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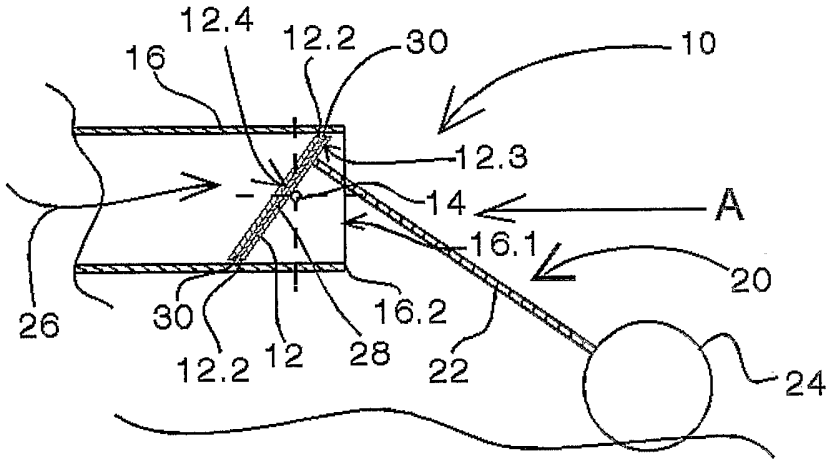
(54) Title: FLOAT VALVE TYPE LIQUID FLOW CONTROL REGULATOR



(57) Abstract: A liquid flow regulator 10 comprises a flow control member in the form of a swivellably mounted flow control disk 12 that is fitted via a horizontal shaft 14 secured the frontal face 12.1 of the disk 12, to a tubular circularly profiled conduit 16 to perform a butterfly valve type operation about a horizontal axis 18, and a mechanically operable flow control member manipulating facility providing an arm arrangement 20 incorporating an arm 22 fitted with a buoyancy member 24. The disk 12 is suitably ovally formed to sealably seat against the inner wall of the conduit 16 while still at a forward slanted angle. The disk is constrained to lie generally in the direction liquid flow along the conduit 16 when fully opening the liquid flow path 26 by the arm 22 coming to rest on the frontal lip 16.2 of the conduit 16 when the disk 12 fully open. The arm arrangement 20 is secured at its inner end to the upper section 12.3 of the disk 12.

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(1) TITLE OF THE INVENTION

FLOAT TYPE VALVE

(2) BACKGROUND TO THE INVENTION

The control of liquid flow along a conduit depending on a downstream condition such as a liquid level or pressure is a well known activity. Where control is achieved via a swivellably mounted member as automatically mechanically controlled without the application of addition power while the extent of force available in causing the member to be swivelled to a conduit opening condition is constrained by other factors the unobstructed release of the member from its conduit closing condition is of particular importance. It is also sometimes desirable to make use of as large as possible liquid flow ability along a conduit even though the flow there along must be controlled.

(3) FIELD OF THE INVENTION

This invention relates to a liquid flow regulator installable to regulate the flow of liquid from an upstream supply according to a downstream demand. Although not so limited the invention finds useful application in the case of serving as a float valve type liquid flow control regulator as thus fitted with buoyancy means.

(4) PRIOR ART DESCRIPTION

Liquid flow controllers for automatically mechanically controlling the flow of liquid along a conduit depending on a downstream condition such as a liquid level or pressure is commonly known in the art. Typically the ordinary float valve comes to mind. A disadvantage of the equipment know to the applicant is that even at maximum flowrate it cannot extensively use the cross sectional diameter of a conduit resulting in a slow response even in the case where quick and extensive flow is required. While in line swivellably mounted equipment such butterfly valves are also commonly used for controlling the flow of liquid along a conduit they are commonly operated with the use of substantial addition power such as being hand operated, thus not performing a continuous controlling function, or operated via an external powering means such as an electric motor in which case the equipment can be used to perform a liquid flow control function. In so performing a liquid flow control function the involvement of the external powering means is particularly important to ensure that the valve

does not remain stuck in its conduit closing condition despite being subject to an opening demand.

(5) BRIEF DESCRIPTION OF THE DRAWING

The invention is now described, by way of example, with reference to the accompanying drawings. In the drawings

Figure 1 shows in diagrammatic sectioned side elevation a liquid flow regulator, according to the invention, in the form of a float valve type regulator in its upstream supply sealing off condition,

Figure 2 shows in diagrammatic detail the fitting of the flow control member of the regulator to its conduit,

Figure 3 shows the regulator in full end view the direction of arrow A in figure 1,

Figure 4 shows the regulator in the same direction as figure 3 though in the flow conduit fully open condition,

Figure 5 diagrammatically shows the operation of the regulator when used for controlling a liquid level, and

Figure 6 diagrammatically shows the operation of a further embodiment of the regulator as fitted with a delaying mechanism for delaying its reaction to an alteration of a liquid level.

(6) DETAILED DESCRIPTION OF THE DRAWINGS

Referring to the drawings, a liquid flow regulator, according to the invention, in the form of a float valve type regulator is generally indicated by reference numeral 10.

The regulator 10 comprises a flow control member in the form of a swivellably mounted flow control disk 12 that is fitted via a horizontal shaft 14 secured the frontal face 12.1 of the disk 12, to a tubular conduit 16 of circular end profile to perform a butterfly valve type operation about a horizontal axis 18, and a mechanically operable flow control member manipulating facility in the form of a liquid level responsive manipulating facility that is provided by an arm arrangement 20 incorporating one or more arms 22 fitted at its position remote from where secured to the disk 12 with a buoyancy member 24. A liquid flow path 26 is thus defined along the conduit 16 along which the flow of a liquid such as water is controlled once the regulator 10, as operatively installed, is in use.

To promote the release of the disk 12 from its conduit closing condition when urged to commence opening in response to the gravitational descent of the member 24, as brought about by a dropping liquid level, the disk 12 is formed to sealably seat against the inner wall of the conduit 16 while still at a forward slanted angle with respect to the transverse plane through the conduit 16 once closing off the latter, as clearly shown in figures 1 and 2. As the conduit 16 is of circular profile the disk 12 is thus of matching oval profile to achieve its sealable seating at the appropriate angle of forward slanting 25. Although not so limited the disk 12 can typically lie at an angle of forward slanting 25 of in the order of 20 degrees once it sealably seats against the conduit 16.

Sealing between the disk 12 and the inner wall of the conduit 16 can be achieved by way of any conventional technique. Typically the peripheral rim 12.2 of the disk 12 can be formed with a circumferential groove 28 into which a sealing ring 30 is fitted once the regulator 10 is ready for use. In addition the inner wall of the conduit 16 can be suitably lined. Otherwise and while not shown, the peripheral rim of the disk 12 can be fitted with permanent sealing substance or the disk 12 can be in the form of opposite rigid planar members between which a resilient leaf is sandwiched to the extent of forming a peripheral sealing strip.

While when in its conduit closing off condition the ease of opening of the disk 12, when so urged, is promoted by its forward slanting stance, as shown in figures 1, 2, 5(a) and 6(d), the extent of swivelling the disk 12 is constrained to cause it to generally lie in the direction liquid flow along the conduit 16, as shown in figures 4, 5(b), 6(a) and 6(b) when fully opening the liquid flow path 26 along the conduit 16 thus enabling the use of substantially the full cross sectional flow area of the conduit 16. Constraining of the disk 12 to so lie in the direction liquid flow along the conduit 16 is achieved by a position along the inner end of the arm arrangement 20 coming to rest on the frontal lip 16.2 of the conduit 16 when the disk 12 fully open, as again shown in figures 5(b), 6(a) and 6(b).

The arm arrangement 20 is secured at its inner end to the upper section 12.3 of the disk 12. The inner end of the arm arrangement 20 extends slightly offset to the transverse direction relative to the frontal face 12.1 of the disk 12. Swivelling of the disk 12 from its flow path closing off condition thus has the effect of the upper section 12.3 of the arm 12 moving towards the discharge end 16.1 of the conduit 16 on opening of the regulator 10.

Although not particularly shown in the drawings the regulator 10 naturally makes provision for its conventional installation to a liquid supply line at the upstream side of the conduit 16.

Referring to figures 1 to 5 and in one embodiment the arrangement 20 consists of one rectilinearly extending rigid arm 22 as thus secured at its inner end to the upper section 12.3 of the disk 12. The free end of the arm 22 carries the buoyancy member 24.

While the arm 22 is shown to extend rectilinearly it will be appreciated that it must be formed to accommodate the location of installation of the regulator 10. If thus submerged when installed the arm 22 will have to be appropriately formed to ensure that the buoyancy member 24 still effectively performs its function. It can thus be formed with one or more locations of discontinuity along its length or even extend arcuately.

In specifically referring to figure 5 the operation of the rigid arm embodiment of the regulator 10 simply involves the opening or closure of the flow path 26 along the conduit 16 once the regulator 10, as operatively installed, is in use in response to the movement of the buoyancy member 24. When the level of liquid in conjunction with which the buoyancy member 24 is used is at a desired upper elevation, the disk 12 is positioned in its conduit sealing condition, as shown in figure 5(a). Dropping of the level results in the descent of the buoyancy member 24 causing the progressive opening of the flow path 26 in response to forward swivelling of the disk 12. The forwardly slanted seating of the disk 12, when in its the flow path 26 sealing condition, and the securing of the arm 22 to the upper section 12.3 of the disk 12 promotes its opening by limiting the possibility its remaining stuck in its flow path sealing condition. Descent of the liquid level thus progressively causes the opening of the flow path 26.

In referring to figure 5(b) maximum opening of the flow path 26 is achieved when the disk 12 has been swivelled to generally lie in the direction liquid flow along the conduit 16. The disk 12 is constrained from swivelling beyond this condition owing to the arm 22 coming to rest against the lip 16.2 of the conduit 16.

It will be appreciated that during use the flow path 26 will not often become fully opened as the object of the regulator 10 is to maintain a desired liquid level. But where liquid is removed at a high rate from a reservoir or the like of which the level is desired to be regulated by the regulator 10, it can be replenished at a substantially full flow path cross sectional area rate as the disk 12, when in its fully opened condition as shown in figure 5(b), only to a small extent affects the flow path cross sectional area.

In another embodiment of the arrangement 20 and referring to figure 6 provision is made for a delaying mechanism in the form of an elbow 34 provided along the arm arrangement 20. The elbow 34, as dividing the arrangement 20 in two arms 22.1 and 22.2, enables the buoyancy carrying arm 22.1 to swivel relative to the trailing arm 22.2 along an arc 42 between an upper stop 38 formed by a stop block 36 fitted to the arm 22.2 and a lower stop achieved by the facing ends of the arms 22.1, 22.2 being formed to come to abut against one another once they extend in general rectilinear alignment with respect to one another. As shown in figures 6(a) and 6(b) the effect of the delaying mechanism is to cause the disk 12 to maintain a specific extent of opening despite a rise in liquid level.

When the buoyancy member 24 is thus at its fully dropped condition, as shown in figure 6(a) the disk 12 is in its fully opened condition. In referring to figure 6(b) a rise in the liquid level causes the arm 22.1 to commence swivelling about the arc 42 in response to a rise in the elevation of the buoyancy member 24 while the arm 22.2 retains its downward pending condition as so gravitationally promoted by the weight of this arm and the forward tilting of the disk 12. Replenishment thus takes place at the maximum supply rate during this phase as the disk 12 is retained at its maximum liquid flow conduit opening condition. This aids in providing a rapid initial replenishment where withdrawal of liquid takes place rapidly.

Once the arm 22.1 comes into abutment with the stop 38 the arm 22.2 also commences to swivel in conjunction with the arm 22.1 causing progressive closure of the disk 12 as shown in figure 6(c) until full closure of the flow path 26 is achieved, as shown in figure 6(d). While the delaying effect of the elbow arrangement is functional on closure of the disk 12, the disk will 12 commence to open without delay in response to a drop in liquid level owing to the effect of gravity on the arm 22.2.

In addition to the advantages of unobstructed opening from its fully closed condition and only to a small extent reducing the cross sectional area of the conduit along which flow is controlled, a further advantage of the invention is that the regulator 10 need not be designed to substantially make provision to overcome an upstream supply pressure when the flow of liquid such as water must be diminished and eventually terminated in response to a rising level. Owing to being mounted to swivel about a central axis 18 the upstream supply pressure effectively exerts a balancing force about the axis 18 on the face 12.4 of the disk 12 thus neither urging it to swivel the one or the other way. The force required to be exerted by the buoyancy member 24 for swivelling the disk 12 into its flow path closing condition must

thus only be of adequate magnitude to achieve such swivelling action. On opening the arrangement 20 need only be of adequate weight to gravitationally cause the forward swivelling of the disk 12 about its axis 18. This has the advantage that the buoyancy member 22 need not provide a large buoyancy force and can be substantially smaller than the buoyancy members used in conjunction with conventional ball valve equipment. As the valve closing action does not require a large torque the arm 22 or arms 22.1, 22.2 need not be lengthy.

these factors thus contribute to a more compact piece of equipment as compared to conventional float valve type equipment with the added advantage that provision is made for a large replenishment flow rate range that can vary between fully closed up to substantially the full cross sectional area of the flow supply tube.

(7) CLAIMS

(1) A liquid flow regulator (10) installable to regulate the flow of liquid from an upstream supply according to a downstream demand comprising

a flow control member (12) that is mounted along a liquid flow conduit (16), along which a liquid flow path is thus defined, and that is suitably installable along a flow line if not forming an integral part thereof for controlling the flow of liquid along such flow line once the regulator (10) is operatively installed, and

a mechanically operable flow control member manipulating facility (20) that is arranged to be responsive to the extent of downstream liquid demand and that appropriately co-acts with the flow control member (12) to cause its displacement to at least its liquid flow permitting condition once subjected to such demand and in the appropriate case vice versa once the demand is satisfied, once the regulator is in use,

characterised in that the flow control member (12) is swivellably displaceably mounted to the conduit (16) to be swivelled about an axis (18) extending at least substantially transverse to the liquid flow path (26) along the conduit (16) between flow path closing and opening conditions in the fully open condition of which the flow control member (12), as suitably formed, only marginally, if at all, reduces the cross sectional flow area along the flow path (26), and in that the flow control member (12) in such a way seats against the inner wall of the conduit (16) to promote its release from its conduit closing condition by the operation of the flow control member manipulating facility (20) once the latter is subjected to a downstream liquid demand.

(2) A liquid flow regulator as claimed in claim 1 in which the flow control member (12) is in the form of a swivellably mounted flow control disk of which the edge thus seats against the inner wall of the conduit (16) once in its closed condition.

(3) A liquid flow regulator as claimed in claim 2 in which the flow control disk (12) is mounted to swivel about an axis (18) that promotes a butterfly type valve action along the conduit (16), as regularly and appropriately profiled, even if only for the section within which the flow control member is operative, to enable proper displacement and seating of the disk (12) between its flow path fully opened condition, in which the disk (12) is constrained to lie at least generally along the flow direction of liquid along the conduit (16) thereby only

marginally reducing the cross sectional flow area along the flow path (26), and a closed condition in which it sealably seats against the inner wall of the conduit (16).

(4) A liquid flow regulator as claimed in claim in claim 3 in which the disk (12) is arranged to sealably seat against the inner wall of the conduit by way of a circumferentially extending seal provided by a sealing ring (30) extending along the periphery of the disk (12).

(5) A liquid flow regulator as claimed in claim 3 in which the disk (12) is arranged to sealably seat against the inner wall of the conduit (16) owing to at least one of the edge of the flow control disk and the inner wall of the conduit presenting a sealing lip and/or being fitted with appropriate lining material for achieving a sealable seat of the disk against the inner wall of the conduit (16) once the flow control member is in its flow path closing off condition.

(6) A liquid flow regulator as claimed in any one of claims 3 to 5 in which the flow control disk (12), when fully closing off the conduit (16), seats against the inner wall of the conduit (16) in a way that promotes its release from its conduit closing off condition by the operation of the flow control member manipulating facility (20) once the latter is subjected to a downstream liquid demand owing to the outline shape of the disk (12) matching to such an appropriate extent with the inner profile of the conduit (16) that the plane of the disk (12) lies at a forward slanting angle (25) into its direction of swivellable opening relative to the transverse plane through the conduit once the disk (12) fully closes off the conduit (16).

(7) A liquid flow regulator as claimed in claim 6 in which the disk (12) is at a forward slant of in the order of 20 degrees with respect to the transverse plane through the conduit (16) once in its conduit closing off condition.

(8) A liquid flow regulator as claimed in any one of claims 3 to 7 in which the flow control disk (12) is mounted to swivel about an axis (18) that extends at least substantially through the centre of the conduit (16).

(9) A liquid flow regulator as claimed in claim 8 in which the flow control disk (12) is trailingly with respect to the direction of liquid flow along the conduit (16) along the zone of inter-securing there between, fitted to a swivellably mounted shaft (14), along which the axis swivelling (18) of the disk (12) thus extends, once closing off the liquid flow path (26), causing the disk (12) in the case where the axis of swivelling (18) extends horizontally once the regulator is operatively installed, to be situated onto the shaft (14) once the disk (12) is swivelled to its conduit fully open condition.

(10) A liquid flow regulator as claimed in any one of claims 3 to 9 in which the liquid flow conduit (16) is of circular end profile while the disk (12), when arranged to form a slanting angle (25) with the transverse plane through the conduit (16) when fully closing off the liquid flow path (26) is of complementary oval shape to cause the proper sealing of the conduit (16) when in its conduit closing off condition.

(11) A liquid flow regulator as claimed in any one of claims 2 to 10 in which the flow control member manipulating facility (20) co-acts with the flow control disk (12), as appropriately mounted, in a way that urges its opening in response to the application of a force as gravitationally brought about once operatively installed.

(12) A liquid flow regulator as claimed in claim 11 in which the flow control disk (12) is mounted to swivel about an at least substantially horizontal axis (18) once the regulator is operatively positioned.

(13) A liquid flow regulator as claimed in claim 12 in which the flow control member manipulating facility (20) is in the form of a liquid level responsive manipulating facility for controlling a liquid level situated downstream of the regulator in maintaining it at a desired level once the regulator as operatively installed is in use, the manipulating facility (20) thus being arranged to cause the displacement of the disk (12) between its liquid flow permitting and closure conditions depending on the downstream demand of liquid.

(14) A liquid flow regulator as claimed in claim 13 in which the flow control member manipulating facility (20) comprises an arm arrangement extending swivelling motion inducing fashion away from the flow control disk (12) and buoyancy means (24) that is fitted to the arm arrangement remote from its position of securing to the disk (12) for causing the disk (12), as thus suitably mounted relative to the conduit (16) to enable the proper operation of the flow control member manipulating facility (20), to swivel between liquid flow path closing and opening conditions in response to the rise and fall of the buoyancy means (24).

(15) A liquid flow regulator as claimed in claim 14 in which, in the case where the disk (12) is mounted to swivel butterfly valve fashion, the arm arrangement (20) is secured to the upper section (12.3) of the frontal face (12.1) of the disk (12), as facing the conduit discharge (16.1), and in a way that results in its extending suitably away from the disk (12) to cause the buoyancy means (24) to effectively operate the disk (12) once the regulator is operatively installed, the securing of the arm arrangement (20) to the upper section (12.3) thus

gravitationally contributing to the release of the disk (12) from its closed condition once so urged.

(16) A liquid flow regulator as claimed in claim 14 or claim 15 in which the arm arrangement (20) is in the form of one rigidly extending arm (22) resulting in the flow control disk (12) being responsive to any movement of the arm (22) as brought about by the alteration of the elevation of the buoyancy means (24) in response to liquid level variation once the regulator is in operative use.

(17) A liquid flow regulator as claimed in claim 14 or claim 15 in which the arm arrangement (20) includes a delaying mechanism (34) constituted to cause the flow control disk (12) to maintain a specific stance within a pre-established range of alteration in the elevation of the buoyancy means (24) once the regulator is in operative use.

(18) A liquid flow regulator as claimed in claim 17 in which the delaying mechanism (34) is in the form of at least one elbow formed between adjacent arms (22.1, 22.2) forming the arm arrangement (20) to cause the buoyancy means carrying arm (22.1) to swivel relative to the trailing arm (22.2), as secured to the disk (12), in the plane of arm arrangement displacement between appropriate stops selected to maintain the flow control disk (12) in a specific condition despite a rise in liquid level, as thus taken up by the swivelling action of the buoyancy means carrying arm (22.1) relative to the trailing arm (22.2).

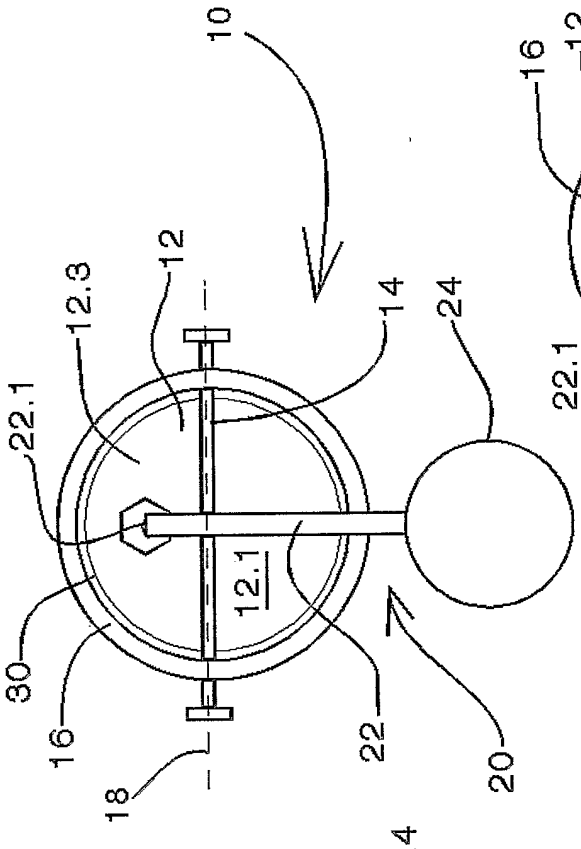


FIGURE 3

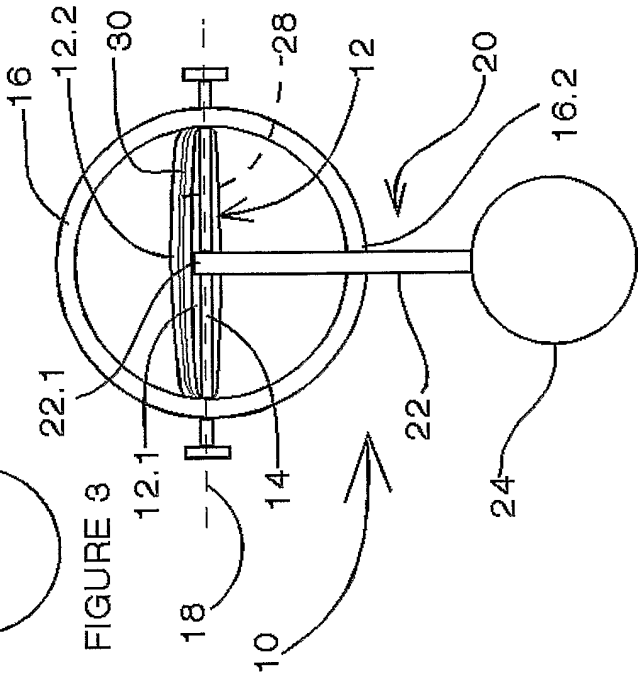


FIGURE 4

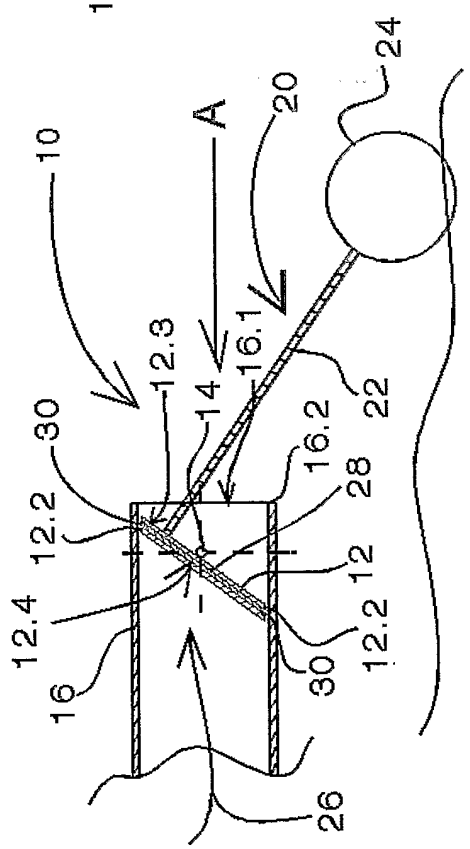


FIGURE 1

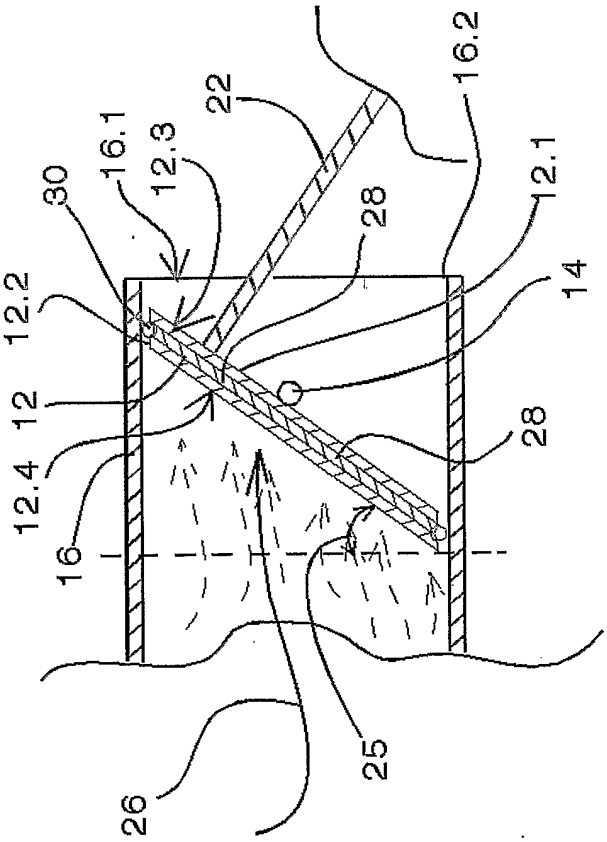
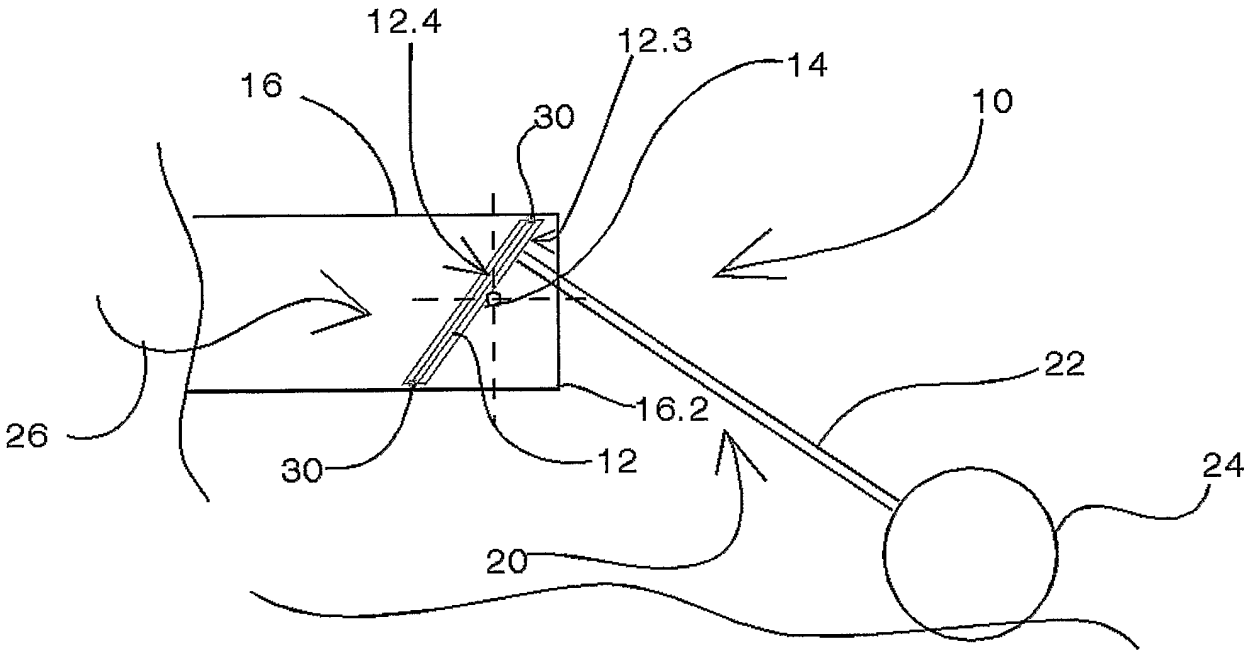
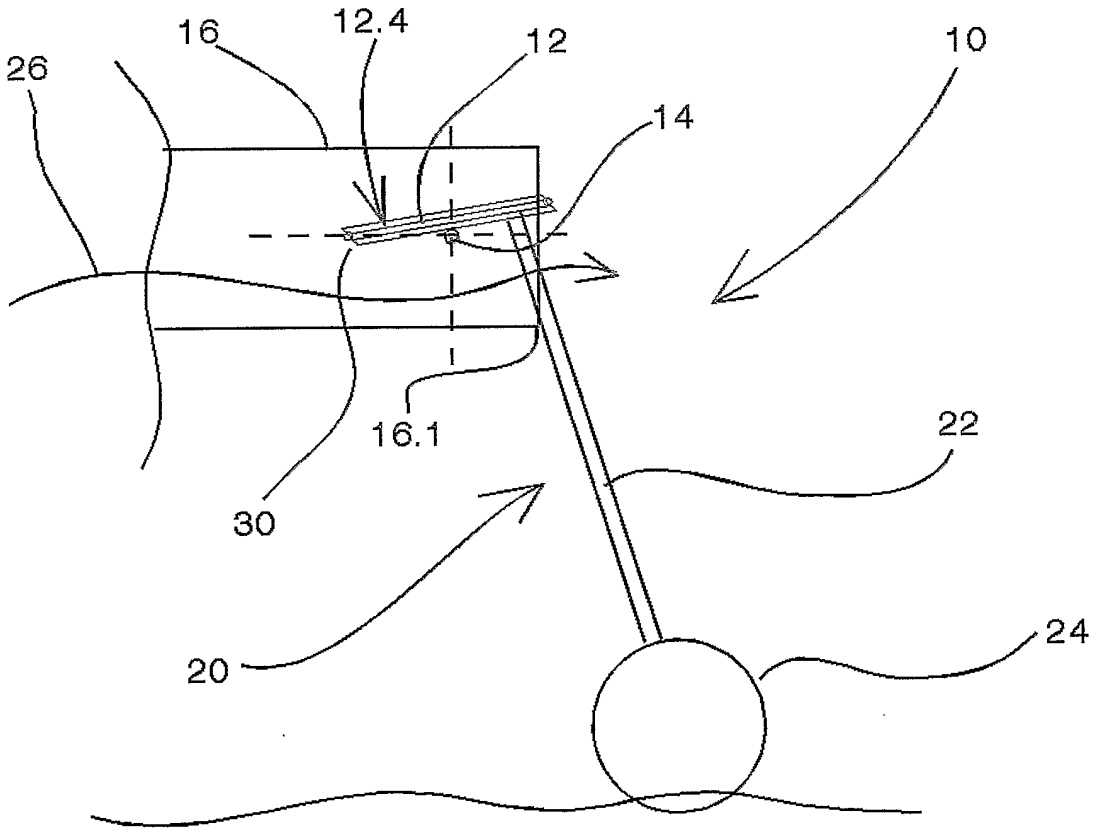


FIGURE 2



5(a)



5(b)

FIGURE 5

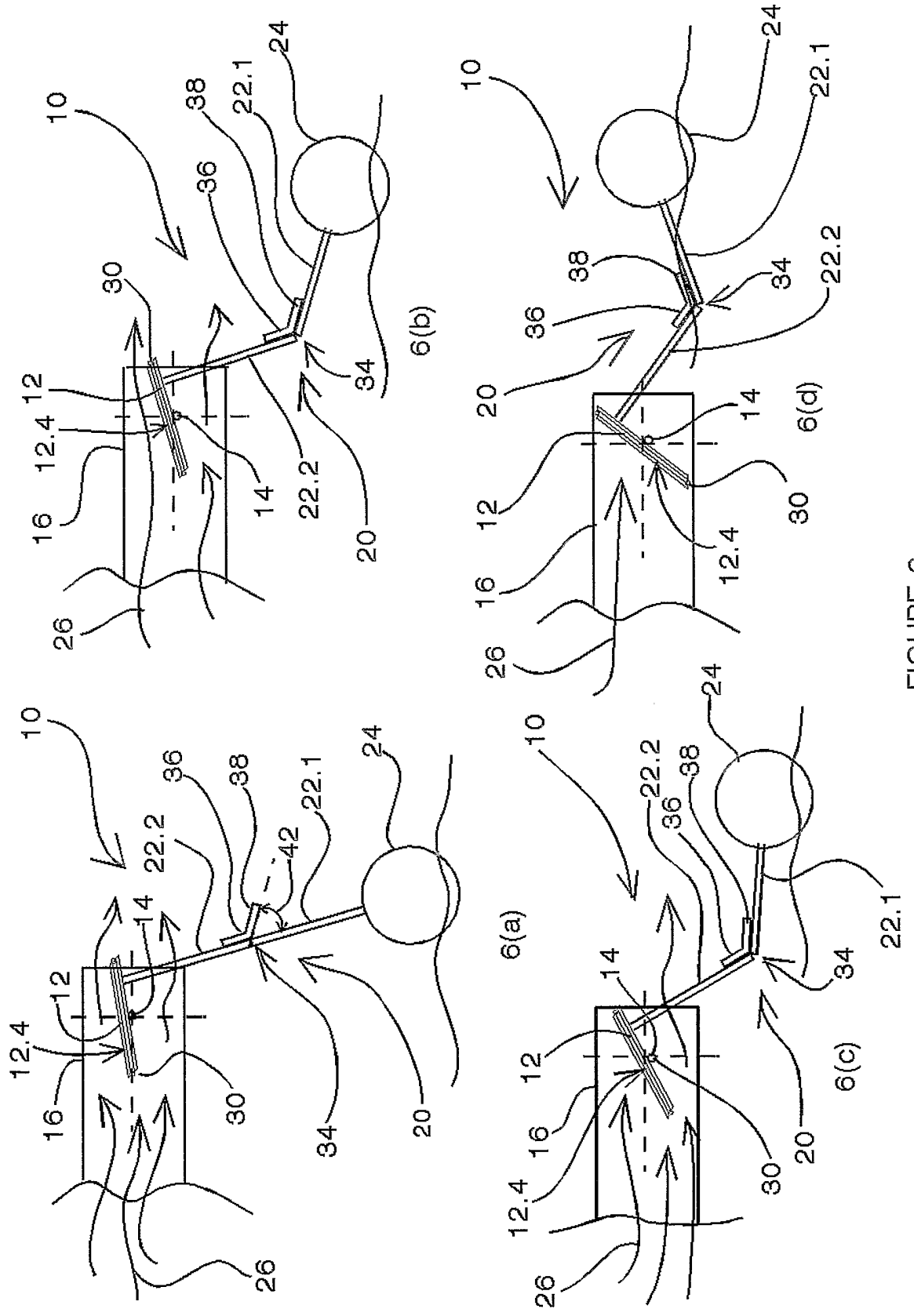


FIGURE 6

INTERNATIONAL SEARCH REPORT

International Application No
PCT/ZA 03/00091

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F16K1/22 F16K31/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F16K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2 934 082 A (HELD CHESTER W ET AL) 26 April 1960 (1960-04-26) column 2, line 3 -column 3, line 15; figures 1-5	1-16
X	US 4 998 571 A (BLUE BARRY M ET AL) 12 March 1991 (1991-03-12) column 4, line 7 -column 7, line 40; figures 1-6	1-16
X	CH 396 770 A (UNHOLZ WALTER) 31 July 1965 (1965-07-31) page 1, line 57 -page 2, line 71; figures 1,2	1-16

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
16 January 2004	04/02/2004

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

Int onal Application No
PCT/ZA 03/00091

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	DE 100 52 383 A (BLAU KUNSTSTOFFTECHNIK ZWEIGNI) 2 May 2002 (2002-05-02) column 2, line 65 -column 4, line 23; figures 1-4	1-16
X	GB 708 298 A (ROY WHITWORTH) 5 May 1954 (1954-05-05) page 1, line 75 -page 2, line 126; figures 1-4	1-16
A	US 5 031 655 A (HEBAUS MICHAEL B) 16 July 1991 (1991-07-16) figures 4-8	1,17,18
A	AT 400 176 B (ORTNER BAUWAREN) 25 October 1995 (1995-10-25) figures 1-4	1,17,18
A	GB 1 306 343 A (APV COMPANY LTD.) 7 February 1973 (1973-02-07) figures 1,2	1

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INTERNATIONAL SEARCH REPORT

....ormation on patent family members

Int nal Application No
PCT/ZA 03/00091

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2934082 A	26-04-1960	NONE	
US 4998571 A	12-03-1991	NONE	
CH 396770 A	31-07-1965	NONE	
DE 10052383 A	02-05-2002	DE 10052383 A1	02-05-2002
GB 708298 A	05-05-1954	NONE	
US 5031655 A	16-07-1991	NONE	
AT 400176 B	25-10-1995	AT 196993 A	15-02-1995
GB 1306343 A	07-02-1973	NONE	