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(54) Improvements in automatic pool cleaners

(57) Apparatus for cleaning a surface submerged in a liquid is disclosed and claimed. The apparatus comprises a body (12) defining a flow passage (28,32,16,18 and 20) therethrough. The flow passage (28,32,16,18 and 20) extends between a main inlet (26) to the body (12) defined in a peripheral region (22) of the body (12) and an outlet (41) from the body (12). The peripheral region (22), in use, being releasably engageable with a surface to be cleaned and the outlet (41) being connectable to a suction source. A pivotal valve (34) is located in the body (12) for intermittently varying the flow of liquid through the body. The apparatus is characterised in that asymmetry is provided between members of pairs of corresponding parts of the apparatus, such as ports (36 and 38) or tubes (16 and 18).

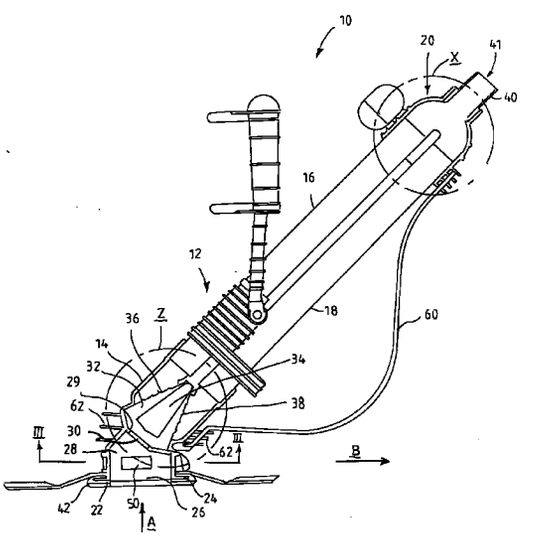

FIGURE 1

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Description

INTRODUCTION AND BACKGROUND

THIS invention relates to cleaners for submerged surfaces. More particularly it relates to suction operable automatic swimming pool cleaners.

Suction operable automatic swimming pool cleaners are known in the art. One such a cleaner is disclosed in US Patent 4,023,227. This machine comprises a body having a planar peripheral region defining a main inlet and which region is releasably engageable with a surface to be cleaned. The body comprises a head defining the aforementioned main inlet, a chamber and a pair of symmetrical exits from the chamber. The body further comprises a pair of similar elongate drive tubes communicating with the pair of exits; and a coupling arrangement connected to the pair of drive tubes and defining an outlet. In use, the body is connected via the outlet to an inlet of a pump and filtration system of a swimming pool. In the chamber there is mounted a symmetrical valve having planar continuous faces for oscillating in the chamber and for intermittently varying the flow of water through the body, thereby to impart kinetic energy to the body, causing the body to move automatically over the surface to be cleaned. As the body moves over the surface, debris is sucked up from the surface through said inlet.

In the aforementioned known cleaner the oscillating movement of the valve is regular, relatively fast and relatively noisy.

OBJECT OF THE INVENTION

It is an object of the present invention to provide alternate apparatus for cleaning a surface submerged in a liquid which the applicants believe will have improved operation.

SUMMARY OF THE INVENTION

According to the invention there is provided apparatus for cleaning a surface submerged in a liquid, the apparatus comprising a body defining a flow passage therethrough extending between a main inlet and an outlet from the body; the body comprising a head defining the main inlet, a chamber and a pair of exits comprising a first exit member and a second exit member from the chamber; a pair of elongate drive tubes comprising a first tube member and a second tube member communicating with the pair of exits; and a coupling arrangement connected to the first and second drive tubes and defining the outlet; the apparatus further comprising a pivotal valve located in the chamber, the pivotal valve having a pair of opposed sealing faces comprising a first face member and a second face member for cooperating with a pair of seats comprising a first seat member and a second seat member at said pair of exits, in use, alternately and repeatedly to obstruct said exits, the apparatus being characterised in that at least one pair of members of said pair of exits, said pair of elongate drive tubes, said pair of sealing faces and said pair of valve seats are asymmetrical.

The term "asymmetrical" is used in this specification to denote that the members of a pair cannot be divided into like portions by a hypothetical line or plane. For example, the first and second tube members may have different diameters and/or the first and second exit members may have different diameters and/or the first and second faces may be asymmetrical about a centre axis of the valve etc.

A baffle plate may be provided between the main inlet and the chamber and a port may be defined off-centre in the baffle plate.

Alternatively or furthermore, the valve may be mounted off-centre in the chamber.

At least one hole may be defined in each of said opposed sealing faces in asymmetrical regions of the opposed faces.

Two further inlets may be defined in asymmetric regions in opposed sidewalls of the head in a region upstream from the valve.

The apparatus may further comprise liquid guide means for imparting whirling motion to liquid flowing through at least part of the body. The means for intermittently varying the flow of liquid through the body is preferably located downstream of the liquid guide means for imparting whirling motion to liquid flowing through at least part of the body.

The liquid guide means for imparting whirling motion to liquid flowing through at least part of the body comprises a plurality of curvilinear projections provided in said peripheral region of the body and defining a plurality of curvilinear channels between them.

The plurality of curvilinear projections may be provided on a face of a footpad, which is mountable on the body in the peripheral region thereof.

The liquid guide means for imparting whirling motion to liquid flowing through at least part of the body may alternatively or in addition comprise at least two further inlets defined in asymmetric regions in opposed sidewalls of the body. The two further inlets may have different sizes.

At least one of said first and second elongate drive tubes may comprise at least one axially extending internal strake.

The head of the apparatus may comprise external fins which are inclined relative to a general plane of said peripheral region.

The apparatus may comprise a bumper assembly arching out from the body, the bumper assembly is preferably made of a material having a specific gravity greater than that of water.

BRIEF DESCRIPTION OF THE DIAGRAMS

The invention will now further be described, by way of example only, with reference to the accompanying diagrams wherein:

figure 1 is a diagrammatic side view of a cleaner according to the invention for cleaning a surface submerged in a liquid;

figure 2 is a diagrammatic view of a footpad of the cleaner, in the direction of arrow A in figure 1;

figure 3 is a section on line III in figure 1;

figure 4 is a transverse section through an elongate drive tube forming part of the cleaner;

figure 5 is a diagrammatic enlarged view, partially sectioned, of the region identified as X in figure 1;

figure 6 is a diagrammatic enlarged view, partially in section, of the region identified as Y in figure 5; and

figure 7 is a diagrammatic enlarged view of the region identified as Z in figure 1.

DESCRIPTION OF PREFERRED EMBODIMENT OF THE INVENTION

A suction operable automatic swimming pool cleaner according to the invention is generally designated by the reference numeral 10 in figure 1.

The cleaner comprises a body 12 comprising a head 14, first and second elongate drive tubes 16, 18 extending from the head 14 and a coupling arrangement 20. The body defines a flow passage for water therethrough extending between a main inlet 26 to the body and an outlet 41 from the body.

The head 14 has a planar peripheral region 22 provided by a flange 24. The main inlet 26 is defined in the peripheral region. Main inlet 26 communicates with a lower chamber 28 which is bounded by a baffle plate 29 defining a port 30 communicating with a chamber 32 for pivotal hammer valve 34. Chamber 32 has first and second exits 36 and 38 communicating with the elongate drive tubes 16 and 18 respectively.

Coupling arrangement 20 comprises a swivel coupling 40 defining outlet 41 and which coupling, in use, is connectable via a flexible hose (not shown), to an inlet of a pump and filtration system (also not shown) of a swimming pool.

As best shown in figure 7, in chamber 32 and about each of exits 36 and 38 there is provided a valve seat 36.1 and 38.1 respectively. Valve 34 having opposed sealing faces 34.1 and 34.2 is mounted off-centre in chamber 32 and, in use, pivots under the influence of water flow through chamber 32, between a first position wherein it obstructs exit 36 and a second position wherein it obstructs exit 38.

As shown in figure 1, a footpad 42 is removably mountable on flange 24. As best shown in figure 2, the footpad 42 comprises a circular body 43 defining a central hole 44, which , in use, communicates with main inlet 26. On the bottom surface of footpad 42 which , in use, bears on the surface being cleaned, there are provided a plurality of curvilinear projections 46 defining a plurality of curvilinear channels 48 extending from the outer periphery of the footpad inwardly towards the hole 44. At least some of the projections 46 are made of a porous resilient material. The projections 46 made of the aforementioned material act like suction pads and serve to improve traction of the footpad 42 on the surface being cleaned.

As shown in figures 1 and 3, in opposed sidewalls 14.1 of head 14 and in the region of lower chamber 28, there are defined two further inlets 50 and 52 which are offset relative to one another on a line which is parallel with the plane of the peripheral region 22.

The aforementioned curvilinear channels impart whirling motion to the water entering the body. Water is also admitted through further inlets 50 and 52, which also impart whirling motion to the water admitted.

In use, the apparatus assumes the attitude illustrated in figure 1 on a submerged horizontal surface to be cleaned. When suction is applied to the apparatus 10 by the said pump, water entraining debris enters the body via curvilinear channels 48 in footpad 42, hole 44 and main inlet 26.

The water flows through chamber 28, port 30 and chamber 32 towards outlet 41. As more fully described in US 4,023,227, water flowing past the valve 34 causes the valve to pivot between the aforementioned first and second positions, thereby alternately and repeatedly to obstruct flow through exits 36 and 38. This alternate and repeated obstruction of exits 36 and 38 causes kinetic energy in a body of water stopped as a result of such obstruction, to be transferred to the cleaner body, thereby to cause the cleaner automatically to move over the surface in the direction indicated by arrow B, shown in figure 1.

It has been found that the operation of the cleaner described hereinbefore may be improved by providing asymmetry between the members of one or more pairs of corresponding parts of the cleaner. For example, the two drive tubes 16, 18 and/or exits 36 and 38 may have slightly different diameters. Furthermore or alternatively, the sealing of the hammer valve 34 on seats 36.1 and 38.1 respectively may be different. This may be achieved by mounting a symmetrical valve 34 off-centre in chamber 32. It may also be achieved by providing the valve 34 with asymmetrical curved sealing faces as shown at C in the broken lines in figure 7. Another or additional way to achieve asymmetry is to provide asymmetrical positioned holes 64.1 and 64.2 in valve 34, one of which 64.2 straddles one edge of the corresponding valve seat 38.1, in chamber 32. In another embodiment a plurality of holes may be provided in the hammer. It has been found that such holes reduce noise emitted by the cleaner during operation.

Asymmetry may also be achieved by offsetting port 30.

As illustrated in figure 4, each drive tube 16, 18 comprises a plurality of axially and radially inwardly extending internal strakes 53. These strakes serve to straighten the flow of water as it passes through the drive tubes 16, 18.

As is clear in figure 6, there is defined a clearance 53 between swivel coupling 40 and a bearing 54 which is a friction fit in the body of coupling arrangement 20. A washer 56 is supported on an inwardly directed flange 58 on the body below the lower end of the coupling 40 and is so shaped that water drawn into the coupling arrangement through the clearance 53 is directed along the inside wall of the coupling 40 in the same direction as the main water flow. This arrangement not only reduces vortices in flow in the region of the coupling arrangement 20, but also increases the flow towards the pump.

The bumper arrangement 60 shown in figure 1 is made of a material having a specific gravity greater than that of water. This increased weight together with the leverage effect of being applied at a distance from the body 12, improves the ability of the cleaner 10 to turn off a sidewall (not shown) of a swimming pool (also not shown).

As shown in figure 1, the external fins 62 on the head 14 are slightly inclined relative to the plane of the peripheral region 22. These fins act like airfoils to press the cleaner 10 into closer contact with the surface being cleaned.

By adopting one or more of the features discussed above, it has been found that the frequency of oscillation is reduced, debris or the like is maintained in suspension and are more readily picked up and there is an increase in the flow of water through the cleaner.

It will be appreciated that there are many variations in detail on the apparatus according to the invention without departing from the scope and spirit of the appended claims.

Claims

1. Apparatus for cleaning a surface submerged in a liquid, the apparatus comprising a body (12) defining a flow passage (28, 32, 16, 18 and 20) therethrough extending between a main inlet (36) and an outlet (41) from the body; the body comprising a head (14) defining the main inlet, a chamber (32) and a pair of exits comprising a first exit member 36 and a second exit member 38 from the chamber; a pair of drive tubes comprising a first tube member 16 and second tube member 18 communicating with the pair of exits; and a coupling arrangement (20) connected to the first and second drive tubes and defining the outlet; the apparatus further comprising a pivotal valve (34) located in the chamber, the pivotal valve having a pair of opposed sealing faces comprising a first face member 34.1 and a second face member 34.2 for cooperating with a pair of seats comprising a first seat member 36.1 and a second seat member 38.1 at said pair of exits, in use, alternately and repeatedly to obstruct said exits, the apparatus being characterised in that at least one pair of members of said pair of exits, said pair of elongate drive tubes, said pair of sealing faces and said pair of valve seats are asymmetrical.

2. Apparatus as claimed in claim 1 wherein there is provided a baffle plate (20) between the main inlet (26) and the chamber and wherein a port (30) is defined off-centre in the baffle plate.

3. Apparatus as claimed in any one of claims 1 and 2 wherein the valve is mounted off-centre in the chamber.

4. Apparatus as claimed in any one of claims 1 to 3 wherein at least one hole (64.1, 64.2) is defined in each of said sealing faces of the valve.

5. Apparatus as claimed in any one of claims 1 to 4 wherein at least two further inlets (50, 52) are defined in asymmetric regions in opposed sidewalls 14.1 of the head in a region upstream from the valve.

6. Apparatus as claimed in any one of claims 1 to 5 comprising liquid guide means (48) for imparting whirling motion to liquid flowing through at least part of the body.

7. Apparatus as claimed in claim 6 wherein the means for intermittently varying the flow of liquid through the body is located downstream of the liquid guide means for imparting whirling motion to liquid flowing through at least part of the body.

8. Apparatus as claimed in claim 7 wherein the liquid guide means for imparting whirling motion to liquid flowing through at least part of the body comprises a plurality of curvilinear projections (46) provided in said peripheral region of the body and defining a plurality of curvilinear channels (48) between them.

9. Apparatus as claimed in claim 8 wherein the plurality of curvilinear projections are provided on a face of a footpad (42), which is mounted on the body in the peripheral region thereof.

10. Apparatus as claimed in any one of claims 6 to 9 wherein the liquid guide means for imparting whirling motion to liquid flowing through at least part of the body comprises at least two further inlets (50, 42) defined in asymmetric regions in opposed sidewalls (14.1) of the body.

11. Apparatus as claimed in claim 10 wherein the two further inlets have different sizes.

12. Apparatus as claimed in any one of claims 1 to 11 wherein at least one of said first and second elongate drive tubes comprises at least one axially extending internal strake (53).

13. Apparatus as claimed in any one of claims 1 to 12 wherein the head has external fins (62) thereon which are inclined relative to a general plane of said peripheral region.

14. Apparatus as claimed in any one of claims 1 to 13 comprising a bumper assembly (60) arching out from the body, the bumper assembly being made of a material having a specific gravity greater than that of water.

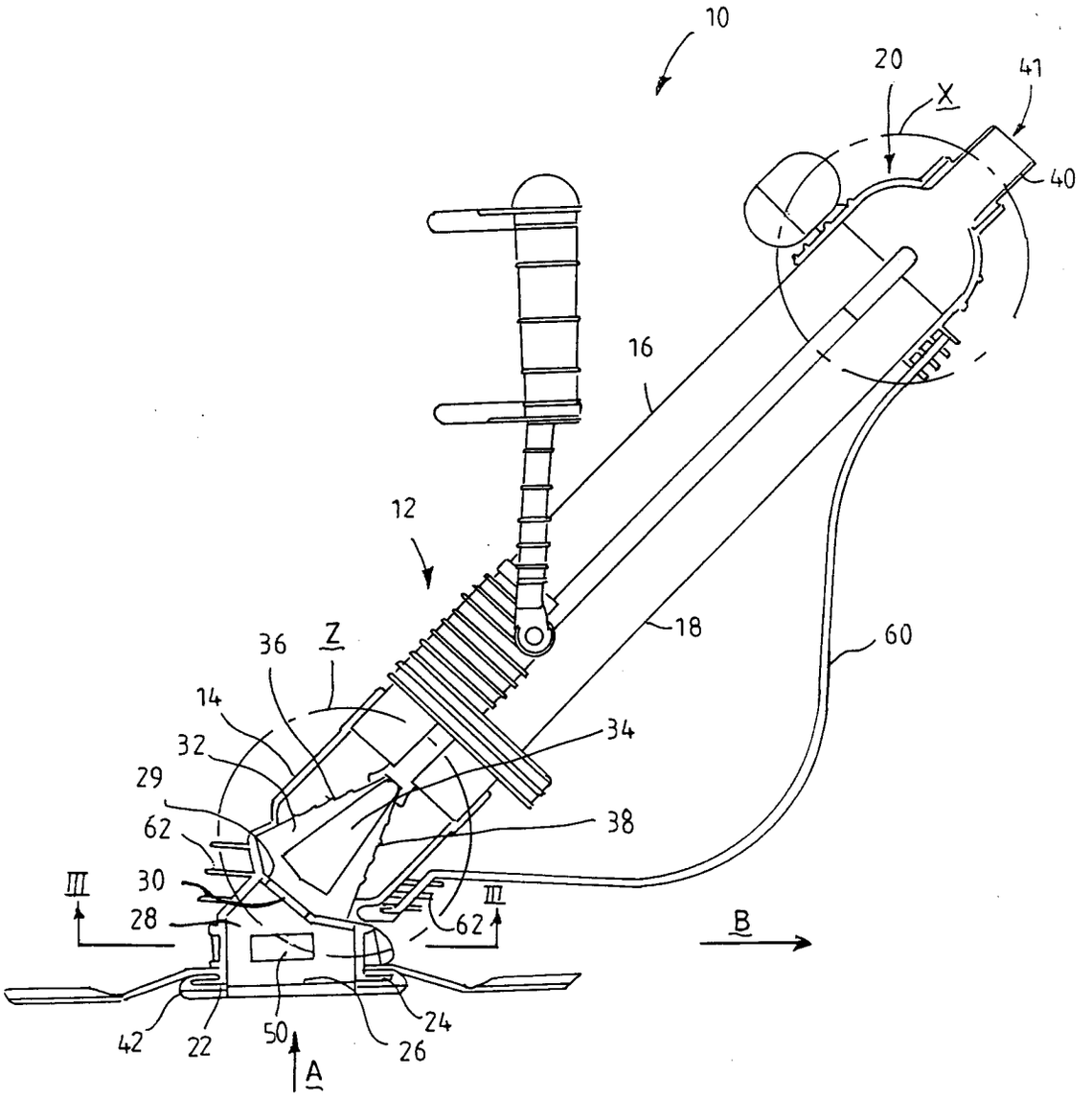
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FIGURE 1

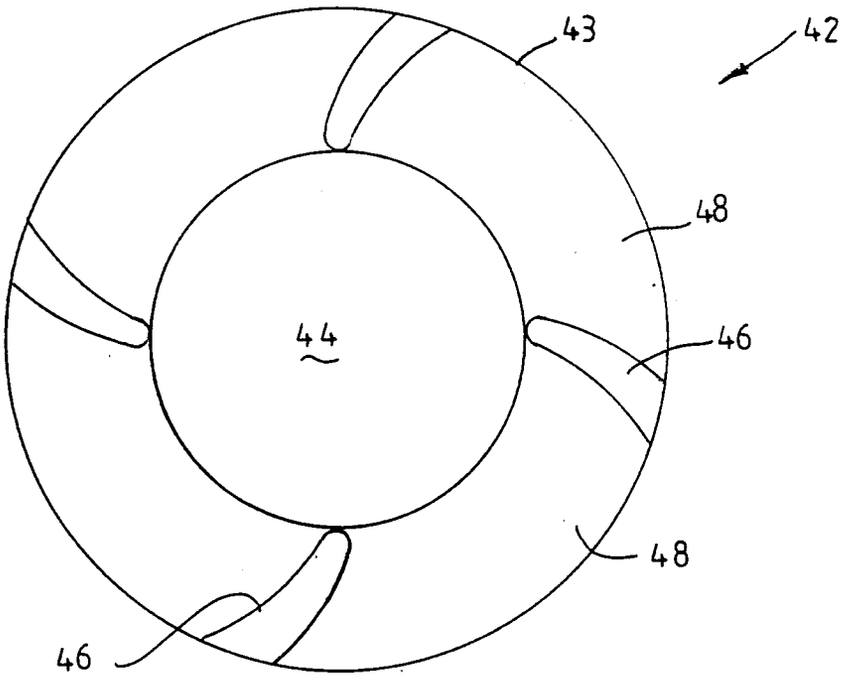

FIGURE 2

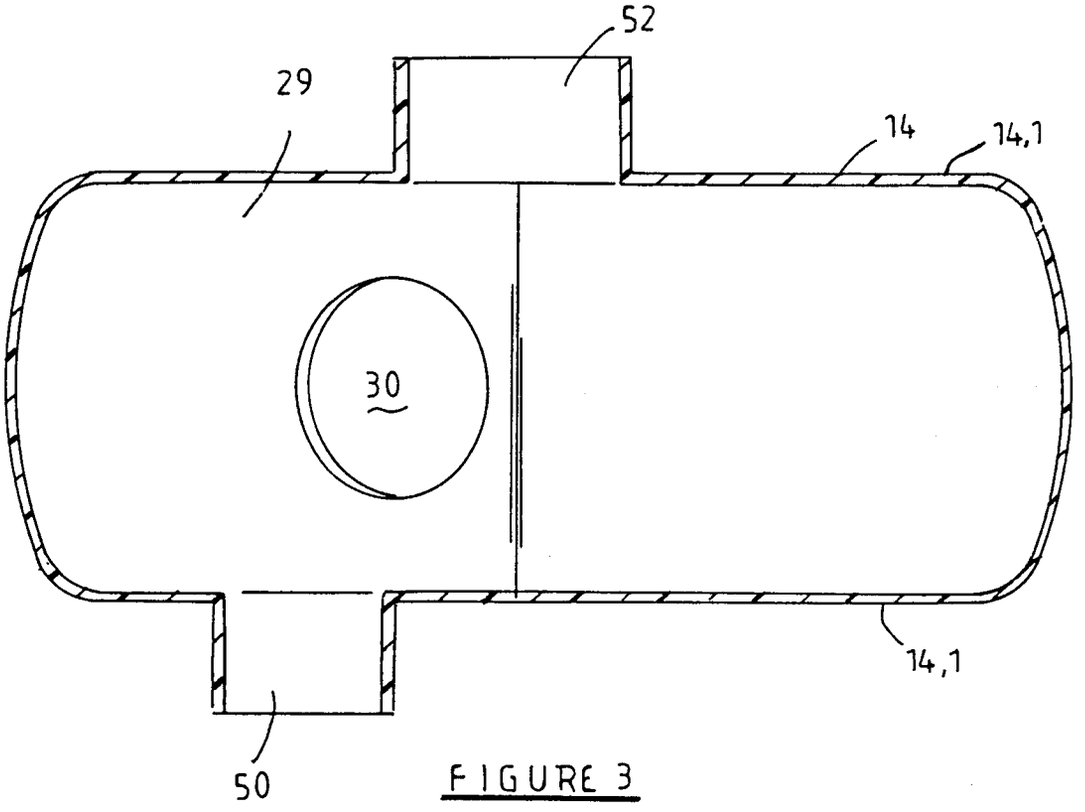

FIGURE 3

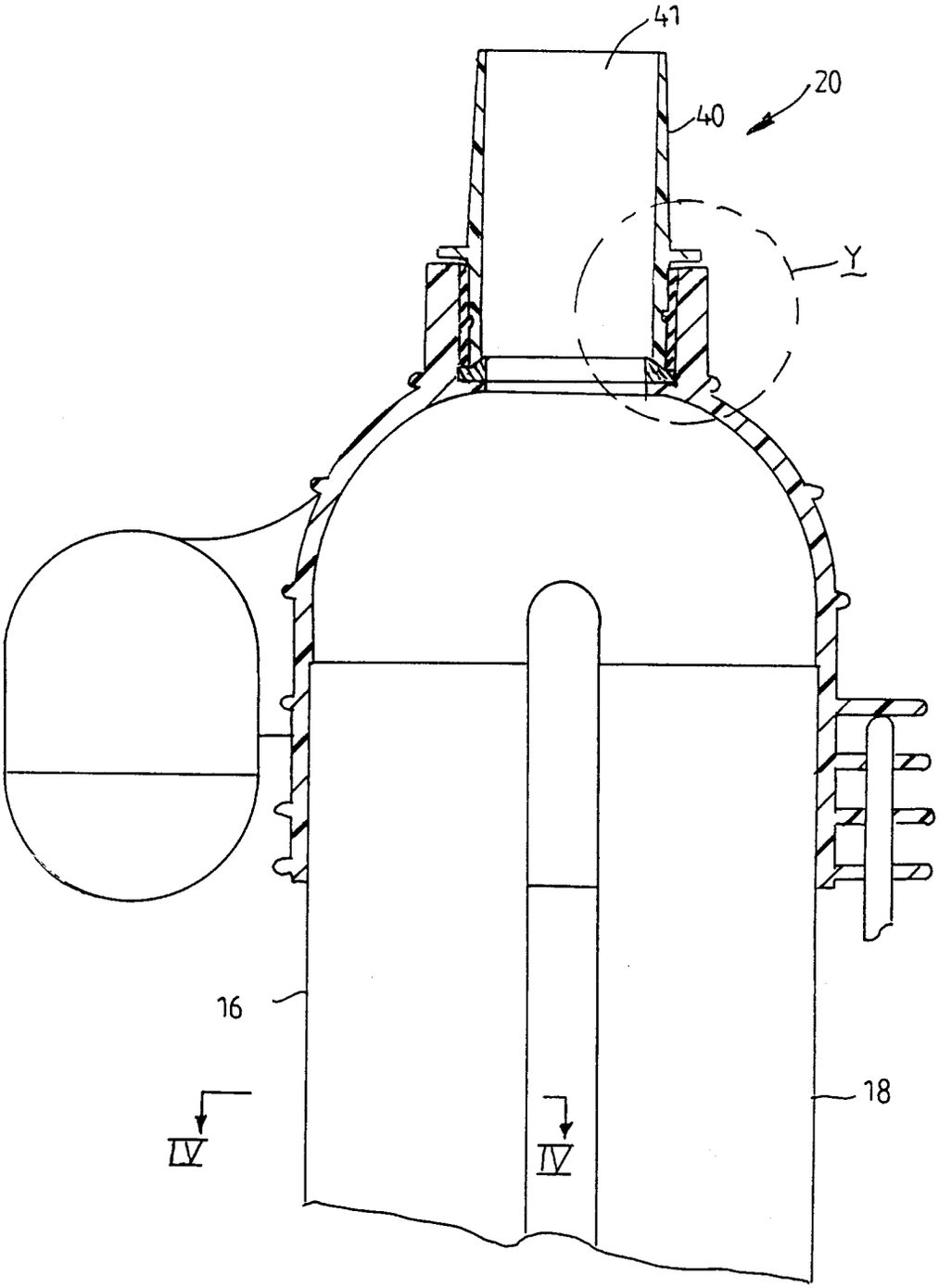

FIGURE 5

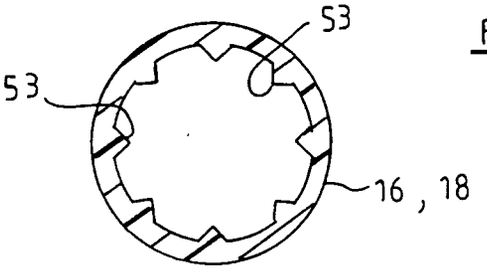

FIGURE 4

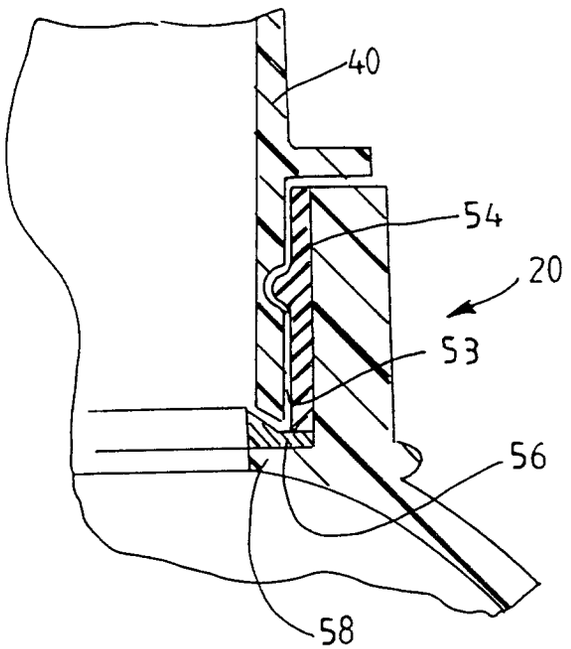

FIGURE 6

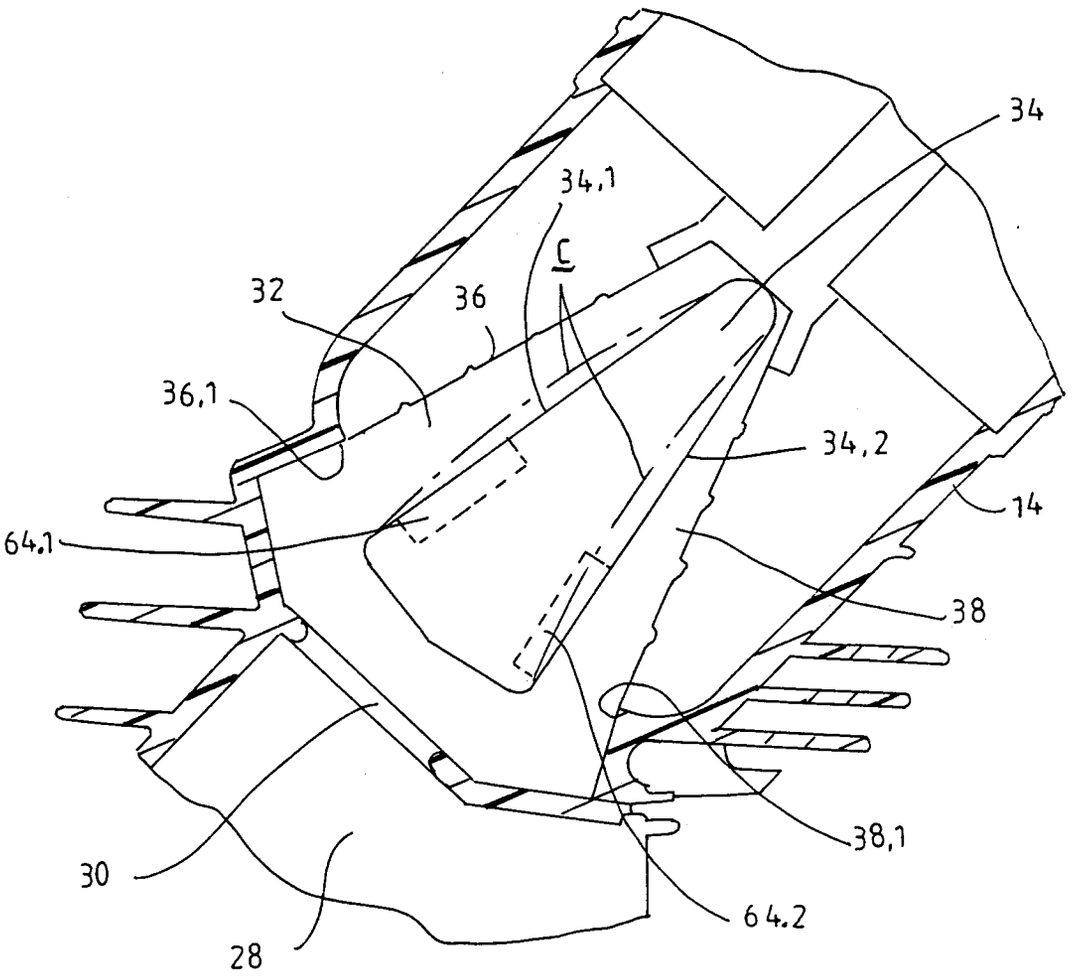

FIGURE 7