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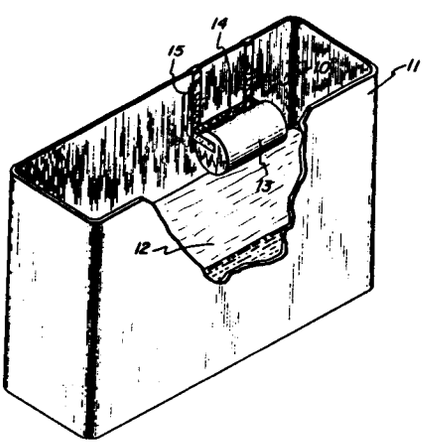
(54) Dispenser for automatically metering liquids in response to liquid level.

(57) A dispenser for automatically metering a liquid-soluble or liquid-suspendible material into a liquid environment in response to a rise and fall in the level of the liquid which comprises a buoyant container adapted for holding the material to be dispensed, said container being adapted for pivotal mounting on an axis which is offset from the axis of the center of buoyancy of said container by an amount from greater than 0% up to about 200% of the distance, a measured along a line through the pivot axis, between said center of buoyancy axis and the outer perimeter of said container, said container having one or more openings in a wall thereof located below the center of buoyancy of said container.



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This invention relates to the field of dispensers used in metering materials, which are liquid-soluble or suspendible, into a liquid environment. It particularly relates to such dispensers adapted for dispensing water-soluble or water-suspendible materials into an aqueous environment. In a preferred embodiment, the invention relates to dispensers for automatically metering materials, such as water-soluble or water-suspendible detergents, bleaches, bactericides or dyes, into toilet tanks during each flushing cycle of the toilet. The dispensers provided by the present invention are of simple, inexpensive construction, having no internal moving mechanical parts, and they depend for their dispensing action only on their unique construction and inherent buoyancy.

There have been numerous approaches described in the prior art to the problem of automatically metering materials, such as detergents, bactericides, bleaches or dyes, into toilet tanks or cisterns. These approaches range from the simple dissolution of a solid block of the desired material directly immersed in the tank or toilet bowl water to generally complex systems which provide siphoning of an aqueous solution of the desired ingredients from a dispenser into the tank water with each complete flushing cycle. One possible approach to the problem, the reliance on the principle of buoyancy of the dispenser itself to

provide automatic dispensing of materials has heretofore received little attention. To the extent this approach has been previously explored at all, the dispensers of the buoyancy type provided by the prior art have certain drawbacks including, among others, a complexity of design and construction which limit the usefulness of the prior art dispensers in modern cisterns and make them commercially unattractive for use.

Thus U.S. Patent 915,629 discloses a toilet tank dispenser having a buoyant float which, on movement up and down with each flushing cycle, turns a dispensing drum via a ratchet mechanism. The drum has a dispensing opening covered by a valve which opens and closes once with each complete revolution of the drum allowing solid disinfectant material contained within the drum to fall by gravity into the tank.

U.S. Patent 1,002,974 discloses a disinfectant distributing device for use in "cisterns" which is based on the up and down movement of a buoyant float. The dispenser has a two compartment receptacle, the compartments being separated from one another by a wall extending partially to the bottom of the receptacle and providing communication between the two compartments. One compartment is filled with the solid disinfectant, potassium permanganate, and the receptacle is hung from a side wall of the

cistern. A float, pivotally mounted to the front wall of the receptacle, is fitted with a ladle which alternately fills with water when the water level in the cistern is lowered and then empties a ladle full of water into the disinfectant containing compartment of the receptacle when the water level is raised. The emptying of the ladle causes the contents of the receptacle to overflow from a spout fitted to an outside wall of the second compartment, the volume of solution dispensed with each cycle corresponding to the volume contained by the ladle.

U.S. Patent 1,365,642 discloses a disinfectant dispensing device which is designed to be hung within the water tank of toilets or urinals for dispensing a liquid type disinfectant. The device consists of a cylindrical tank-type reservoir rotatable about its central axis, fitted diametrically with a pipe within one end wall of the reservoir. One end of the pipe opens within the reservoir, and the other opens outside the reservoir and is directed to a cup affixed to the end wall of the reservoir near the rim thereof. Liquid flows from the cylinder down the pipe into the cup until the liquid level in the cup seals the end of the pipe. A float is attached to the reservoir via a chain and serves to rotate the reservoir about its axis, first in one direction and then in the other, during a flushing cycle of the toilet. Thus as the

water flows out of the toilet tank and the cylinder is rotated, the liquid in the cup runs out into the tank.

U.S. Patent 4,370,763 discloses a dispenser for mounting inside a toilet tank and intended to dispense bleach, dye and detergent into the tank. The dispenser is pivotally suspended at one end from a mounting bracket and is equipped with two compartments, 18 and 20, one adapted for holding and dispensing a source of bleach, such as calcium hypochlorite, the other for holding and dispensing a dye and a detergent, and each compartment is equipped with a buoyancy chamber. When the toilet tank is filled with water, the buoyancy chambers cause the dispenser to tip upward about its pivot allowing water to enter both compartments through holes in the end walls thereof. However, after both compartments 18 and 20 are filled, the water is maintained out of contact with the bleach, dye and detergent by an inclined wall 40 and a connecting wall 44. Thus during the quiescent period, that is in the period between flushings, the bleach, dye and detergent are isolated from the water in the tank. When the toilet is flushed, the dispenser tips downward about its pivot allowing the water to flow around the bleach, dye and detergent, and to leach a small amount of those materials from their compartments, before flowing out of holes in the opposite end walls of the dispenser.

It will thus be seen that the dispensers provided by the prior art are structurally complex, and in some instances would be expensive to manufacture.

BRIEF DESCRIPTION OF THE INVENTION

In contrast to the dispensers disclosed by the prior art, with the exception of the mounting bracket used to suspend them, the dispensers provided by the present invention are essentially one piece units that are simple and inexpensive to produce. More specifically, the present invention is directed to an essentially unitary dispenser for automatically metering liquid soluble or liquid suspendible solid materials into any liquid environment in response to a rise and fall in the level of the liquid which comprises a buoyant container adapted for holding the material to be dispensed, said container being pivotally mounted on an axis which is offset from the axis of the center of buoyancy of said container by an amount from greater than 0% up to about 200% of the distance, as measured along a line through the pivot axis, between said center of buoyancy axis and the outer perimeter of said container. The container is provided with one or more openings, which may be of any shape, such as round, square, rectangular or elongated, in a wall thereof, the opening(s) being generally located below the center of buoyancy of the container.

In a preferred embodiment, the dispenser comprises an essentially closed, hollow, buoyant container having a compartment for holding the material to be dispensed.

The invention is described below with reference to the accompanying drawings wherein:

Fig. 1 is a perspective view partly cut away of a toilet tank or cistern, partially filled with water, showing a typical use of one form of a dispenser of the invention.

Fig. 2 is a front view of the dispenser of Fig. 1 illustrating the dispenser first as it would appear when water in the tank is rising and just prior to initiation of the filling portion of the filling and dispensing sequence of the dispenser and, in phantom, the position of the dispenser at the end of its filling sequence when the level of the water has risen to its normal height.

Fig. 3A is a sectional view on line III-III of Fig. 2 illustrating the dispenser at the same portion of the filling and dispensing sequence shown in Fig. 2.

Fig. 3B is a sectional view similar to Fig. 3A illustrating the dispenser as it would appear during the filling and the dispensing portions of its filling and dispensing sequence.

Fig. 3C is a sectional view, similar to Figs.

3A and 3B, illustrating the dispenser in a non-dispensing mode as the dispenser would appear during the quiescent period of a flushing cycle.

Fig. 3D is a sectional view, similar to Figs. 3A, 3B and 3C, illustrating the dispenser in a non-dispensing mode as the dispenser would appear when the level of the water in the tank is below the dispenser and out of contact therewith.

Fig. 4 is an enlarged end view on line IV-IV of Fig. 2 illustrating the relationship between the pivot axis of the dispenser and the axis of its center of buoyancy.

Fig. 5 is an enlarged, exploded partial front view illustrating one means for adjustably mounting the dispensers of the invention on a mounting strap.

Referring to Figs. 1 and 2, a dispenser of the invention, represented by general reference numeral 10, is disposed in a toilet tank or cistern 11 in which changes in the level of water 12 with each flushing cycle cause the dispenser to move between a non-dispensing and a dispensing mode as a consequence of the changes in water level. As the water level in the tank rises during a flushing cycle, the dispenser rotates between a full down position, shown

in full in Fig. 2, to a full up position, shown in phantom in Fig. 2, the upward rotation, indicated by arrow "a", being caused by rise in the water level, indicated by arrow "b". The dispenser comprises a buoyant container 13 pivotally suspended from a generally U-shaped mounting bracket 14 which is affixed to a pair of mounting straps 15.

As indicated in Fig. 4, the container, represented throughout the drawings herein as being cylindrical in shape, is pivotally suspended from mounting bracket 14 about its pivot axis, represented by "A", which is located above the axis of the center of gravity, corresponding to its center of buoyancy, represented by "B". It is essential in the operation of the present dispenser that the pivot axis A be offset from the center of buoyancy axis B in order for the dispenser to alternately pivot between the dispensing and non-dispensing modes in response to the falling and rising level of water during a flush and refill cycle, respectively, of the toilet, a process which will be described below. In the various figures used herein to illustrate the invention, the amount that pivot axis A is offset from the center of buoyancy axis B as measured along a line through the pivot axis, corresponding to distance A-B in Fig. 4, is depicted as about 50% of the radius of the cylinder, i.e. 50% of the distance between the center of buoyancy and the outer perimeter of the cylinder, an amount

of offset found to be advantageous for the particular configuration of buoyant container here specifically depicted. However, it is to be understood that the amount of offset shown is only a particularly preferred one and that any amount of offset between the two axes, from greater than 0% to about 200%, that will permit the dispenser to function in the desired manner is considered to be within the ambit of the invention. A preferred amount of offset is from greater than 0% up to 100% of the distance between the center of buoyancy and the outer perimeter of the container. When the amount of offset is greater than 100%, then arms on both ends of the container, and extending beyond the outer perimeter of the container, must, of course, be provided.

In determining the amount of offset of the pivot axis from the center of buoyancy axis, it is intended that the distance be calculated with reference to a cross-sectional plane, such as depicted in Fig. 4, which is normal to the pivot and center of buoyancy axes. In the practice of the present invention, the pivot axis can be offset from the center of buoyancy axis by any distance from greater than 0% up to 200% of the distance, as measured along a line extending through the pivot axis, between the center of buoyancy axis and the outer perimeter of the container as viewed in the aforementioned cross sectional

plane.

The method of operation of the dispensers is best seen with reference to Figs. 3A, 3B, 3C and 3D. As shown in Fig. 3A, container 13, which contains material, represented by numeral 19, to be dissolved or suspended in the water of the tank, has an opening 16 in the side of the container. The opening is shown in the drawing as being generally positioned diametrically aligned with the pivot axis A. It should be understood, however, that such diametrical positioning is not essential to the operation of the device, because as will be seen from the description which follows, the partial filling and emptying of the dispenser with water, which is essential to the functioning thereof, can occur when the opening is offset from a diametrical alignment with the pivot axis.

The dispenser is depicted in Fig. 3A as it would appear while the water 12 in the tank is rising and has reached the level shown in the drawing. At that level, and with that orientation of the dispenser, water from the tank cannot enter the dispenser through the opening because of the resistance of air within the dispenser. However, as the water in the tank continues to rise, the container will rotate about pivot axis A until the opening is even with the surface of the water as depicted in Fig. 3B. At that point, water will begin to flow into the dispenser,

and the flow will continue, as the dispenser pivots upward with continuing rise in the level of the water, so long as the opening is even with the surface of the water. However, as the water continues to rise to its maximum level, the dispenser pivots to the point depicted in Fig. 3C where the opening is above the surface of the water, and at that point the flow of water into the tank is shut off by conventional valve means.

The water 12a which has thus entered the container dissolves a small amount of the container contents to be dispensed with the next flushing of the toilet. When the toilet is then flushed, the level of the water in the tank falls, and the container will pivot downwards until the opening is once again in the general position depicted in Fig. 3B, where the water in the container 12a then flows out into the tank. The outflow will continue until the dispenser pivots downwards to the point where the opening becomes covered by the water within the dispenser, at which point a small residual amount of water, as depicted in Figs. 3A and 3D, may be held within the dispenser by the balance between the air pressure within and outside the dispenser. On automatic refilling of the tank, the filling and rotating of the container recycles as described above. From this description it will be seen that the dispensers of the invention operate automatically, dispensing and fil-

ling with each complete flushing and refilling cycle of the toilet.

It is intended that the term "center of buoyancy",as used in this specification, be understood to refer to that center as it would exist in use conditions of the dispensers, and preferably the center should not change its location to any substantial degree as the dispenser contents are consumed with repeated use of the dispenser. That objective can be achieved by proper choice of the physical form and the placement of the dispenser contents. Thus the invention contemplates the use, for example, of pellets or tablets of the material to be dispensed which can either be placed loose within the dispenser or within a movable "cage" structure within the dispenser and permitted to move about within the dispenser under the influence of gravity as the dispenser rotates through the dispensing and non-dispensing modes. Alternatively, and preferably, the material to be dispensed, for example in tablet, pellet or molded cake form, can be affixed to the inner wall of the dispenser in such a location that water entering the dispenser can make contact with the material and leach some of it out for the next dispensing part of the sequence. For such use, the material can be essentially fixed in position within the dispenser, for example by bonding to the inner wall or by encasement within a perforated "cage" structure

integral with the inner wall. When the position of the material to be dispensed is fixed within the dispenser, it is particularly preferred that it be so positioned that it only comes in contact with the water inside the dispenser during the dispensing and filling portion of the sequence but does not come in contact with the water when the dispenser is oriented in its non-dispensing mode. Such preferred positioning of the container of the dispenser contents is represented by reference numeral 19 in each of Figs. 3A, 3B, 3C and 3D, representing a mass of material to be dispensed. By so-positioning the dispenser contents, the rate of dissolution or suspension can be minimized, thus prolonging the useful lifetime of the dispenser contents.

In accordance with the foregoing description, the dispensers of the invention are positioned within the liquid with which they are used at such a height that the container opening 16 is above the surface of the liquid when the liquid has reached its highest level. However, it will be appreciated that the dispensers can also be mounted at such level that they are entirely submerged beneath the liquid during a quiescent period. In fact, when the dispensers are used in a toilet tank, such mounting is a preferred one when, in order to insure that an effective

amount of the dispenser contents will be retained in the toilet after flushing, it is desired to provide for emptying of the dispenser contents into the last portion of the flush water.

That objective can be readily achieved with the present dispensers by mounting them near the bottom of the cistern and locating the pivot axis, the center of buoyancy axis and opening 16 so that, when the dispenser is fully submerged, the dispenser opening will be oriented at the top of the inverted dispenser. The dispensers, when so designed and mounted, will fill and empty in the same manner described before except that ingress of water into the container will stop when the hydrostatic pressure on the outside of the container balances the air pressure inside. Because of their positioning near the bottom of the tank, the dispensers will not begin to empty until most of the water has flowed from the tank.

It will also be evident from the foregoing description that, when multiple openings 16 are used in the container 13, they must be axially aligned with one another and parallel to the pivot axis of the container. Otherwise, as will be seen with reference to Figs. 3A and 4, any second or greater number of openings offset upward in the direction of the center of buoyancy and the pivot point axes will act as an air escape or intake port and will thus

allow a greater volume of water to enter the container during the filling sequence with consequent diminution in the distance between the pivot point and the buoyancy point axes. The distance between these axes can thus be maintained essentially constant, and the buoyant effect optimized, by axial alignment of the openings as described.

In using the dispensers of the invention, they are removably hung or affixed to the inside wall of the tank, with which they are used, at a predetermined height relative to the normal water level in the tank so that they will function properly during a complete filling and emptying cycle of the tank. For purposes of illustration, such use has been described with reference to toilet tanks or cisterns where it may be desired to add, for example, bleaching agents, dyes, bactericides, etc. to the cistern water. The dispensers however are not limited to such use, and in fact they may be used in any system having a controllably variable liquid level in an environment to which it is desired to automatically add materials in response to the rise and fall of the liquid level.

For whatever purpose the dispensers of the invention are to be used, it may be desirable to mount the dispenser to the inner wall of a tank in such way that the height of the dispenser relative to the normal liquid level in the tank can be adjusted up or down as necessary for more

effective use in a particular application. One such adjustable mounting means is illustrated in the drawings herein and in particular in Fig. 5. As depicted in the drawings, mounting strap 15, suspended from the tank rim, is fitted with a plurality of pegs 17 having enlarged heads, and mounting bracket 14 has mounting holes 18 at both ends of the bracket, the holes, in the general shape of a keyhole, having a circular portion and a slotted portion. The enlarged heads of pegs 17 are sized so they will pass through the circular portion of the mounting holes but not through the slotted portion. The bracket is thus secured to the strap by engaging the round portion of the hole at both ends of the bracket with an appropriate pair of pegs on the two straps and then pulling downward on the bracket to engage the pegs within the slotted portion of the holes. The method of adjustably mounting the dispensers just described is one method of accomplishing the stated purpose. However the means by which such mounting is effected is not a critical feature of the invention, and other means well known in the art and familiar to the skilled worker would be equally effective.

The means for pivotal mounting of the dispenser on a mounting bracket as described above can comprise short cylindrical extensions 20 molded into the end walls of the buoyant container which fit within holes in mounting

bracket 14. Any conventional means for pivotal mounting of the container to the brackets, however, would serve the purpose as well. Such conventional means include, for example and without limitation, a rod passing through the container for engagement with holes in the brackets or cylindrical pegs molded into the brackets for engagement with sockets molded in the end walls of the container.

Moreover, although the invention has been described herein with reference to containers which are circular in transverse cross section, the particular cross-sectional shape is likewise not a critical feature of the invention. On the contrary, it is only necessary that the container be buoyant and of such construction and shape that, when suspended on an axis offset from the axis of its center of buoyancy, it can pivot about the former axis to cut off the flow of liquid into the container and to then discharge its contents into the liquid as the level of the latter falls. Thus in addition to containers of circular transverse cross section, those which are elliptical or polygonal in cross section, including triangular, square, rectangular, etc. cross sections, would serve the purpose of the invention as well and are considered to be within the ambit thereof.

It is believed evident from the foregoing that the dispensers of the invention are characterized by simplicity of construction and operation and would be

economical to make and use. They can be so constructed that, if desired, the container 13 can be opened, for example by removal of an end wall, and refilled with a material to be dispensed, or alternatively they may be constructed for one-time use. In either case, they can be fabricated of inexpensive and readily worked materials such as plastics, for example polystyrene, polyvinyl chloride, polyethylene, polypropylene and the like.

C L A I M S

1. A dispenser for automatically metering a liquid-soluble or liquid-suspendible material into a liquid environment in response to a rise and fall in the level of the liquid which comprises a buoyant container adapted for holding the material to be dispensed, said container being adapted for pivotal mounting on an axis which is offset from the axis of the center of buoyancy of said container by an amount from greater than 0% up to about 200% of the distance, as measured along a line through the pivot axis, between said center of buoyancy axis and the outer perimeter of said container, said container having one or more openings in a wall thereof located below the center of buoyancy of said container.

2. A dispenser according to claim 1, wherein said pivot axis is offset from said center of buoyancy axis by an amount from greater than 0% up to 100% of the distance between said center of buoyancy axis and the outer perimeter of said container.

3. A dispenser according to claim 2, wherein said pivot axis is offset about 50% of the radius of said cylindrical container from the center of buoyancy thereof.

4. A dispenser according to any one of the preceding claims, comprising an essentially closed, hollow buoyant container having a compartment adapted for holding said material for dispensing.

5. A dispenser according to claim 4, wherein said container is a cylinder having a circular transverse cross-section.

6. A dispenser according to claim 4 or 5, wherein said container has a single opening in said container wall.

7. A dispenser according to claim 4 or 5, wherein said container has a plurality of openings in said container wall.

8. A dispenser according to any one of the preceding claims containing a bleach, dye or a bactericide as the liquid soluble or liquid-suspendible material.

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9. A dispenser according to any one of the preceding claims, which includes means for vertically adjustably mounting the dispenser in a tank.

FIG. 1

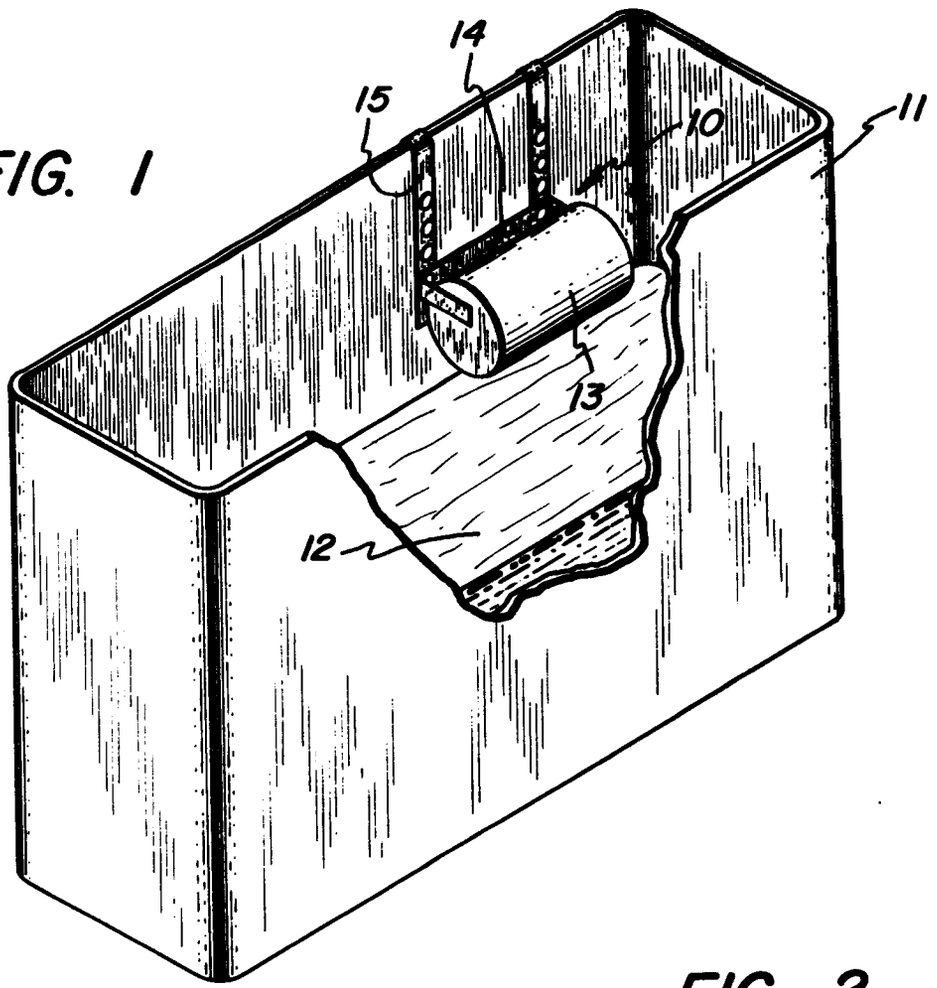

FIG. 2

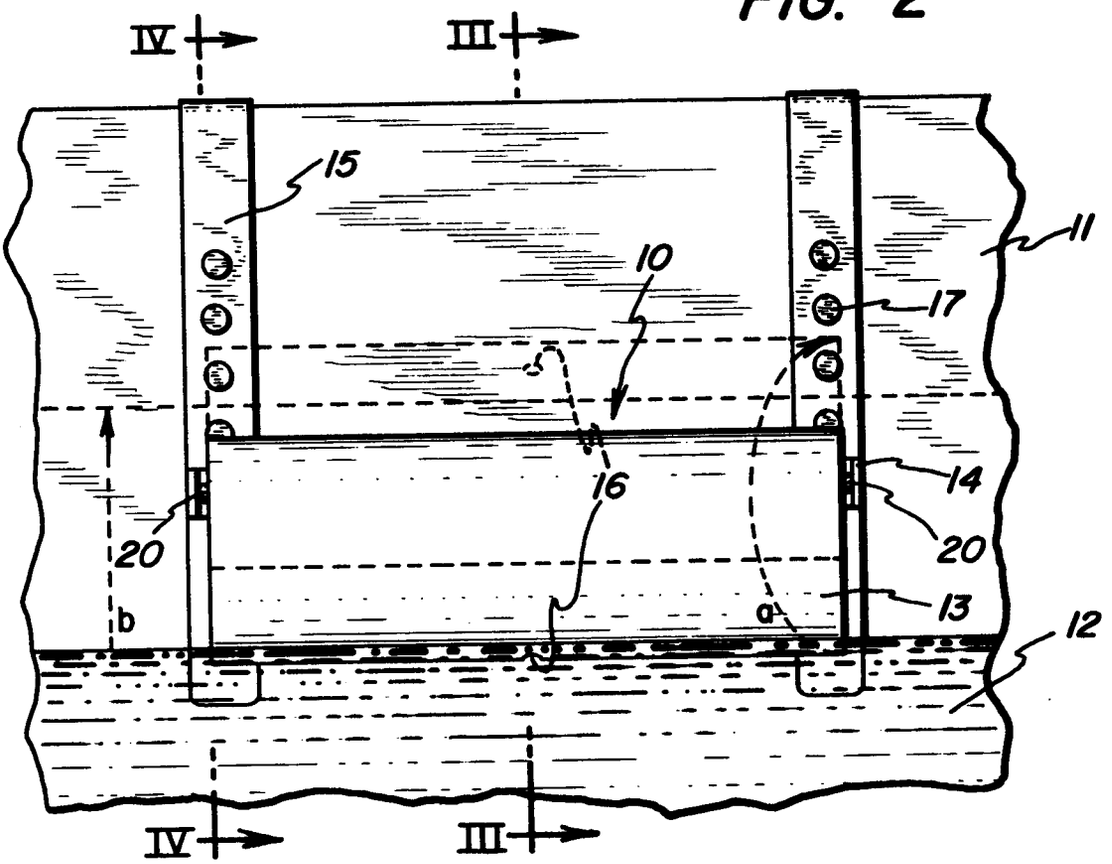

FIG. 3A

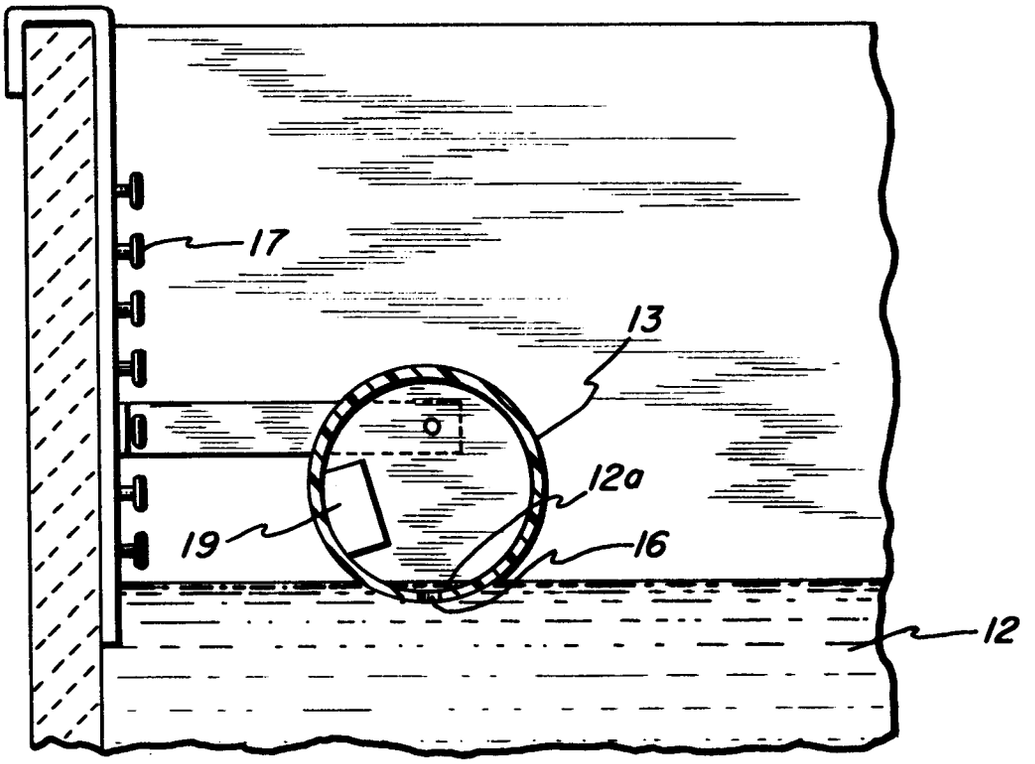

FIG. 3B

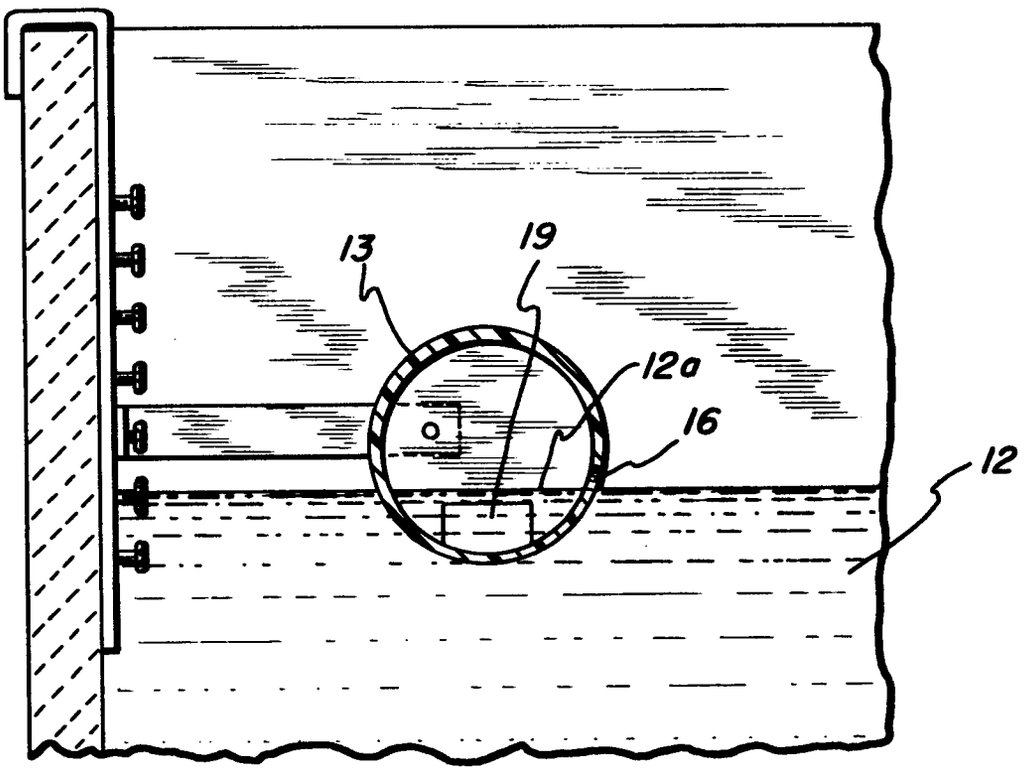

FIG. 3C

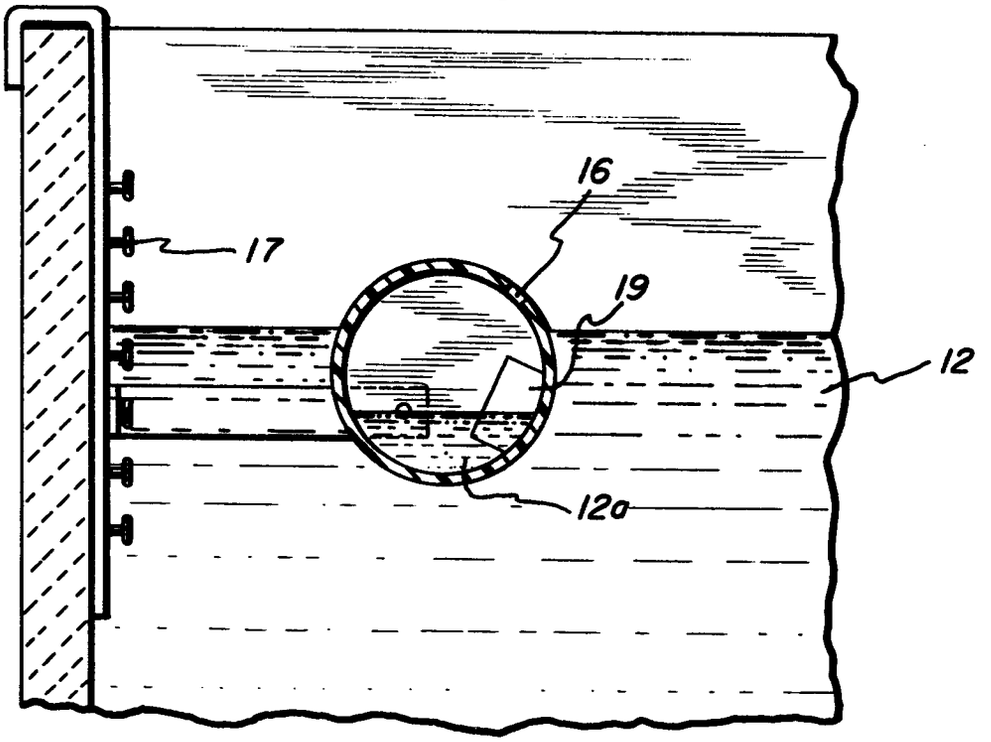

FIG. 3D

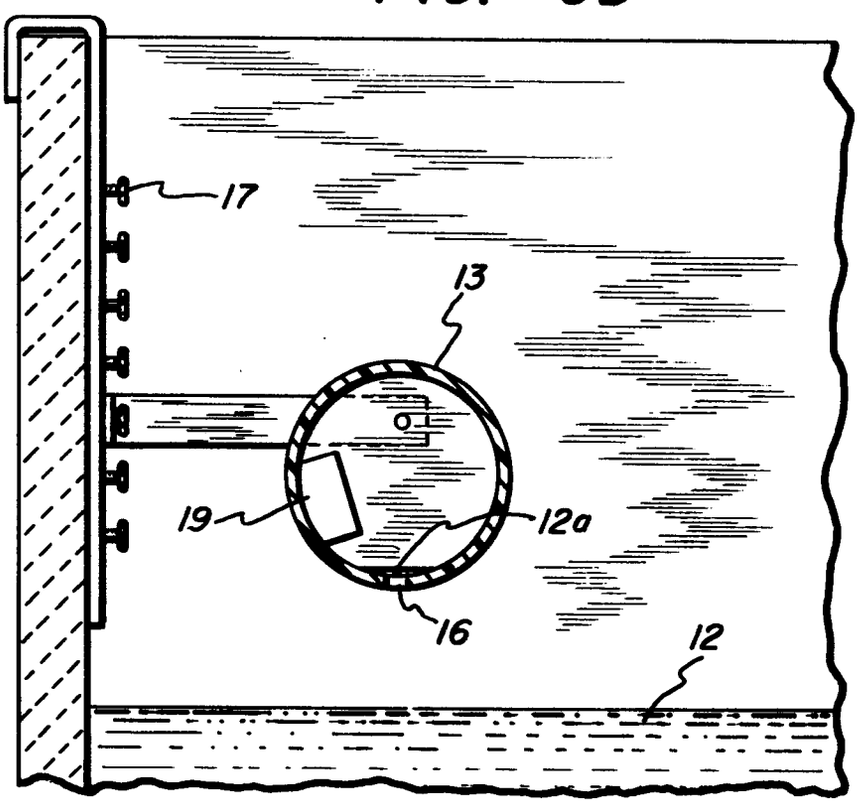

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FIG. 4

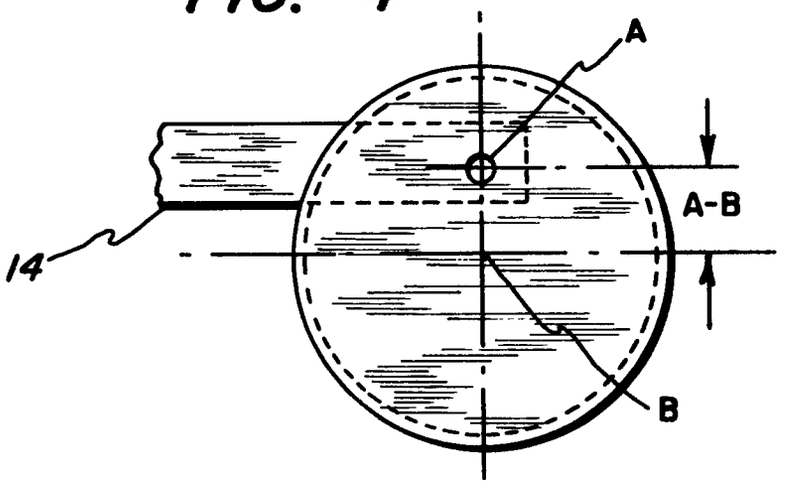

FIG. 5