April 14, 1970 W. O. BAKER 3,506,489

METHOD AND APPARATUS OF CLEANING A POOL

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FIG. 1

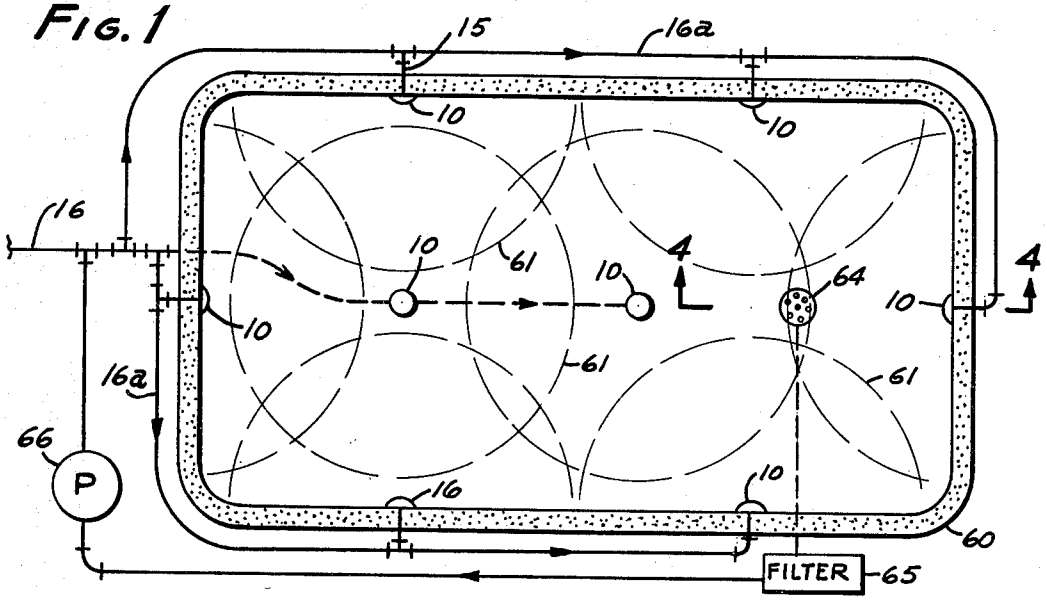


FIG. 3

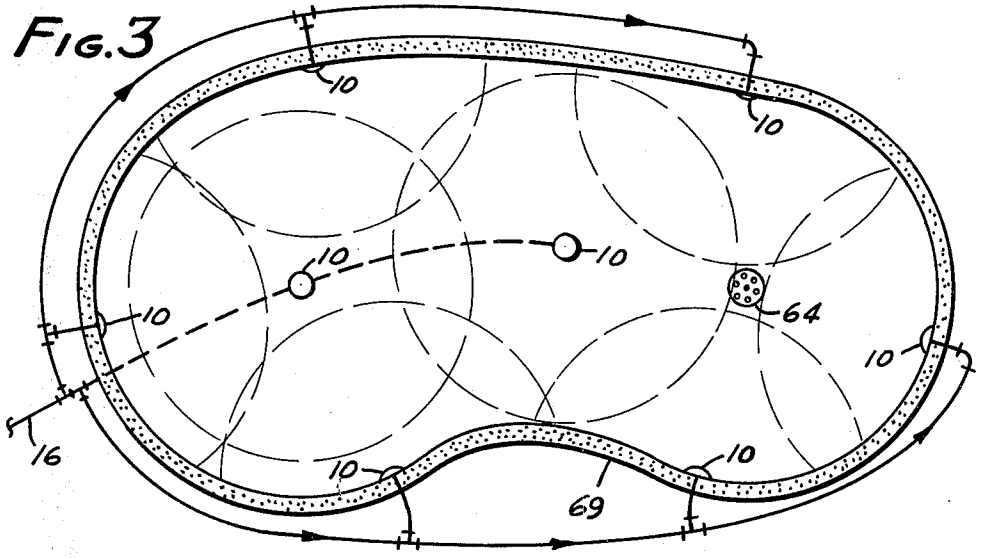
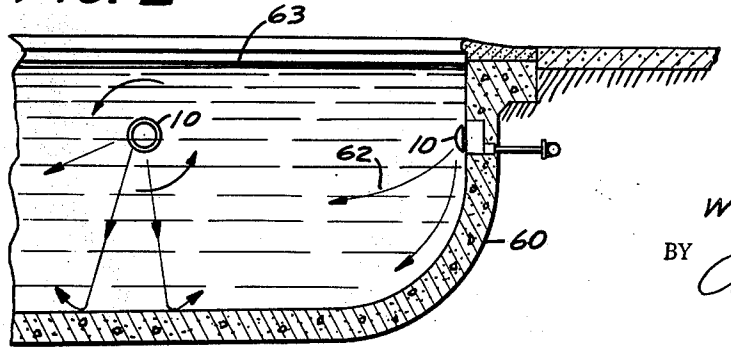


FIG. 2

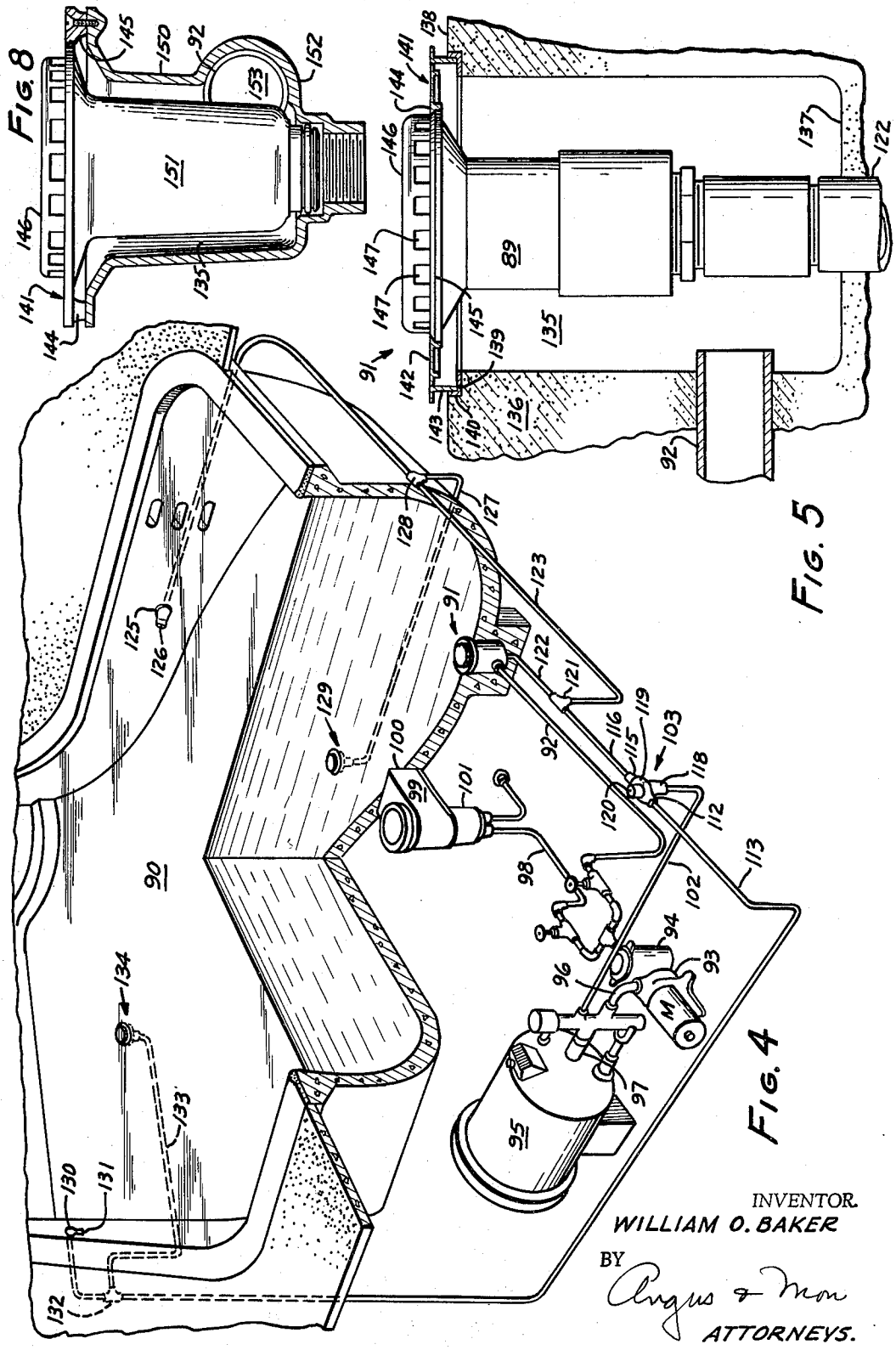


INVENTOR.
WILLIAM O. BAKER
BY Angus & Mon
ATTORNEYS.

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FIG. 7

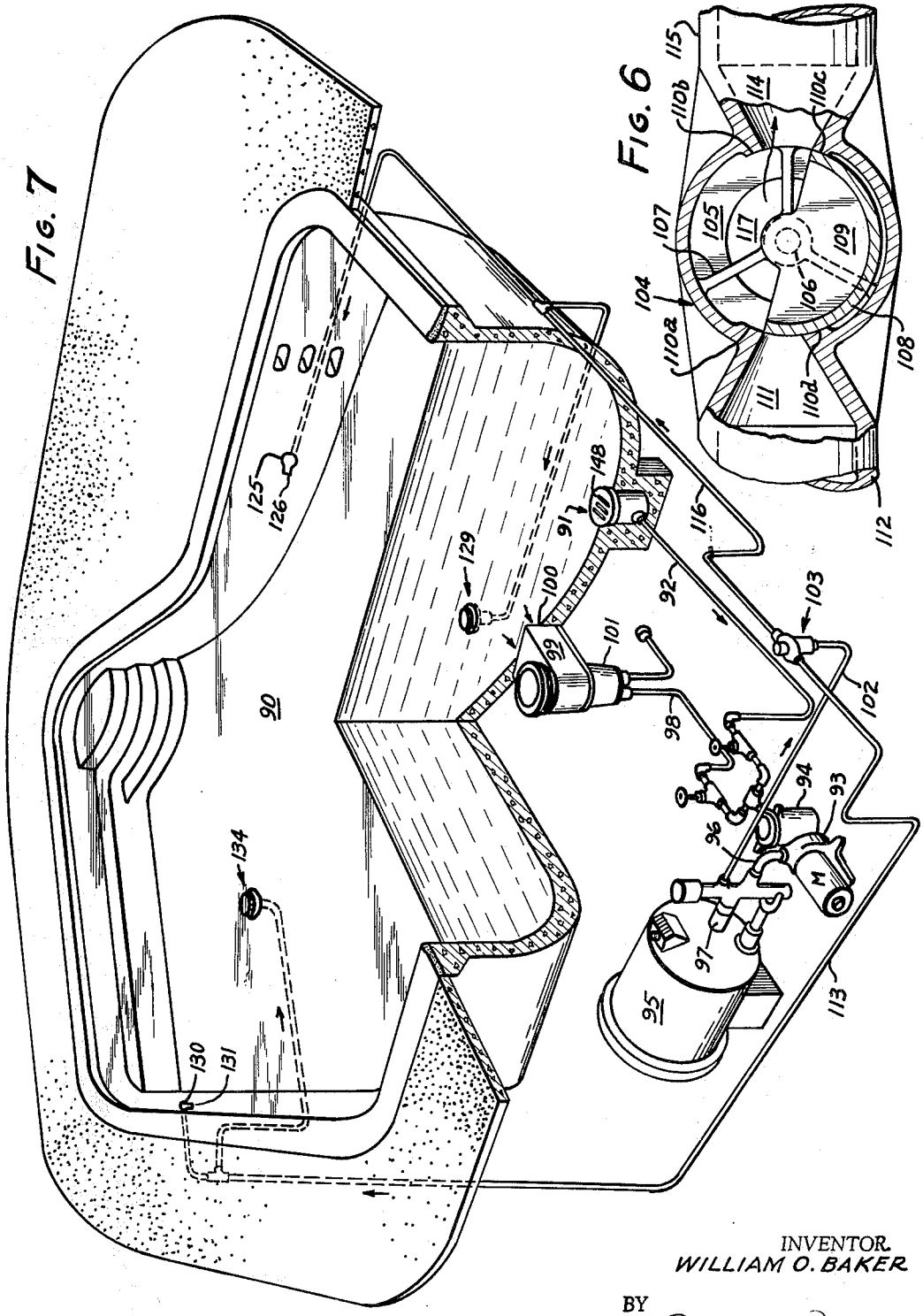


FIG. 6

INVENTOR.
WILLIAM O. BAKER

BY
Angus & Mor
ATTORNEYS.

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3,506,489

METHOD AND APPARATUS OF CLEANING A POOL

William O. Baker, West Covina, Calif., assignor to Swimquip, Inc., El Monte, Calif., a corporation of California

Continuation-in-part of application Ser. No. 637,608, May 10, 1967, which is a continuation-in-part of application Ser. No. 507,607, Oct. 22, 1965, which in turn is a continuation-in-part of application Ser. No. 291,885, July 1, 1963. This application Aug. 26, 1968, Ser. No. 770,133

Int. Cl. B08b 7/04

U.S. Cl. 134—10 13 Claims

ABSTRACT OF THE DISCLOSURE

Individual ones of a plurality of jet streams of liquid are successively and intermittently maintained in different fixed angular directions from a position at an interior wall surface of a pool to sweep and agitate dirt settling at or near said surface, and to move it and keep it in suspension in the pool liquid. The pool liquid is filtered thereby removing dirt from the pool. According to another aspect of this invention, a plurality of jet streams is maintained at different positions, and the jet streams are intermittently and successively operated so that at least one of the jet streams is maintained on while another is maintained off.

This application is a continuation-in-part of my co-pending application Ser. No. 637,608, filed May 10, 1967, for "Method and Apparatus of Cleaning a Pool," now abandoned which is a continuation of my co-pending application Ser. No. 507,607, filed Oct. 22, 1965 for "Method and Apparatus of Cleaning a Pool," now abandoned which in turn is a continuation-in-part of my co-pending application Ser. No. 291,885, filed July 1, 1963, for "Method of Cleaning a Swimming Pool," now abandoned.

This invention relates to the cleaning of swimming pools, and has for an object to clean a pool automatically and efficiently.

A related object is to carry out the automatic cleaning without staining the pool.

It has long been a problem in cleaning swimming pools to remove the sediment and solid particles which settle from the water and accumulate on the floor and sides of a swimming pool. Surface skimming operations will not remove it; nor is the common operation of recirculating the water from a drain in a pool through a filter and back into the pool, effective in the absence of a method of keeping the dirt in suspension.

Attempts have heretofore been made to automatically activate the water at the bottom of a pool to stir up the dirt particles and keep them in suspension. One method has been to mount nozzles on the sides of the pool aimed toward the drain to direct a high velocity stream of water along the surface of the pool toward the drain at the bottom. The high velocity stream of water forces the dirt particles into suspension and moves them toward the drain. This method has disadvantages, however. The water upon leaving the fixed nozzles must have enough momentum to send a current of water to the drain at the bottom of the pool. The amount of water flow necessary to create the required momentum is greater than the amount needed to adequately filter the pool by consecutive dilution. Therefore, a larger pump and filter are required to operate such a system than are normally required for pool cleaning.

Another disadvantageous factor in the use of such a system resides in the fact that pool water normally contains substances in a dissolved state as well as in suspension. Such dissolved substances can include copper sulphates, iron oxides and acids used in purifying the water. When they are played along the surfaces of the pool for long periods of time in a fixed path of flow, they will cause staining of the pool surface.

Other proposals for automatic cleaning have involved the use of moving elements such as water hoses which move and whip around the bottom of the pool. Such moving objects in a pool have obvious disadvantages of unsightliness and interference with swimming.

Another system proposed has involved the use of rotating nozzles from which water jets are ejected, the rotational force on the nozzle being derived from the same flowing water which is ejected from the nozzle. Whatever area of the pool floor or wall is reached by the jet will be subjected to its cleaning action. Typical of these are the arrangements shown in Miller Patents 3,247,968 and 3,247,969, both issued Apr. 26, 1966, involving the use of a nozzle device which is constantly rotated by water pumped into it and ejected from a pair of nozzles offset from the axis of rotation.

Such rotating nozzle arrangements have the inherent disadvantage that the torque applied to the nozzle pair, if sufficient to overcome the friction of the rotating nozzle member at its bearing and in rotating through the pool water, must be so great as to produce an undesirably high speed of rotation of at least the order of about 10 revolutions per minute. The reason for such a high rate of rotation being undesirable is that the water jet exiting from the orifice of the rotating nozzle into the pool is forced into a spiral path in the pool. This follows from the fact that once the jet has been ejected from the nozzle into the pool water, the jet cannot move sideways through the pool water, and hence cannot extend radially from the axis of rotation like the spokes of a wheel. Since any given rate of flow through a nozzle produces a jet stream of a limited effective length through the pool water, it is apparent that the faster the nozzle rotation, the tighter and more compact will become the spiral of the jet, thereby resulting in a smaller area of the pool wall or floor surface which can be swept by the jet.

It is seen from the foregoing discussion that in order to obtain efficient cleaning of swimming pool wall and floor surfaces by rotating water jets, the jet should extend radially outward from the axis of rotation, like a spoke of a wheel. This could be accomplished if the rate of rotation of the nozzle be made slow enough, such as the order of about one revolution per hour. This would be in effect as though the nozzle were substantially stationary in any one direction, and such very slow rotation might be accomplished by some sort of electric servo or clock mechanism adequately waterproofed and attached to the nozzle in the pool and operated by an outside source of electric power. But from the standpoint of economics and complication and technical difficulties with such immersed equipment, it is not practical in a pool. The only practical source of power for moving a nozzle immersed in a pool is the pumped water which is to create the jet from the nozzle.

My experimental work with a device like that of the Miller patents has shown that the nozzles cannot be made to rotate at a speed of less than about ten revolutions per minute, when there is any rotation at all, and therefore cannot avoid the undesirable spiraling, which results in an undesirable small area which can be swept by the jets.

I have attempted to overcome the disadvantage of rotating nozzles like that of the Miller patents, by provision of a single nozzle directed radially from the axis of rotation, the turning force of which was provided

by a relatively small orifice through the side of the nozzle which produced a small water jet extending from the nozzle in a direction perpendicular to the direction of the nozzle and to the axis of rotation. This small driving jet rotated the nozzle, but whenever the force of the driving jet was sufficient to produce any rotation at all, the rotation could not be caused to be less than about ten revolutions per minute, and for the same reasons as in the case of the Miller patent devices. Further experiments with a pair of such nozzles oppositely directed and with their axes passing through the axis of rotation, failed to produce rotation any slower than 10 revolutions per minute whenever rotation was produced at all. Furthermore, the rotational speed could not be reduced by use of such expedients as provision of a needle bearing to reduce bearing friction and shortening the nozzles as much as possible to reduce friction from the pool water.

Following my above-mentioned experiments with rotating nozzles, I have heretofore proposed to overcome the above-noted difficulties and disadvantages in the use of rotating nozzles by rotating the nozzles by means of a water-driven Pelton wheel connected to the nozzles through a train of reducing gears. Such an arrangement is shown in my copending application Ser. No. 637,608, filed May 10, 1967. It was hoped that this arrangement would allow the speed of rotation of the rotating nozzles to be slowed down to an acceptable speed so that the direction of the water jet would be straight out from the exit nozzle and not undergo any perceptible spiraling effect, such as incurred in the case of the Miller patent arrangements while allowing the Pelton wheel to rotate fast enough to avoid stalling due to friction and also to accomplish the above objectives without undue pressure loss.

Upon building and testing such a device in which the gear reduction train had a ratio of about 1500:1, I found the rotating nozzle could not as a practical matter be slowed down to less than ½ revolution per minute which was not sufficiently slow to eliminate the spiraling effect of the water jet to an acceptable level. The reason the Pelton wheel device was not practical was a combination of the spiraling effect of the water jet and high head loss through the Pelton wheel and orifices required to make the unit function. Experiments with this Pelton wheel device indicated that in order to obtain a desirable speed of nozzle rotation of about 1 revolution per hour or less which would produce a cleaning effect from the water jet of about 7 feet, it would be necessary to provide a gear train between the nozzle and Pelton wheel with a considerably higher gear reduction ratio than the 1500:1 ratio which was actually tried out. The use of such a high ratio gear train would be excessively expensive and would increase the pressure drop through the mechanism thus making this application impractical.

Exeprience has shown that in order to achieve practical and effective cleaning of the wall or floor surfaces of a pool, about fifteen to twenty-five gallons per minute of water should be ejected from the nozzle. As the flow through the nozzle is reduced below fifteen gallons per minute, the length to which the jet extends through the pool water decreases rapidly, and as the flow is increased above twenty-five gallons per minute, the resulting increased flow is so small as to be not worthwhile, as the length of the jet does not increase appreciably with the increased flow above twenty-five gallons per minute.

In the tests experiments No. 20 silica sand of 3½ mm. diameter, was spread on the pool areas to be cleaned. Loam soil and the heavier adobe type soil were also used, as was charcoal which was a lighter test material. Sand is the most significant test material as sand exists in all soils and invariably falls in a swimmng pool as blow sand, and it is at least as difficult to sweep with the jet as any other of the usual materials to be agitated into suspension in the pool water for filtering. In the case of the Miller patent devices and the experiments with rotating nozzles discussed above, the maximum cleaning radius was found to be about three feet.

The arrangement of my present invention overcomes the above-stated disadvantages of such rotating nozzle devices as those of the said Miller patents and of the Pelton wheel with the gear train. Furthermore, it provides a method of cleaning the surfaces of the side walls and floor of a pool automatically, without the use of moving water hoses or conduits or an excessive amount of water flow or filter capacity, and without staining the pool. Basically my present invention involves directing the jet in a number of different angular directions from the nozzle for finite periods of time in each direction.

In accordance with my present invention, I am able to produce the desirable effect of a very slowly rotating nozzle of the order of 1 revolution per hour or less, and with a flow from the nozzle of as much as 25 gallons per minute and a straight radially extending jet of 7 feet or more which is the radius of the surface being cleaned, while avoiding any sticking or stopping of any rotating element. Furthermore, this is accomplished by use of the water which flows to the nozzle from which the jet emanates.

By suitable timing mechanism, the length of time of the jet in any one direction can be adjusted as desired. Thus, a jet may be sent in each direction for an appreciable period of time. It is not generally practical to send the jet in any one direction for a period of time less than about one-half minute. A water jet sent from the nozzle into a pool of water does not immediately reach out to a point near its full extent in less than one-half minute. Even after a time of one-half minute, the jet will still continue to reach out slowly in the same direction up to about three minutes. After the three-minute period any further extension of the jet in that direction becomes relatively slight. Accordingly, it may be stated that the finite time for the jet in each of its appointed directions should ordinarily be between one-half and three minutes, although there is usually no harm in extending the time beyond three minutes.

After the finite time period has expired in any one jet direction, the jet is caused to be sent in its next appointed direction for another finite period of time and so on until the jet has been sent in all of its appointed directions from the point of origin of the jet. For example, if the jet is to sweep a complete circle, and assuming that it will have eighteen different appointed directions uniformly spaced, the adjacent ones of the established directions will be 20 degrees apart, and if the system is timed to send the jet in each of its directions for three minutes, it will take about fifty-four minutes for the jet to cover the entire circle, assuming that the time interval between the successive jets is not appreciable.

In the case of most pools, I prefer to use more than one of these jets, which will be spaced apart from each other by proper distances to insure that all parts of the pool are acted upon by the arrangement of water jets.

In the operation of this cleaning method, one or more of the water jets will ordinarily be maintained substantially all the time during the normal filtering of the pool. Thus, dirt will be maintained in suspension in the pool water and filtered out through the pool filter in the usual manner.

The cleaning method can readily be carried out by means of suitable fittings attached to the bottom and side walls of the pool and connected with a system of water under pressure, ordinarily the pool filtering pump, to produce the water jets.

A desirable, but optional, feature resides in the location of a jet device at the position of a drain of the pool.

According to a feature of the invention, the angular direction of a jet is shifted from one of its established

angular directions to the next direction by action of the water itself which is brought to the jet-producing nozzle. A related feature resides in the use in a water conduit leading to the jet nozzle device of a valve means effective intermittently to shut off and turn on the flow of water to the nozzle device, thereby causing the shift of nozzle direction by means of these water flow discontinuities.

A further related feature resides in the use of a valve mechanism which receives the pumped or pressurized water which is to be sent to the jet nozzles and directs it first to one jet nozzle device for a finite period of time to shift its jet direction and establish the finite time of the jet in that direction, and then shifts the water flow to another jet-producing nozzle to shift its jet direction and establish the finite time of its water jet.

This last-mentioned feature has the advantage of allowing water from a pool to be pumped through a filter and then alternately into the water line to one jet-producing device followed by introduction into the water line to a second jet-producing device. This allows two separate water lines to be operated alternately and with the full flow attainable from a given sized pump and filter. If it were attempted to supply both water lines at the same time with the same water flow there would be required an extra capacity pump and filter which would involve further expense.

The foregoing and other features of the invention will be more readily understood from the following detailed description and the accompanying drawings of which:

FIG. 1 is a plan view of a rectangular shaped swimming pool equipped with water fittings to produce water jets according to this invention;

FIG. 2 is a section view taken at line **4**—**4** of FIG. 1;

FIG. 3 is a plan view of a kidney shaped swimming pool equipped with water fittings for producing the cleaning action;

FIG. 4 shows a partially cutaway view of a swimming pool provided with a pumping and filtering system and with outlets into the pool, some of which provide jets in the form of intermittent jets sent in different angular directions;

FIG. 5 is a view partially in cross-section at the main drain of the swimming pool of FIG. 4;

FIG. 6 is a view partially in cross-section of a timed valve used in the system of FIGS. 4 and 7;

FIG. 7 shows another partially cutaway view of a swimming pool with a filtering and pumping system and with a different arrangement of outlets comprising intermittent water jets; and

FIG. 8 shows a modification of the arrangement of FIG. 5.

FIGS. 1 and 2 show water fittings such as fittings **10** connected to water main **16** by pipes **16***a* and mounted into the side walls and floor of a rectangular shaped pool, the side walls and floor being herein referred to as the swimming pool walls or surfaces. The main and pipes are represented by the lines, and the arrows in the lines represent the direction of water flow. It is preferred that top **13** of casing **11** be level with the inner wall and floor surfaces of the pool. Each of the fittings causes a water jet to flow over a surface area having a perimeter denoted by dotted lines **61**. By proper positioning of the jet devices or fittings in the walls and floor of the pool, substantially the entire surface of the pool is covered. The curved edges and corners of the pool change the direction of water flow denoted by arrows **62** as shown in FIG. 2.

It is desired that the water jet is not shot above the water surface **63** of the pool. Hence, the fittings are disposed sufficiently below the surface of the water so that the jet of water will not have enough momentum to shoot above the surface. It may be desired that the fittings on the side wall surfaces have small orifice openings, or the water pressure at their inlets may be low in comparison to the water pressure at the fittings on the floor of the pool so that the momentum of the water leaving the wall fittings will be smaller than that on the floor. This will allow the floor fittings to have a greater coverage than the wall fittings and the wall fittings will not shoot a jet of water out of the pool when the head rotates to the position of a vertically directed jet of water.

As the water current moves over the floor and/or wall surfaces of the pool, solid particles of dirt and debris lying on said surfaces are forced by the current back into suspension in the water. A drain **64** at the bottom of the pool allows the water to drain from the pool to circulate through a filter **65** and a pump **66** back to the water fittings **10**. The filter operates to clean the water of the suspended solid particles and the pump then pumps the water back to the fittings.

FIG. 3 shows a kidney shaped pool **69** with water fittings **10** mounted in the walls and floor of the pool in a similar manner as previously described in connection with the rectangular shaped pool. In this case, however, the positioning of the fittings in the sides and bottom of the pool will generally be different from that of the rectangular shaped pool due to the curvature of the walls.

The positionings of the fittings in FIGS. 1 and 3 are only shown as examples of the method of cleaning the pool and it must be understood that the positioning is entirely arbitrary. The positioning will depend upon such factors, for example, as the depth of the water of the pool where the fitting is placed, the effective coverage of the fitting, the location of the steps, or other obstacles in the pool.

FIG. 4 shows another arrangement for cleaning a swimming pool by action of water jets, which in this case involves the use of intermittent jets of water which are successively directed in different angular directions from the position of the jet. The swimming pool **90** is shown with its wall partly broken away for illustration of the parts. According to common practice, the main drain **91** of the pool is located at its lowermost position in the pool, through which water is withdrawn from the bottom of the pool through pipe **92** and drawn by a motor-operated pump **93** through a suitable strainer **94** which removes debris before entry of the pool water into the pump. The pump sends the pool water into a filter **95** through pipes **96** and **97**. At the same time the pump draws water through a pipe **98** from a skimmer **99** located at the surface of the pool water. Because of the fact that the pool walls are shown broken away at the region of the skimmer, its attachment in the pool wall is not shown. The skimmer can be of a well-known type needing no detailed description here, and may be constructed for example as shown in U.S. Pataent No. 3,067,879, issued Dec. 11, 1962. Its elevation at the pool wall is such that the normal pool water level is about half-way up the entrance passageway **100** of the skimmer, through which it is drawn to pass through a suitable debris-collecting basket (not shown herein, but illustrated in said Patent No. 3,067,879) located within housing **101** from where it passes through pipe **98** through the strainer **94** to the pump. The pump water delivered from the output of the filter passes through a pipe **102** to a motor driven selector valve **103** which may be constructed as shown in FIG. 6.

The selector valve comprises a generally cylindrical housing **104** providing an internal compartment **105** within which is fitted a valve shaft **106** concentrically located within the cylinder and mounted in a suitable bearing supported by webs **107** fixed to the housing. The shaft carries a valve gate in the form of a half cylinder **108** supported by a solid portion or web **109** fastened to the shaft. This gate makes sliding contact with surfaces **110***a*, **110***b*, **110***c* and **110***d* formed as parts of a cylinder centered at the shaft and acting as valve seats. Between seats **110***a* and **110***d* there is an outlet port **111** leading to an outlet section **112** which threads to a pipe **113**. Op-

posite port **111** there is a similar outlet port **114**, located between seats **110***b* and **110***c*, leading to an outlet section **115** which threads to an outlet pipe **116**. At the bottom of chamber **105** there is an inlet port **117** opening downwardly into a section **118** which is threaded to pipe **102**. The upper parts of the housing and chamber **105** are closed by a top closure **119** to which there is attached a motor **120**, the shaft of which attaches with the shaft **106** of the valve. The motor **120** is of the slow drive type, made slow by means such as gears (not shown) which causes rotation of the shaft **106** slowly so that the valve member **108** intermittently and successively closes the ports **111** and **114**, the lower port **117** always being open. Thus, water is always free to enter the chamber **105** through port **117** and to be emitted from the chamber **105** either through port **111** or port **114**.

A pipe T **121** is fitted to pipe **116**, and from this T there are brought two pipes **122** and **123**. The pipe **122** is connected to a jet-producing device **89** located within the main drain **91** in the floor of the pool as shown in FIG. 5. This jet-producing device is of a character which sends a jet of water in a certain direction laterally along the surface of the pool floor, when the valve port **114** is open. Each time the valve port opens after being closed, the jet is sent in a different lateral direction. Thus, successive water jets each in a fixed direction are sent from device **89** in successively different angular directions, around the device **89**. Details of construction and operation of the intermittent jet-producing device **89** are given in the co-pending application of David A. Stanwood, entitled "Liquid Jet Producing Device," Ser. No. 500,583, filed Oct. 22, 1965, now U.S. Patent No. 3,408,-006, granted Oct. 29, 1968, and assigned to the same assignee as the present application.

The pipe **123** is carried around the outside of the pool wall to an outlet **125** located in a side wall somewhere below the water surface the outlet being of a type provide with a directional deflector **126** which is preferably adjustable. This functions to send the water into the pool and by proper adjustment can be sent in any desired direction, for example, laterally to sweep along the side wall. This will tend to circulate the water around the pool. A branch pipe **127** is led off from pipe **123** by a T **128**, pipe **127** leading to another outlet **129** at the floor of the pool at some distance from the main drain **91**. The outlet **129**, carried up through the concrete bottom wall of the pool, can be the same type of jet-producing device as the device **89** of FIG. 5.

The pipe **113** is brought to still another location at the outside of the pool where it is brought to an outlet **130** at the side wall of the pool and provided with a baffle or deflector **131** to send the water output in a desired direction such as tangentially along the pool wall, preferably in the same direction around the pool as provided by outlet **125**. A T **132** placed in line **113** provides for a branch pipe **133** which leads to another outlet **134** which is in the floor of the pool at a shallower part of the pool than at the main drain and at some distance from outlet **129** and from the main drain **91**. Outlet **134** is of the same jet-producing type as outlets **129** and **89**.

The main drain **91** is, according to common practice, in the form of a chamber **135** formed within the bottom wall **136**, ordinarily of concrete, at the deepest part of the pool. This chamber **135** is, according to common practice, of a cylindrical shape and provided a circular bottom **137** through which pipe **122** extends and is sealed by the cement to prevent leakage between the exterior of the pipe and the concrete. Around the open top of the chamber **135** there is fitted to the concrete wall an annular ring **139** whose internal diameter is the same and flush with the internal diameter of the chamber **135**; and this ring has an upstanding cylindrical portion **140**, the top of which is flush with the upper surface **138** of the bottom wall of the pool. In most pools, a grate in the form of a circular member will be fitted within the member **140** resting on the ring **139**. In the present situation, however, such a grate is dispensed with and instead, the upper open end of chamber **135** is covered by the water jet-producing device **89** and its mounting member **141**. The member **141** comprises an annular ring portion **142** mounted on a number of legs **153** spaced apart from each other around the annulus and resting on the ring **139** and in contact with the ring **140** as shown. The legs **143** are tall enough to hold the ring **142** at some distance above the surface **138** of the concrete so that there is ample space for communication between chamber **135** and the water of the pool. Thus, water drained from this main drain through pipe **92** will flow from the pool into chamber **135** through these spaces between adjacent legs **143**. The inner portion of the member **142** is formed as a circular bracket **144** which rests against an outer peripheral rim **145** of the housing of the water jet-producing device **89**. Extending upwardly from the rim **145** there is provided a cap **146** provided with a number of spaced ports **147** separated equidistant from each other and directed in successively different angular directions all around the 360° periphery of cap **146**. Each of these ports **147** communicates with an interior chamber of device **89** which receives water being pumped into the pool through pipe **122**.

Since the particular jet-producing device **89** is that shown in the above-mentioned co-pending application Ser. No. 500,583, filed Oct. 22, 1965, of David A. Stanwood, assigned to the same assignee as the present application, it need not be described here in detail. It is sufficient to say that the internal mechanism of this device provides that when water is introduced into this device through pipe **122** under pressure, the pressurized water will squirt out of one of the ports **147** horizontally along the bottom surface of the pool in the direction to which the port is directed. Then when the pressure is shut off, the jet of water will cease, but the next time the pressure is turned on, the jet of water will be directed out through the next adjacent port in a somewhat different angular direction. In this way, as the water in pipe **122** is intermitently turned on and off, the jets of water from the ports **147** will be emitted from successively different and adjacent ports all around the perimeter of the device **89**.

Each of the jet-producing devices **129** and **134** will operate in the same way as device **89** when pressurized intermittently by the water pressure, a difference of devices **129** and **134** from device **89** being that devices **129** and **134** are not associated with any drain from the pool. Instead, the housing of the jet device can be cemented into the pool wall, leaving the ports **147** exposed to produce the jets in the pool.

Where the jet device is placed at the main drain as in FIG. 4, the action will be somewhat different than at other positions such as with devices **139** and **134**. At the main drain, the fast jet emitted from a port **147** passing horizontally over plate **142** and into the pool water will create a reduced pressure at the region below plate **142** and at the spaces between legs **143**, thus tending to facilitate the passage of water into the main drain.

FIG. 7 shows an arrangement of water outlet devices in a swimming pool somewhat different from that shown in FIG. 4. In FIGS. 4 and 7 the same parts are designated by the same numerals. FIG. 7 differs from FIG. 4 in that in FIG. 7 the main drain **91** does not contain any water jet-producing device **89**. Instead, the main drain simply comprises a chamber **135** covered by a circular grated cover plate **148** through the spaces of which the water can flow from the pool to the chamber **135**. There are, however, in FIG. 7 the jet-producing outlets **129** and **134**, the same as in FIG. 4 Likewise, in FIG. 7 there are the side wall outlets **125** and **130** directionally baffled in a manner similar to that in FIG. 1.

To operate the system of FIGS. 4 and 7, the motor M is powered by a suitable electric power line (not shown)

which operates pump **94** to draw water from the pool through the skimmer **99** through pipe **98** and at the same time from the main drain **91** through pipe **92**, this water drawn from the pool being controllable by hand valves in a well-known manner.

The water after being cleaned by strainer **94** is pumped into the filter **95** where it is cleaned and purified and sent into the outlet line **102** to the inlet port **117** of valve **103**. The motor **120** for rotating the valve member **108** can be powered from the power line and adjusted and geared to rotate the valve at any desired rate, for example from a fraction of a minute to several minutes or more per revolution. During about half the time of rotation of the valve member, the valve port **111** will be closed by the valve and during the other approximate half time the other valve port **114** will be closed. Whenever one of the ports is closed the other port will be open, so that the water entering the valve chamber at **105** will pass out through the open one of the ports to be sent into either pipeline **113** or pipeline **116**.

When valve port **114** is open, the pressurized water in line **116** will be sent into pipe branch **122** to pressurize the jet device **89** (and **129**), which will send a jet of water out through one of their ports **147**, along the bottom wall of the pool for as long a time as valve port **114** is open; and at the same time outlet **125** will deliver to the pool. When port **114** then closes while port **111** is open, the water jet will be shut off at device **89** (and **129**) and will be turned on at jet device **134**; and correspondingly, a jet of water will be directed out one of the ports of device **134** along the surface of the pool floor in the vicinity of that device; and of course, outlet **130** will be delivering in its established direction.

Referring to FIG. 7, since there is no jet-producing device in the main drain of this arrangement, all of the water jetting which occurs at the floor of the pool will be due to the two jet devices **129** and **134**.

When the rotary valve has turned sufficiently to open its port **114** again, while port **111** is closed, the jet devices **89** and **129** will again be operative. But by reason of the mechanism within the jet device, as noted above and explained in detail in said co-pending Stanwood application, the jet will this time be directed out of the port **147** which is adjacent to the port from which the preceding jet had been emitted; and this second port will be at a somewhat different angle from the first port. The jet from the second port will then be on for a period of time. This action of alternating the water pressure from ports **111** and **114** of the valve will result in successive intermittent jets from the jet-producing devices, and each successive jet will be at a different angle around the horizontal circle.

The side wall inlets **125** and **130** into the pool, when directed by their baffles as shown in FIGS. 4 to 7 along the side walls, will circulate the water around the pool while the jet devices **129** and **134** in the bottom wall or floor of the pool are sending out their jets. This combination of jetting the water along the bottom while at the same time circulating the water in one direction around the side walls of the pool has an especially salutary effect in cleaning the pool which is much more effective than the mere sum total of the effects of the bottom wall devices and the side wall devices separately. The water jets at the floor, either of the continuous type or the intermittent type described hereinabove, will move the undesired solids into different sections of the pool from the location of the jets. Some of the solids go into suspension or move up above the pool floor and may find themselves in remote spots such as corners of the pool, while other parts of the solids are swept more directly toward the main drain (by jet devices located away from the drain). Those parts of the solids which tend to linger along the sides or remote corners are moved by the water being circulated due to the action of the outlets **125** and **130** in the side walls, thus being carried around the pool to the surface skimmer in the case of those which remain at the surface. In the case of matter in suspension or floating in the pool water which is not carried to the skimmer, this circulating action will still have the effect of causing it ultimately to fall or be moved into the main drain.

FIG. 8 shows an arrangement of a jet device at a main drain which can be used in lieu of that shown in FIG. 5. Like numbers in FIGS. 5 and 8 represent similar parts. In FIG. 8, chamber **135** for the sump or main drain is encased by a metal container **150** which can be fitted into the concrete of the pool floor (not shown). Within the chamber there is a jet device **151** which can be of a type similar to device **89** of FIG. 5. Instead of introducing a drain pipe in the manner of the pipe **92** of FIG. 5, the side wall of member **150** is rounded or bulged at **152** at one side near the bottom thereof; and into this bulge there is threaded the drain pipe **92**. The principal difference in the arrangements of FIGS. 5 and 8 is that in the arrangement of FIG. 8, the drain water is drawn tangentially out of the sump chamber **135**, which draws water evenly and without vortexing from along the pool floor through the spaces **144** between the legs **145** which hold member **144** raised above member **150**, carrying dirt with it; and by imparting a rotating movement lower down in the sump near the drain pipe.

It will be recognized that as many water jet devices and also side outlets may be placed in the pool as may be desired, depending considerably on the size and dimensions of the pool. A smaller pool will of course have fewer water outlets than a larger pool. Thus the arrangement of FIG. 7 will usually be for a smaller pool than the arrangement of FIG. 4.

The arrangements of FIGS. 4 and 7 can be set up to take any desired length of time for the water jets to occur all around the 360° of the jet-producing device, and thus the desired amount of time and cleaning in any one direction from the jet device can readily be set up.

It will be recognized that the selector **103** is not limited to the two outlet ports which are shown. It may have any greater number of outlet ports as may be desired, and each outlet port may be connected to corresponding outlets in the pool.

It should be understood that the practice of the invention is not limited to the use of the particular fittings shown in the drawings, which are illustrated simply to show forms of fittings which could be used.

Other water jet fittings than those illustrated in FIGS. 4, 5 and 7 may be developed or used and the invention is not limited to the use of these particular structures. Furthermore, it is not essential that the water jets be sent step by step through a full 360° at each jet position. For example, stepping back and forth within a segment of a full circle, would be possible.

In this specification and appended claims it should be understood that the term "wall," unless otherwise stated, is broadly used to cover any of the interior surface walls of the pool, whether horizontal floor walls or vertical side walls.

The invention is not limited to the particular arrangements and methods illustrated and described herein, which are given by way of illustration rather than of limitation, and the invention is not limited except in accordance with the scope of the appended claims. It is particularly noted that the term "pool" as used herein is not restricted to swimming pools nor to the use of water, but broadly covers other forms of containers for water or other liquid.

What is claimed is:

1. The method of cleaning the interior wall surface of a pool containing liquid which comprises successively maintaining individual ones of a plurality of straight-line jet streams of liquid for successive periods of at least one-half minute each in different fixed angular directions for a substantial distance from a position at said wall within the pool to sweep and agitate dirt settling at or near said surface, to move the dirt and keep it in suspension in the pool liquid, and filtering the liquid of the pool to remove

the dirt from the pool liquid, the different directions being separated by a finite angle.

2. The method according to claim 1 wherein the individual jet streams are successively and intermittently maintained by directing and maintaining a first of the jet streams in a fixed straight-line direction for at least one-half of a minute from a position adjacent said surface and directed along the wall surface, and then directing and maintaining a second of the jet streams for at least another one-half of a minute from said position in a fixed straight-line direction angularly different from the direction of the first jet stream and without rotation of the jet stream.

3. The method according to claim 1 wherein a liquid jet stream projector capable of emitting a jet stream is at said position adjacent said wall surface, said projector having selection means for selecting individual ones of a plurality of fixed directions from which the jet stream is emitted, said method further comprising selecting a first fixed direction of said projector, emitting a first jet stream of liquid from said projector in said first fixed direction along said surface for at least one-half of a minute, then selecting a second fixed direction of said projector by action of the liquid flow which will form the jet stream, and emitting a second jet stream from said projector in said second fixed direction along said surface for at least one-half of a minute.

4. A method according to claim 1 in which said jet stream is at the floor of a pool and liquid is emitted into the pool at a side wall thereof in a direction laterally along said side wall to circulate water around the pool, and skimming off some of the circulating water at the water at the water surface, whereby dirt existing or sent to said side wall is removed from the pool.

5. The method of cleaning water in a pool which comprises intermittently maintaining individual ones of a plurality of straight-line jet streams of water in fixed directions from a first position at a wall surface of the pool, intermittently maintaining individual ones of a plurality of straight-line jet streams of water in fixed directions from a second position at the wall surface of the pool, each jet stream being maintained for at least one-half minute, and intermittently and successively operating said jet streams so that a jet stream is maintained for at least one-half minute from said first position while no jet stream is maintained from the second position and so that subsequently a jet stream is maintained for at least one-half minute from the second position while not jet stream is maintained from the first position, and continuously filtering the pool water.

6. The method according to claim 5 in which said jet streams are at the floor of the pool and water is emitted into the pool at a side wall thereof in a direction laterally along said side wall to circulate water around the pool, and skimming off some of the circulating water at the water surface, whereby dirt existing or sent to said side wall is removed from the pool.

7. The method according to claim 5 further including intermittently and successively altering the direction of the jet stream at each position by action of the water flow which is to constitute the jet stream.

8. The method according to claim 1 wherein said plurality of jet streams are maintained from such positions in said pool that all of said jet streams together sweep and agitate dirt from substantially the entire wall surface area of the pool below the liquid level in the pool.

9. The method of circulating and cleaning the water in a swimming pool which comprises pumping the water out of the drain located at the bottom wall of the pool, filtering the water, and subsequently pumping it into the pool in a straight-line jet stream maintained for at least one-half minute in a fixed straight-line direction substantially parallel to a wall surface of the pool at the floor thereof from a position immediately above the drain, and intermittently and sequentially altering the direction of the jet stream by action of the water flow which produces the jet stream to successive fixed straight-line directions for finite periods of time of at least one-half minute each, all of said jet streams together being directed from said position to clear dirt from an area surrounding said drain in a 360° arc around said drain, whereby water being pumped out of the pool flows into the drain beneath the position of the origin of the jet while the jet stream is flowing.

10. In combination with a pool: means for drawing water out of the pool and filtering it, means for returning filtered water to the pool, said last named means including a conduit, a water projecting means attached to said conduit and located at a position adjacent the wall surface of the pool, said projecting means comprising a plurality of outlets which direct water jet streams in different respective angular directions from the projecting means along said wall surface, means connected with said projecting means and operated by discontinuity of the water flow through said conduit for shifting the jet stream from one to another of the outlets, and intermittent means at said conduit for intermittently reducing the water flow through said conduit thereby producing discontinuities of water flow which shift the jet stream from one outlet to another, said intermittent means producing discontinuities at intervals of at least one-half minute.

11. Apparatus according to claim 10 further including a second water projecting means located at a second position adjacent the wall surface of the pool, said second projecting means comprising a plurality of outlets which direct water jet streams in different angular directions from the second projecting means along said wall surface, second conduit means connecting said second projecting means to said intermittent means, and means connected with said second projecting means and operated by discontinuity of the water flow through said second conduit for shifting the jet stream from one to another of the outlets at said second projecting means, said intermittent means successively directing water flow first to the first-named conduit and then to the second conduit, whereby the intermittent means successively directs water to said conduits for periods of at least one-half minute.

12. Apparatus according to claim 10 further including a drain within the pool, said drain comprising a chamber located in the pool floor, said means for drawing water out of the pool being adapted to draw water out of said chamber, said water projecting means being located above said chamber and somewhat above the level of the floor, all of the jet streams together being capable of clearing dirt from a 360° arc around said chamber.

13. Apparatus according to claim 12 in which a drain pipe is fitted tangentially into said chamber to create a rotating motion of water into the chamber near the drain pipe as it is being drained out, thus collecting water uniformly and without vortex at the entrance to said chamber.

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SAMIH N. ZAHARNA, Primary Examiner

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,506,489 Dated April 14, 1970

Inventor(s) William O. Baker

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3,	line 56	"Exeprience" should be --Experience--
	line 68	"the" should be --these--
Column 4,	line 37	"time has been left out --time period--
Column 8,	line 7	"153" should be --143--
Column 11,	line 33	"at the water" in twice
	line 49	"not"should be --no--

SIGNED AND
SEALED
SEP 8 - 1970

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents