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POOL VACUUM

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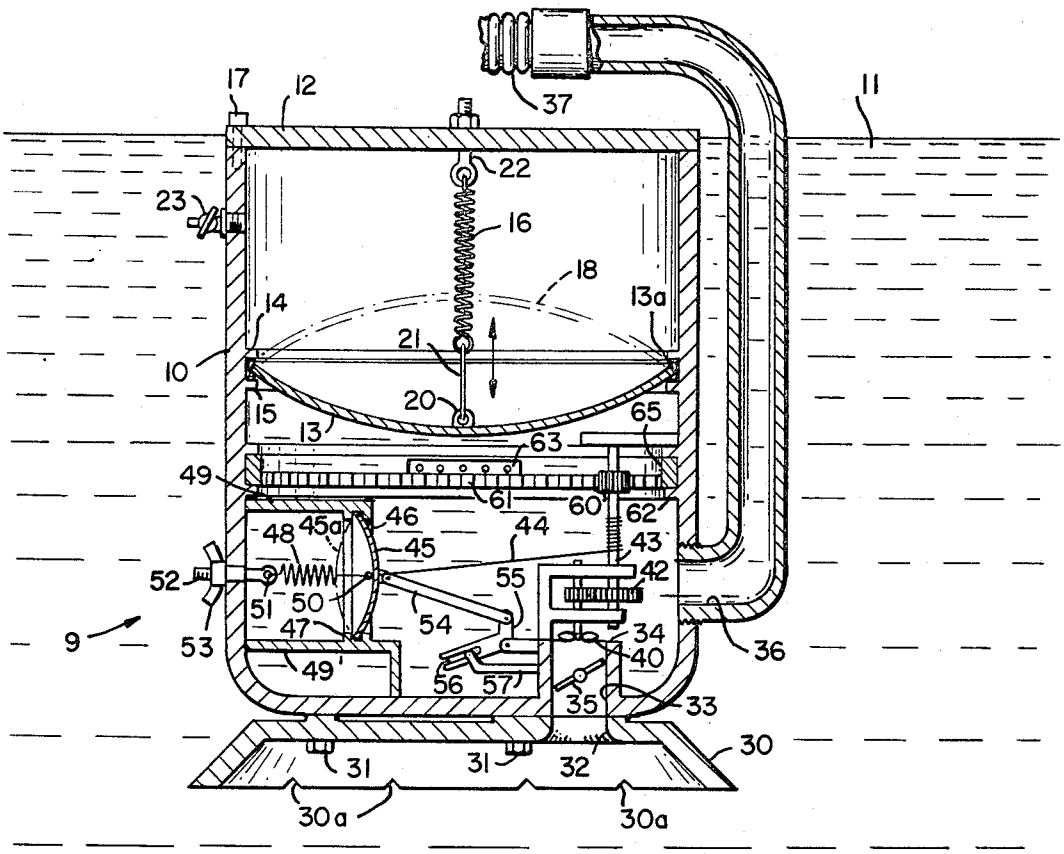

FIG_1

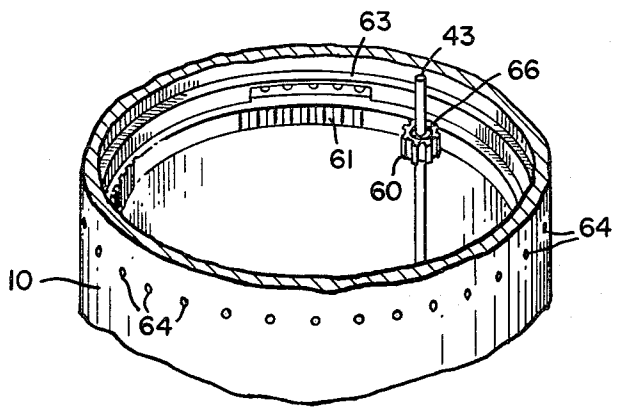

FIG_2

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POOL VACUUM

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This invention relates to cleaning devices and more particularly to automatic cleaning devices for cleaning the bottom of water filled pools, for example swimming pools.

All water filled pools, and particularly swimming pools, require periodic cleaning to remove dirt and debris collecting on the bottom. In the case of swimming pools it has been the practice to clean the pool bottom by vacuuming the pool. The vacuum, operated much like a carpet vacuum, usually consists of a cleaning nozzle attached to the end of a long handle and a flexible hose is used to connect the nozzle to the suction side of a pump used for circulating the pool water through the filter. With the pump operating, the pool is vacuumed by manually moving the nozzle over the bottom of the pool in a sweeping motion. Before the pool is vacuumed it should remain idle for a time to permit the dirt and debris to settle to the bottom.

While the above method of vacuuming pools is satisfactory, it does have several disadvantages. A major disadvantage is the labor and time required to vacuum a large pool. Also the pool cannot be used while the dirt and debris settle and the vacuuming is being accomplished.

In the past various automatic or semi-automatic cleaning systems have been proposed. These systems have not been acceptable because of their high original cost, high cost of installation and complexity of operation. In the smaller sized pools, manual vacuuming has remained the only suitable method for cleaning the pool due to the lack of a simple, inexpensive automatic vacuuming device.

The present invention solves the above problems by providing an inexpensive, automatically operated cleaning device for removing debris from the bottom of pools. The cleaning device of this invention is relatively simple and, as a result, its operation is not complex. Further, it does not require any special installation modifications or maintenance. Also, since it operates automatically it can clean the pool in off hours, for example at night. It is operated with suction and therefore is compatible with the existing filtering system of pools.

The vacuuming device of this invention uses a closed housing having a cleaning nozzle attached to one end. Orientation is provided through buoyancy design to insure the housing will remain upright when it is placed in the pool and the nozzle will properly contact the bottom when the device descends. Incorporated within the housing is a mechanism for causing the housing to alternately submerge to the bottom of the pool and then rise to the surface. More particularly this mechanism comprises means for alternately changing the buoyancy of the housing so it will submerge and rise in the pool in a cycling manner. Located on the bottom of the housing, the nozzle is connected to the suction inlet of the filter pump so the dirt and debris will be swept from the bottom of the pool when the device submerges and the cleaning nozzle contacts the bottom of the pool. A feature of this invention is a means to move randomly the vacuuming device about the pool to insure cleaning all of the bottom of the pool. One means for providing movement is the use of the filter pump suction to create a low pressure on one side of the device as it submerges and rises. The unequal pressures will then move the device to a new location and by arbitrarily changing the area of low pressure about the housing, the device will have a random movement across the pool bottom.

From the above description it is seen that the cleaning device of this invention comprises a cleaning nozzle attached to a housing which alternately submerges and rises in the pool. In addition, the container is moved across the bottom of the pool in a random manner. In this way the complete bottom of the pool is vacuumed without requiring sweeping of the pool bottom with a manual vacuum.

The filter pump of the pool filtering system is used to supply the suction power to operate the vacuuming device as well as to sweep the debris from the pool bottom. Thus, the device is compatible with the existing filter system. Generally the vacuuming device is connected to the filter pump by the same type flexible hose that is normally used to connect a manually operated vacuum to the filter pump.

The above advantages of this invention will be more easily understood from the following description of a preferred embodiment when taken in conjunction with the attached drawing in which:

FIG. 1 is a vertical section of a vacuuming device constructed according to this invention and showing the device in a floating or raised position; and

FIG. 2 is a partial isometric view of a mechanism used to achieve random movement of the device in the pool.

Referring to the attached drawings, there is shown a vacuum device **9** having a buoyant housing **10** floating at the surface **11** of the pool. The housing may be any desired shape but is preferably cylindrical in shape and closed at both ends. The housing should be formed of a corrosion resistant material, as for example, stainless steel or aluminum. An economical method for fabricating the major elements of this invention is to form them from aluminum castings. As shown, the housing may have a removable top **12** that is secured to the end of the housing by means of cap screws **17** with a seal therebetween. The housing is divided into two chambers by a flexible diaphragm **13** which has its outer periphery retained between two inwardly extending flanges **14** and **15**. These flanges may be formed integral with the housing or formed separately and fastened to the housing, and seals **13*a*** are provided on opposite sides of the diaphragm to prevent fluids from moving between the chambers.

The diaphragm **13** may be formed of metal, plastic or reinforced plastic. The main requirement for the diaphragm is that it be resilient and capable of moving with a spring-like action from the position shown in FIG. 1 to the position indicated by broken lines **18**. This snap action is common in disc springs. The diaphragm acts as a snap action device in moving from one position to another to change the buoyancy of the housing and divides the housing into upper and lower chambers.

The diaphragm **13** is biased in an upward direction by means of a tension spring **16**. A rod **21** connects the lower end of spring **16** to an eye **20** mounted at the center of the diaphragm. The top of the spring is connected to an adjusting eye bolt **22** that is fastened in the top **12**. A valve **23** is provided to permit control of the air pressure in the upper chamber so that the pressure can be matched with the suction head developed by the pool's filter system.

A cleaning nozzle **30** is attached to the bottom of the housing **10**. The nozzle is secured to the housing by means of bolts **31** and should be formed of a corrosion resistant material such as cast aluminum. Design of the nozzle may be variable and it can have circular or oblong shapes. The mouth of the nozzle is provided with a plurality of grooves **30*a*** which permit dirt and debris to enter the nozzle with the flow of water when it is resting on the bottom and subsequently be transported to the filter by the pump. Alternatively the nozzle could have a plurality of feet to hold its mouth slightly off the bottom.

Flow entering the mouth of the nozzle leaves through opening **32** which is aligned with a tubular section **33** in the housing communicating with its lower chamber.

The tubular section **33** forms a standpipe in the lower chamber which terminates in an open end **34**. The tubular section is provided with a butterfly-type valve **35** that is opened and closed by means of the mechanism described below to control the flow through this section and the nozzle. Also the lower chamber, below the diaphragm **13**, is connected to the filter pump by means of a conduit **36** screwed into the housing and a flexible hose **37**.

The valve operating mechanism includes a propeller or turbine **40** rotatably mounted in the tubular section **33** of the housing. It is mounted above the butterfly valve **35** in tubular section so that it will be rotated by the flow of water through the section and drives a capstan **43** through a train of gears **42**. While only two gears are shown in the train **42**, it may be necessary to use additional gearing to develop sufficient torque to drive the capstan **43** at a desired rotational speed. One end of a stretchable cord **44** is attached to the capstan while the other end is secured to a spring member **45**. The spring member is preferably formed of spring material (a disc spring) in order that it may snap from the position shown to the dotted position **45***a* without stopping in intermediate positions. Edges of spring member **45** are retained between notches **46** and **47** formed integrally with two support arms **49** and **49'** that project from the housing.

The spring member **45** is biased toward the near wall of the housing by a tension spring **48** which has one end **50** connected to the spring member with the opposite end **51** connected to an adjusting eye bolt **52**. The eye bolt passes through the side wall of the housing and is provided with a wing nut **53** which provides a means for adjusting the tension of the spring.

An operating lever **54** is pivotably attached to the inside face of the spring disc member **45** at one end and a bell crank **55** at the other end. The crank, in turn, is pivotably mounted on a post that projects from the side of the tubular section **33** projecting into the housing. A forked end **56** on the one end of the crank receives a pin on one end of the valve operating lever **57** which controls valve **35**, snapping it open or closed as the spring member pops back and forth.

The upper end of the capstan **43** is provided with a spur gear **60** that engages a ring gear **61** which is used to effect the random movement of the device across the bottom of the pool. The ring gear is mounted for rotation between a pair of flanges **62** projecting inwardly from the side walls of the housing **10**. This ring gear has a small upwardly projecting flange **65** that is provided with a window **63** for a valve function. This window is aligned with a series of openings **64** formed circumferentially in the housing, and as the ring gear turns, the window exposes a different group of openings to flow, changing the area of low pressure about the outside of the housing.

As explained above, the suction of the filter pump operates the device by changing the buoyancy until it sinks to the bottom to clean an area of the pool under the nozzle. The buoyancy is then increased and at the same time flow through the nozzle is restricted so the device will rise toward the surface. During the descent and ascent the device is moved horizontally in a random pattern to insure that the whole pool bottom is cleaned of debris. As shown in FIG. 1, the vacuum has risen to the surface because the valve **35** is closed. With valve **35** closed, the suction of the filter pump will reduce the pressure in the lower chamber of the housing and the diaphragm **13** will snap to the position shown in FIG. 1. The flow of water to the suction pump will not be completely stopped when the valve **35** closes since some water will enter through the openings **64** effecting the horizontal movement.

When the vacuum reaches the surface or before stretchable cord **44** will have reversed the direction of the propeller **40** unwinding the cord until the spring **48** will snap the spring disc member **45** to the left and open the valve **35**. Since the flow of water past the propeller **40** is closed off when the valve **35** closes, the propeller will stop and the tension stored in the cord can reverse the rotation of the propeller unwinding the cord **44** on the capstan **43**. Also a clutch arrangement (not shown) could be connected with the bell crank **55** to release the propeller from the gear train to facilitate unwinding the cord while valve **35** is closed. It may be necessary to adjust the tension on spring **48** to insure that the spring member does not open the valve until the vacuum rises a short distance off the bottom.

When the valve **35** opens, the pressure in the lower compartment will rise since the filter pump will have substantially less restriction on its suction head. The increase in pressure will permit the spring **16** to snap the diaphragm to the position indicated by broken line **18** shown in FIG. 1. This will increase the volume of water in the lower chamber and reduce the volume of air in the upper chamber, reducing the buoyancy. Losing buoyancy, the vacuum will sink to the bottom of the pool where the vacuum nozzle picks up debris under it in the same manner as manual vacuums since valve **35** will remain open for a short period after the nozzle contacts the pool bottom. It may be necessary to adjust the air pressure in the upper compartment by means of the valve **23** to insure that the spring **16** will be able to move the diaphragm to its upper position when the valve **35** opens.

As the vacuum rises or sinks it will move in a direction where the openings **64** in the housing opened by the window **63** on the ring gear **61**. Also as the filter pump pulls water through the conduit **36** with valve **35** in the open position, it will cause water to again flow past the propeller **40**. As the propeller rotates, it will slowly wind cord **44** again to repeat the process. The frequency at which the valve **35** is snapped open and closed can be controlled by changing the pitch of the propeller and ratio of gear train **42**.

When the vacuum reaches the bottom of the pool it will remove the dirt and debris through the nozzle **30**. The time that the vacuum remains on the bottom will be controlled by the period required to wind the cord **44** which overcomes spring **48** causing spring plate **45** to snap valve **35** closed as explained above. As the valve **35** closes the filter pump will reduce the pressure in the lower chamber by sucking water therefrom and, as the water is pulled from the lower chamber, the diaphragm **13** will snap downward increasing the volume of the upper chamber. At this point the housing is buoyant and the vacuum will then rise. The cycle is subsequently repeated.

Usually it is desirable to connect gear **60** to the capstan **43** with a one way ratchet **66** so it does not produce drag when the tension in cord **44** reverses the direction of turbine **40** with valve **35** closed.

While the invention has been described with relation to a particular valve and operating mechanism, obviously others could be used. An important feature of the invention is that the device is alternately changed in buoyancy, first being decreased to cause it to sink and then being increased to cause it to rise. In addition a means is provided to cause the vacuum to move randomly about the pool. Thus it is seen any means may be used that will control the volume of water in the vacuum to cause it to descend and ascend in the pool by controlling its buoyancy.

Several alternative mechanisms can be employed. In one such embodiment a gas filled bladder can be used in the upper portion of the housing to replace the diaphragm. The valve operating mechanism could be replaced with pressure responsive valves having spools capable of operating the valve in response to pressure

changes and orifice bleed systems to control frequency of the bobbing cycles.

What is claimed is:

1. An automatic pool cleaning device for cleaning debris from the bottom of water-filled pools to be used in combination with a filter pump comprising a housing having a variable size buoyancy chamber therein, a cleaning nozzle means fixed to said housing, fluid communication means interconnecting said nozzle and the inside of said housing, valve means within said fluid communicating means to control fluid flow therethrough, conduit means connecting said inside of said housing and the suction side of said filter pump, and means responsive to fluid flow through said nozzle and said housing to said filter pump operable to actuate said valve means and regulate the size of said buoyancy chamber at a frequency that will cause said housing to cycle up and down off the bottom of the pool.

2. The automatic pool cleaning device as defined in claim 1 wherein additional means are included to move the housing horizontally in the pool in a random manner as it cycles up and down.

3. The automatic pool cleaning device as defined in claim 1 wherein the variable size buoyancy chamber in the housing includes a diaphragm positioned in said housing to divide it into upper and lower chambers and biasing means for holding said diaphragm in one direction at the reduced pressures in said lower chamber when the valve means is open but insufficient to retain said diaphragm in such position when the pressure in said lower chamber is further reduced by closing said valve means.

4. An automatic pool cleaning device as defined in claim 1 wherein the means responsive to fluid flow through the housing which operates the valve means and regulates the size of the buoyancy chamber includes a fluid driven turbine positioned near the valve means and an actuating assembly for converting turbine movements into valve actuation.

5. An automatic pool cleaning device as defined in claim 2 wherein the means for achieving random movement of the housing about the pool in a generally horizontal plane includes a driven ring valve assembly having a window and a plurality of openings positioned circumferentially around the periphery of the housing under said ring valve so such window will be in registry with only certain openings in certain portions of said housing as it rotates whereby a reduced pressure is developed adjacent to that portion of said housing which will cause said housing to move in that direction during ascent or descent of said housing in the pool.

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EDWARD L. ROBERTS, *Primary Examiner.*