United States Patent

Wulc

[15] **3,676,885**

[45] **July 18, 1972**

[54] RANDOM MOTION VEHICLE

[72] Inventor: **Stanley S. Wulc,** 1027 Washington Lane, Rydal, Pa. 19046

[22] Filed: **March 15, 1971**

[21] Appl. No.: **124,318**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 28,453, April 14, 1970.

[52] **U.S. Cl.** **15/1.7,** 15/319

[51] **Int. Cl.** **E04h 3/20,** A47l 5/00

[58] **Field of Search** 15/1.7, 344, 350, 351, 319; 210/241

[56] **References Cited**

UNITED STATES PATENTS

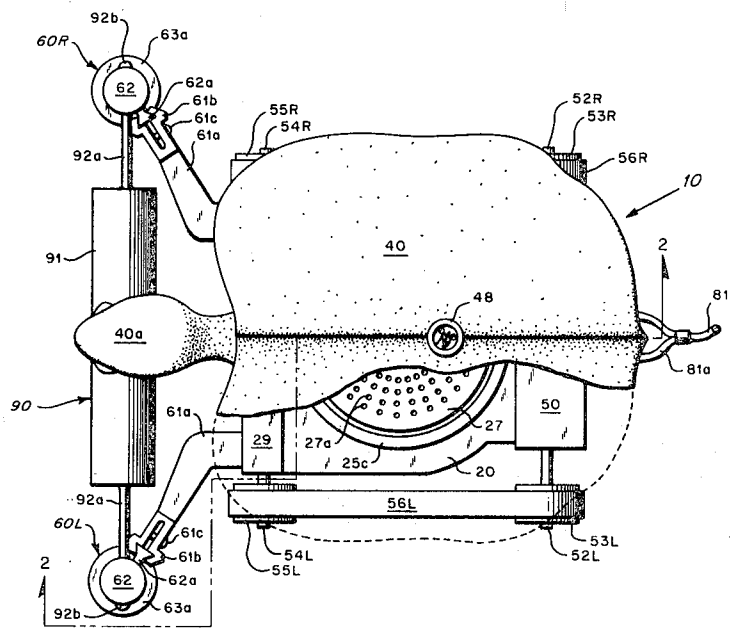
R26,741	12/1969	Myers	15/1.7
2,923,954	2/1960	Babcock	15/1.7
3,439,368	4/1969	Myers	15/1.7

Primary Examiner—Edward L. Roberts
Attorney—Paul Maleson

[57] **ABSTRACT**

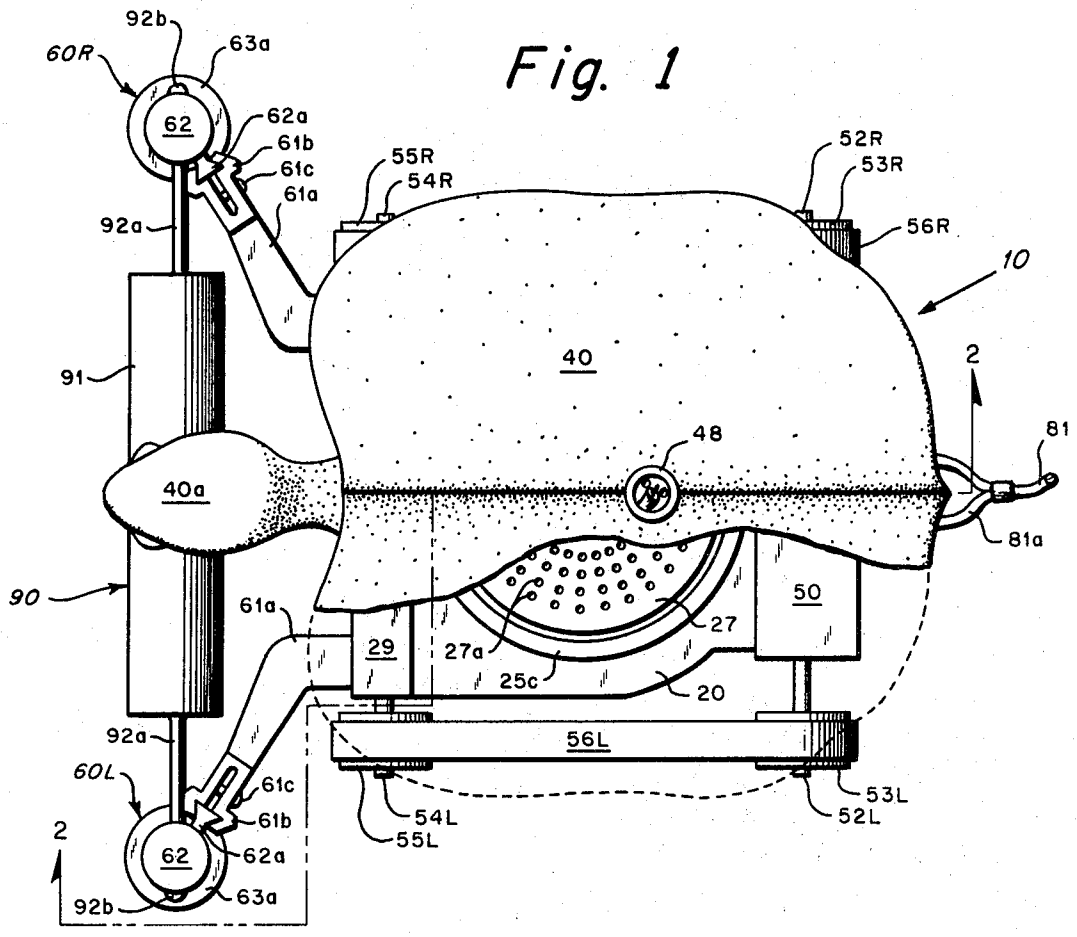
An improved random motion suction cleaner vehicle adapted to translate along and clean the interior bottom surface of a pool or tank in a randomly oriented pattern. The improved cleaner has suction inlet mechanisms, and driving as well as sensing means cooperating with programmed logic means to direct the motion of the vehicle in accordance with pre-programmed instructions. The cleaner includes removeable liquid intake containers to allow ease in cleaning the vehicle when such is necessary. For ease of handling, the improved vehicle incorporates a weight mechanism which is removeably secured to the suction cleaner base cover. A further improvement to the improved vehicle includes the addition of a multi-directional switch mechanism to sense obstacles in the path of vehicle translation. Added program logic considerations lock the drive control of one set of wheels while allowing another set to continuously operate after an obstacle is impacted thereby leading to a rotation of the vehicle away from the constraining force.

9 Claims, 5 Drawing Figures



2 Sheets-Sheet 1

Fig. 1



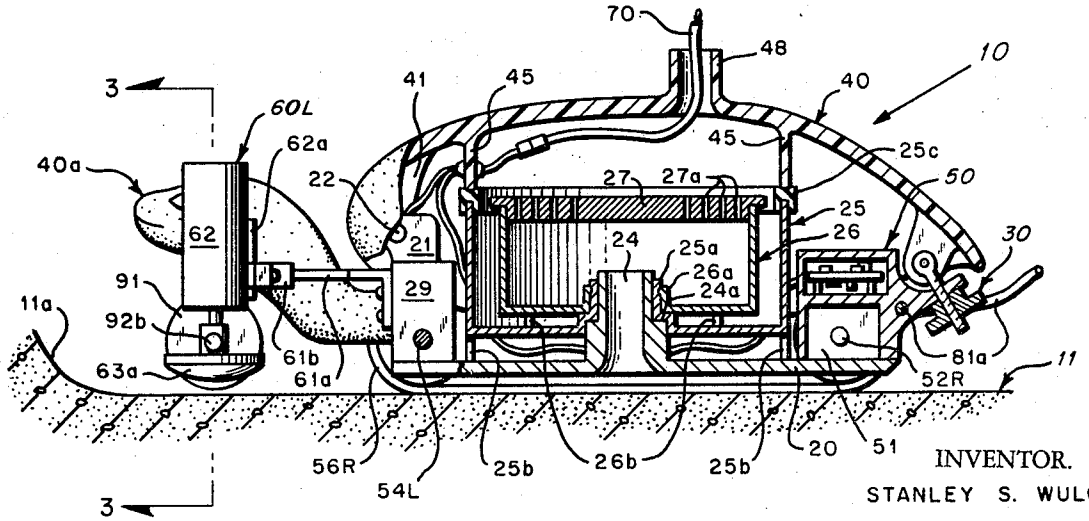


Fig. 2

INVENTOR.
STANLEY S. WULC

BY Paul Maleson
ATTORNEY

Fig. 3

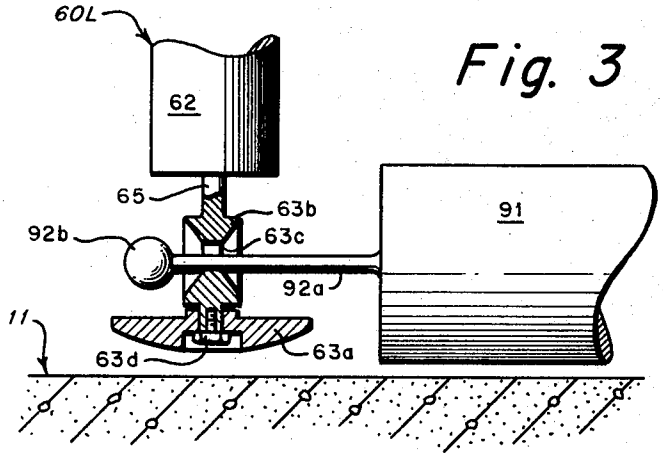
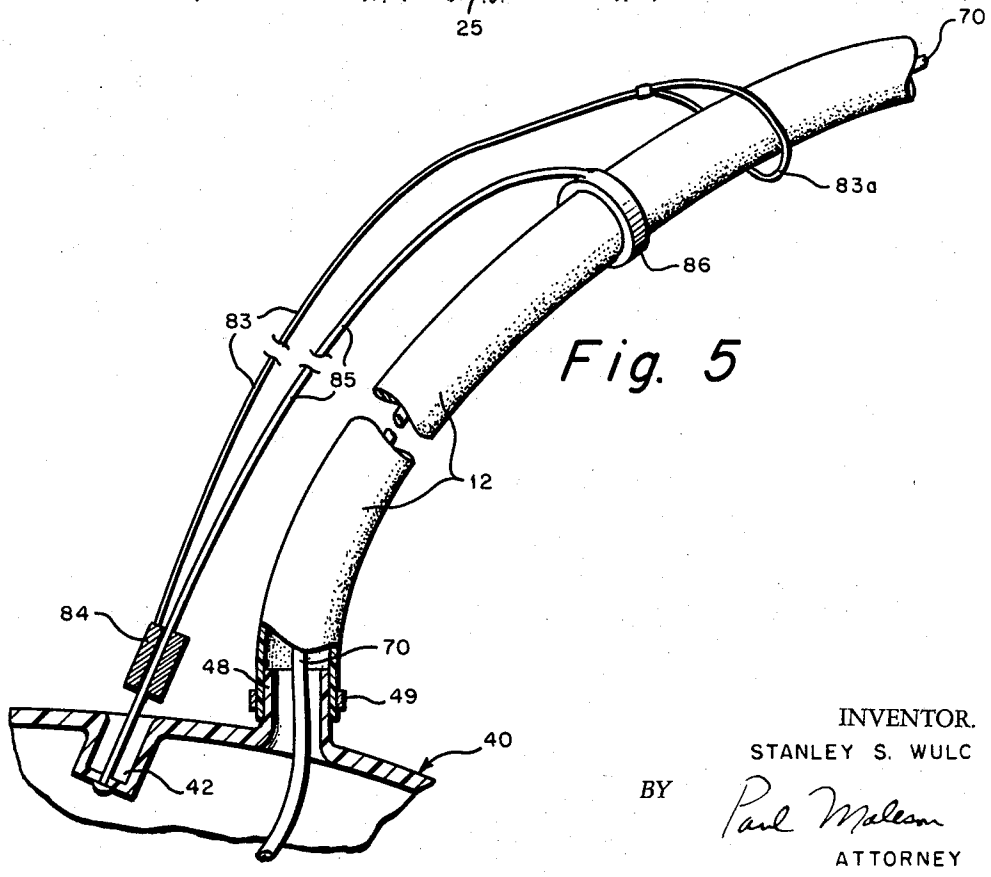


Fig. 4

Fig. 5



INVENTOR.
STANLEY S. WULC

BY Paul Maleson

ATTORNEY

RANDOM MOTION VEHICLE

CROSS-REFERENCES TO RELATED APPLICATIONS

1. this application is a continuation-in-part of application, Ser. No. 28,453, filed Apr. 14, 1970

2. this application incorporates by reference application Ser. No. 28,453, filed Apr. 14, 1970

3. this application incorporates by reference application, Ser. No. 80,950, filed Oct. 15, 1970.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the field of random motion vehicles. In particular this invention pertains to the field of random motion suction cleaners to clean the interior surfaces of pools or tanks. More in particular, this invention pertains to the field of suction cleaners having sensing mechanisms to contact and redirect the translated motion of the vehicle in accordance with pre-programmed logic specifications.

2. Prior Art

Suction cleaning vehicles used to clean interior surfaces of tanks or pools are known in the art. It is also known in the art to provide devices adapted to be moved along surfaces in a random manner and to further turn away from the boundaries of an obstacle path. However, such prior art demands the use of high voltages below the liquid line thereby increasing the hazzard of electrical discharge. Some of the prior art requires relatively heavy and cumbersome gear mechanisms and other mechanical elements to provide an adequate turning motion.

Other prior art devices in this field utilizing control means for operation are bigger, are more expensive, and control with less accuracy than the subject invention. In addition, none of the prior art found has incorporated a multi-directional switch into the sensing mechanism as this invention. Further, prior art has not included removeable weight mechanisms to aid in handling the vehicle when it is submerged and for ease of removal of the cleaner from the tank or pool. In addition, none of the prior art found has further provided the improvements of including removeable liquid intake containers to materially aid in cleaning the apparatus assembly.

SUMMARY OF THE INVENTION

It is an object of this invention to provide an electronic programmed drive control to automatically direct a vehicle across a surface in response to the sensing of obstacles.

It is another object of this invention to provide a suction cleaner for the bottom of tanks and pools adapted to move in a random pattern over the bottom surface and to sense the walls of the tank or pool or other obstacles and reorient the translation path away from them.

It is a further object of this invention to provide an improved suction cleaner incorporating removeable liquid intake containers for ease in cleansing the vehicle after operation.

It is a still further object of this invention to provide removeable weight mechanisms to the cleaner vehicle in order to ease the handling of the cleaner vehicle when removing it from a submerged operating condition.

It is another object of this invention to provide an improved sensing switch to sense obstacles in the path of the translating vehicle.

It is an additional object of this invention to provide increased logic programming for the drive control system to optimize the motion of the vehicle after striking obstacles.

An improved random motion suction cleaner vehicle adapted to move across the interior bottom of a tank to sense and redirect the vehicle movement away from obstacles. The cleaner vehicle includes in combination, a base member having an openable cover and a suction opening passing through the base member. The cleaner vehicle further includes a pair of independent drive means on the base member responsively operable to a pair of obstacle contact means which are moveably secured to the base member. A logic and control means on the base member is operatively connected to the drive and sensing means. The improvement to the random motion vehicle being liquid intake means which is removeable from the suction cleaner vehicle. The liquid intake means is positioned within the base cover forming a continuous particle path from the suction opening to an outlet in the base cover.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of the random motion vehicle, with the outside covering partially fragmented;

FIG. 2 is an elevation cross-sectional view of the vehicle taken along the section line 2—2 of FIG. 1;

FIG. 3 is an enlarged fragmented view, partially and cross-section, of part of the switch actuation;

FIG. 4 is an elevation view, partially fragmented, partially cross-section, of the vehicle and its hose and lanyard connections; and,

FIG. 5 is an enlarged view, partially fragmented and partially in cross-section of the hose, weight and lanyard structure of the vehicle.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIGS. 1 and 2 there is shown improved random motion suction cleaner vehicle **10** adapted to move across the interior bottom of tank or pool **11** having as its main purpose removal of particulates of extraneous materials from tank floor **11**. As an objective in obtaining the random path motion taken by vehicle **10** along surface **11** there includes internally located mechanisms to sense obstacles **11a** and redirect the movement of vehicle **10** away from such obstacles. Major components of cleaner vehicle **10** include base **20** having an openable cover **40** which as shown in the Figures takes the outline of a turtle or some like contour which would be esthetically pleasing. A pair of obstacle contact sensing mechanisms **60R**, **60L** are secured through leg extensions **61a** to bulkhead **29**. Mechanisms **60R**, **60L** as shown, extend transverse to longitudinally directed and flexible head member **40*a***, being connected by cylindrical member **91** of elongated sensor assembly **90**. Sensors **60R**, **60L** upon contact with obstacles **11a**, initiate control assembly or logic means **50** within assembly **10** to redirect motion **51** actuation of wheel shafts **52R**, **52L**, **54R**, and **54L** and drive assembly **10** away from the obstacle restraint through programmed linearly directed motion of traction belts **56R**, **56L**.

In general operation, it is seen that vehicle **10** passes over pool or tank bottom surface **11** wherein particulates of material are drawn through cleaner inlet **24** into the interior of cleaner **10** due to a controlled pressure gradient created by an externally located pump (not shown in the figures). The pressure gradient continually draws liquid from the tank or pool through cleaner outlet **48** into hose **12**, containing electric cable **70**, and then to a filtration unit not important to the inventive concept. When vehicle or cleaner **10** strikes or impacts obstacles or tank protuberances **11a**, through boundary contact of outer sensor assemblies **60R**, **60L**, internal logic programmed into control assembly **50** redirects motion of vehicle **10** in another directional movement.

An improvement to the operation of cleaner vehicle **10** includes a permutation in the liquid intake system defining outer container **25** and inner container or basket **26**. Containers **25**, **26** are positioned within vehicle **10** having apertures **27*a*** to provide a continuous particle path from tank or pool bottom surface **11**, through suction opening **24**, and eventually passing to cleaner outlet **48**.

Suction opening **24** is provided in the bottom of vehicle **10** through base **20** which as is shown in FIG. **2** is substantially positioned proximate pool or tank surface **11**. Outer basket or container **25** being circular in geometrical contour when viewed in a direction normal to the horizontal plane, is provided to form an inner chamber of vehicle **10**. Outer container **25** is provided at an upper surface of a circumferential lateral wall with a resilient sealing member or resilient rim **25*c***. As is

shown, rim 25c contacts sealing rim 45 extending downward from base cover or shell 40 to provide a flow chamber for particles passing through vehicle 10 while simultaneously protecting other mechanisms of cleaner 10 from becoming water or liquid saturated. Container 25 rests in an equilibrium position upon base 20 through vertically directed leg members 25b which extend from a bottom planar surface of basket 25. Leg members 25b are removeable from base 20 to allow removal of container 25 from vehicle 10. To position outer container 25 with some positional accuracy boss 25a is provided on a bottom surface thereof to pass over suction opening 24.

Inner basket or container 26 is encompassed by outer container 25 within base cover 40. As shown in FIG. 2, basket 26 is positioned around intake 24 and interfaces with outer basket boss 25a at inner basket boss periphery 26a. Both containers 25 and 26 rest on intake opening shoulder 24a and remain in vertical contact through gravity assist. To provide further stability, inner basket legs 26b extend from a bottom surface of container 26 contacting a lower surface of external container 25. Legs 26b may in general, be a multiplicity of extended members, lugs or in simplest construction merely a rim member passing circumferential to the bottom surface of container 26.

Container 26 is provided with inner basket lid 27 having a plurality of openings or apertures 27a to provide a particle selection or straining function. As described container 26 is removeable from vehicle 10 when cover 40 is unlatched and opened through latching assembly 30 where bracket 21 is pivoted about pin member 22. Container 26 shown in detail in FIG. 2 is presented in simplified form for ease of illustration, for example apertures 27a may be formed on all boundary surfaces of member 26 or container 26 may in itself be a mesh strainer mechanism. Such deviations in the actual assembly of container 26 does not involve the basic inventive concept of the improvements herein related to vehicle 10.

Improvements to containers 25, 26 of vehicle 10 as herein described provide for removal from base 20 when cover 40 is in an open position. In the manner described, containers 25, 26 may easily be lifted from intake opening 24 manually and with little effort. It has been found advantageous in the cleaning operation to permit removal of the straining system from vehicle 10. Containers 25, 26 may now be taken remote from vehicle 10 for washing purposes and such provides the additional advantage of lightening cleaner 10 by emptying it of liquid when containers 25, 26 have been removed.

Of major importance in the convenient use of vehicle cleaner 10 is the ease of manipulation and handling which may be affected. In order to achieve a system which is heavy enough to provide good traction on surface 11 while in operation yet be easily removeable from the tank or pool, removeable weight 82a has been added to vehicle 10 as shown in FIG. 4. In the manner shown, weight 82a is removeably secured to base cover 40 and may be manipulated external to the tank for displacement of weight 82a from assembly 10. The weighting mechanism includes weighted member 82a having a through opening slightly greater in diameter than hose 12. Member 82a is therefore slideably insertable on the outer surface of hose 12. Attachment line or lanyard 82 is secured to weight 82a on a first end and passes substantially coincident but separable from hose 12 to a second end of loop 82b which surrounds an upper circumferential perimeter of hose 12.

In normal operating conditions, lanyard 82 passes external to the tank and weight 82a may be removed from cover 40 manually by an operator merely pulling on line 82. In this way, cleaner 10 may be lightened when removal from the tank is necessitated. When vehicle 10 is placed on surface 11, weights 82a may be interfaced with cover 40 by gravity assist thus increasing the weight of cleaner 10 by a desired amount.

Weighted member 82a, as shown, may be a collar having a desired density to increase the overall weight of cleaner 10. Collar 82a is a ring shaped member having the aforementioned through opening to allow it to slide over hose 12. In application, collar 82a has been constructed of lead or some like material having the necessary high density property.

Ease of removal of cleaner 10 from the tank or pool may be accomplished utilizing removal line 81 shown in FIG. 4. Line 81 terminates at a first end in lower loop 81a which is attached to latch mechanism 30. The attachment of lower loop 81a to vehicle 10 may be removeable, as shown, or fixed dependent on the operators discretion and not important to the basic inventive concept herein involved. Upper loop 81b passes circumferential to hose 12 perimeter in a manner analogous to that described for loop 82b. Loop 81b forms a second end to line 81, remote from first end 81a and positioned external to the tank or pool for ease of handling by an operator.

By pulling on line 81, an operator may remove vehicle 10 from the tank or pool in a simplified manner. This method of hauling cleaner 10 from the liquid is desireable since it permits assembly 10 to be dragged along bottom surface 11 and along the vertical walls of the tank or pool allowing wheels 53R, 53L, 55R, 55L to move against these surfaces. This procedure provides protection against damage to internally located working mechanisms, and prevents pivoting of assembly 10 as would take place if the lifting point were more centrally located on cleaner 10.

An embodiment to the weighted mechanism concept is shown in FIG. 5. In this embodiment weighted member 84 is separate and distinct from hose 12 being slideable on guide line 85. Weighted member or collar 84 interfaces with cover 40 within recessed chamber 42. As can be seen, recess 42 provides a stationary platform for collar 84 and additionally reduces frictional drag forces over cover 40. Weight 84 contains a through opening slightly greater in diameter than guide member 84 to allow slideable movement thereon. Guide 85 is attached on opposing ends to a bottom surface of recess chamber 42 and to an outer surface of hose 12 respectively. Guide 85 is secured to hose 12 through guide clamp 86 which firmly holds line 85 to hose 12 with little or no relative movement.

Weight 84 may be slideably moved along guide line 85 through manipulation of lanyard 83. Loop element 83a of line 83 passes circumferentially around hose 12 and is located external to the tank or pool for ease of manipulation by an operator. An opposing end of line 83, taken with respect to loop member 83a, is secured to weighted collar or ring member 84 to permit force constraint when slideably moving member 84 over line 83.

As was the case for weight 82a, member 84 may be formed of lead or some like high density material to increase the overall weight of assembled unit 10. A further advantage of this embodiment in separating member 84 from hose 12 is to permit removeable hose clamp 49 to be easily attached to hose 12. This facilitates the ease of removal of hose 12 from outlet 48 and permits complete separation in the clamping and weighted mechanism assemblies.

FIGS. 1, 2 and 3 show improvements in the obstacle sensing means for cleaning vehicle 10. Leg extensions 61a are secured on opposing ends respectively to bulkhead 29 and switch members 62 of outer sensor assemblies 60R, 60L. Respective leg extensions 61a are positioned on switch members 62 through brackets 62a. Clamp members 61b of extensions 61a interface with, and secure legs 61a to switch members 62. Tightening screws 61c pass normally through elongated legs 61a to insure a rigidly secured connection between the contiguous elements.

Sensor element 63a formed in the contour of a mushroom as is shown, is attached rigidly to switch actuator 65 through bolts 63d. In this manner, sensors 63a may be vertically adjusted with respect to arms 61a. This adjustment allows an operator selection in the degree of rise in slope permissible in bottom surface 11a before the sensing means will actuate control assembly 50. Stem 63b, attached to sensors 63a, includes opening or elongated slot 63a through which axle or shaft members 92a pass. The end of shafts 92a are expanded to form spherical head elements 92b of sufficient diameter such that shafts 92a may not be withdrawn through openings 63c.

Shafts 92a expand to a larger diameter cylindrical member 91 passing transverse to the longitudinal direction defined by

the movement of vehicle **10**. The diameter of cylindrical member **91** is predetermined such that the lowermost extent is substantially as low as the lowest extent of sensors **63***a*. Connection of sensor assemblies **60**R, **60**L through shafts **92***a* and cylindrical member **91** allow operation of sensing mechanisms even if contact with obstacles **11***a* is made between assemblies **60**R, **60**L.

A large tolerance is provided when shafts **92***a* are passed through openings **63***c* of stem **63***b*. In this manner, when one sensor **63***a* contacts obstacle **11***a* directly, there will be sufficient non-actuating motion at the opposing sensor position so that only the actual contacting sensor **63***a* will force motion of switch actuator **65** to operate corresponding switch member **62**. Logic circuits within control assembly **50** provide that there be a lock out or clamping as one or the other of switch members **62** is actuated, however, the free play or last motion herein provided further insures that the desired one of members **62** is tripped when a contact is made. Where impact is made along shafts **92***a* or cylindrical member **91** it has been found that one or the other of switch members **62** will be actuated.

A further improvement to the programming logic of assembly **10** includes the control assembly **50** programming to include the stopping or halting of one or the other set of wheels **53**R, **53**L or **55**R, **55**L after contacting obstacle **11***a* combined with a continued motion of the other set of wheel members. Incorporation of this added logic within system **10** allows a rotating or turning of assembly **10** after contacting obstacle **11***a*.

The improved invention herein described has been shown to be an effective, randomly orientable pool or tank cleaner which provides increased reliability and ease of handling over previous mechanisms. While the invention has been described with certain specific embodiments thereof, it will now be understood further modifications will suggest themselves to those skilled in the art, and it is intended to cover such modifications within the scope of the appended claims.

What is claimed is:

1. An improved random motion suction cleaner vehicle adapted to move across the interior bottom of a tank to sense and redirect said movement away from obstacles, said cleaner vehicle including in combination, a base having an openable cover, an outlet in said cover, a suction opening passing through said base, a pair of obstacle contact sensing means moveably secured to said base, a pair of independent drive means on said base, a logic and control means operatively connected to said drive means and said sensing means, on said base, wherein said improvements comprise:

liquid intake means comprising an outer container and an inner container and being completely removeable as a unit from said suction cleaner vehicle, said liquid intake means positioned within said base cover forming a continuous particle path from said suction opening to said outlet in said base cover,

said outer container being removeably secured to said suction cleaner vehicle within said base cover and between said base cover and said base, and,

said inner container being removeably secured to said suction cleaner vehicle and said outer container, said inner container positioned within said outer container and including a plurality of apertures having a predetermined mesh opening size,

each of said inner and outer container being provided with a hole in the bottom thereof, said suction opening fitting through both said holes, providing a predetermined flow path through said suction opening, said inner container, said outer container, and said outlet in said base cover, in that order.

2. An improved random motion suction cleaner vehicle adapted to move across the interior bottom of a tank for sensing and redirecting said vehicle movement away from obstacles, said cleaner vehicle including in combination, a base cover enclosing said base and having an outlet passage formed through said base cover, a hose secured to said base cover communicating with said outlet passage, said hose extending out of said tank, a pair of obstacle contact sensing means moveably secured to said base, a pair of independent drive means on said base, a logic and control means operatively connected to said drive means and said sensing means, on said base, wherein said improvement comprises:

weight means removeably secured to said suction cleaner base cover, said weight means being removeable from said base cover by manipulation of said weight means external to said tank.

3. The improved random motion suction cleaner vehicle as recited in claim **2** wherein said weight means includes:

a. a weighted member slideable insertable on said hose; said weighted member located at an interface between said hose and said base cover when weight is added to said cleaner vehicle; and,

b. attachment means having opposing first and second ends, said first end being secured to said weighted member and said second end remote from said first end and surrounding a circumference of said hose.

4. The improved random motion suction cleaner vehicle as recited in claim **3** wherein said attachment means includes:

a lanyard secured to said weighted member on said first end and looped around said hose on a second end extending remote from said lanyard first end.

5. The improved random motion suction cleaner vehicle as recited in claim **2**. wherein said weight means includes:

a. a weighted member removeably secured to said base cover and mated to said base cover within a recess provided therein;

b. a guide secured on opposing ends to said hose and said base cover respectively, said weighted member being slideably secured to said guide; and,

c. a lanyard secured to said weighted member on a first end thereof, said lanyard being looped around said hose on a second end remote from said lanyard first end, said lanyard being slideable with respect to said hose.

6. The improved random motion suction cleaner vehicle as recited in claim **2** including:

vehicle movement means secured to said vehicle on a first end and to said hose on a second end of said movement means remote from said vehicle movement means first end.

7. The improved random motion suction cleaner vehicle as recited in claim **6** wherein said vehicle means second end is slideably secured to said hose.

8. The improved random motion suction cleaner vehicle as recited in claim **2** wherein said pair of obstacle contact sensing means includes:

a. a frame member extending in a longitudinal direction normal to a horizontal plane, said frame having a base element with a central opening passing therethrough;

b. obstacle contact means external to said frame and passing through said central opening;

c. unidirectional translation means within said frame fastened to said contact means to transform randomly oriented obstacle loads into a longitudinal motion; and,

d. switch means contained within said frame and actuated through said longitudinal motion imparted by said translation means.

9. The improved random motion suction cleaner vehicle as recited in claim **2** wherein said logic and control means is permanently programmed to control said drive means in response to said sensing means including:

singular halting means for one of said pair of drive means, said other drive means for continued motion to provide a turning of said cleaner vehicle after contacting an obstacle.

* * * * *