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The title of the invention has been amended (Guidelines for Examination in the EPO, A-III, 7.3).

(54) Propulsion device for steering.

(57) In a boat with at least one side steering propeller (5A, 5B) is in the hull provided a recess in the shape of a downward turned trough in which expediently the lower part of a motor-and-propeller-aggregate (10'), and a tunnel-and-cover-unit (40') with water openings, may be accommodated. The propellers (5A, 5B) may be provided with peripheral rings (6A, 6B) which by means of a belt (9) or a gear are driven by at least one, after assembly of the aggregate (10') and the unit (40') with the hull, inside the hull located driving motor (8, 8'). Each propeller ring defines the great wheel in a reduction gear means, which makes it possible to obtain a high reduction ratio, and thus to use advantageous, fast rotating driving motors.

The tunnel may have a suitable, from the conventional cylindrical shape differing profile. The hull with the recess can be produced by a conventional laminated-plastic-method with the aid of a special core inserted in the mould.

The device is particularly advantageous when boats of the leisure boat size shall be provided with one or more side steering propellers, which according to one alternative of the invention is possible even additionally in an already finished boat where originally no side steering propeller was intended.

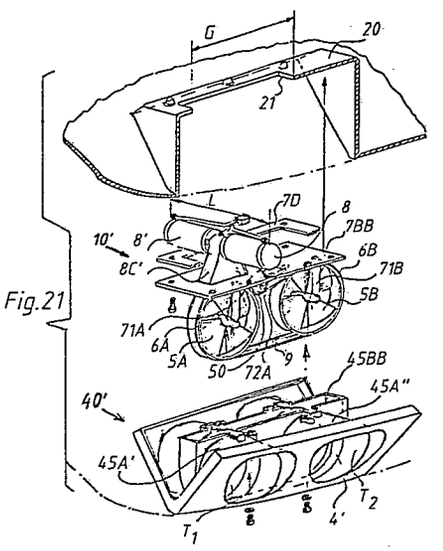


Fig.21

EP 0 328 499 A1

Description

Boat device

The invention refers to a device of the kind stated in the preamble of annexed claim 1.

In order to facilate manoeuvering of larger deplacement vessels,e.g. at low speed and/or with side wind, it has been known to provide at least one side steering propeller (lateral thruster) in a cylindrical tunnel at the bow end or at the stern end of the vessel.

According to the state of art, the side steering propeller (when not being rectractable) is accommodated in a tunnel or passage which extends, somewhat above the keel, athwarships of the vessel and of the hull and is defined by an undivided, cylindrical tube which at both sides of the hull has an orifice in the shape of a circular opening for the intake and discharge of water (in the following: water opening). The entire water openings, i.e. even their highest parts, must lie under the water line of the respective vessel, or air would be sucked in.

In SE-B-7.001 is described a side steering propeller which is placed in a cylindrical flow tunnel at the bow of a large commercial vessel. The propelller is mounted on a crankshaft at the lower end of a long, narrow housing which is located in a vertical channel extending from an opening in an inner deck of the vessel, which lies above the water line, to the flow tunnel which lies quite under the water line. The housing is suspended from a support member which is provided at said opening and which also carries a steam engine which with the aid of two long connecting rods in said housing drives the crankshaft and thus the side steering propeller. No gear, bevel, reduction or other, is provided.

In US-A-4,294,186 is described a retractable lateral thruster device for use on shallow draft vessels such as house boats. The device comprises a propeller surrounded by an external cylindrical flange, i.e. a peripheral ring, to which a ring gear is bonded. The peripheral ring is driven, with the aid of an idler gear, by a drive gear mounted on the outgoing shaft of an electric motor and having a slightly greater diameter than the peripheral ring. Consequently, the propeller does not rotate at a lower speed, but, on the contrary, at a somewhat higher speed than the motor.

It is also known to provide vessels with more than one side steering propeller, each of them being then accommodated in a separate tunnel and driven by a separate motor of its own.

Side steering propellers accommodated in tunnels or tubes are supported by an arm or a bracket which is suspended from the uppermost part of the tube and at its lower end carries a combined reduction and bevel gear box with an outgoing shaft on which the propeller is nonrotarily mounted.

Said gear box, located as it is in the middle of the water stream generated in the tube by the propeller, has streamlined shape and is made as small as possible, so as to minimize water resistance. Inside the hull is provided a reversible electric or hydraulic motor with a vertical outgoing shaft for driving the gear box. Said shaft passes through the hull of the vessel in an opening inside said arm or bracket, which is hollow, or at least provided with a channel for the shaft (or for a chain, serving as an alternative transmission means).

A side steering propeller must always have a somewhat smaller diameter than the respective tube or passage in order to be able to rotate therein. Because even the uppermost part of the respective tube lies under the water line, so lies even the highest part of the propeller always under the water surface. The diameter of the tube, and thereby also of the propeller, is consequently limited by the dimension between the keel and the water line (constructional height) which in various types of hulls is available in their bow (or stern) part.

A propeller with a given diameter must rotate, in order to deliver the same effect, with a higher speed, than a propeller of the same type having a greater diameter, but the risk for cavitation augments with increasing rotational speed.

For driving a side steering propeller appear fast rotating electric motors (e.g. with 8.000 to 9.000 rotations per minute) best suited. However, the degree of speed reduction, which may be obtained in the above mentioned combined reduction-and-bevel-gear box, is limited, because the diameter of the greatest wheel, which can be accommodated in the gear box, is limited, as the gear box shall, of course, offer a so small resitance to water, as possible. In order to be able to use fast rotating motors as the ones mentioned above, it would be necessary to provide another reduction gear in the hull, whereby the costs of the whole device would increase.

It is therefore one object of the present invention to provide a device in connection with side steering propeller systems and the respective hulls, which, in comparison with known solutions, can be produced more economically, is more effective in operation, and can be used even, and in particular, with boats not going beyond the size of leisure boats, e.g. cabin-type boats with greater length than 5m, where the need of lateral thrust is often felt.

Another object of the invention is to provide a method for producing the hull of such a boat. Still another object of the invention is to enable installation of a side steering propeller device in finished boats where such an installation originally has not been considered, and which consequently have a hull without any tunnel or passage athwardships.

The principles of the present invention are evident from the enclosed patent claim 1, further improvements and alternative embodiments being comprised in the attached sublaims. The device according to the invention can easily be adapted to hulls with various bottom shapes, including hulls with low constructional height between the keel and the water line, it enables the use of small, fast rotating driving motors, and allows an advantageous production, in an unaltered conventional mould, of a plastic hull adapted to the purpose.

According to the invention, the side steering propeller and its driving motor are jointed into a motor-and-propeller-aggregate which as a single unit may be easily built-in in the hull and easily be removed therefrom, e.g. for repair or exchange purposes. Preferably, said aggregate is used in combination with a likewise readily mountable and dismountable flow tunnel unit, in which the side steering propeller operates.

The invention shall now be explained more in detail with the aid of the enclosed schematical drawings, which refer to exemplary embodiments, and in which

Fig. 1 is a side view of a cabin boat with a side steering propeller device according to the invention;

Fig. 2a shows, at a larger scale, the bow part of the boat of Fig. 1, a cover over the recess havings been removed;

Fig. 2b shows, at the same scale, the same bow part in operational condition;

Figs. 2c and 2d show two alternative embodiments of the bow part in a boat according to the invention;

Fig. 3 shows the production of a hull with a recess according to the invention;

Fig. 4 shows, on the one hand, an alternative method of producing a hull with a recess according to the invention, and on the other hand the recess thus obtained;

Fig. 5 shows a cover for covering the recess in the hull;

Fig. 6 shows, in section, an alternative embodiment of the recess and cover;

Fig. 7 shows in perspective a unit consisting of an inset member and a cover;

Fig. 8 shows a core for the production of the inset member of Fig. 7;

Fig. 9 illustrates the production of the inset member of Fig. 7 with the aid of the core of Fig. 8;

Fig. 10 shows in cross-section a side steering propeller and flow channel device according to the invention;

Fig. 11 shows a second embodiment of the device in cross-section at a minor scale;

Fig. 12 shows a third embodiment in a side view at a still smaller scale;

Fig. 13 shows a fourth embodiment in cross-section;

Fig. 14 shows in side view the embodiment of Fig. 13;

Fig. 15 shows in a longitudinal section at a larger scale how the side steering propeller is mounted in the devices of Figs. 10 and 13;

Fig. 16 shows in cross-section a filter in the device of Fig. 15;

Fig. 17 shows in side view at a minor scale a fifth embodiment;

Fig. 18 shows a detail in Fig. 17 at a larger scale;

Fig. 19 shows a sixth embodiment in side view;

Fig. 20 shows a detail in Fig. 19 at a larger scale;

Fig. 21 shows an embodiment with two propellers;

Fig. 22 is a comparison of various propeller sizes;

Figs. 23 to 25 show schematically various arrangements with two propellers;

Figs. 26 to 28 show schematically various arrangements with three propellers;

Fig. 29 shows in cross-section an inset member to be mounted in a conventional hull;

Fig. 30 shows in side view one half of the inset member of Fig. 29;

Fig. 31 shows the inset member of Fig. 29 in built-in condition;

Fig. 32 shows schematically three alternative ways of mounting the inset member of Fig. 20 in the hull;

Fig. 33 shows another embodiment of an inset member for posterior installation;

Fig. 34 is a side view of the inset member of Fig. 33, and

Fig. 35 shows schematically three alternative ways of mounting the inset member of Fig. 32 in the hull.

Parts with identical function are in all drawing figures denoted with identical or analogical reference numerals.

In Fig. 1 is shown a cabin boat 1 arranged according to the present invention and having a plastic hull 2 with a keel 1a and a bow 1b. A recess 3 (Fig. 2a) is arranged (in a manner described in detail bellow) in the bow part of the hull under the water line V, and the boat is provided with a side steering propeller (in the following: propeller) 5 which is accommodated in a flow tunnel T according to the invention.

In Fig. 2a is shown, at a larger scale, the bow part 2A of the hull 2 so, as it appears immediately after the hull has been produced, i.e. before a motor-and-propeller-aggregate 10 (Fig. 10) and a cover 4 (Fig. 5), or possibly a flow tunnel unit 40 (Fig. 7), have been set in. Said aggregate 10 comprises at least, as will be explained more in detail bellow, at least one reversible, preferably electric, motor 8, at least one side steering propeller 5 with propeller blades 5A and with a peripheral ring 6, and possibly mechanical interconnecting means between the motor or motors and the propeller or propellers.

The recess 3 has the cross-sectional shape of a downwards, i.e. toward the keel, open trough, and the production of a hull with such a recess in a mould will be described bellow. The direction, in which the hull 2 is taken out of the mould, is indicated by an arrow P'.

In Fig. 2b is the same bow part 2A shown after a side steering propeller aggregate 10 and a flow tunnel unit 40 have been set in, i.e. so as also shown in Fig. 1. The dash-dotted line A indicates the limits of the space which is maximally needed in the part of the hull above the keel 1a to accommodate the whole device according to the invention. By the double arrow P are indicated the directions in which the side steering propeller aggregate is set in in the hull 2, and removed therefrom.

In the Figures 2c and 2d are shown two other alternative embodiments of the recesses 3' and 3'' respectively, and of the component parts accommodated therein. In the embodiment of Fig. 2d is the recess

3″, in addition to being open downwards, also completely open forward, i.e. towards the stem 1b of the bow. It will be noted that in the examples of Figs. 2b and 2c the rotational axis M of the electric motor 8 always extends radially relative the rotational axis C of the side steering propeller.

Production of the hull with the recess and of the cover

The hull 2 is produced in accordance with Fig. 3 in the following manner. In a mould 200 for the production of a conventional hull of moulded laminated plastic (i.e. a hull without any recess for a side steering propeller) is a core 210 set in on the location where the recess 3, 3′, 3″ etc. is desired. The lowest part 211 and the lateral parts 212 of the core 210 correspond exactly to the mould 200 at the respective location. In its uppermost part 213 has the core 210 the shape which is desired for the wall 20 which limits the interior of the hull 2 owards the recess 3, 3′, 3″ etc.

The hull 2 is thereafter produced in conventional manner, whereby a recess 3, 3′ etc. is formed at the respective location, thanks to the core 200. In the wall 20, thus obtained, is then an opening 21 (Fig. 21) with desired shape made (sawn out).

Alternatively, and as shown in Fig. 4 (in the left hand half), an opening 21′ with a flange 21a may be produced in the wall 20 with the aid of an extra core 211. The main core 210A is at its periphery provided with protruding flanges 210A′ which produce recessed, band-shaped portions in the hull 2 serving for the attachment of a cover 4 (Fig. 5).

With the aid of the core 210 is further a negative mould (not shown) produced for the manufacture of said, in Fig. 5 shown, cover 4, which is intended to cover the recess 3. The cover 4 has a peripheral shape (4′ in Fig. 2c, and 4″ in Fig. 2d) which corresponds to that of the recess, and it is provided with two water openings 4A located opposite one another. Each water opening 4A may alternately act as an intake opening or a discharge opening, depending on the direction of rotation of the side steering propeller 5. The outer surface 4B of the cover 4 has a shape which merges with that of the neighbouring parts of the hull 2.

Production of the flow tunnel

In the most simple case, a flow tunnel T is obtained by affixing the cover 4 to the hull 2, as is shown in the right hand half of Fig. 4. The cover 4 may e.g. be bonded along its periphery at 4b, where it rests in the recessed band-shaped parts of the hull 2 obtained with the aid of the peripheral flanges 210A′ of the core 210.

It is however important that the tunnel T be shaped so that turbulent flow of water is prevented therein, and to this purpose may e.g. the recess 3‴ of Fig. 6 have semi-cylindrical shape in its uppermost part, and also the inner surface of the cover 4‴ may be made semi-cylindrical, so that the conventional shape of a cylindrical tunnel for a side steering propeller is obtained.

To enable mounting of a motor-and-propeller-aggregate according to the present invention, it is important that the recess 3, 3′, etc. shows at least in its middle part (where the side steering propeller is accomodated) a profile which at least at one side of such a diameter D of the side steering propeller 5 which is perpendicular to the direction P of Figs. 2b to 2d on no location falls bellow this diameter. E.g.in Fig. 6 has the lowermost part of the recess 3‴ a constant dimension B, complying with the condition $B \geqq D$.

The recess 3, 3′ must, of course, also have a depth or heighth H which in said middle part does not go bellow the diameter D, i.e. $H \geqq D$.

Preferably, however, the tunnel T is according to Fig. 7 embodied by a special inset member 45 which has a central part 45B which complies with the above dimensional condition ($B \geqq D$), and two lateral tunnel parts 45A which project from the central part. Expediently, the inset member 45 is joined with the cover 4 to a tunnel-and-cover-aggregate, or flow tunnel unit 40, where the lateral tunnel parts 45A extend between the central part 45B and the water openings 4A in the cover 4.

The inset member 45 is attached to the cover 4 e.g. by a bonding technique which is conventional in the laminated plastics field, and the whole unit 40 may e.g. with the aid of mounting screws 46, which pass through openings 46A, may be affixed to the hull 2.

The central part 45B is uppermost provided with an assembly or mounting opening 45B′ through which the side steering propeller 5 and its mounting means can pass. It will be understood from the drawing that the opening 45B′ also may be perceived as an opening in a common wall 45A′ of the two lateral tunnel parts 45A.

The inset member may be produced e.g. according to Figs. 8 and 9 in such a manner, that a core 450 of sand or, preferably, wax, is with the aid of protrusions 451 placed in a divided mould 460. By producing the inset member 45 in this manner (or with some similar technique), great freedom in shaping the flow tunnel T on the inside as well in cross-section, i.e. parallelly with the keel 1a, as in longitudinal section, i.e. in the direction athwartships is obtained. This is a very important difference relative to the conventional straight, cylindrical tunnels for side steering propellers.

The tunnel T may e.g. obtain a shape athwartships which at least in its the upper part slopes from a highest point above the keel downwards to the water openings, as is seen in Fig. 4 in a tunnel T without an inset member, and in Fig. 7 (generatrix E) or in Fig. 10 in a tunnel embodied by an inset member 45.

Thanks to the possibility to shape the flow tunnel in the said sloping manner, it is possible to adopt for the

side steering propeller even so great a diameter D, that the highest part of the propeller lies over the water line V (Fig. 1) of the boat, while the water openings 4A at the same time lie completely under the water surface W (Fig. 10), so that air cannot be sucked in.

Even if the highest portions of the propeller in rest condition lies above the water surface W, the whole tunnel T be flooded as soon as the propeller 5 is activated, so that the propeller 5 in operation is totally immerged in water the same as in conventional devices. It is to be noted in this contetxt that, as already introductorily has been stated, a propeller with a greater diameter, such as one whose highest part may lie above the water line, can operate at a lower rotational speed than a propeller with a smaller diameter, and that lower rotational speed means lower cavitation.

Another important advantage of the inset member 45 is the fact that the profile of the tunnel T in the direction parallel with the keel 1a may be shaped so as to continously change from an elongate, rectangular shape, corresponding to the water openings 4A, to a circular shape corresponding to the circular openings 45AA by which the lateral tunnel parts 45AA open in the central part 45B. These openings 45AA practically coincide with the periphery of the propeller 5.

At the same time, the flow tunnel may along its entire lenth maintain essentially the same through-flow area, irrespective of the actual profile, so that the risk of turbulent flow is not greater than in a cylindrical tube, and while the water openings have upper edges 4AA (Fig. 7) lying as low bellow the water line V (i.e. so close to the keel 1a) as possible, the uppermost part of the circular openings 45AA may lie over the water line V, the flow tunnel T having also in every intermediate sectional plane between the circular openings 45AA and the water openings 4A an identical through-flow area.

The possibility to use, with unchanged hull shape and completely under the water line V lying water openings 4A, side steering propellers which may have a greater diameter because they partly may extend above the water line, is an important advantage of the present invention, as such propellers have greater thrust effect.

In the following table is shown the relation between the propeller diameter D (in millimeters), the reduction ratio U (rotational speed of the motor : rotational speed of the propeller) and the thrust S of a bow propeller in a stationary boat (in kiloponds; 1 kp = 0,9 newton).

The table has been established for propellers with three blades and with a P/D ratio 0,6 (where P stands for pitch), when driven by a 1,2 hp (appr. 0,9 kw) motor rotating with 9.300 rotations per minute and having a coefficient of efficiency of 45%.

Table I

D	U	S	D	U	S
100	1,82	17,5	220	6,78	29,5
120	2,47	19,7	240	7,84	31,3
140	3,19	21,9	260	8,96	33,0
160	3,99	23,9	280	10,14	34,7
180	4,86	25,8	300	11,38	36,3
200	5,79	27,7			

With a three-fold increase of the propeller diameter, the thrust force augments more than twice, and at the same time a more than six times greater reduction ratio is necessary.

It will be understood that in a flow tunnel T, which according to the present invention is embodied by an inset member 45, can, besides of the motor-propeller-aggregate of the present invention, also the introductorily mentioned, conventionally mounted side steering propeller be used, i.e. a propeller mounted with the aid of a reduction-and-bevel-gear box which is suspended on a carrier arm or bracket penetrating into the flow tunnel in the inset member.

The side steering propeller, its operation and mounting

According to the invention, a side steering propeller 5 (Fig. 7) is used which is provided with a peripheral ring 6 extending along the outer ends 5A′ of all propeller blades, and affixed to at least one of them. It may e.g. be a side steering propeller of the kind described in US-A-4,294,186, whose peripheral ring is provided with a spur gearing for receiving a driving force (torsional moment) from a driving means located inside the hull. According to the present invention, however, and as will be explained more in detail bellow, also other types of gearing, and even quite different types of peripheral rings for the reception of a torsional moment may be used.

By using a propeller with a peripheral ring is, among other things, the advantage obtained, that at the same time as any bevel gear in the middle of the propeller flow is omitted, a considerably greater reduction ratio may be obtained, because the peripheral ring, with the greatest diameter a given flow tunnel allows, may act as the greatest wheel of a reduction gear.

In motors for driving side steering propellers is the relation of weight and cost to the effect an important parameter. Permanent magnetic motors, such as are used e.g. as starter motors in motor cars etc., are available at reasonable cost and in great quantities. An optimal combination of the parameters

price-thrust-weight is obtained, when a small motor with high rotational speed, such as one of the above mentioned permanent magnetic motors, is combined with a propeller having a large diameter. The propeller may be preferably manufactured totally of plastic (e.g. in a divided mould) and integrally with the pe ripheral ring.

The propeller ring 6 may be driven by a driving wheel mounted on the outgoing shaft of an electric or hydraulic motor, embodying the driving means, either immediately, or via an interposed means such as an idler gear. Said driving wheel defines according to the present invention the smallest wheel of the reduction gear, and in practice a reduction ratio in the order of 1:5 to 1:12 may easily be achieved, which is considerably more than what can be obtained in a reduction gear located at the propeller hub.

A first embodiment of a flow tunnel and side steering propeller according to the present invention is shown in cross-section in Fig. 10.

The side steering propeller 5 has a peripheral ring 6 with a crown gear (contrate gear) ring 6B - best seen in the lower part of the drawing, and in Fig. 25 - meshing with a driving wheel 8B with spur gearing, having a rotational axis A extending at right angles to the rotational axis C of the propeller. It will be noted that in this embodiment the outgoing shaft 8A is the only mechanical power transmission means between the motor 8 and the peripheral ring 6.

The propeller 5 is by its hub mounted on a bearing bolt means 7A for free rotation. The bearing bolt means 7A is firmly attached to, or made integral with, a carrier arm or bracket 7 (the construction of the hub bearing and of the bearing bolt means will be explained more in detail bellow in connection with Figs. 15 and 16).

A support plate 7B has a "water side" (wet side) which in Fig. 10 is turned downward, and a "hull side" (dry side) which in Fig. 10 is turned upward. The carrier arm or bracket 7 is from bellow anchored in the support plate 7B, i.e. it is attached to said water side, while on the reverse side of the carrier plate, i.e. on said hull side, a reversible electric motor 8 is mounted with the aid of a flange 8C. The terms "from bellow" etc. and "from above" etc. in connection with the support plate 7B shall in the present description and in the accopanying claims always be understood in the sense of "from/or on the water side" and "from/or on the hull side" respectively (cfr. e.g. Figs. 2a and 2d).

The electric motor 8, which is fed and manoeuvred by means of a cable 8D, has a vertical outgoing shaft 8 which in a tight manner (with the aid of a packing) passes through an opening 71B in the support plate 7B and carries said driving gear wheel 8B which meshes with the crown gear (contrate gear) ring 6B on the propeller ring 6. The driving gear wheel 8B and the gear ring 6B define a reduction gear with so high a reduction ratio, that a fast rotating motor may be used as driving means.

The arrangement is preferably such, that the propeller ring 6 with the gear ring 6B at least along a part of their circumference are accommodated in a groove 45B" in the central part 45B (as best seen lowermost in Fig. 10). As also the drive wheel 8B is located outside the tunnel T, the whole gear device lies outside the actual flow area. The cylindrical inner surface 6C of the propeller ring 6 is shaped as a continuation of the adjacent parts T' of the tunnel T, the lateral tunnel parts 45A opening in the central part 45B with circular openings 45AA aligned with said inner surface 6C.

The support plate 7B is by means of fastning screw bolts 7C tightly attached to the periphery of an opening 21 in the wall 20, whereby the inside of the hull 2 is sealed against the water in the tunnel T. Said opening 21 coincides with the assembly opening 45B' in the inset member 45, so that the side steering propeller 5 may be brought into the central part 45B of the unit 40 by being inserted through both said openings 21 and 45B'. The opening 21 is preferably made rectangular, as seen e.g. in Fig. 21, and the opening 45B' is, best seen in Fig. 7, dimensioned and shaped so as is required by the propeller and its support means.

The inset member 45 (more exactly the unit 40) is by another set of assembly screws 46A, and with the aid of connecting members 40B, attached to the support plate 7B and to the said screw bolts 7C.

The aggreagte 10, comprising the side steering propeller 5, the carrier arm 7, the support plate 7B, and the motor 8, can as a single unit be introduced into the opening 21 from above or from bellow, i.e. from the inner side or from the outer side of the hull, thanks to the fact that the support plate 7B rests at one end (the right hand end in Fig. 10) on the wall 20 from above, and at the other end (the left hand end in Fig. 10) from bellow, so that a limited tipping movement will bring the plate 7B through both openings 21, 45B'.

In said unit 10 defines the carrier arm 7 a first carrier means, the support plate 7B a connecting member, and the motor flange 8C a second carrier means.

In Fig. 11 is shown an alternative embodiment, where the first carrier means is defined by two carrier arms 7, 7', and to the support plate 7B is from the opposite side, i.e. from above, sealingly attached a second carrier means which in this case is embodied by a water-tight hood (case) 8C'.

Through the hood 8C' passes in a water tight, but rotary manner a driving shaft 80 which is parallel with the rotational axis C of the side steering propeller, and which inside the hood 8C' non-rotarily carries a driving wheel embodied by a spur gear 8B'. Outside the hood 8C' are two reversible electric motors 8, 8' connected to the driving shaft 80, one on each side of the hood, so that the driving shaft 80 defines a common outgoing shaft of the two electric motors, or, more correctly, a common extension of their own outgoing shafts. The motors 8, 8' are firmly attached to the hood 8C' e.g. with the aid of flanges (best seen in Fig. 14) and they may rotate e.g with 8.000 to 9.000 rotations per minute.

Within the hood 8C' is further an idler gear 8A' freely rotarily mounted between the driving gear wheel 8B' and the propeller ring 6, which in this case is in known manner provided with a spur gear 6B'. The primary purpose of the idler gear - which is an example of a mechanical power transmission means and which does not

influence the reduction ratio between the driving wheel 8B′ and the gear ring 6B′ - is to allow to locate the motors 8, 8′ at a suitable distance from the propeller 5 without increasing the driving wheel 8B′.

In Fig. 12 is shown an alternative embodiment in which a worm screw 8B″, meshing with a corresponding gear on the propeller ring 6, is mounted on the outgoing shaft 8A of the motor 8, said shaft extending in this case neither vertically, nor horizontally, but aslant, subtending an angle α of appr. 45° with the support plate 7B. It will be noted that even in this embodiment no separate mechanical power transmitting means are needed between the motor 8 and the propeller 5.

In the embodiment of Figs. 13 and 14 is the flow tunnel T straight, and the propeller ring 6 has the shape of a conventional belt pulley with a smooth, and somewhat cambered circumferential surface. At the upper end of the hood 8C′ is in the function of the driving wheel a belt pulley 8B, with a considerably smaller diameter than the propeller ring, non-rotarily mounted on a shaft 80 in the same way as the gear 8B′ is mounted in the embodiment of Fig. 11.

Also as in the embodiment of Fig. 11, the shaft 80 extends parallel with the rotational axis C of the propeller 5 and projects, sealed, out of the hood 8C′. Outside the hood are two, e.g. with 8.000 to 9.000 rotations per minute rotating, and to the hood 8C′ firmly attached, reversible electric motors 8, 8′ with their outgoing shafts non-rotarily connected to the shaft 80.

The shaft 80 has (in the embodiments of Fig.11 as well as of Figs. 13 and 14) for attachment to the motors 8, 8′ (i.e. to their own outgoing shafts) on either end a non-circular connection opening 80′. Alternatively, one non-circular through-opening may extend along the entire length of the shaft 80. The motors 8, 8′ are affixed to the hood 8C′ by means of flanges 81.

In this alternative embodiment, the first carrier means is defined by a cranked lever 70 with arms 71 and 72, of which the arm 72 is rotarily attached to the support plate 7B′. The cranked lever 70 is affected in the sense of arrow Q by a compression spring 73.

The belt pulley 8B″ and the propeller ring 6 are connected by a driving belt 9 of the so-called poly-V-type (multiple-splined belt) which is tensioned by the action of the spring means 73. Said belt 9 is one example of mechanical power transmission means between the motors 8, 8′ and the propeller 5.

As the opening 710 in the support plate 7B′ has such a size, as to allow both branches of the belt 9 to pass through, the support plate 7B′ adopts rather the shape of a rectangular support flange.

The small belt pulley 8B″ is, in known manner, fluted in accordance with the multiple-splined-type driving belt, and on the locations where the driving belt 9 contacts the small driving wheel 8B′ and the propeller ring 6 are stationary water wipers 74 of the coulter type provided.

"Aquaplaning" is prevented due to the fact that the poly-V-belt (multiple-splined belt) contacts a smooth surface, instead of a fluted one, on the peripheral ring 6.

Alternatively, a toothed belt may be used, and on the peripheral ring are then, preferably, some (e.g. three) teeth are omitted between each two neighbouring teeth (see Fig. 24).

In Figs. 15 and 16 is shown, at a larger scale, a preferred manner how to rotarily mount the side steering propeller e.g. in the devices of Figs. 10 or 13, on a stationary (non-rotary) shaft pivot, with automatic water cooling and water lubrication.

In the hub portion 5B of the propeller 5A is an axial through-opening 5B′ provided by means of which the propeller 5A may be rotarily mounted on a stationary (non-rotary) shaft pivot or bearing bolt 7A with a cylindrical mantle surface. The shaft pivot or bearing bolt 7A is provided with an axial water channel 77 which extends from the free end of the shaft pivot along a part of the total length of the shaft pivot.

The channel 77 has an intake opening 77A at said free end of the shaft pivot 7A, and a discharge opening 77B on the said mantle surface in the area where the propeller hub 5B is mounted thereon. Consequently, water for cooling and lubricating purposes is lead through the water channel 77 to the location, where the propeller hub 5B is mounted. Between said mantle surface of the shaft pivot 7A and the wall of the axial opening 5B′ in the hub portion 5B are teflon (reg. trademark) insets 78 mounted, at least some of them provided with discharge passages 78A for "used" water.

In order to prevent sand etc. to enter into the water channel 77, and also to clean the intake opening 77A of the channel 77 from vegetation, a slot filter 30 is mounted in front of said intake opening 77A. The filter 30 comprises a package of circular discs 31 of a first kind, where each disc is provided with a plurality (sex in Fig. 15) of openings 31 along its periphery. The discs 31 are firmly attached to, and supported by, an arm 32, which in its turn is affixed to the hub portion 5B of the propeller, so that the entire package of the discs 31 rotates together with the propeller.

Between the rotary discs 31 are stationary discs 33 of a second kind, with triangular shape and sharp edges, provided, non-rotarily (by means of splines) supported by a shank 34, which in its turn is with the aid of a flange 34A with openings 34A′ non-rotarily attached to the non-rotary shaft pivot 7A. (The discs 31 of the first kind have a central opening 31B with a greater diameter than the shank 34, so that their rotation is not impeded).

A sealing ring 35 prevents water to reach the intake opening 77A along some other path than through the openings 31A. The path of the water through the device is shown by arrows in Fig. 15. The filtring and cleansing effect is achieved by the rotation of the discs 31 relative the discs 33, the cleansing effect being in particular due to the sharp edges of the discs 33.

An end piece 36 which is secured by a bolt 36A passing through the shaft pivot 7A (and which is overbridged by the arm 32) holds the propeller 5 in place.

In Figs. 17 and 18 is shown an alternative embodiment of the device of Fig. 11, where the carrier arms 7 and

7′ are omitted, and the first carrier means, which rotarily supports the propeller 5, is embodied by a set of rolling elements, e.g. balls 70 of glas or stainless steel which are distriburedalong the periphery of the propeller ring 6, where, adjacent the gear ring 6B′, a groove 70A is provided to this purpose.

A co-operating groove 75A is provided in a ring 75 which from bellow is firmly attached to the support plate 7B′. The area of the rolling elements 70 and of their tracks 70A, 75A is sealed by V-rings 75B and 75C. The sealing ring 75C has such a shape in profile, as to achieve also a lateral (seal towards the lateral tunnel parts 45A). To the same purpose serves a side sealing ring 75D.

In Figs. 19 and 20 is shown another embodiment of a side steering propeller 5 mounted with the aid of a set of rolling elements 70 distributed along the propeller ring. In all embodiments of the side steering propeller so far described, the peripheral ring 6 has had the function of the greatest wheel in a reduction gear. In the embodiment of Figs. 19 and 20 defines the peripheral ring 6′ the rotor in a three-phase motor by being made of non-magnetic material such as plastic, and a plurality of armature elements 61 being embedded along its entire periphery.

A stator ring 90, also of plastic, i.e. a non-magnetic material, and which is firmly attached to the water side of a support plate 7B″, surrounds the propeller ring 6′ as close as possible, and embodies a stator with reversible polarity, e.g. of the same kind as a stator in a conventional three-phase motor.

Each armature element 61 is embodied by a package of transformer sheets 61A surrounded by an aluminium ring 61B, and the stator ring 90 comprises a plurality of stator elements 91, each defined by a winding 91B which is encircled by a package of transformer sheets 91A (field winding). The stator elements 91 are fed with a 12V or 24V three-phase current from an electronic vibrating converter 92. The vibrating converter 92 is controlled by a reversing switch 93 which is provided at the manoeuvre station of the boat, and is adapted to automatically adopt zero position. The vibrating converter 93 may also allow a phase shift resulting in increased rotational speed, so that change-over relays may be omitted.

Arrangement with a plurality of propellers located side by side

The fact, that according to the invention the recess 3 may obtain practically any desired shape and/or dimension, enables that even several flow tunnels, each appertaining one separate side steering propeller, may be provided side by side, and all propellers may be driven by a single motor, or, more correctly, by a single driving wheel 8B, 8B″.

In Fig. 21 is shown in detail an alternative embodiment of the device according to Figs. 13 and 14 with two side steering propellers 5A, 5B, each served by its own flow tunnel T_1, T_2 (embodied by lateral tunnel parts such as 45A′, 45A″) which are connected to a common central part 45BB. The cover 4′ in the flow tunnel unit 40′ has separate water openings 4A′, 4A″ for each tunnel T_1, T_2, i.e. for each lateral tunnel part such as 45A′, 45A″.

Both propellers 5A, 5B are driven by a single driving belt 9 (e.g. of the poly-V-type) which inside the hood 8C′ of the aggregate 10′ contacts the belt pulley 8B″ (Figs. 13 and 14, not seen in Fig. 21), and further the two peripheral rings 6A, 6B of both propellers 5A, 5B. The belt is tensioned by a pulley 50 mounted on a spring-affected arm 72A (spring 73′ in Fig. 23).

The propellers 5A, 5B are supported by carrier arms 71A, 71B which are anchored in a common support plate 7BB, 7D being a packing used when the support plate 7BB is affixed along the periphery of the opening 21.

Said opening 21 in the wall 20 has in the direction of the keel 1a (Fig. 1) a length G which is somewhat greater than the largest dimension L of the aggregate 10′in the direction at right angles to the keel. For mounting into the hull, the aggregate 10′ is rotated into a position in which the two lengths G and L are parallel one with another, the motors 8 and 8′ are from bellow introduced through the opening 21, whereupon the aggregate 10′ is again turned into the operative position shown in Fig. 21.

In Figs. 23 and 24 are very diagrammatically shown three alternatives of an arrangement with two side steering propellers, in Figs. 25 to 28 are shown three alternatives with three side steering propellers, and Fig. 22 is a comparison between the sizes of two single propellers II and III respectively which have the same performance as two and three propellers of the size I respectively.

Fig. 23 is a diagram of the embodiment shown in detail in Fig. 21, 9A and 9B being parts, shown at a larger scale, of possible alternative embodiments of the driving belt 9. In this embodiment, both propellers 5A, 5B rotate in the same direction K.

In the embodiment of Fig. 24, the two propellers 5A, 5B are driven by a belt 9′ of the kind shown at 9B in Fig. 23. While the belt pulley 8B″ has a full number of teeth, on the peripheral ring such as 6B′ is between two adjacent teeth always at least one tooth, and preferably more teeth, omitted. Both propellers 5A, 5B rotate in the same direction K. A part of a driving belt embodying a further possible alternative, is shown at a larger scale at 9C.

In Fig. 25 is shown an alternative embodiment of the device of Fig. 10, where a gear element 51 is interposed between the propellers 5A, 5B. The gear element consists of two cylindrical spur gear wheels which are non-rotarily connected one with another by a short shaft pivot, and which mesh with the gear rings of the two propellers 5A, 5B on opposite sides of the rotational axis Z of gear element 51, whereby rotation of both propellers in the same direction (arrows K) is obtained even in this embodimen. The shaft pivot serves also for

mounting the element 51 in some non rotating part, such as a bearing 32. The interposed gear element may also be embodied by a single gear wheel provided on at least one end with a bearing bolt etc..

At a larger scale is shown in Fig. 25 how the gear element 51 meshes with the gear ring 5A, which in this case is provided with a crown gearing (contrate gearing). This representation applies also to the engagement of the gear wheel 8B with the gear ring 5 in Fig. 10.

In Fig. 26 is shown an alternative to Fig. 24, where three propellers 5A, 5B, 5C are with the aid of two pulleys 52 driven by a single two-sided toothed belt 9C (shown in greater detail in Fig. 24), one of the propellers rotating in reversed direction than the other ones, so that its blades must have reversed pitch (meaning only that the respective propeller, quite identical with the two other propellers, is mounted on its shaft pin in reverse position).

In Fig. 27 is shown an alternative to the embodiment of Fig. 23, which comprises three propellers 5A, 5B, 5C and three additional pulleys 52, and where all three propellers rotate in the same direction K.

In FiG. 28 is shown an alternative to fig. 25 with three propellers 5A, 5B, 5C and two gear elements 51.

Mounting the device in the boat additionally

The principle of the present invention may be applied with advantage also when a finished boat, possibly already in use, additionally shall be provided with a side steering propeller. In Fig. 29 is shown in cross-section, in Fig. 30 in side view (but only one half), and in Fig. 31 in finished condition, an inset member 450 comprising a tunnel to be mounted in a finished hull 2′ (Fig. 31). The inset member 450 is preferably manufactured with such a length L′, as to fit into hulls with different transverse profiles.

The inset member 450 is cut along the lines R_1 for adaptation to the configuration of the respective hull. The hull 2′ is first cut by a horizontal cut R_2 and by a vertical cut R_3, whereupon the inset member is inserted into, and, as shown at N, tightly bonded with the hull, e.g. by a technology known in the field of laminated plastic.

Finally, a horinzontal cut R_4 is made in exact alignment with the surface of the wall of the inset member 450. In the inset member 450, thus mounted, is the unit 10 inserted in the same manner as described above.

In Fig. 32 are shown three different alternatives of the anglular position of the inset member 450 in the hull. In Fig. 33 is shown in cross-section, and in Fig. 34 in side view, an alternative embodiment of the inset member 450A with circular water openings 4A, and in Fig. 35 are shown three alternatives of the angular position of the inset member 450A of Fig. 34 in the hull.

In the embodiments of Fig. 29 to 35 defines the wall 450′, 450A′ of the inset member 450, 450A the wall, which separates the inner of the hull from the area of the flow tunnel T, and in which the opening 22 with a flange 22′ (Fig. 9), or the opening 22A with a flange 22A′ (Fig. 32) is arranged. The flange 22′ or 22A′ serves for the attachment of the support plate 7B or of the aggregate 10.

Consequently, a wall which separates the inner of the hull from the flow tunnel area can be embodied either by a wall (such as 20′) which is a part of the hull itself (Fig. 4), or by a wall (450, 450AS) which is a part of the inset member, or it may be at the same time concern walls apertaining to the hull and to the inset member (Fig. 10, 13) and having at least partly coinciding openings 21, 45B′.

Claims

1. Device for generating lateral thrust in a boat (1) and comprising at least one side steering propeller (5) which with the aid of a rotary bearing means (5B, 7A) is mounted in a flow tunnel (T) extending athwardships through the boat's hull (2) above the keel (1a) thereof, and which is driven by a driving means (8) generating a reversible torsional moment, the driving and the bearing means being borne by a support member mounted around a mounting opening through which the side steering propeller and its bearing means can be introduced into the flow tunnel, **characterized by**

- the mounting opening (21, 21′, 22, 22A, 45B′) being provided in a wall (20, 20′, 45A′, 450′, 450A′) which defines the upper limiting wall of the flow tunnel (T);
- the support member being defined by a support plate (7B, 7B″, 7BB) which has a water side turned toward the flow tunnel (T) and a hull side turned toward the inside of the hull (1a) and which is sealingly, but removably affixable to said wall (20, 20′, 45A′, 450′, 450A′) along the periphery of the said mounting opening (21, 21′, 22, 22A, 45B′);
- the rotary bearing means being adapted to carry the side steering propeller (5) in a position where the upper part of its periphery is closely adjacent the water side of the support plate (7B),

so that a compact motor-and-propeller-aggregate (10), comprising the driving means (8), the support plate (7B), the rotary bearing means (5B, 7a) and at least one side steering propeller (5) is obtained, which up to said water side is immersible in the flow tunnel (T) and which as one unit may be readily mounted in the hull and removed therefrom by fastning or releasing the support plate (7B).

2. The device of claim 1, **wherein** the flow tunnel (T) is accommodated in a trough (3, 3′, 3″) which is prepared in the bottom part of the hull's wall, is open toward the keel (1a), and covered by a removable cover (4, 4′, 4″) which on the outside merges with adjacent parts of the hull's wall and which is provided with at least two opposite water openings (4A) defining water intake and water discharge openings of the

flow tunnel (T).

3. The device of claim 1 or 2, **wherein** the mounting opening (21) is rectangular and two opposite edges thereof lie at different levels, so that the motor-propeller aggregate (10) by a tipping motion can be mounted on its place either from the inside, or from the outside of the hull (2).

4. The device according to any one of the preceding claims, **wherein** the side steering propeller (5) is in known manner provided with a peripheral ring (6) for receiving the torsional moment generated by the driving means.

5. The device of claim 4, **wherein** the driving means is defined by at least one hydraulic or electric motor (8) which is mounted on the hull side of the support plate (7B) and has an outgoing shaft (8A) carrying a driving wheel (8B, 8B′ 8B″ 8B‴) with a considerably smaller diameter than the peripheral ring (6), so that a substantial reduction of the rotational speed between the driving wheel (8B, 8B′ 8B″ 8B‴) and the propeller (5) is obtained, mechanical power transmission means (8A′, 9), additional to said outgoing shaft (8A), and sealingly passing through the support plate (7B), being provided when necessary to connect said driving wheel (8B′, 8B″) with the peripheral ring (6).

6. The device of claim 5, **wherein** the outgoing shaft (8A) of the motor (8) extends radialy relative to the rotational axis (C) of the propeller (5) and carries on the water side of the support plate (7B) a spur gear defining said driving wheel, the peripheral ring (6) of the propeller (5) being provided with a meshing crown gearing (contrate gearing).

7. The device of claim 5, **wherein** the outgoing shaft (8A) of the motor (8) subtends an acute angle (α), such as 45°, with the support plate (7B) and carries on the water side thereof a driving wheel embodied by a worm screw (8B‴), the propeller ring (6) being provided with a gearing which meshes the worm screw (8B‴).

8. The device of claim 5, **wherein** a water-tight hood (8C, 8C′), defining a carrier means for the motor or motors (8, 8′), projects from the hull side of the support plate (7B), sealingly surrounding an opening (710) in the support plate, and carrying at its opposite end, in water-tight and rotary manner, a shaft (80) which extends parallel with the rotational axis (C) of the propeller (5), on at least one side projects from the hood (8C, 8C′), and non-rotarily carries, on its part inside the hood (8C, 8C′), the driving wheel (8B″), at least one of its parts projecting from the hood (8C, 8C′) being identical with, or attachable to, the outgoing shaft (8A) of the motor or motors (8, 8′).

9. The device of claim 8, **wherein** both the propeller ring (6B′) and the driving wheel (8B′) are provided with spur gearing.

10. The device of claim 8, **wherein** the propeller ring and the driving wheel define belt pulleys interconnected by a driving belt (9, 9A, 9B, 9C).

11. The device of claim 10, **wherein** the driving belt (9) is a poly-V-belt (multiple-splined-belt) and the driving wheel (8B″) is provided with corresponding grooves, while the propeller ring (6) has a smooth, cambered outer surface without grooves.

12. The device of claim 10, **wherein** the belt is a toothed belt (9A-C), the driving wheel (8B″) and the propeller ring (6) are provided with corresponding teeth, and on the propeller ring (6) is between each two adjacent teeth at least one tooth omitted.

13. A device according to one or more of the claims 10 to 12, **characterized by** wiper elements (74) being provided at the contact points of the belt (9, 9A, 9B, 9C) with the driving wheel (8B″) and/or with the propeller ring (6).

14. A device according to any one of the preceding claims, **characterized by** the propeller (5) having a hub portion (5B) with an axial opening (5B′) for rotary mounting on a non-rotary bearing bolt or shaft pivot (7A) which is rigidly attached to, or made integral with, at least one carrier arm (7, 71) which in its turn is attached to the support plate (7B).

15. The device of claim 14 and any one of the claims 10 to 13, **characterized by** the carrier arm being pivotally attached to the support plate (7B) and affected by a spring means (73) for tensioning the belt (9, 9A-C).

16. The device of claim 14 or 15, **wherein** the propeller (5) is mounted on the bearing bolt (7A) with the aid of a water-cooled and water-lubricated bearing means which comprises a water admission channel (77) extending lengthwise in the bearing bolt (7A) between an intake opening (77A) at a free end of the bearing bolt (7A) and a discharge opening (77B) closer to the other end of the bearing bolt (7A).

17. The device of claim 16, **wherein** at the said intake opening (77A) is a filter (30) provided for cleaning inflowing water, comprising at least one disc (31) of a first kind which is non-rotarily attached to said hub portion (5B) and has at least one opening (31A) communicating with the water admission channel (77), and at least one disc (33) of a second kind which is non-rotarily attached to the bearing bolt (7A), is located closely adjacent said at least one disc (31) of the first kind and has such a shape that, when the disc (31) of the first kind rotates, each opening (31A) therin is alternately shielded and set free by the disc (33) of the second kind.

18. The device of claim 17, **wherein** the disc or discs (31) of the first kind are circular and are provided with a plurality of openings (31A) along their periphery, and the disc or discs (33) of the second kind are triangular with sharp, cutting edges (33A).

19. A device according to any one of the claims 5 to 14, **characterized by** the propeller (5) being mounted to the support plate (7B) with the aid of a roll bearing means which comprises a plurality of

stainless rolling elements (70) located between a first rolling track (70A) on the periphery of the propeller ring (6) and a second rolling track (75A) provided in a bearing ring (75) which is firmly attached to the water side of the support plate (7B).

20. A device according to any one of the claims 5 to 19, **characterized by** the propeller ring (6′) being made as the rotor of an electric motor, and the driving means being defined by a ring-shaped stator means (91) which is firmly attached to the water side of the support plate (7B) and encircles the propeller ring (6′) to define therewith a reversible electric motor.

21. A device according to any one of the preceding claims, **characterized by** the flow tunnel (T) being defined by an inset member (45) insetable into the hull (2) of a boat (1) and comprising a central part (45B) with an assembly opening (45B′) through which a side steering propeller (5) with its bearing means can be inserted, and at least two lateral tunnel parts (45A) extending at opposite directions from the central part (45B).

22. The device of claim 21, **wherein** the inset member is adapted for inserting into a hull (2) which originally was not intended to carry a side steering propeller and in which water openings are provided additionally, the lateral tunnel parts (45) being exepediently dimensioned so as to cover a plurality of various hull types.

23. The device of claim 21, **wherein** the inset member (45) is dimensioned and shaped for accommodation in the recess (3, 3′, 3″) of a hull (2) which from the beginning is adapted to the purpose.

24. The device of claim 23, **wherein** the inset member (45) is merged with the cover (4, 4′, 4″) into a flow tunnel unit (40), the lateral tunnel parts (45A) being attached to the cover (4, 4′, 4″) along the periphery of the water openings (4A) in the cover (4).

25. A device according to any one of the claims 21 to 24, **wherein** the lateral tunnel parts (45A) at least in their upper portions slant downwardly from the central part (45B), the water openings (4A) have a longitudinal shape, and the profile of the lateral tunnel parts (45A) continuously varies, retaining an unchanged through-flow area, from a longitudinal shape corresponding to the water openings (4A) to the circular shape of openings (45B‴) by which the lateral tunnels parts (45A) open into to central part (45B) and which correspond to the peripheral ring (6) of the side steering propeller (5) accommodated in the central part (45B).

26. The device of claim 25, **wherein** the uppermost portion of the central part (45B) lies above, and the upper edges (4AA) of the water openings (4A) under the water line (V) of the boat (1).

27. A device according to any one the preceding claims, **characterized by** the recess (3, 3′, 3″) being dimensioned so as to accommodate at least two, side by side located flow tunnels (T) or lateral tunnel parts (45A), all having a common central part (45BB) for at least two propellers (5A-C) located side by side, all propellers (5A-C) in the common central part (45BB) being supported by a single support plate (7BB) and driven by a single driving belt (9, 9A-C).

28. A device according to any one of the preceding claims, **characterized by** the recess (3, 3′, 3″) being dimensioned so as to accommodate at least two, side by side located flow tunnels (T) or lateral tunnel parts (45A), all having a common central part (45BB) for at least two two propellers (5A-C) located side by side, all propellers (5A-C) in the common central part (45BB) being supported by a single support plate (7BB) and provided with gear rings, a first propeller being driven by the driving gear wheel (8B) on the outgoing shaft of the motor or motors, and the other propeller or propellers being driven by the first propeller with the aid of an interposed driving gear element (51).

29. A method of producing a hull (2) of a boat (1) according to one or more of the preceding claims, **characterized by** the steps of inserting in a mould (200) for conventional production of a plastic laminated hull, a core (210,) the outer parts (211, 212) of which correspond to the mould, while its inner parts and the cross-sectional profile have the shape of the wall (21) limiting the recess (3, 3′, 3″) relative the inner of the hull (2), and thereafter producing the hull in conventional manner.

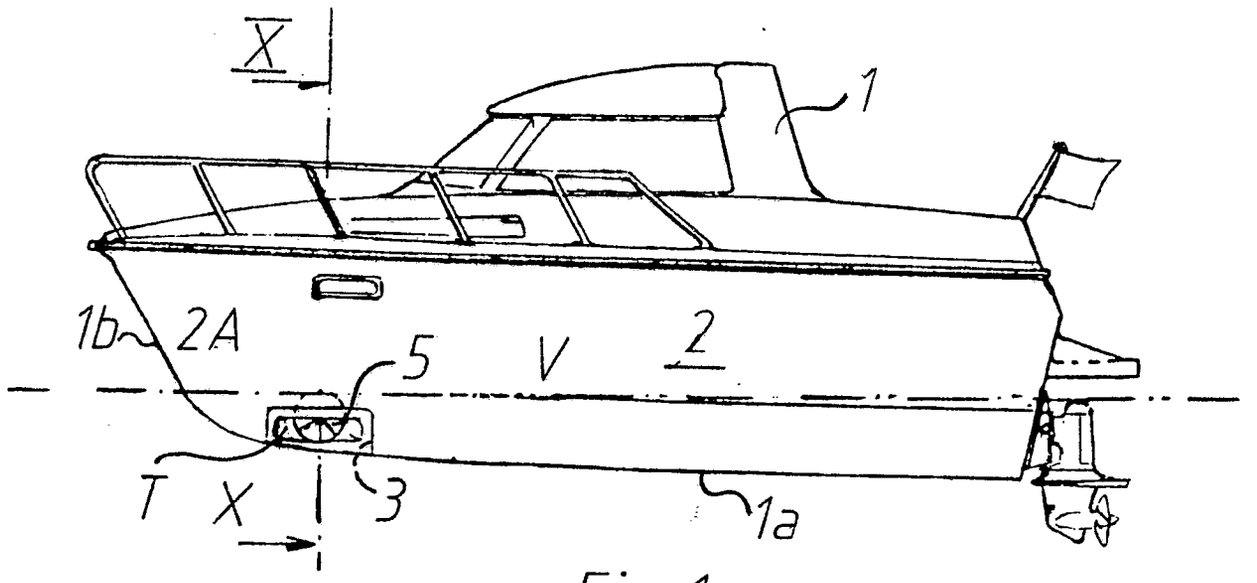


Fig. 1

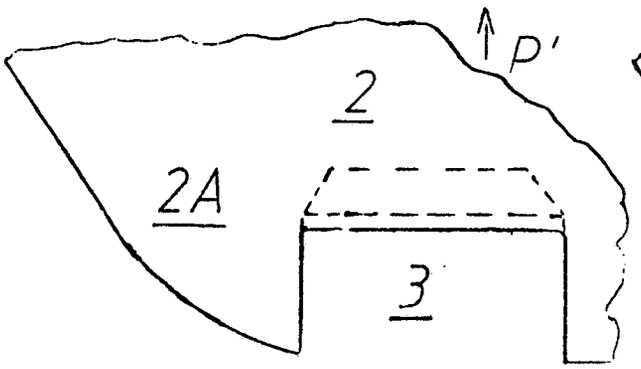


Fig. 2a

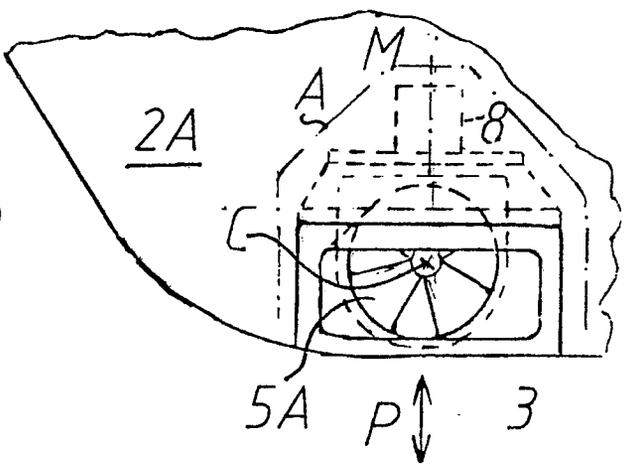


Fig. 2b

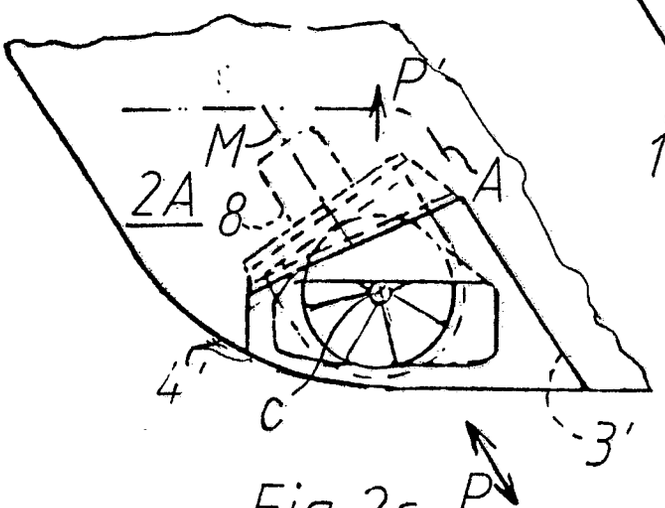


Fig. 2c

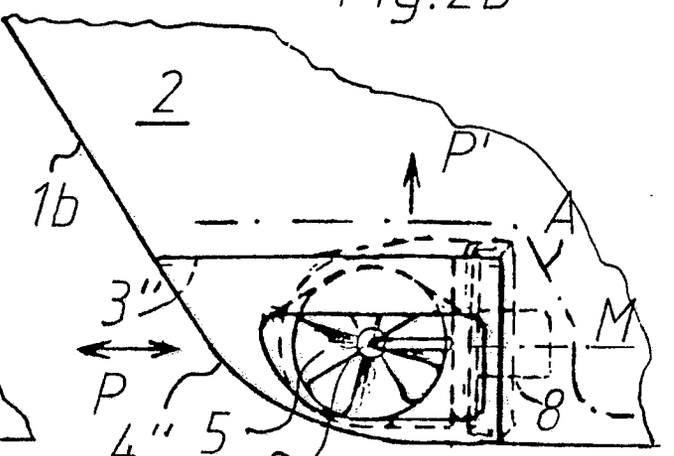


Fig. 2d

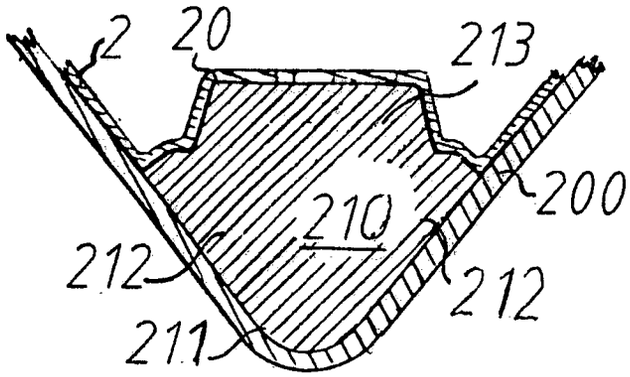


Fig.3

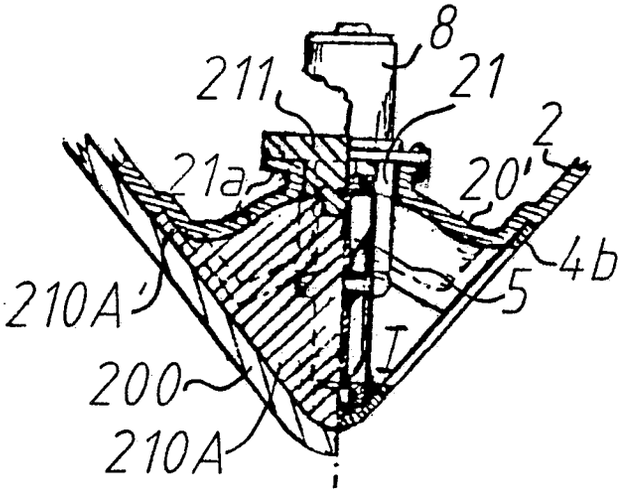


Fig.4

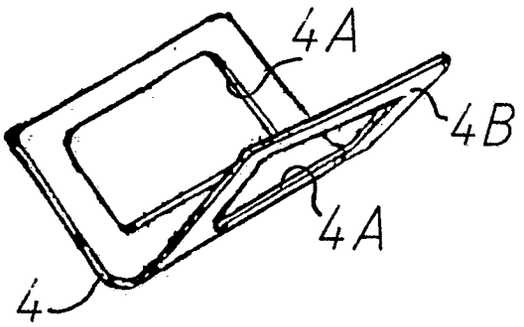


Fig.5

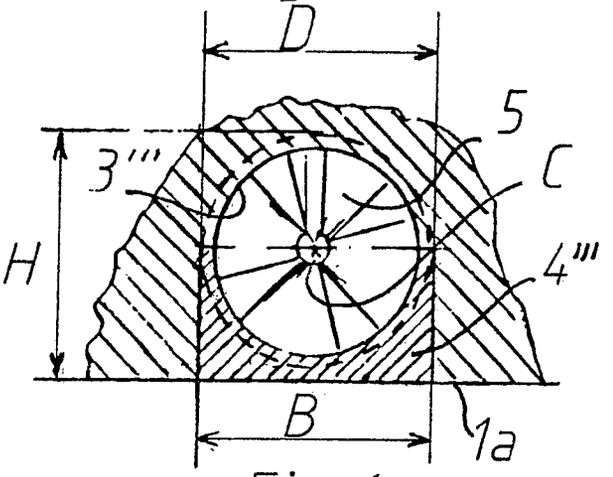


Fig.6

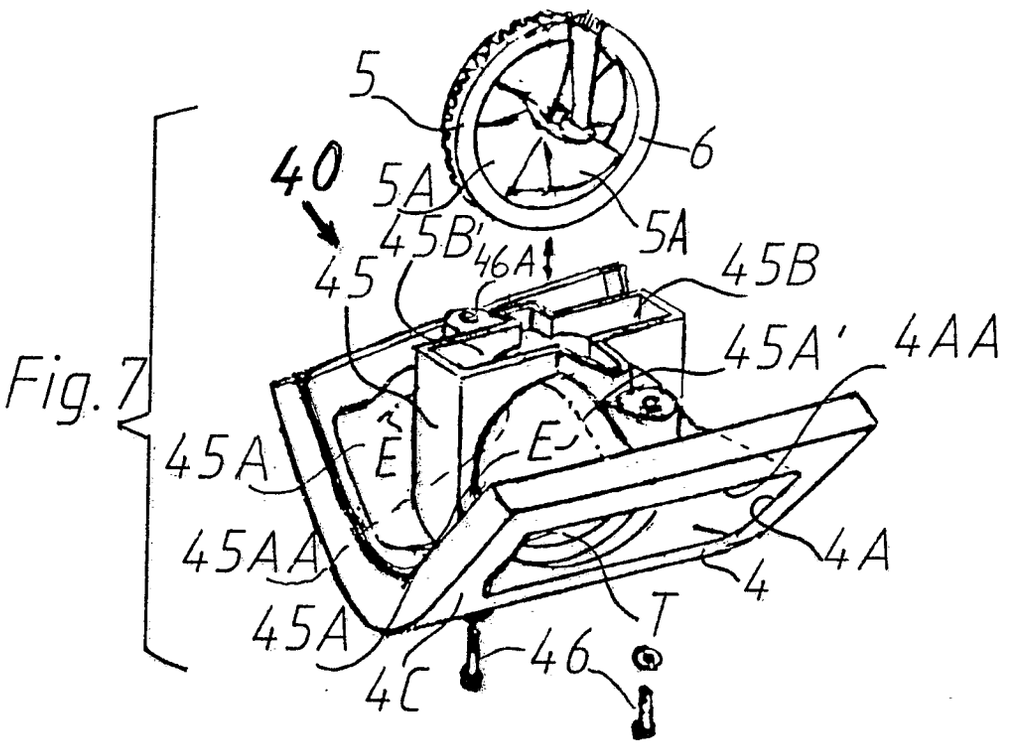


Fig.7

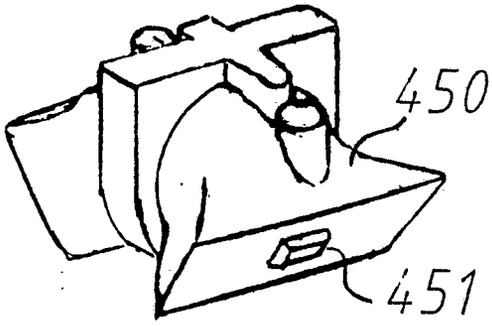


Fig.8

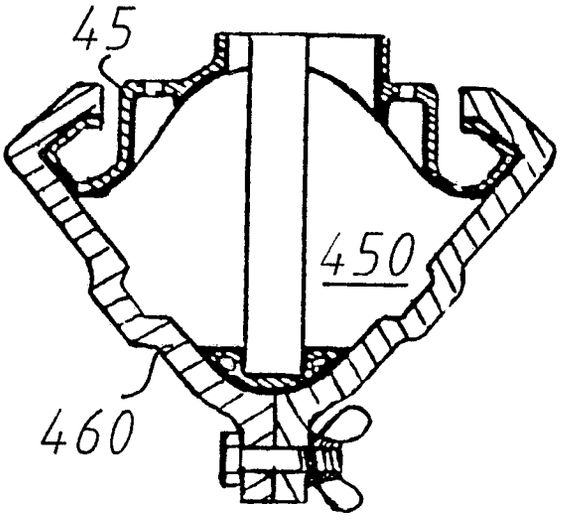


Fig.9

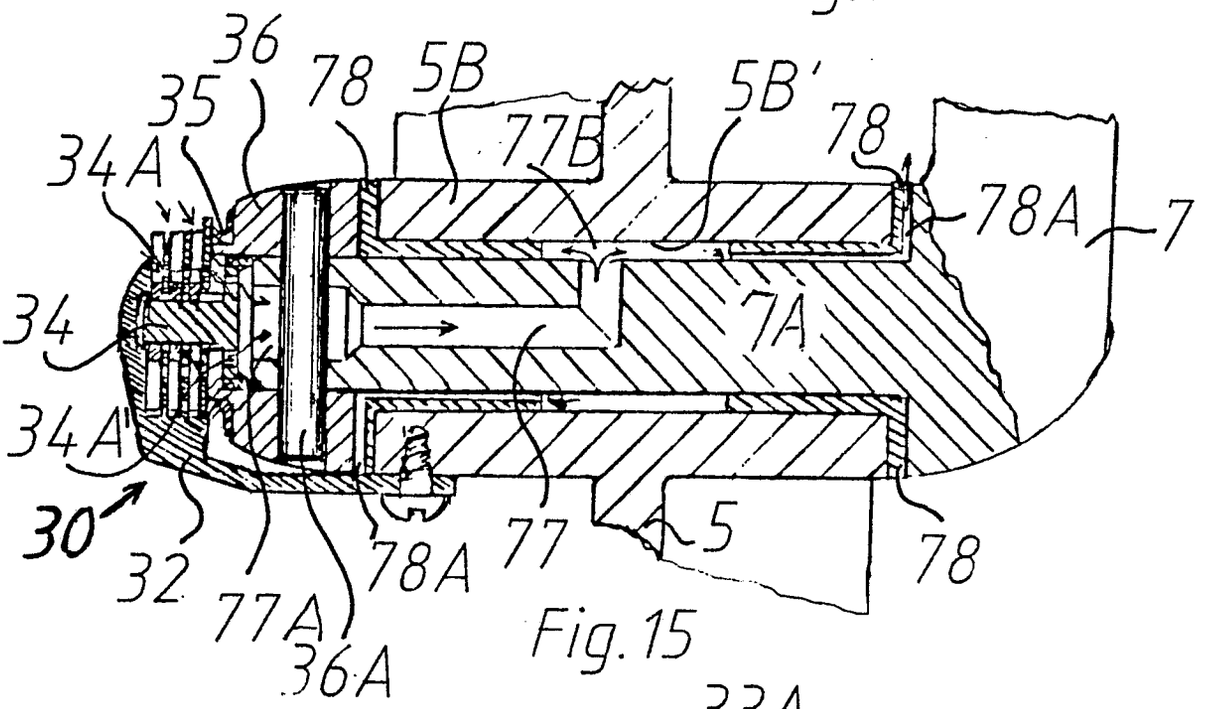


Fig.15

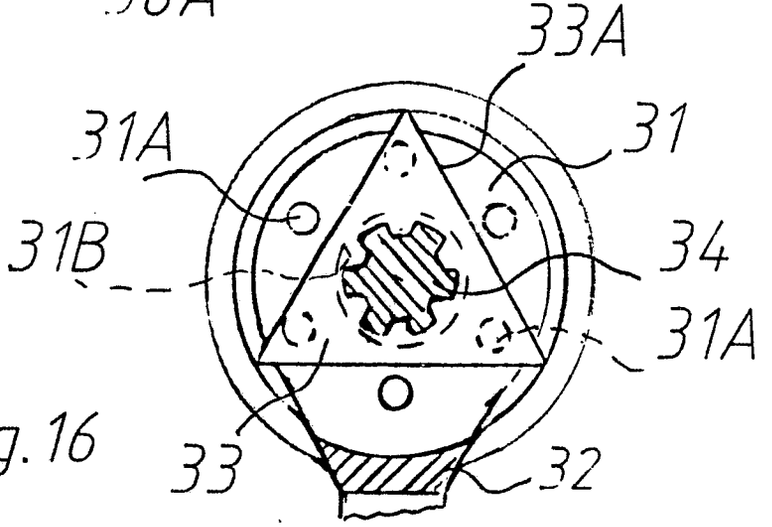


Fig.16

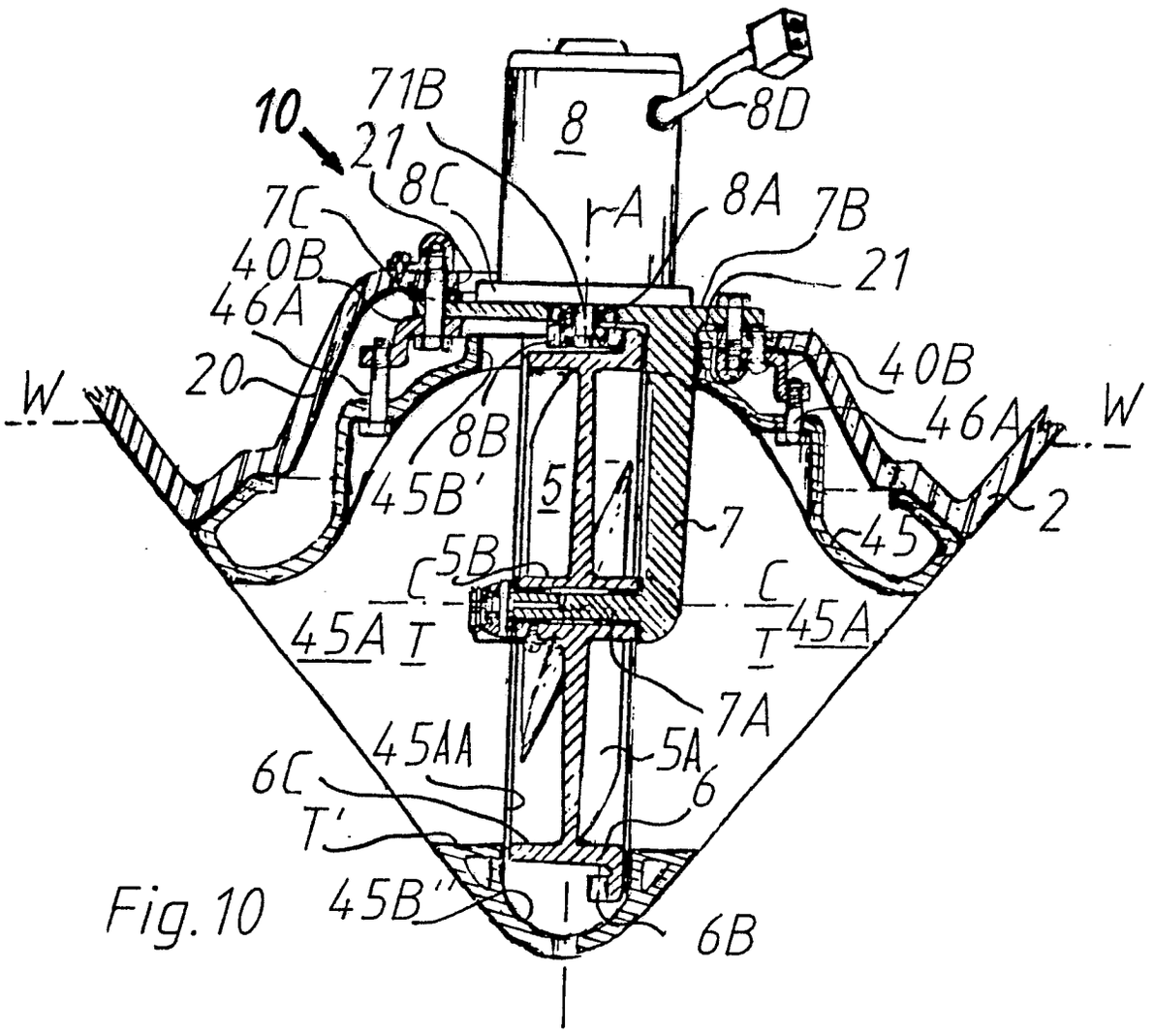


Fig. 10

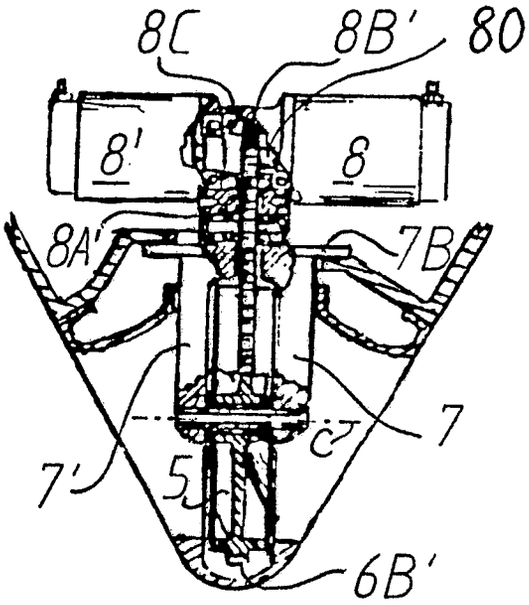


Fig. 11

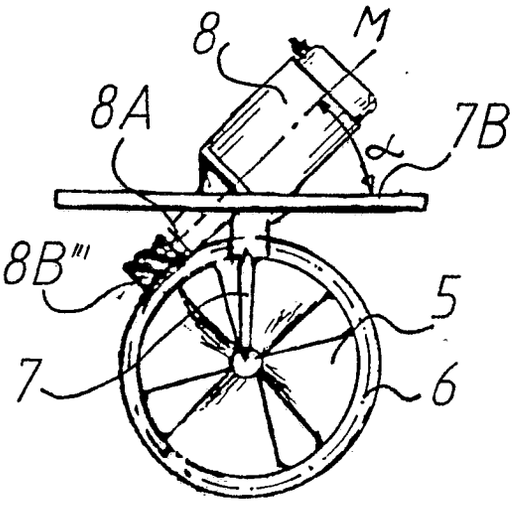


Fig. 12

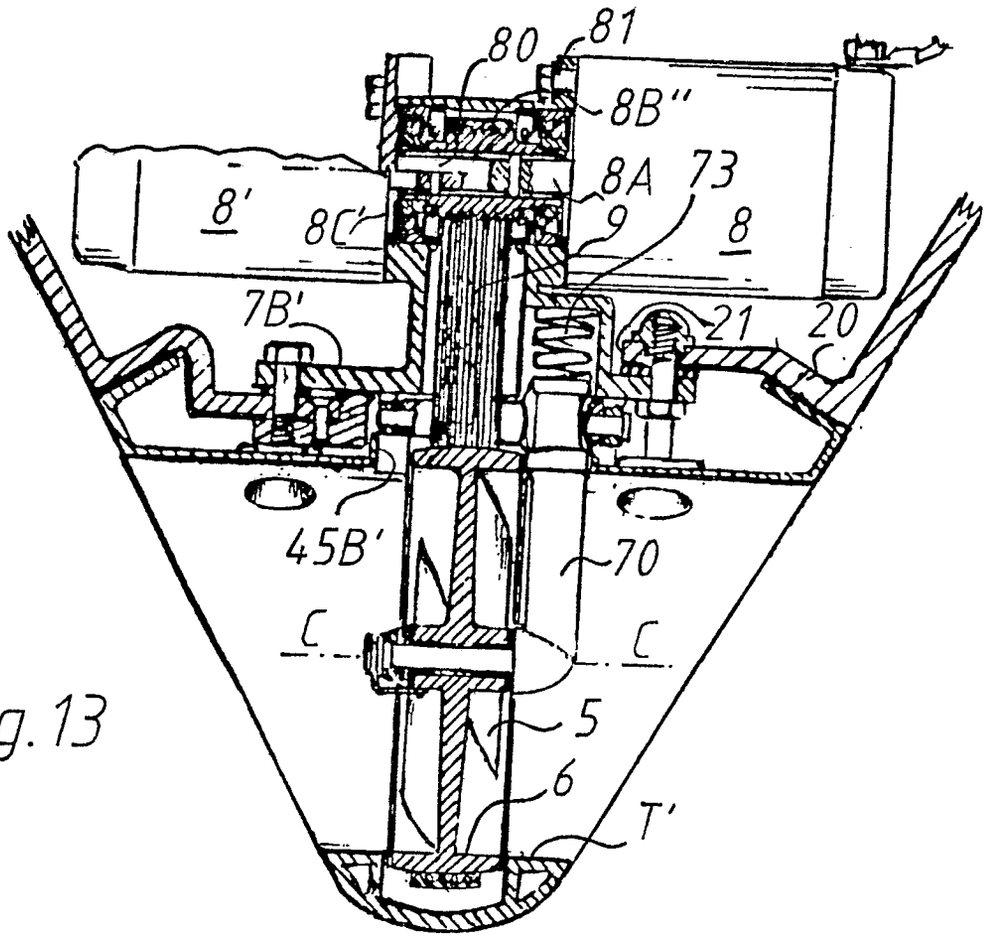

80
81
8B''
8A
73
8'
8C'
9
8
7B'
21
20
45B'
70
C
C
5
6
T'

Fig. 13

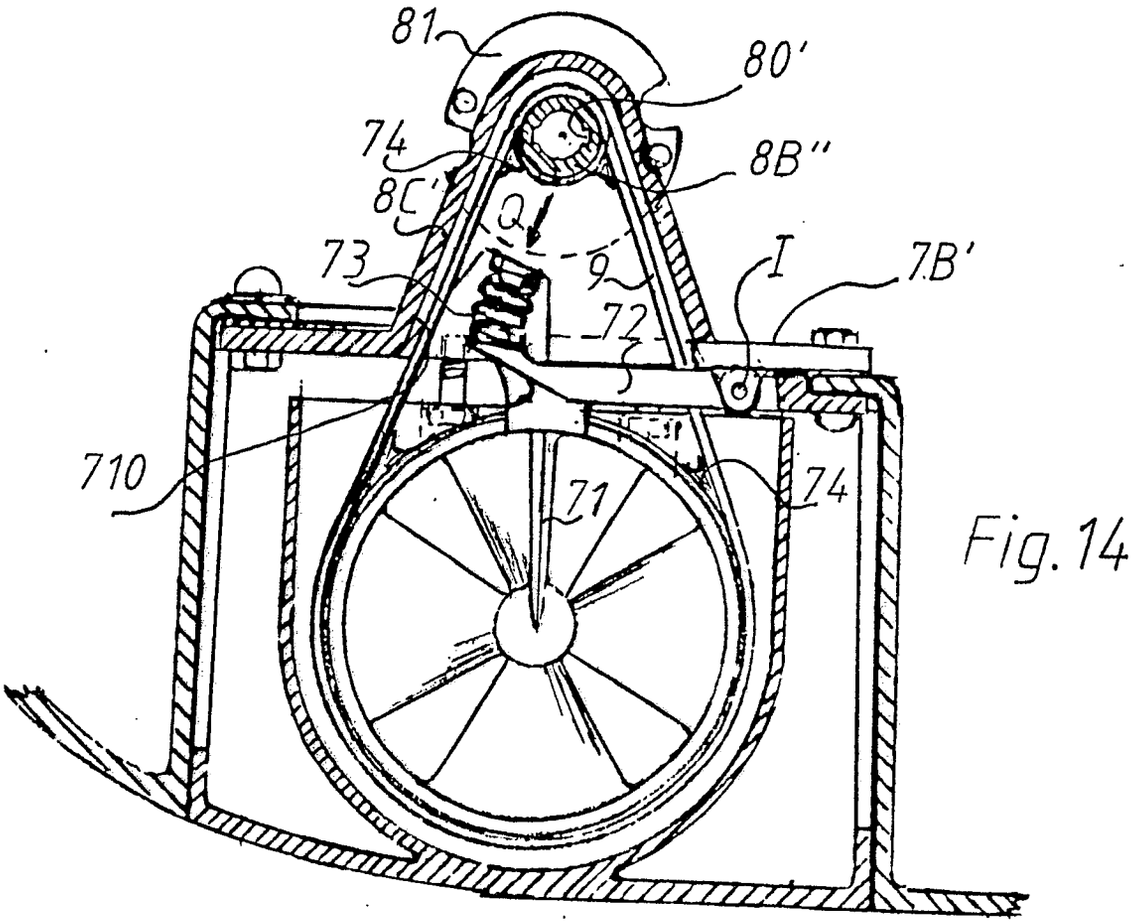

81
80'
74
8B''
8C'
Q
73
9
I
7B'
72
710
71
74

Fig. 14

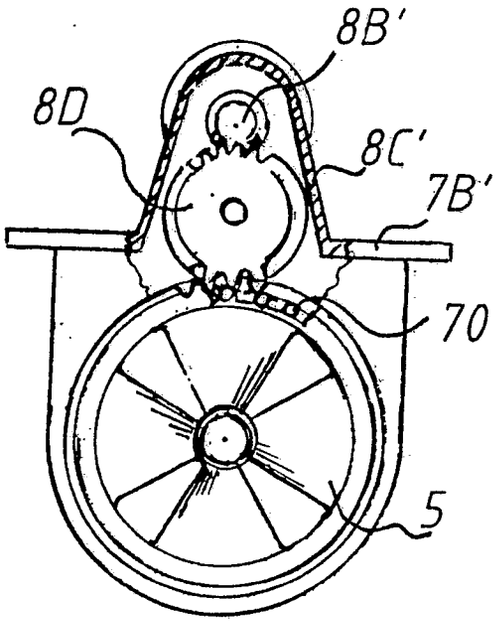


Fig.17

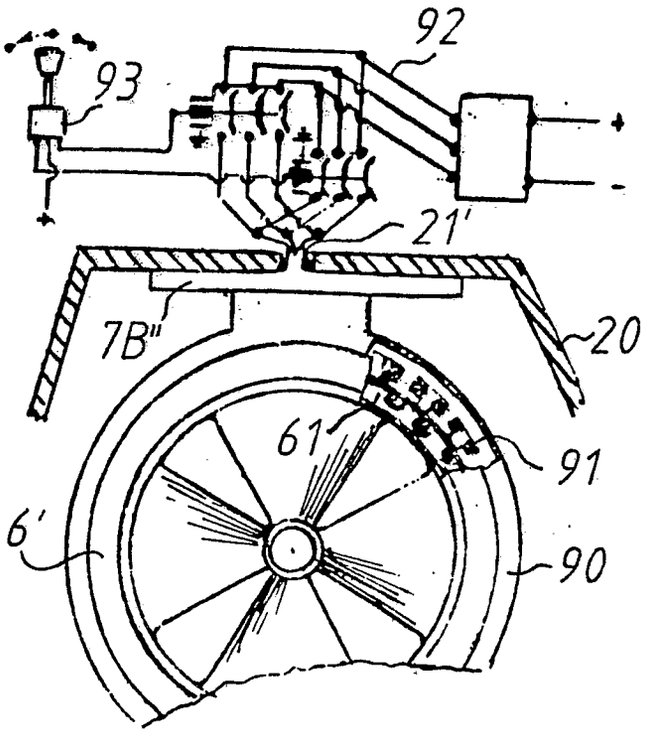


Fig.19

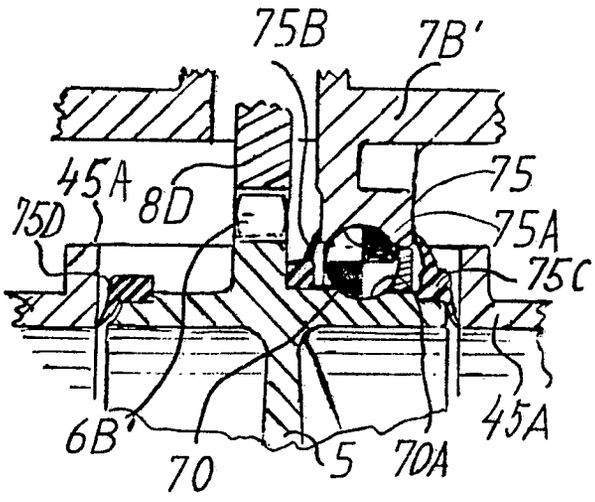


Fig.18

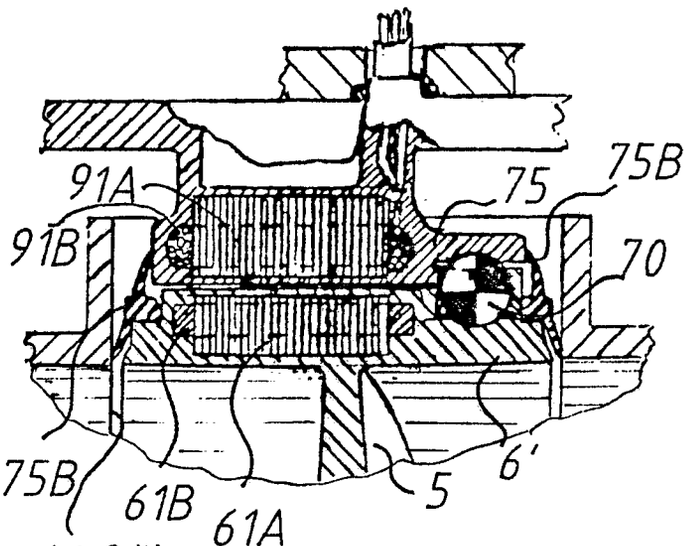


Fig.20

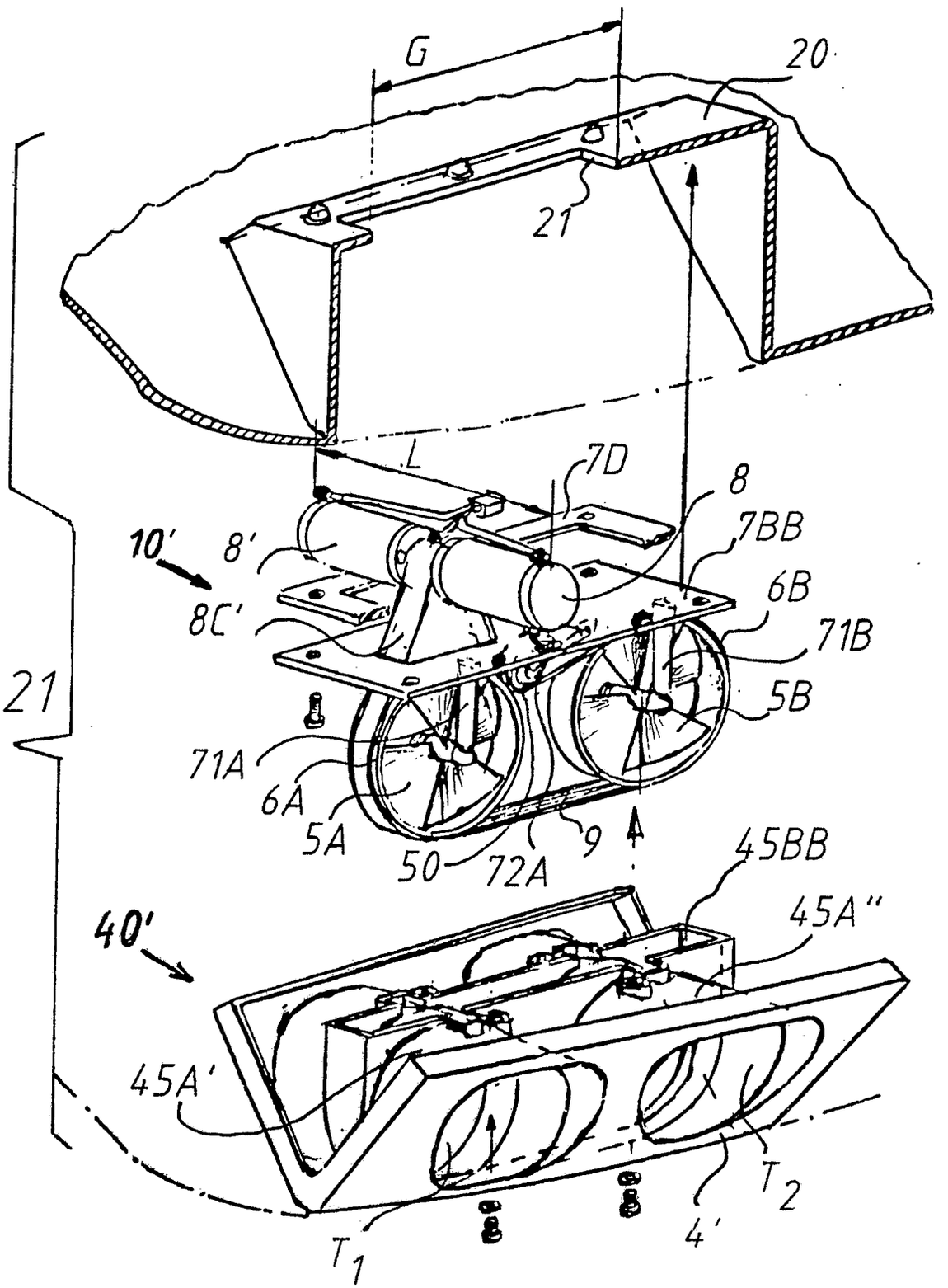

G
20
21
L
7D
8
7BB
10'
8'
6B
8C'
71B
5B
71A
6A
5A
50
72A
9
45BB
45A''
40'
45A'
T2
4'
T1

Fig.21

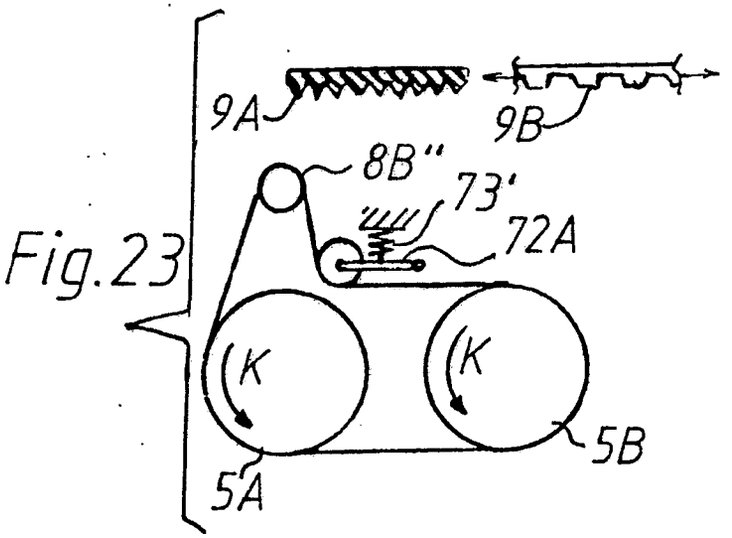


Fig.23

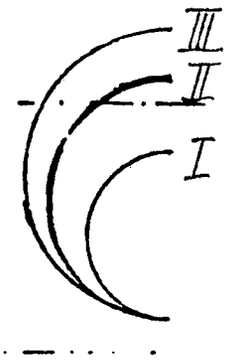


Fig.22

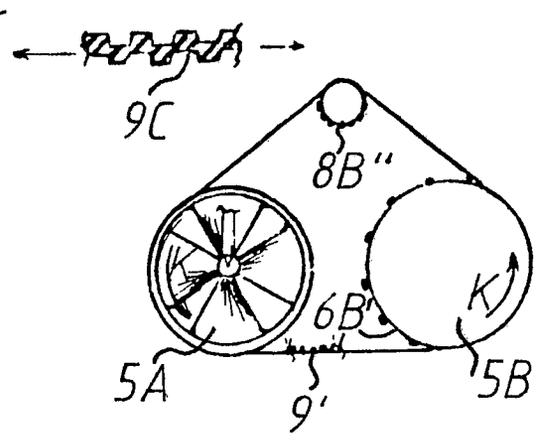


Fig.24

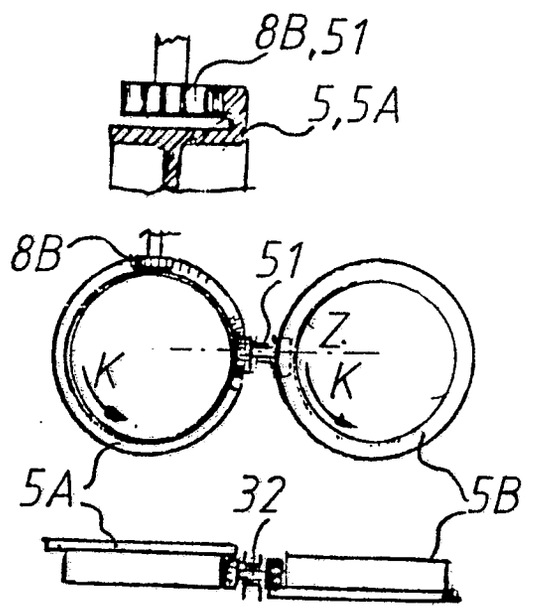


Fig.25

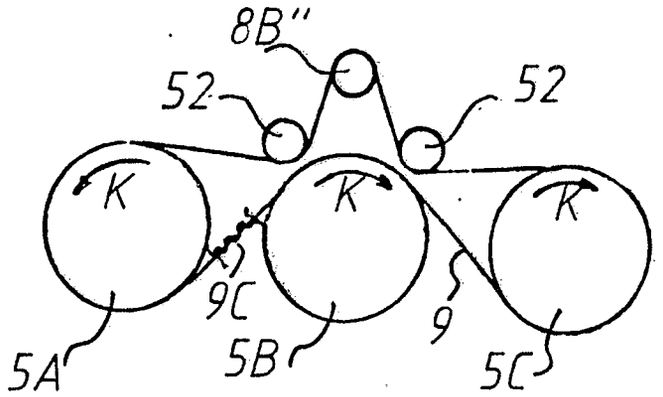


Fig.26

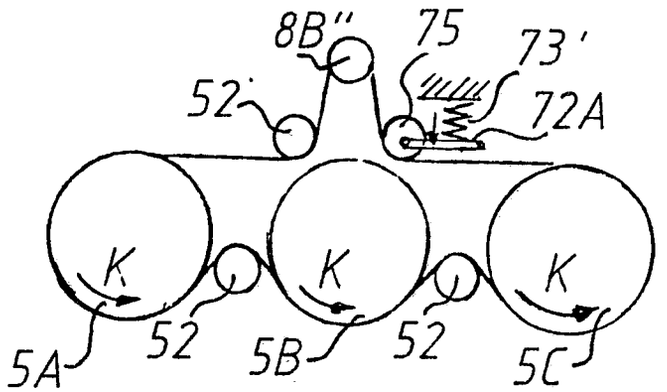
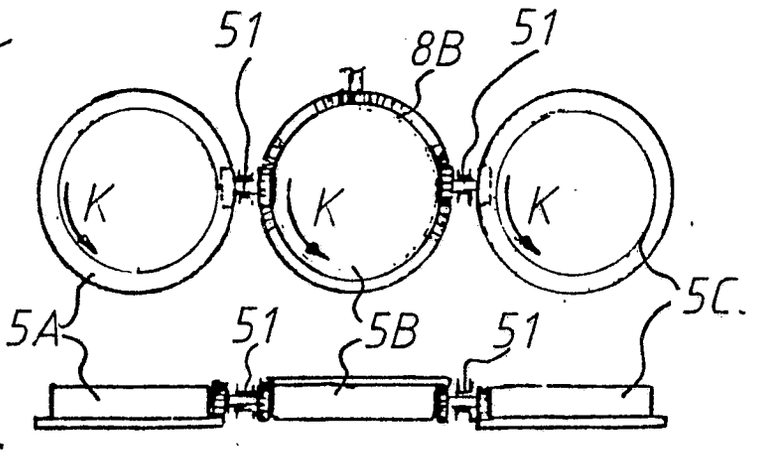


Fig.27

Fig.28



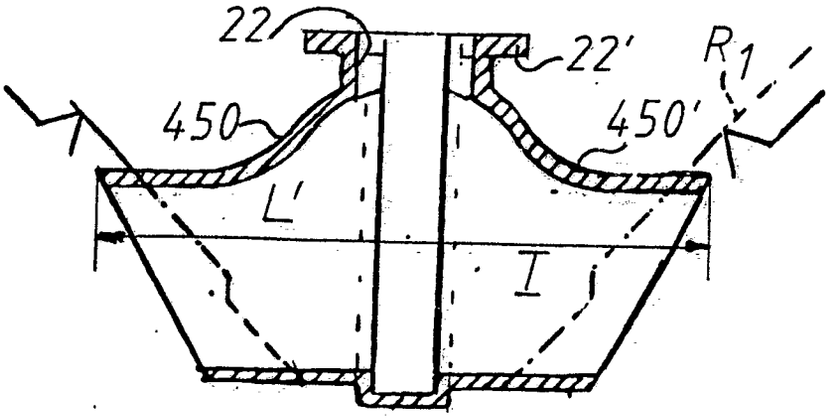


Fig.29

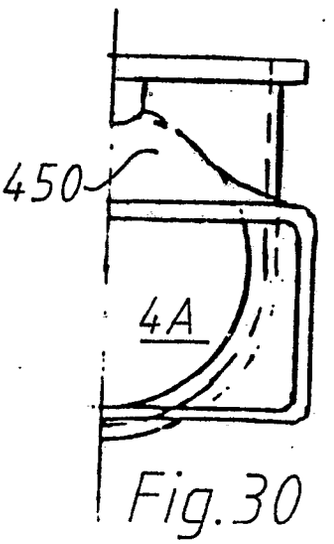


Fig.30

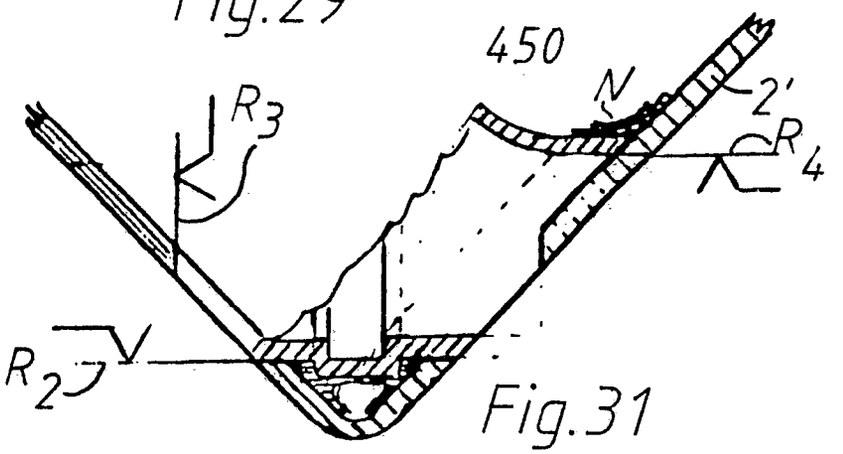


Fig.31

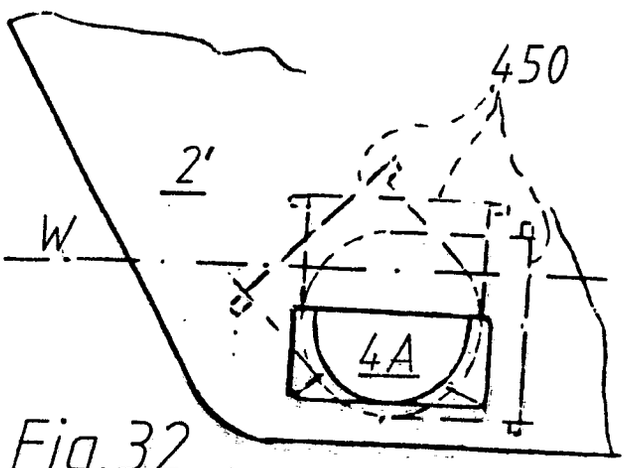


Fig.32

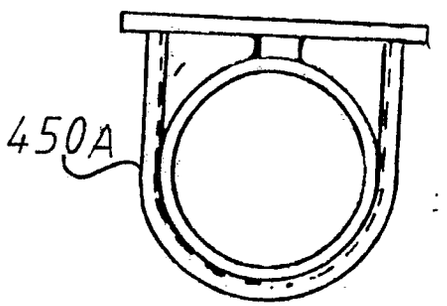


Fig.34

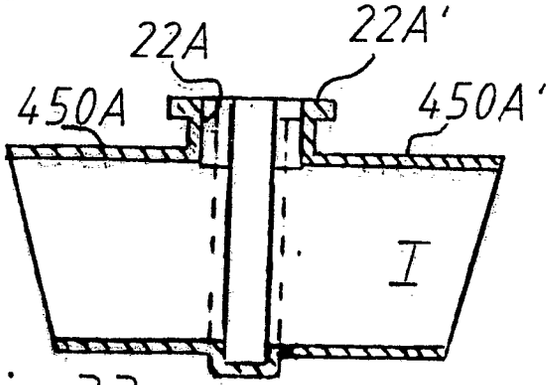


Fig.33

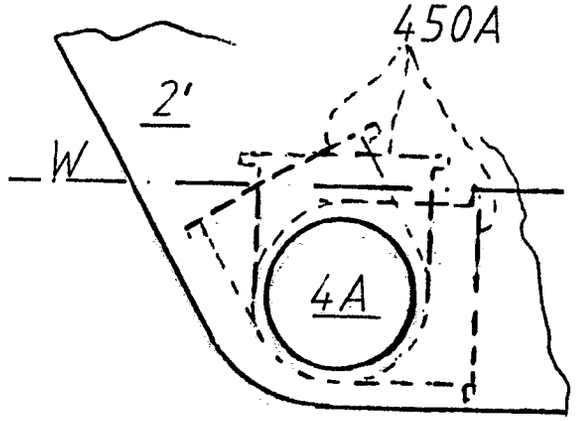


Fig.35

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EUROPEAN SEARCH REPORT

Application Number

EP 89 85 0029

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	GB-A-1 107 461 (VICKERS et al.) * Page 1, line 33 - page 3, line 67; figures 1,2 *	1,14,21-24	B 63 H 25/42 B 63 H 25/46
Y		2-6,8,9,20,25-28	
A		19	
Y,D	US-A-4 294 186 (WARDELL) * Whole document *	2-6,8,9	
A,D		7	
Y	US-A-2 652 505 (MATHEISEL) * Column 2, line 29 - column 3, line 37; figures 1-4 *	20	
Y	DE-A-2 262 843 (SPEKSNIJDER) * Whole document *	25,26	
Y	US-A-1 197 850 (SATTERTHWAITE) * Figures 1-12 *	27,28	
X	DE-A-2 264 416 (FLEUCHAUS) * Figure 1a *	29	TECHNICAL FIELDS SEARCHED (Int. Cl.4) B 63 H B 63 B
A	US-A-3 707 939 (BERG) * Abstract; figures 1-5 *	10-12,15,19,20,27	
A	US-A-3 580 210 (SVENSEN) * Abstract; figures 1-14 *	15,17,18	

-/-

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11-05-1989	DE SENA Y HERNANDORENA A

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Application Number

EP 89 85 0029

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	DE-C-1 650 724 (C. HURTH MASCHINEN- UND ZAHNRADFABRIK) * Column 2, line 36 - column 4, line 25; figure 1 *	16,19, 20	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11-05-1989	DE SENA Y HERNANDORENA A

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L : document cited for other reasons

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