Feb. 9, 1960 H. H. BABCOCK 2,923,954

SUBMARINE SUCTION CLEANER

Filed July 5, 1955

3 Sheets-Sheet 1

FIG. 1.

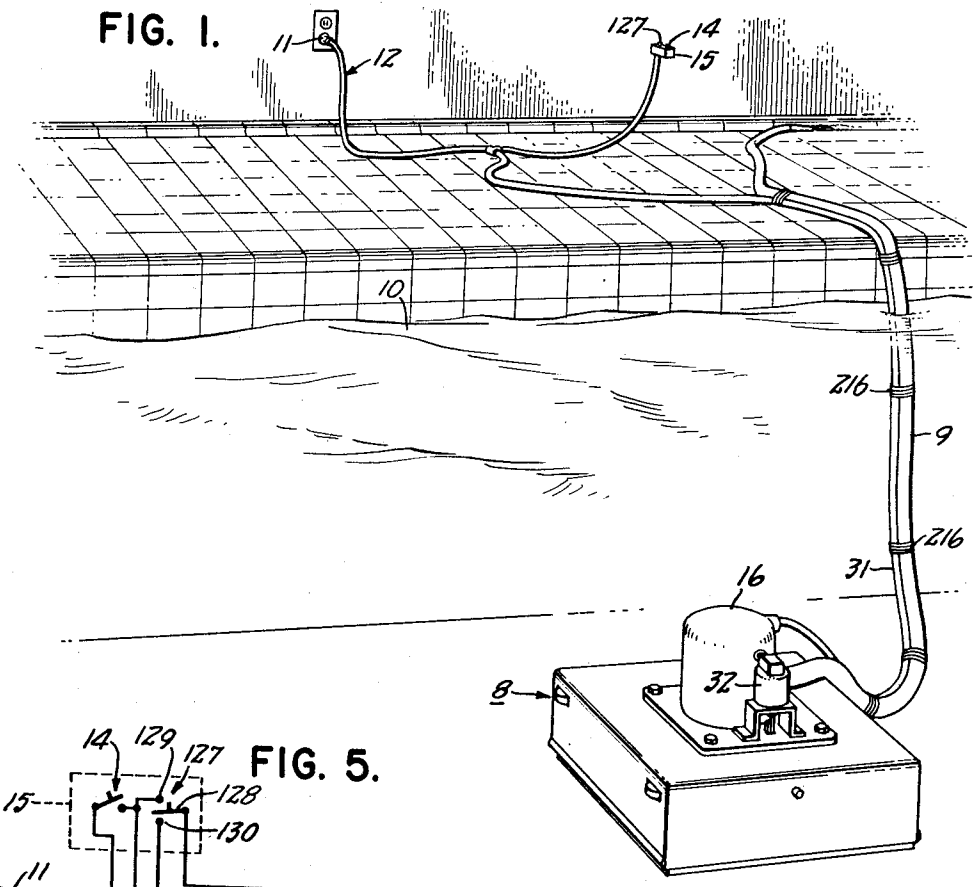


FIG. 5.

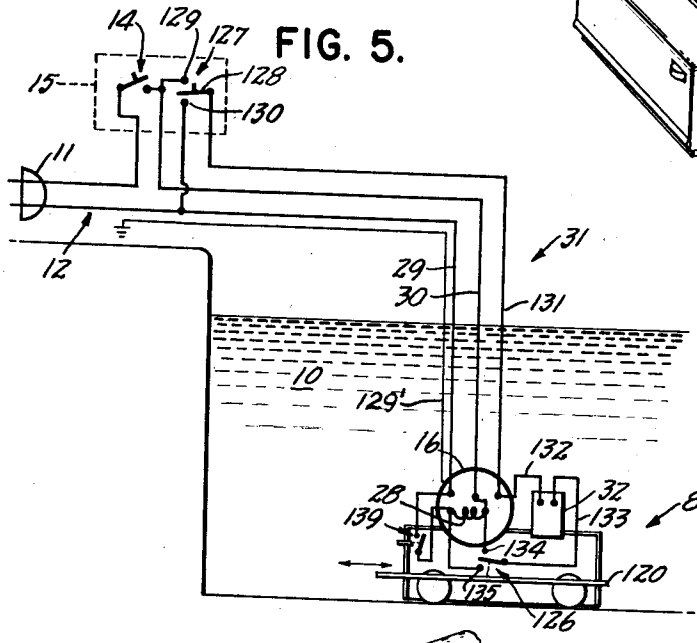


FIG. 6.

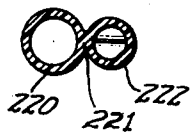
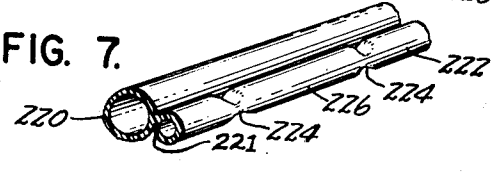


FIG. 7.



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3 Sheets-Sheet 2

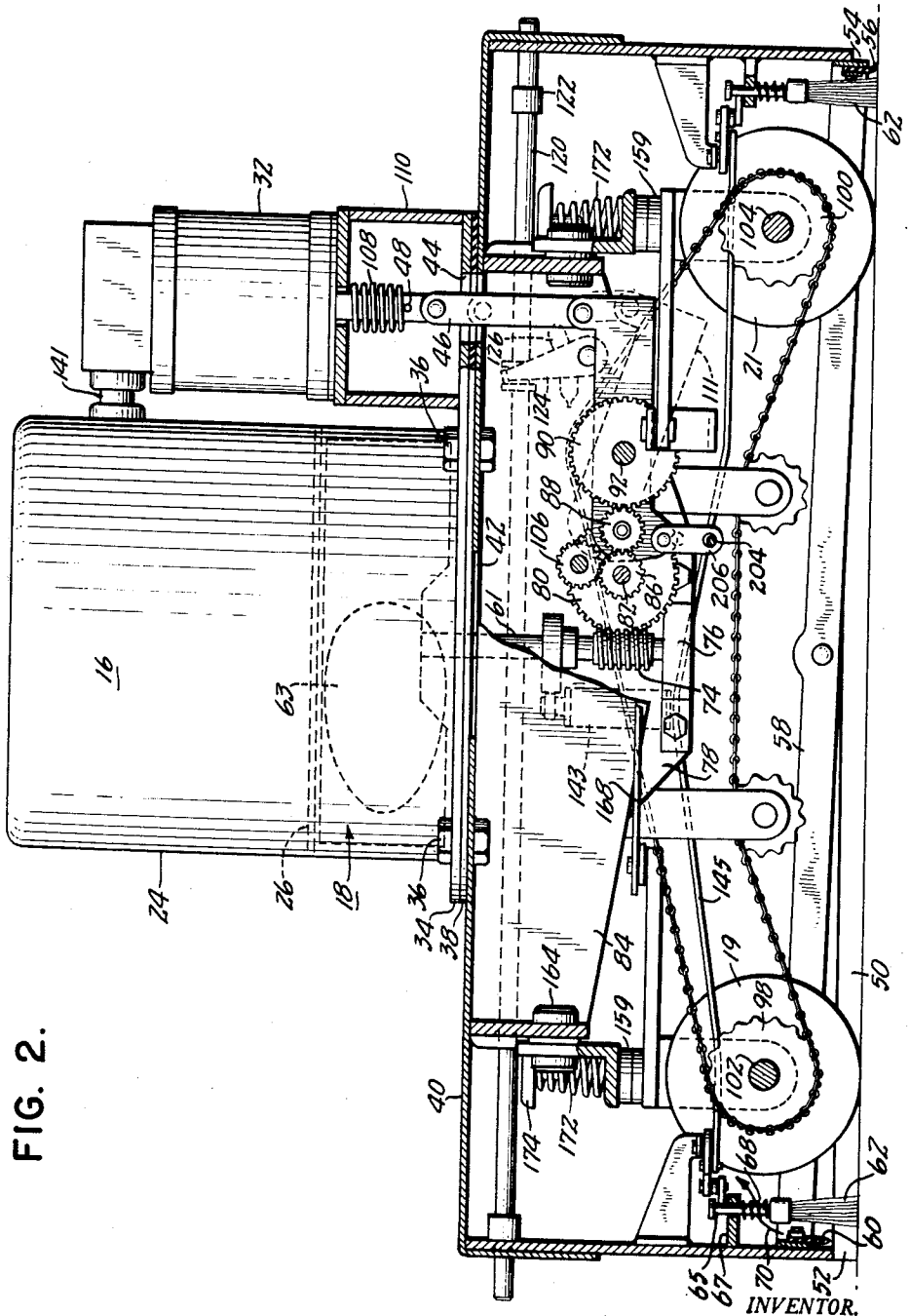

FIG. 2.

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3 Sheets-Sheet 3

FIG. 3.

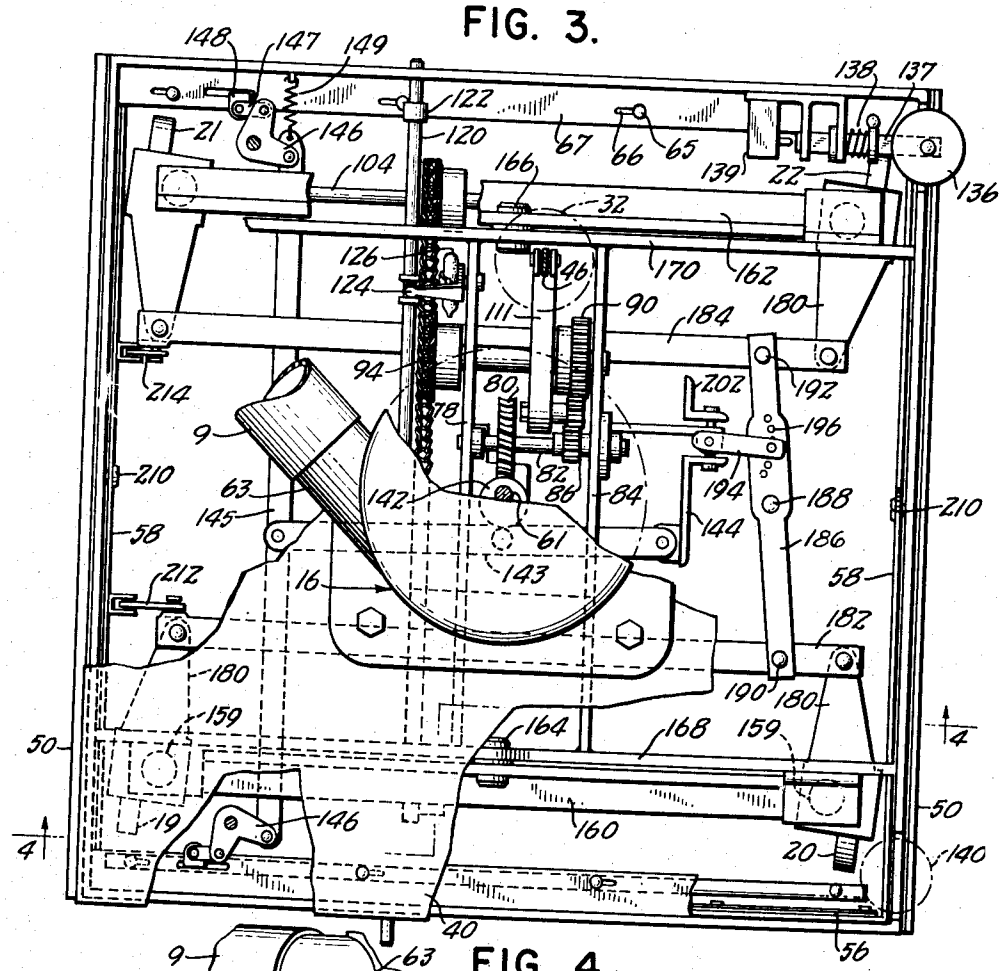
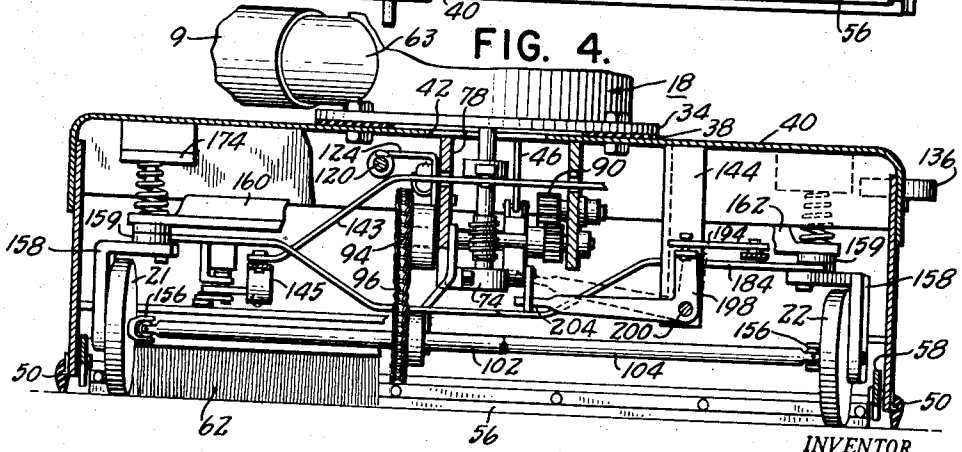


FIG. 4.



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SUBMARINE SUCTION CLEANER

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Application July 5, 1955, Serial No. 519,961
13 Claims. (Cl. 15—1.7)

The present invention relates to cleaning apparatus adapted for the cleaning of the bottom surfaces of pools, tanks, and the like and more particularly relates to submarine suction cleaners.

Among the objects of the present invention are to provide effective and easily-controlled submersible suction cleaners for automatically cleaning the bottoms of tanks and the like, and particularly well adapted for use in swimming pools.

During use, swimming pools collect a large amount of dust, dirt and sediment which tends to build up a mucky silt layer on the floor of the pool. To maintain sanitary conditions and to have the water pleasant for swimming and prevent waders from stirring up clouds of silt, as they walk about, it is necessary thoroughly to clean the pool floor at frequent intervals.

Prior to this invention, two awkward and expensive systems have commonly been used for cleaning the bottom surfaces of swimming pools. For large municipal type pools, in many cases, divers are employed to clean the pool floor during periods when the pool is not in use. For home pools it has been customary to use long-handled suction nozzles which are swept along the pool floor by an operator standing near the edge of the pool. This is extremely tiring and often takes as long as six hours for cleaning an average small home pool. Moreover, these methods both involve the use of remote suction pumps with long lengths of suction hoses which are run under the water. Such suction hoses must be reinforced, as a practical matter to prevent collapse, and so are heavy, stiff, and hard to handle, and quite expensive.

Devices have been proposed for scrubbing pool floors, but these have not been adopted commercially because of their complexity and the need for complicated controls and guides. In certain cases remote pumps and suction hoses are utilized, with their attendant disadvantages. Some such prior devices involve the use of floats at the surface with complicated interconnections of cables and hoses extending between these floats and the cleaning device near the bottom.

Among the many advantages provided by the described submarine suction cleaner embodying the present invention are those resulting from the fact that the cleaner is automatic in operation and highly effective in cleaning a pool floor as it traverses back and forth. In this submarine cleaner the driving motor is directly associated with the cleaner which rolls on the pool floor.

Another advantage of the submarine suction cleaner described herein is the fact that the suction pump is directly mounted on the cleaner and is operated by the driving motor. Inasmuch as the liquid being discharged from the pump is at a pressure greater than the surrounding liquid in the tank, an ordinary highly flexible, light weight and inexpensive type pressure hose is enabled to be used as the discharge hose. The cleaner is automatically controlled to reverse the direction of its traverse or alternatively is steered by remote control from the surface.

A further advantage of the submarine cleaner described herein is its adjustable four-wheel steering which enables an accurate adjustment of the traversing of the cleaner as it moves back and forth across the bottom of the pool in a zig-zag course down the length thereof regardless of the pool width. Thus, the desired amount of overlapping of the cleaning swaths is obtained regardless of pool size. The cleaner has a pair of intake openings extending completely across each end, and a controllable baffle structure closes up whichever intake opening is at the rear end of the cleaner. When the cleaner reverses direction the baffle structure automatically reverses to open up the other intake and close the one which was open. Inside of the cleaner there are yieldable brushes which scrub the bottom of the pool to help loosen any silt which is sucked up through the pump. In the embodiment of the invention described these brushes are driven and reciprocate transversely of the cleaner body as it advances over the pool or tank floor.

In the submarine cleaner described the entire area beneath the cleaner body is subjected to a continuous suction action. Flexible skirts extend down from each side of the cleaner body against the pool floor, forming seals to prevent liquid from being drawn in from the sides. The intake openings are relatively narrow slots, one at each end, contiguous with the pool floor, and the rear one always is closed. Thus, the velocity of the liquid drawn into the body of the cleaner through the front intake opening is sufficiently high to erode and remove sediment, producing an effective scrubbing action. The cleaner body is supported on four wheels mounted on springs so as to accommodate undulations in the pool floor. All of the wheels are driven to obtain increased traction for driving the cleaner over the slopes found in the bottoms of some swimming pools and tanks and are steerable for producing the highly desirable traversing mentioned above. Control sensing elements are mounted at each end of the cleaner and also at the side, as described in detail, producing automatic control and traversing action.

In this specification and the accompanying drawings is shown and described a preferred embodiment of the present invention which consists in the features of construction, arrangements of parts, and elements as exemplified in this embodiment. However, it is to be understood that this described embodiment is not intended to be exhaustive nor limiting of the scope of the invention, but on the contrary is given for purposes of illustration in order that others skilled in the art may fully understand the invention and the principles thereof and the manner of applying the invention in practical use and modifying and adapting it in various forms, each as may be best suited to the conditions of a particular use.

The various features, aspects and objects of the present invention will be more fully understood from a consideration of this specification in conjunction with the drawings, in which:

Figure 1 is a partial perspective view illustrating the submersible cleaner in operation on the floor of the pool;

Figure 2 is a longitudinal vertical sectional view through the cleaner of Figure 1;

Figure 3 is a top view partially broken away to show further details of the driving and controlling elements of the cleaner;

Figure 4 is a transverse vertical sectional view taken generally along the line 4—4 in Figure 3 looking up;

Figure 5 is a schematic circuit diagram of the control and power circuits;

Figure 6 is a cross sectional view of an improved buoyant hose; and

Figure 7 is a perspective view of this hose, showing the spaced chambers providing buoyancy.

In operation, the cleaner, generally indicated at **8**, is lowered by means of the flexible hose **9** under the water **10** into an initial position, which is usually in one corner of the pool floor or other convenient position. Then the electric plug **11** on a waterproof power cable **12** is plugged into a suitable outlet and an on-off switch **14** in a manual control unit **15** is closed. This switch **14** is preferably of the toggle or similar type which remains closed untii actuated into open position. An electric motor **16**, which operates a pump **18** and drives the wheels **19**, **20**, **21**, and **22**, is located within the upper part of a waterproof casing **24** and is separated by a partition **26** (see Figure 2) from the pump chamber in the lower part of this casing. Electrical power is supplied to the motor windings **28** through leads **29** and **30** in a four-wire cable **31**, and, assuming that a control solenoid **32** is energized, the drive elements of the cleaner are in the respective conditions shown in Figure 2 and the cleaner is driven toward the left in Figure 2.

In certain pool or tank installations a fixed suction pump is already available nearby with suitable suction hose. Then, the motor **16** may be used as a drive motor for moving the cleaner with the end of this suction hose connected to the cleaner, and the automatic control and steering operations of the cleaner are used to great advantage. However, the described embodiment of the invention, which operates as a self-contained cleaner with a pressure-type discharge hose has many advantages for use in most installations and provides very desirable flexibility in operation.

In this illustrative embodiment of the invention the casing **24** has a lower rectangular flange **34** suitably secured as by bolts **36** down against a gasket **38** resting on top of the main housing **40** of the cleaner. This housing completely encloses the cleaner body on top and on all sides except for a central top port **42** communicating with the pump **18** and with a small clearance hole **44** through which extends a control link **46** pivotally coupled to the armature **48** of the solenoid **32**. A pair of flexible skirts **50** (see also Figure 4) extend down from opposite sides of the housing **40** and form resilient seals with the pool floor, thereby preventing any significant amount of liquid from entering the interior of the housing **40** from either side.

A pair of narrow intake openings **52** and **54**, respectively, extend across either end of the cleaner contiguous with the pool floor. As the cleaner moves to the left the rear opening **54** is advantageously closed off by means of a controllable baffle structure including a resilient baffle **56** carried by a rockable cradle **58** explained in detail hereinafter. The other resilient baffle **60** is raised up by the cradle **58** to clear the front intake **52** through which the water is sucked with considerable velocity. Thus, any silt on the pool floor within or immediately ahead of the opening **52** is drawn up off of the pool floor and up into the interior of the housing **40** and then through the port **42** and through the pump **18** into the discharge hose **9** connected firmly to one side of the casing **24** as shown in Figures 3 and 4. The pump **18** is of the centrifugal type and includes an impeller secured to an extension of the motor shaft **61** with a plurality of impeller blades, two of which are indicated by dotted lines in Figure 2, and arranged to produce a large rate of flow out of a tangential discharge nipple **63** coupled to the hose **9**. The water discharged from the upper end of the hose **9** may be thrown away, or in many cases is conveniently used to water grass or plants.

Where filtering equipment is available, the water from the discharge hose **9** is filtered and returned to the pool.

To enhance the scrubbing action, a brush **62** extends across the width of the cleaner immediately behind the opening **52**. This brush is movably mounted by means of headed pins **65** loosely passing through slots **66** in a horizontal support bracket **67**. The bristles are yieldingly urged against the pool floor by a plurality of compression springs **68** around the individual pins **65**. A similar brush is mounted immediately inside of the other opening **56**. There is considerable space between the two brackets supporting the brushes **62** and the tops of the brushes so that a large part of the intake flow advantageously passes upwardly ahead of each brush and over them as shown by the arrow **70**. This produces an extremely effective scrubbing and suction action, removing substantially all dirt from the pool floor. The brushes are reciprocated by a drive linkage described below.

In certain instances a single brush extending across the width of the housing **40** near the center of the cleaner is used instead of the pair of brushes shown. But the arrangement as shown with each brush located just inside of the low intake port **52** or **54** is most effective. The sediment eroding action of the rapid intake flow through the port is combined with the scrubbing action of the brush which kicks up any of the dirt not lifted by the intake flow alone. The dirt is caught in the flow **70** and continues up to the pump.

Controllable drive mechanism

In order to provide motive power, the extended motor shaft **61** projects down through the pump intake port **42** and is secured to a worm **74**. This shaft **61** has its lower end journaled in a bearing **76** secured by a bracket **78** within the housing **40**. The worm **74** drives a gear **80** fastened to a shaft **82** journaled in the bracket **78** and in a parallel bracket **84**. Further speed reduction is provided by a small drive gear **86** fixed to this same shaft **82** and coupled through a shiftable idler gear **88** to a large drive gear **90** which is connected through a shaft **92** supported between these brackets to a chain drive sprocket **94**. A chain **96** shown as a ladder-type chain of corrosion resistant wire which resists clogging, engages this sprocket and runs around a pair of axle sprockets **98** and **100** fastened to the medial portions of the axles **102** and **104**, respectively.

In reversing the direction of drive, the shiftable idler gear **88** is moved to an upper position where it engages a reversing idler **106** turning with the gear **86**. This reversing is controlled by the solenoid **32** and by a compression spring **108** around its armature **48** bearing down against a retaining pin, as shown in Figure 2 biasing the armature toward its lower position. A waterproof shield **110** surrounds the lower end of the armature and this spring and thus prevents water from being sucked in through the clearance hole **44**. When the solenoid **32** is de-energized the spring **108** moves the armature down and pushes the control link **46** down to its lower position shown in dotted outline. The link **46** is connected to one end of a shift lever **111** pivotally supported on the shaft **92** with the shiftable idler **88** supported on the other end of this shaft so that is swings up to engage the reversing idler **106** when the solenoid is de-energized. This motion of the shift lever **111** also serves to control the steering mechanism as explained in detail further below.

In order successively to energize and de-energize the solenoid **32** automatically to reverse the cleaner **8** when it reaches opposite sides of the pool, a push rod **120** is provided projecting beyond both ends of the cleaner and having suitable stop sleeves **122**. For example, when the left end of this push rod (see Figure 2) strikes a pool wall it is pushed to the right which actuates a control arm **124** to close a waterproof switch **126**. As shown, this is a mercury switch of a double-throw type.

The solenoid **32** is connected in circuit with this push-rod actuated switch **126** and with a double-throw control switch **127** in the hand control unit **15** in such a way that the direction of travel of the cleaner is reversed automatically by bumping a wall or other obstruction and can be reversed at will by actuating the switch **127**.

The circuits for operating the solenoid **32** include a contact arm **128** in the switch **127** adapted to engage either a contact **129** connected to the wire **30** or a contact **130** connected to the wire **29**. A wire **131** extends from this arm **128** to the cleaner chassis, and the circuit to one terminal of the solenoid **32** is completed through a jumper lead **132**. Another lead **133** extends from the other terminal of the solenoid **32** to the center contact of the mercury switch **126**. The other two contacts **134** and **135** of the switch **126** are connected to opposite sides of the motor winding **28**. The cable **31** may include a fourth wire **129'** for the purpose of electrically grounding the cleaner frame.

Thus, whenever the push rod is shifted, the energization of the solenoid **32** changes, i.e. it becomes energized, or becomes de-energized, as the case may be, and the cleaner reverses direction. Likewise, whenever the manual control switch **128** is flipped over, the cleaner reverses direction, regardless of its previous direction, and regardless of the position of the push rod **120**.

In order to turn off the motor **16** automatically when the cleaner has passed back and forth across a pool or tank sufficient times to traverse to the opposite end from its starting point, a sensing roller **136** (Figure 3) is horizontally mounted on a push rod **137** near one corner of the cleaner. The roller **136** projects from the side of the cleaner in the direction in which the steering mechanism, described hereinafter, causes the cleaner to traverse. A spring **138** biases the push rod **137** toward its outer position. When the cleaner reaches the far end of the pool, the rod **137** is depressed, actuating a waterproof switch **139** (see also Figure 5) to interrupt the circuit through the motor winding **28**.

When the cleaner is initially lowered into the pool, the side containing the sensing roller **136** is directed toward the opposite end of the pool. The roller **136** enables the cleaner as it nears the end of its run to move along closely adjacent to the end of the pool while the switch **139** is being depressed. As indicated at **140**, a second sensing roller may be included in this side of the cleaner near the other corner for actuating a switch similar to switch **139** in the motor circuit to turn it off in case this corner of the cleaner is adjacent the wall of the pool or tank at the end of a run. The leads **132** and **133** are grouped in a waterproof sleeve **141** between the motor casing **24** and the top of the solenoid casing.

Instead of having the motor and solenoid casings waterproof, the pump and solenoid may be of the type adapted to have water admitted therein, with the windings themselves suitably protected.

Brush oscillating mechanism

In order to oscillate the brushes **62** in opposite directions laterally at high speed, an eccentric cam **142** on the motor shaft extension **61** engages a small roller (Figure 3) on an arm **143**, pivoted at one end to a fixed bracket **144** depending within the housing **40**. The other end of the arm **143** is pivoted to a longitudinally movable rod **145** connected at each end through bell cranks **146** and short links **147** to tabs **148** on the tops of the respective brushes. A spring **149** holds the small roller in engagement with the cam **142**.

In certain applications where a slower brush speed is desired, the arm **143** is actuated from a similar eccentric cam, not shown, on the shaft **82**. When a single brush near the center of the cleaner is used, it is similarly supported and oscillated.

Wheel support mechanism

The cleaner described herein is highly advantageous in its traversing motion whereby the swaths which are cleaned during each traverse overlap in a neat pattern completely to clean the pool floor. To enable steering of this cleaner, each of the four wheels has an axle stub connected to its respective drive axle **102** or **104**, respectively, by a universal joint **156**. Each wheel supports the cleaner by means of an L-shaped bracket **158** having a vertical leg outside of the respective wheel with the end of the associated axle stub journaled therein. A horizontal leg portion of each bracket **158** is secured by a pivot **159** to the respective ends of cross arms **160** or **162**, respectively, associated with the axles **102** and **104** and parallel thereto. Each of these pivots **159** is located directly above the associated universal joint **156**, whereby the wheels are enabled to be turned without any canting of the drive axles **102** or **104**.

The cross arms **160** and **162** are centrally pivoted at **164** and **166**, respectively, to a pair of transverse brackets **168** and **170**, thus enabling the wheels to ride up and down with respect to the cleaner housing in order to accommodate any uneven places in a pool floor. As shown these cross arms have upstanding stiffening flanges with raised central tabs through which the pivots **164** and **166** are fastened. The parallel longitudinal brackets **78** and **84** are secured at each end to these transverse brackets **168** and **170**, as seen best in Figure 2, thus providing firm support for the motor and pump. The ends of the transverse braces in turn are secured to the opposite sides of the housing to form a strong rigid structure. To provide the desired degree of support for the housing regardless of any rocking motion of the cross arms **160** and **162** due to any irregularities in the pool floor, coil springs **172** secured to seats **174** on the transverse stiffening brackets **168** and **170** secured to the underside of the housing **40** and bear down against the ends of the cross arms directly over the wheel pivot points **159**. These springs provide substantially equal supporting forces to the four corners of the housing **40** during operation.

A certain degree of resilient damping support action is provided by the yieldable skirts **50** running along both sides of the housing and bearing against the pool floor. Thus, the motion of the cleaner is extremely smooth and it is efficient in sucking up any silt from the pool floor even in regions which are quite rough.

Steering mechanism

In order to turn the wheels for traversing the pool floor, steering arms **180** project from the wheel brackets **158** and have their ends pivotally connected to a pair of tie rods **182** and **184** associated with the cross arms **160** and **162**, respectively. These tie rods have their central portions bowed down to clear the other mechanism and are moved transversely of the cleaner body in opposite directions by means of a tie lever **186** connected by a central pivot pin **188** to the body of the cleaner. The connections **190** and **192** between the ends of this tie lever and the tie rods **182** and **184** have sufficient play to accommodate the arcuate motions of the various parts. To turn this tie lever, an adjustably positioned steering link **194** is connected between any one of a plurality of arcuately positioned holes **196** in a widened area of the lever **186** and one arm of a bell crank lever **198** having its elbow pivoted at **200** between a pair of vertical angle braces **202** and **144** depending from the housing **40**. The other end **204** of this bell crank lever is connected by a link **206** to the shift arm **111** immediately below the gear **88**. Thus, as the shift arm **111** is moved at the end of each traverse to reverse the cleaner, the four wheels are turned slightly to produce the desired traversing of the cleaner. For small pools the steering link **194** is connected in one of the holes **196** closer to the pivot **188** to turn the wheels more sharply and vice versa. Thus, the desired amount of overlap is obtained between successive cleaning swaths.

In arranging the internal mechanism as described the various parts are arranged to make the over-all height of the cleaner as small as possible and to keep the center of gravity low so the cleaner will resist overturning on steeply inclined pool or tank floors.

Intake baffle mechanism

The intake baffles **56** and **58** are secured to opposite ends of a rockable cradle **58** having a fulcrum pin **210** at the mid point of opposite sides of the cleaner. When one of the resilient baffles is lowered to block one of the intake openings the other baffle is automatically raised to clear the other opening. To rock the cradle **58** about the fulcrum pins **210** as the wheels are turned and the cleaner is reversed, a pair of inclined links **212** and **214** (Figure 3) extend up at an angle from points on the cradle equally spaced on opposite sides of one of the pins **210**. These inclined links are pivotally connected at their lower ends to the cradle and at their upper ends to the adjacent ends of the tie rods **182** and **184**, respectively. As shown in Figure 3 the tie rod 184 is shifted to the left, thus depressing the baffle **56**.

Among the many other advantages of the submarine suction cleaner described herein is that its effective efficient cleaning action reduces the time required for a person to clean a pool, thus also utilizing less water when it is discharged from the pool. If desired, the discharged water can be filtered and returned to the pool.

As shown in Figure 1, among the advantages of this submarine cleaner with the pump and pressure discharge is that ordinary lawn-type pressure hose **9** is used. It is relatively flexible and light in weight. The electric cable **31** is shown as conveniently taped to the hose at spaced points **216**.

Improved buoyant hose

An improved extruded plastic buoyant hose is shown in Figures 6 and 7. This hose has a generally figure **8** cross section with the larger tube **220** used to convey liquids or gases, as the case may be. In order to give added displacement and buoyancy, the smaller parallel tube **222** integrally connected to the tube **220** is filled with a suitable gas, usually air in spaced chambers **226**. This tube 222 is pinched closed at spaced points **224** along its length to form the separate chambers **226**.

This hose is manufactured by extruding a plastic tube through a cored die having an annular opening. Air or other suitable gas is introduced through the cored die into the tube and maintained at suitable pressure within the continuous tube to keep it from collapsing before the plastic cools. The tube is extruded onto a conveyor which carries the inflated tube away from the extruder while the plastic cools, normally under water sprays, at a considerable distance from the extruder.

There is a running seal roller having a rim approximately ⅛ of an inch wide which is positioned close to the extruder. This running seal roller is positioned sufficiently close to the extruder to engage the plastic tube before the plastic has cooled below the sealing temperature. This running seal roller continuously crushes a narrow strip along the length of one side of the tube down and seals it against the other side of the tube which is supported on the conveyor, dividing the original tube at **221** into two smaller tubes **220** and **222** having a generally rounded B-shape. Projecting from one side of the running seal roller and extending parallel to the roller axis and located near the rim is a sealing lug which crushes spaced points on the tube **222** on each revolution of the running seal roller. This makes a series of equally spaced transverse seals **224** extending completely across the tube **222**, forming a series of plastic buoyancy pockets **226** containing gas trapped therein.

The gas is held in the tube **220** by means of a pinch roller which rolls along the tube **220** squeezing it down against the conveyor. This pinch roller is spaced sufficiently far from the extrusion die so that the plastic has cooled well below the sealing temperature before being engaged thereby. The tube **220** springs back to its cylindrical shape after passing this pinch roller. In

certain instances the running seal **221** is made by a pair of running seal rollers engaging opposite sides of the originally extruded tube. Also, the tubes **220** and **222** can, in certain instances, be manufactured through the use of an extrusion die having a figure 8 cross section, without the use of the running seal roller. However, I prefer to use the running seal roller for it enables the use of standard cored circular or annular dies which are now in use for extruding plastic hose.

A controlled flow of air or other suitable gas is introduced into the interior of the tube **222** from the extrusion die. The rate of this controlled flow is sufficient to keep the tube **222** properly supported from within to prevent its collapse during its passage from the extrusion die to the second pinching device. This controlled flow supplies the gas which is successively trapped in the chambers **226** as the hose moves away from the extrusion die past the second pinching device and then on to the pinch rollers.

There are many advantages in using this type of buoyant hose with a submarine suction cleaner as described to keep the hose from dragging on the bottom of the pool behind the cleaner. In addition, this type of buoyant hose is adapted for use in refueling ships at sea. In certain applications this buoyant hose is adapted to be used as a buoyant conduit, and electric wires are run through the hose **220**, which thereby provides an insulating, protective, waterproof covering as well as providing the desired buoyancy to float the conduit assembly.

The plastic used is a copolymer of vinyl chloride-vinyl acetate suitably plasticized with tricresyl phosphate or vinyl chloride and vinylidene chloride copolymers suitably plasticized.

From the foregoing it will be understood that the embodiment of the present invention described above is well suited to provide the many advantages set forth, and since different embodiments may be made of this invention and as the apparatus herein described may be varied in various parts, all without departing from the scope of the invention, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense and that in certain instances, some of the features of the invention may be used without a corresponding use of other features, or without departing from the scope of the invention.

I claim:

1. A submarine suction cleaner including a body adapted to be submerged beneath the liquid in a tank for cleaning the bottom surface of the tank, supporting and reversible driving mechanism on the body for moving the body along the bottom surface of a tank, said reversible driving mechanism including sensing means at opposite ends of the body adapted to reverse direction after an obstacle has been engaged by the sensing means, said body having skirt means extending down along opposite sides closely adjacent to the bottom of the tank defining a suction chamber open at the bottom and extending beneath a major portion of the underside of the body and having an elongated intake opening extending across one end of the body contiguous with the bottom surface along which the body is moving and feeding into said suction chamber, said opening having a small height relative to its length, a continuous suction pump on said body, said pump having a suction inlet communicating with the interior of said suction chamber, and a pressure-type discharge hose connected to the discharge of said pump and adapted to extend from said cleaner out of a tank.

2. A submarine suction cleaner adapted to be submerged beneath the liquid in a tank for cleaning the bottom surface of the tank comprising a body adapted to run along the bottom surface of the tank and having driving mechanism which is reversible in operation, said reversible driving mechanism including sensing means at

opposite ends of the body adapted to reverse the direction after engaging an obstacle, said body having a substantially liquid tight housing closing in all sides of the cleaner forming a suction chamber beneath the cleaner within said housing, said suction chamber extending over a major portion of the underside of the cleaner, resilient skirts projecting down on opposite sides of the cleaner body with their lower edges engaging the bottom surface of the tank on both sides of the cleaner effectively sealing both sides of the housing, thereby preventing the entry of liquid into said housing from either side, said housing having intake openings into the housing extending across opposite ends of the cleaner and contiguous with the bottom surface of the tank, a suction pump on said body having an intake communicating with the interior of said housing for sucking liquid from within said housing, whereby a reduced pressure is maintained continuously in said suction chamber adjacent to the bottom surface of the tank providing added traction for running along the bottom surface of the tank and discharge means connected to the discharge of said pump for removal of the liquid and dirt drawn in through said intake openings.

3. A submarine suction cleaner adapted to be submerged beneath the liquid in a tank for cleaning the bottom surface of the tank comprising a body having a reversible driving and steering mechanism adapted to run the body along the bottom surface of the tank and traversing the body back and forth across the bottom surface along partially overlapping paths, said body including sensing means at each end for reversing the direction of drive upon encountering an obstacle, said driving and steering mechanism changing the path of the cleaner slightly upon each reversal for following partially overlapping paths, a housing on said body closed in at the top and extending down on all sides to positions near the bottom surface of the tank to form a suction chamber, resilient skirts projecting down from the two sides of said housing closely adjacent to the bottom surface of the tank and sealing up said sides of the housing, at least one end of said housing being open adjacent to the bottom surface of the tank, said housing having a port therein spaced a substantial distance above the bottom of said housing and a submersible suction pump of the continuous action type having an intake communicating with said port for sucking liquid from said chamber, and a submersible electric motor coupled to said pump, a pressure type discharge hose connected to said pump, and a submersible electric cable connected to said motor.

4. A submarine suction cleaner adapted to be submerged beneath the liquid in a tank for cleaning the bottom surface of the tank and having a body including reversible drive and steering mechanism adapted to run the body back and forth along the bottom surface of the tank following paths which partially overlap and zig-zag back and forth across the bottom of the tank progressing over the area of the bottom, said body including sensing means at opposite ends of the body adapted to reverse the direction of drive after reaching an obstacle, said reversible drive and steering mechanism changing the direction of the path of the cleaner slightly during each reversal in direction thereby to follow partially overlapping zig-zag paths for cleaning the area of the bottom surface, means defining a suction intake opening extending across the width of the body at one end, an electric motor on said body, a suction pump on said body driven by said motor and communicating with said intake opening, and a discharge hose of the flexible pressure type connected to said pump and adapted to extend up out of the liquid, said hose having sufficient strength for lifting said cleaner from the bottom of a tank.

5. A submersible suction cleaner for swimming pools and tanks and the like adapted to run beneath the water in a pool for cleaning the pool floor comprising a body, two pairs of supporting wheels thereon, said wheels being

mounted on stub axles which are pivotally connected to the body for steering, a steering arm connected to each of said stub axles, tie rods interconnecting the steering arms of each pair of wheels, a drive axle for the wheels of each pair connected by a universal joint at each end to the stub axles of the wheels of that respective pair, a sprocket secured to each of said drive axles, a drive chian engaging each of said sprockets, an electric motor on said body, a drive sprocket driven by said motor and also engaging said chain, and electromagnetic means coupled to each of said tie rods and arranged simultaneously to turn all of said wheels in the same direction.

6. A submersible suction for swimming pools adapted to run beneath the water for cleaning the pool floor comprising a body, a submersible electric motor mounted on said body and having a vertical shaft extending downwardly, a centrifugal pump coupled to said shaft, a worm gear near the lower end of said shaft a driven gear engaging said worm and a shiftable drive mechanism including a shift arm and an idler gear thereon coupled to said driven gear, a solenoid on said body, an armature actuated by said solenoid and coupled to said shift arm, at least one drive wheel on said body adapted to engage the pool floor, and a drive connection between said idler gear and said drive wheel.

7. A submarine cleaner adapted to be submerged beneath the liquid in a tank for cleaning the bottom surface of the tank and adapted to be connected to a suitable suction source comprising a body, a plurality of wheels on said body for engaging the bottom surface of the tank, steering mechanism connected to all of said wheels for simultaneously turning said wheels by equal amounts, reversible drive mechanism coupled to at least one of said wheels for moving the body along the bottom surface of a tank, and a pair of intake openings extending across said body near opposite ends contiguous to the bottom surface of the tank and adapted to communicate with said suction source.

8. A submarine suction cleaner including a body adapted to be submerged beneath the liquid in a tank for cleaning the bottom surface of the tank and adapted to communicate with a suction source, supporting and reversible driving mechanism on the body for moving the body back and forth along the bottom surface of a tank, a pair of intake openings on the body on opposite ends near the bottom surface along which the body is moving arranged to communicate with said suction source, and baffle means selectively closing one of said openings, said baffle means being coupled to said reversible driving mechanism and being operated in synchronism therewith for closing the opening at the rear of the cleaner with respect to the direction of drive.

9. A fully automatic submarine suction cleaner for cleaning swimming pools, tanks, and the like adapted to run beneath the liquid on the bottom surface for cleaning the bottom surface, supporting and reversible driving mechanism on the body for running the body back and forth along the bottom surface including a submersible electric drive motor carried by the body, a submersible electric cable connected to said motor, control mechanism for reversing the direction of drive, a sensing element at each end of the body responsive to contact with an obstruction for actuating the reverse control mechanism, means defining an intake opening effectively extending substantially across each end of the body closely adjacent to the bottom surface, a brush immediately inside of each opening and extending along the length of each opening, means holding each brush down against the bottom surface, each opening and its associated brush defining an intake channel passing in through the opening and up before and above the brush, and a continuous suction pump having its intake communicating with said intake channels and being driven by said electric motor.

10. A fully automatic suction cleaner for swimming pools and tanks and the like adapted to run beneath the

liquid on the bottom surface for cleaning the bottom surface comprising a body adapted to be submerged including a plurality of supporting and driving members, said body having a pair of resilient skirts extending down near the bottom on opposite sides of the body defining a suction chamber beneath the body which is exposed to and closely adjacent to the bottom surface of the tank with a pair of intake openings extending across opposite ends of the body feeding into said suction chamber and being adjacent the bottom, a submersible electric motor on said body for operating said driving members, an obstruction sensing means at each end of the body, a reversible drive control mechanism on said body responsive to said sensing means for reversing said driving members, a mechanical means for slightly changing the axis of movement of the body upon reversing direction, brush means inside of and closely adjacent to each opening and engaging the bottom so that the intake flow through each opening is up and over the adjacent brush, a submersible electric cable for energizing said motor, and a continuous suction pump on said body driven by said motor having a suction side communicating with the interior of said body, whereby a continuous suction is maintained in said suction chamber for increasing the traction of said supporting and driving members.

11. A submersible suction cleaner as claimed in claim 10 including an on-off switch in circuit between said cable and said motor, and second obstruction sensing means at one side of the cleaner for actuating said switch.

12. A fully automatic suction cleaner for swimming pools and tanks and the like adapted to run back and forth along partially overlapping zig-zag paths beneath the liquid on the bottom surface for successively cleaning partially overlapping strip-areas of the bottom comprising a cleaner body adapted to be submerged and including a plurality of rotating driving members on the underside, a reversible driving mechanism on said body connected to said driving members and including a submersible electric motor, an obstruction sensing means at each end of the body, said reversible driving mechanism being responsive to actuation of said obstruction sensing means for reversing the direction of motion, a mechanical steering mechanism for changing slightly the angle of the path of motion of the cleaner upon each reversal of motion and for maintaining all of said driving members in alignment so as to steer the cleaner along straight lines at an angle to one another as it progresses back and forth, thereby following partially overlapping zig-zag paths over the bottom surface, means defining a pair of intake openings at the two ends of the cleaner extending across the full width of the cleaner generally perpendicular to the direction of travel, means for selectively opening the leading one of said intake openings in the direction of travel, a continuous suction pump on the cleaner body having its suction side communicating with said intake openings, and discharge means connected to the outlet of said pump.

13. A fully automatic submersible suction cleaner for swimming pools and tanks and the like adapted to run back and forth beneath the liquid on the bottom surface for successively cleaning partially overlapping paths which progress across the bottom surface comprising a cleaner chassis adapted to be submerged and including revolvable members projecting down beneath the chassis and adapted to run along the bottom surface, reversible driving and steering mechanism on said chassis connected to said revolvable members and including a submersible electric motor, a submersible electric cable for energizing said motor, obstruction sensing means at opposite ends of the chassis, said reversible driving and steering mechanism being responsive to actuation of said obstruction sensing means for reversing the direction of motion and changing slightly the path of motion of the cleaner during reversal of direction and maintaining all of said revolvable members in alignment so as to guide the cleaner along straight overlapping paths as it traverses back and forth, said cleaner chassis having a suction chamber closely adjacent to and exposed to the bottom surface, said suction chamber extending beneath a large part of the cleaner chassis and including skirts extending down on opposite sides of the chassis closely adjacent to the bottom surface, a continuous suction pump on said chassis having its intake communicating with the interior of said suction chamber for providing a continuous increased traction of said revolvable members, means defining a pair of intake openings at the two ends of the cleaner extending across the width of the cleaner and connected to the intake of the pump, and a flexible discharge hose connected to the discharge of said pump.

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