the well 12 and that portion, which is still to be found in the lower branch pipe 25a of the discharge system and in the pump housing 16, as a result of static pressure from such cargo residues.

[0041] In the following there will be described the solution according to the present invention, at the same time as consideration is given to the desire for optimal working conditions in the normal unloading operation.

[0042] The embodiment, which is shown herein, is based on the principle known per se that an auxiliary pump is utilised in addition to the main pump.

The solution according to the invention

[0043] According to the present invention the known impeller 15 forms a part of the main pump 14a, while in the illustrated embodiment an auxiliary pump 30 forms one piece with the impeller 15, that is to say the main pump 14a and the auxiliary pump 30 constitute an integral member.

[0044] In Fig. 5 an auxiliary pump 30' is shown in the form of a separate member, comprising an impeller

member 31' and a cover member 32'. The auxiliary pump 30' is adapted to be able to be fastened to the impeller 15 of the main pump via fastening screws received in bores 33' correspondingly as shown to the left in Fig. 5.

[0045] Alternatively the auxiliary pump 30' can constitute an integral part of the impeller of the main pump.

[0046] The cover 32' is adapted to be clamped in place between impeller member 31' of the auxiliary pump 30' and impeller 15 of the main pump adapted for this. Alternatively the cover member 32' can be screwed in place or secured in another suitable manner to impeller member 31' of the auxiliary pump 30'.

[0047] For the sake of simplicity certain details are shown on a larger scale in the impeller member 31' according to Fig. 5, which correspond to the details in the impeller member 31 according to Fig. 3. In the following description therefore reference is made alternately to Fig. 3 and Fig. 5 for the sake of simplicity. Details which are corresponding in the two solutions are represented by the same reference numerals.

[0048] The auxiliary pump 30 (see Fig. 3 and 4) is especially effective in connection with the stripping phase according to the present invention, that is to say on stripping via the auxiliary pump 30, but is necessarily also active during the unloading operation itself.

[0049] In the embodiment illustrated in Fig. 3 the auxiliary pump 30 consists of an upwardly and outwardly diverging, sleeve-shaped or bell-shaped impeller member 31. The impeller member 31 projects, as shown in Fig. 2, with a lower inlet 35 a considerable length below lower edge 15a of the impeller 15 and an additional length below lower edge 16c' of the guide shield 16c, downwards towards the bottom of the tank well 12. If desired the inlet 35 can be localised so tightly above the bottom of the tank well 12 that the free inflow of the pump medium to the interior of the impeller 31 can be accurately ensured (such alternative localising is not shown further herein).

[0050] The impeller member 31' (see Fig. 5) has externally an upwardly and outwardly diverging guide face 36, which at a lower portion 36a extends approximately rectilinearly upwards at an oblique angle $\underline{u}$ and continues thereafter obliquely upwards and outwards with an upper curved portion 36b, which in turn continues in impeller 15 of the main pump 14a further radially outwards via a curved portion 15b (see Fig. 3) and a subsequent rectilinear portion 15c. The impeller member 31' (see fig. 5) has internally an equivalent upwardly and outwardly diverging guide face 37, which at a lower portion 37a extends approximately rectilinearly upwards at an oblique angle $\underline{v}$ and continues thereafter obliquely upwards and outwards with an upper curved portion 37b, which empties out into an upper circular outlet chamber 38.

[0051] The outlet chamber 38 is defined above by the cover 32' (see Fig. 5) or a terminating face 32 (see Fig. 3), while below it communicates with a relatively

smooth-walled flow-through chamber 39, which has an increasing cross-section from the inlet 35 towards the chamber 38. The inlet 35 is shown with a minimum diameter D1 (see Fig. 5), while the outlet chamber 38 is shown with a maximum diameter D2, where the maximum diameter D2 is at least one and a half times greater than the minimum diameter D1 and preferably, such as is shown in Fig. 3 and 5, twice as large as the minimum diameter D1.

[0052] In Fig. 4 seven outlet ducts 40 are shown, which empty radially outwards from the outlet chamber 38 to an adjacent equivalent seven mutually separated flow through ducts 41 of the impeller 15. In practice the number of outlet ducts 40 and the number of ducts 41 can be greater or smaller than seven, all according to need.

[0053] In Fig. 4 there is shown in section flow through ducts/openings 41, central axis 41a of which extends curved in a radial plane along the centre axis 40a of the outlet ducts/openings 40.

[0054] In the embodiment illustrated in Fig. 5 the outlet ducts 40 extend radially outwards in a vertical plane through coinciding central axis of chambers 38 and 39, that is to say at right angles to the peripheral wall of the chamber 38, and thereby at a considerable angle to guide blades 42 of the impeller 15 (see Fig. 4).

[0055] Alternatively the central axis 40a of the outlet ducts/openings 40 can extend in a vertical plane parallel to the centre line 39a of the chamber 39, that is to say at a significant oblique angle to the peripheral wall of the chamber 38 and thereby at a smaller oblique angle to - or more or less in a direction along - respective guide blades 42 (see Fig. 5) of the impeller 15. According to Fig. 5 axis 40a of the outlet ducts/openings 40 forms a vertical angle $\underline{u}$ with central line 41a of the ducts 41 and a vertical angle $\underline{v}$ with upper defining face 36c of the duct 41.

[0056] During consideration of Fig. 3 it is evident that by means of auxiliary pump 30 two separate flows A and B are obtained for the supply of cargo medium to the main pump in a conventional unloading sequence, namely a main flow A arranged radially outside the auxiliary pump 30 and an extra flow B arranged internally in the auxiliary pump 30. It is evident from Figs. 3 and 4 that the combined flow through the seven ducts/openings 40 constitutes a small fraction of the main stream A through the ducts 41. When the unloading operation, which is based on the main flow A, goes towards conclusion, the flow B can continue fully in that the inlet 35 of the auxiliary pump 30 is submerged in the cargo to a level below the lower edge 16c' of the screen 16c.

[0057] By means of the internal guide faces 37 diverging conically upwards several practical advantages are obtained.

[0058] As a consequence of the relatively uniform and smooth external and internal guide faces 36,37 of the auxiliary pump 30 diverging conically upwards, there can be created controlled, relatively calm movements of

the cargo externally on the auxiliary pump and internally in the passage 39 and particularly in and by the lower inlet 35 of the auxiliary pump 30.

[0059] As a consequence of the cross-section increasing upwardly relatively uniformly in combination with the upper, radially directed outlet ducts/openings 40, there is achieved firstly a generally favourable suction effect or pumping effect internally in the duct 39. In combination with the above-mentioned suction effect there is obtained an additional suction effect, namely that which is exerted towards the chamber 38 via the ducts/openings 40 from the flow through passages 41 by means of the impeller 15 of the main pump 14a. The design of the duct/the chamber 39, such as shown in Fig. 3, having a gradually increasing cross-section in the flow direction B gives in itself a pumping effect internally in the impeller 30. In addition said cross-sectional increase provides a tendency for an accumulation of pump medium in the chamber 38 just in front of the outlet ducts 40, so that the external suction effect from the ducts 41 towards the ducts 40 can be utilised in an effective manner internally in the impeller 30. It is considered as an advantage that the portions of the pump medium which are introduced into the duct/chamber 39 can be kept in place relatively stable within the impeller independently of possible variations in the flow of pump medium to the inlet 35 of the impeller 30.

[0060] In practice it has been found that even small changes of the flow path of the cargo through the impeller 15 can act negatively on the wish for an optimally adjusted unloading operation.

[0061] Further it has been found in practical trials that the application of an extra pump arrangement, can provide an effective collecting up of residues of the cargo from the tank well 12 especially when these cargo residues are picked up by the usual guide blades 42 of the main impeller 15.

[0062] Alternatively to the construction according to Fig. 5 the ducts 40 can, if desired, be milled ("utfrese") or remoulded ("utstøpe") partly in the impeller 30' and partly in a cover which covers the auxiliary pump 30' at a level above the chamber 38. In such a case the cover member and the impeller member are fastened effectively together in a mutually non-rotatable manner, for example by means of fastening bolts and/or guide pins.

[0063] Without examples of it being shown herein the use can also be considered of a separate insert member, which is arranged axially displaceable internally in the auxiliary pump 30 and which is movable a limited axial length internally in the auxiliary pump 30. The insert member can initially project radially below the inlet 35 and for example by means of a spring force be pressed downwards to a level just above the bottom of the tank well. By arranging sideways directed intake openings in the insert member the insert member can if necessary be arranged rather tightly up to the bottom of the tank well.

[0064] In a third embodiment, as illustrated in Fig. 6,

an auxiliary pump 30" is shown of corresponding external contour to that which is shown in Figs. 3 and 5, but with a somewhat differing wall thickness and somewhat differing internal contour. The auxiliary pump 30" is made of a plane steel plate, which is pressed to the part-conical contour illustrated, so that a part-conical sleeve is formed of essentially uniform wall thickness. In the finally fashioned sleeve, such as shown in Fig. 6, a number (for example six or seven) flow-through openings 40" (of which only two are shown in Fig. 6) are drilled in an obliquely upwardly and outwardly directed direction. Provision is made for the upper edge portion 40a" of the bores to be flush with an internal guide face 36a" on impeller 15 of the main pump. More specifically the upper peripheral edge portion 30a" of the sleeve, that is to say the peripheral edge portion just above the openings 40", is fixed inserted into and fast welded to an annular cavity 36" in an external guide face 36b" on impeller 15 of the main pump.

[0065] The auxiliary pump 30", which is in the form of said sleeve, is shown in Fig. 6 in a permanently integrated condition in impeller 15 of the main pump. A cup-shaped portion 15" known per se on the impeller 15 projects a distance downwardly into the sleeve or the auxiliary pump 30" and forms internal guide means in the upper half of the passage 39 and defines an upper chamber 38, which has a decreasing cross-section heightwise in the same.

Claims

1. An unloading pump arrangement, which is suitable for submersion in the cargo of a ship's cargo tank (10a) and which has a pump inlet (13) which is suitable for arrangement in or by a well (12) at the bottom (11) of the tank (10), where the pump arrangement (14) comprises a main pump (14a) and an auxiliary pump (30,30',30") which is drive connected through a vertical axis with impeller (15) of the main pump (14a) and which has a lower inlet end (35) which is suitable for arrangement at a level between the bottom of the well (12) and the under side of the blades (15c) of the impeller (15) and an upper discharge end at a level above the under side of the blades (15c) of the main pump (14a), and where the unloading pump a discharge pipe (26) which is suitable for discharging cargo at a delivery location via deck (10d) of the ship,

characterised in that auxiliary pump (30,30',30") which has the form of a part conical sleeve portion or bell portion, provided with an internal flow passage (39), has the maximum radial internal and external dimensions at the discharge end of the auxiliary pump (30,30',30") and the minimum radial internal and external dimensions at the lower inlet end (35) of the auxiliary pump (30,30',30"), and the auxiliary pump (30,30',30") at the dis-

charge end thereof has a discharge chamber (38) communicating with the impeller (15) of the main pump (14a) through discharge openings (40,40"), which empty directly out from the periphery of the discharge chamber (38) at the height of the flow-through passage (41) of the main pump and being arranged between a conical internal guide surface and a conical external guide surface of said sleeve formed auxiliary pump.

2. Arrangement in accordance with claim 1, characterised in that the internal flow passage (39) of the auxiliary pump (30, 30', 30") has an increasing cross-sectional area between the lower inlet (35) and the upper outlet (at 38), the ratio between diameter D2 at the outlet (at 38) and diameter D1 at the inlet being greater than 1, that is to say $D2/D1 > 1$.
3. Arrangement in accordance with claim 1 and 2, characterised in that the external guide face (36) of the auxiliary pump (30,30',30") has a flow-increasing peripheral dimension.
4. Arrangement in accordance with one of the claims 1-3, characterised in that the outlet openings (40,40") empty out into the flow-through duct (41) of the main impeller (15) at a level with blades (15c) of the main impeller (15).
5. Arrangement in accordance with one of the claims 1-4, characterised in that the auxiliary pump (30") is formed from a sleeve of relatively thin-walled material diverging from below obliquely upwards and outwards, and

that the sleeve is secured via its upper peripheral edge portion (30a") at a guide portion (36a",36b") in impeller (15) of the main pump, the outlet openings (40") being formed just by, that is to say immediately below the fastening of the sleeve to the impeller (15) of the main pump.

6. Arrangement in accordance with claim 5, characterised in that the upper peripheral edge portion (30a") of the sleeve is received in an annular cavity (36") in an inner guide portion (36a",36b") curved obliquely upwards and outwards in the impeller (15) of the main pump,

the peripheral edge portion (30a") being flush with an upper, inner guide portion (36a") in the impeller (15) of the main pump.

7. Arrangement in accordance with claim 5 or 6, characterised in that outlet openings (40") of the sleeve have the radially outermost portion of the upper opening edge (40a") extending obliquely upwards

and outwards flush with the upper, inner guide portion (36a'') in the impeller (15) of the main pump and the radially innermost portion of the upper opening edge extending obliquely upwards and outwards flush with a lower, inner guide portion (36b'') in the impeller (15) of the main pump,

the outlet openings (40'') of the sleeve being preferably formed from obliquely upwardly and outwardly directed bores.

Patentansprüche

1. Entladepumpenanordnung, die zum Eintauchen in die Ladung eines Schiffsladetanks (10a) geeignet ist und die einen Pumpeneinlass (13) hat, der zur Anordnung in oder an einer Vertiefung (12) an dem Boden (11) des Tanks (10a) geeignet ist, wobei die Pumpenanordnung (14) eine Hauptpumpe (14a) und eine Hilfspumpe (30, 30', 30'') umfasst, die durch eine vertikale Achse mit einem Pumpenrad (15) der Hauptpumpe (14a) antriebsverbunden ist und die ein unteres Einlassende (35), das zur Anordnung auf einem Niveau zwischen dem Boden der Vertiefung (12) und der Unterseite der Schaufeln (15c) des Pumpenrads (15) geeignet ist, und ein oberes Auslassende auf einem Niveau oberhalb der Unterseite der Schaufeln (15c) der Hauptpumpe (14a) hat, und wobei die Entladepumpe ein Auslassrohr (26) aufweist, das zum Entlassen von Ladung über das Schiffsdeck (10d) an einem Abgabort geeignet ist,
dadurch gekennzeichnet,

dass die Hilfspumpe (30, 30', 30''), die die Form eines mit einer inneren Strömungspassage (39) versehenen teilweise konischen Hülsenabschnitts oder Glockenabschnitts hat, maximale radiale innere und äußere Abmessungen an dem Auslassende der Hilfspumpe (30, 30', 30'') und minimale radiale innere und äußere Abmessungen an dem unteren Einlassende (35) der Hilfspumpe (30, 30', 30'') hat, und
dass die Hilfspumpe (30, 30', 30'') an ihrem Auslassende eine Auslasskammer (38) hat, die mit dem Pumpenrad (15) der Hauptpumpe (14a) durch Auslassöffnungen (40, 40'') kommuniziert, die sich direkt aus der Peripherie der Auslasskammer (38) heraus auf Höhe einer Strömungsdurchgangspassage (41) der Hauptpumpe entleeren und zwischen einer konischen inneren Führungsfläche und einer konischen äußeren Führungsfläche der hülseförmigen Hilfspumpe angeordnet sind.

2. Anordnung nach Anspruch 1,
dadurch gekennzeichnet,
dass die innere Strömungspassage (39) der Hilfs-

pumpe (30, 30', 30'') einen Bereich mit ansteigenden Durchmesser zwischen dem unteren Einlass (35) und dem oberen Auslass (bei 38) hat, wobei das Verhältnis zwischen einem Durchmesser D2 an dem Auslass (bei 38) und einem Durchmesser D1 an dem Einlass größer als 1 ist, das heißt $D2/D1 > 1$ ist.

3. Anordnung nach Anspruch 1 und 2,
dadurch gekennzeichnet,
dass die äußere Führungsfläche (36) der Hilfspumpe (30, 30', 30'') eine strömungsvergrößernde Umfangsabmessung hat.

4. Anordnung nach einem der Ansprüche 1 - 3,
dadurch gekennzeichnet,
dass die Auslassöffnungen (40, 40'') sich in die Strömungsdurchgangsleitung (41) des Haupt-Pumpenrads (15) auf einem Niveau der Schaufeln (15c) des Haupt-Pumpenrads (15) entleeren.

5. Anordnung nach einem der Ansprüche 1 - 4,
dadurch gekennzeichnet,

dass die Hilfspumpe (30'') aus einer Hülse von relativ dünnwandigem Material gebildet ist, die von unten schräg nach oben und außen divergiert, und
dass die Hülse über ihren oberen Umfangsrandabschnitt (30a'') an einem Führungsabschnitt (36a'', 36b'') an dem Pumpenrad (15) der Hauptpumpe gesichert ist,

wobei die Auslassöffnungen (40'') genau an, d. h. unmittelbar unterhalb der Befestigung der Hülse an dem Pumpenrad (15) der Hauptpumpe ausgebildet sind.

6. Anordnung nach Anspruch 5,
dadurch gekennzeichnet,
dass der obere Umfangsrandabschnitt (30a'') der Hülse in einem Ringhohlraum (36'') in einem schräg nach oben und nach außen gekrümmten inneren Führungsabschnitt (36a'', 36b'') in dem Pumpenrad (15) der Hauptpumpe aufgenommen ist, wobei der Umfangsrandabschnitt (30a'') mit einem oberen inneren Führungsabschnitt (36a'') in dem Pumpenrad (15) der Hauptpumpe fluchtet.

7. Anordnung nach einem der Ansprüche 5 oder 6,
dadurch gekennzeichnet,
dass sich ein radial äußerer Abschnitt des oberen Öffnungsrandes (40a'') der Auslassöffnungen (40'') der Hülse schräg nach oben und nach außen, bündig abschneidend mit dem oberen inneren Führungsabschnitt (36a'') in dem Pumpenrad (15) der Hauptpumpe erstreckt und sich ein radial innerster Abschnitt des oberen Öffnungsrandes der Auslas-

söffnungen (40") der Hülse schräg nach oben und nach außen, bündig abschneidend mit einem unteren inneren Führungsabschnitt (36b") in dem Pumpenrad (15) der Hauptpumpe erstreckt, wobei die Auslassöffnungen (40") der Hülse vorzugsweise aus schräg nach oben und nach außen gerichteten Bohrungen gebildet sind.

Revendications

1. Ensemble à pompe de déchargement, qui peut être immergé dans le chargement d'une citerne (10a) de navire et qui a une entrée (13) de pompe qui peut être placée dans un puits (12) ou au niveau d'un puits placé au fond (11) de la citerne (10), dans lequel l'ensemble à pompe (14) comprend une pompe principale (14a) et une pompe auxiliaire (30, 30', 30") qui est raccordée pour être entraînée par l'intermédiaire d'un axe vertical par la roue (15) de la pompe principale (14a) et qui a une extrémité inférieure d'entrée (35) qui peut être placée à un niveau compris entre le fond du puits (12) et la face inférieure des ailettes (15c) de la roue (15) et une extrémité supérieure de refoulement à un niveau supérieur à la face inférieure des ailettes (15c) de la pompe principale (14a), et dans lequel la pompe de déchargement comporte un tube d'évacuation (26) qui convient à l'évacuation du chargement à un emplacement de distribution par l'intermédiaire du pont (10d) du navire,
caractérisé en ce que la pompe auxiliaire (30, 30', 30") qui a la forme d'une partie de cloche ou d'une partie de manchon tronconique, ayant un passage interne d'écoulement (39), a des dimensions radiales internes et externes maximales à l'extrémité de refoulement de la pompe auxiliaire (30, 30', 30") et des dimensions radiales internes et externes minimales à l'extrémité inférieure d'entrée (35) de la pompe auxiliaire (30, 30', 30"), et
la pompe auxiliaire (30, 30', 30") comporte, à son extrémité de refoulement, une chambre de refoulement (38) qui communique avec la roue (15) de la pompe principale (14a) par des ouvertures de refoulement (40, 40") qui débouchent directement à l'extérieur de la périphérie de la chambre de refoulement (38) à la hauteur du passage de circulation (41) de la pompe principale et sont placées entre une surface conique interne de guidage et une surface conique externe de guidage de la pompe auxiliaire en forme de manchon.
2. Ensemble selon la revendication 1, **caractérisé en ce que** le passage interne de circulation (39) de la pompe auxiliaire (30, 30', 30") a une section qui croît entre l'entrée inférieure (35) et la sortie supérieure (en 38), le rapport du diamètre D2 à la sortie (en 38) et du diamètre D1 à l'entrée étant supérieur

à 1, c'est-à-dire $D2/D1 > 1$.

3. Ensemble selon la revendication 1 et 2, **caractérisé en ce que** la face externe de guidage (36) de la pompe auxiliaire (30, 30', 30") a une dimension périphérique qui augmente le débit.
4. Ensemble selon l'une des revendications 1 à 3, **caractérisé en ce que** les ouvertures de sortie (40, 40") débouchent dans le conduit de circulation (41) de la roue principale (15) à un niveau correspondant aux ailettes (15c) de la roue principale (15).
5. Ensemble selon l'une des revendications 1 à 4, **caractérisé en ce que** la pompe auxiliaire (30") est formée d'un manchon d'un matériau à paroi relativement mince qui diverge depuis la partie inférieure obliquement vers le haut et vers l'extérieur, et
le manchon est fixé par sa partie de bord périphérique supérieur (30a") au niveau d'une partie de guidage (36a", 36b") dans la roue (15) de la pompe principale,
les ouvertures de sortie (40") étant formées juste au-dessous, c'est-à-dire immédiatement au-dessous de la fixation du manchon à la roue (15) de la pompe principale.
6. Ensemble selon la revendication 5, **caractérisé en ce que** la partie de bord périphérique supérieur (30a") du manchon est logée dans une cavité annulaire (36") dans une partie de guidage interne (36a", 36b") courbée obliquement vers le haut et vers l'extérieur dans la roue (15) de la pompe principale,
la partie de bord périphérique (30a") se trouvant au niveau d'une partie interne supérieure de guidage (36a") dans la roue (15) de la pompe principale.
7. Ensemble selon la revendication 5 ou 6, **caractérisé en ce que** des ouvertures de sortie (40") du manchon ont la partie radialement la plus externe du bord d'ouverture supérieur (40a") qui s'étend obliquement vers le haut et vers l'extérieur au niveau de la partie interne supérieure de guidage (36a") dans la roue (15) de la pompe principale et la partie radialement la plus interne du bord d'ouverture supérieur qui s'étend obliquement vers le haut et vers l'extérieur au niveau d'une partie interne inférieure de guidage (36b") dans la roue (15) de la pompe principale,
les ouvertures de sortie (40") du manchon étant de préférence formées depuis des trous dirigés obliquement vers le haut et vers l'extérieur.

FIG. 1

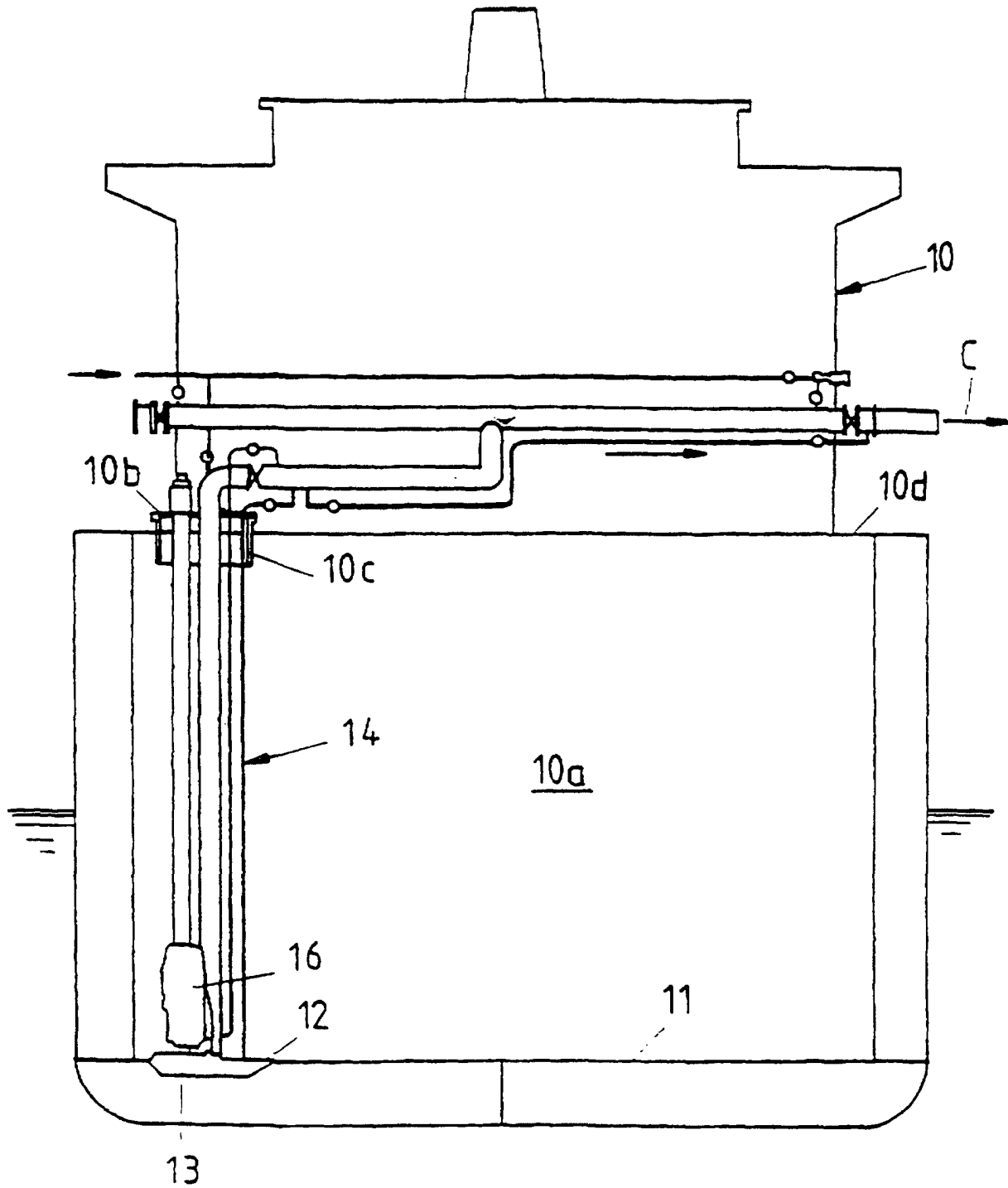


FIG. 2

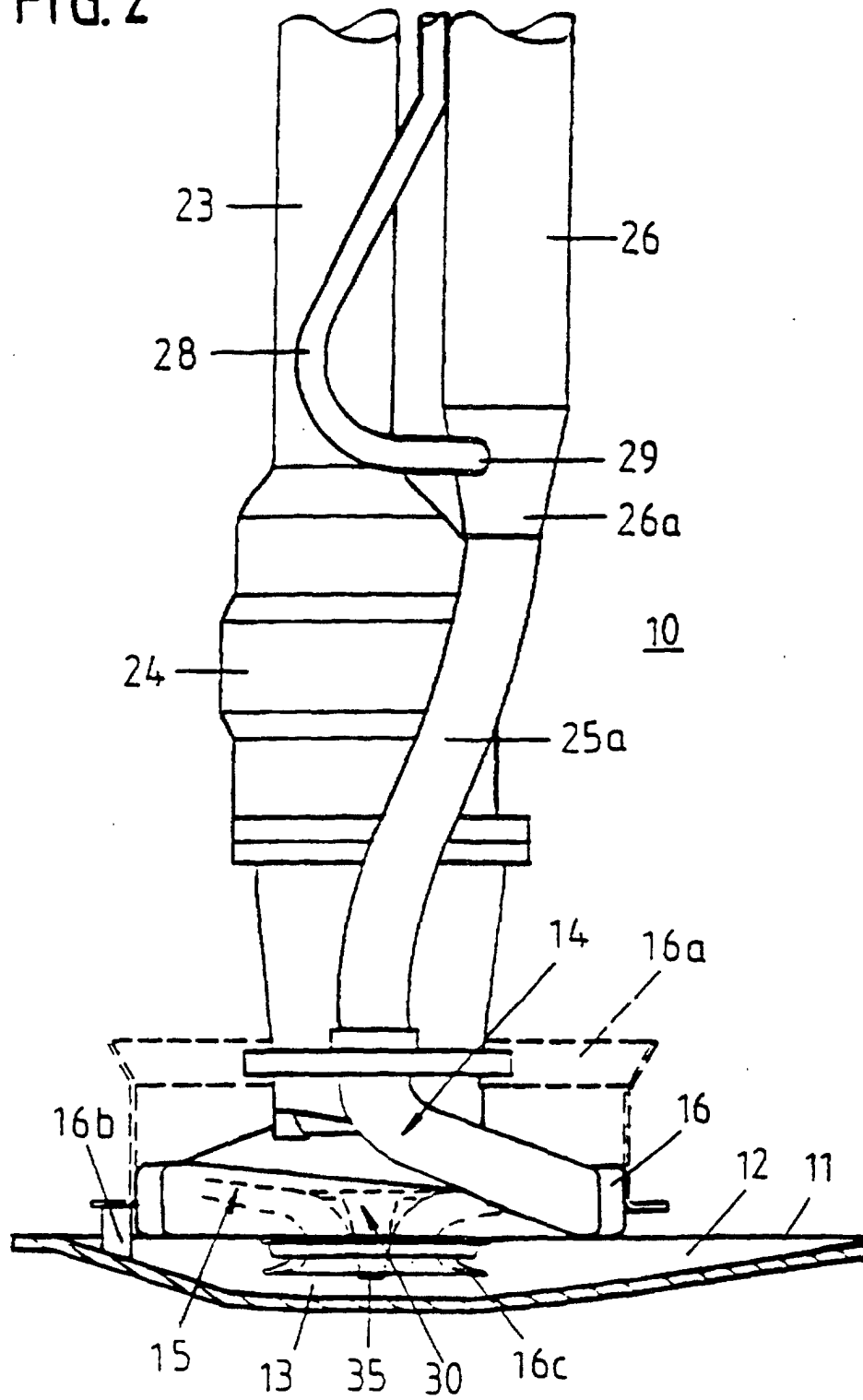


FIG. 3

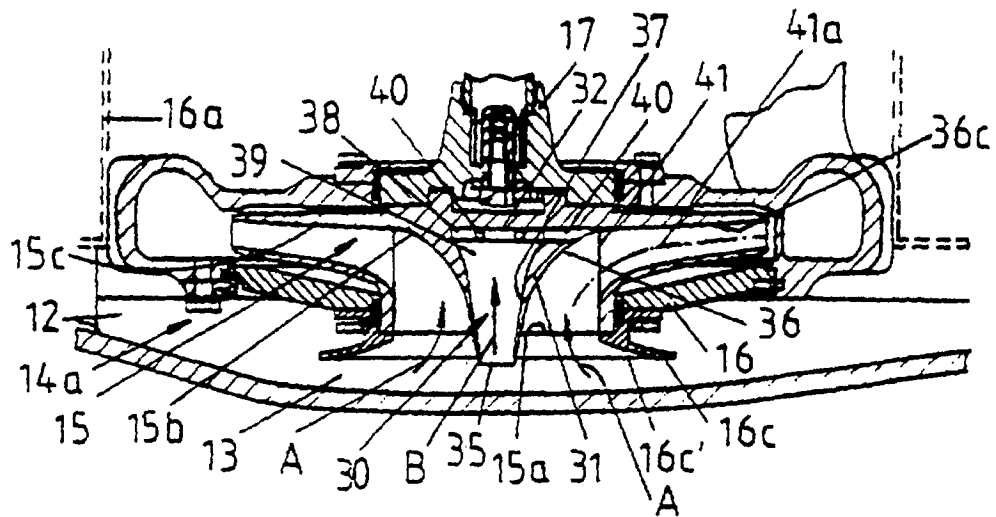


FIG. 4

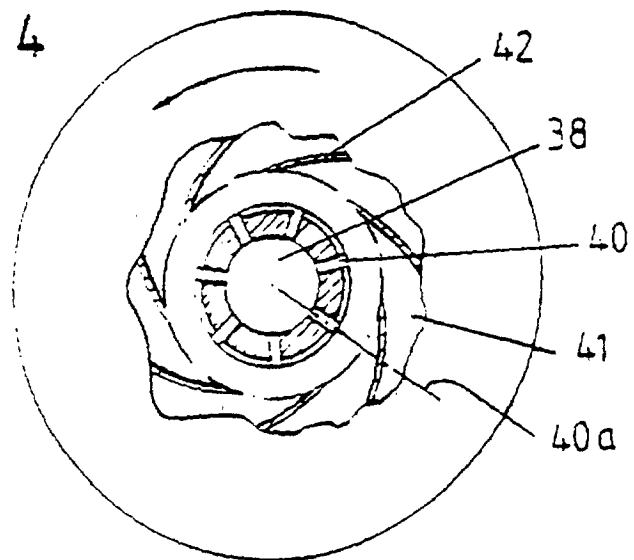


FIG. 5

