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AUTOMATICALLY CYCLING SWIMMING POOL CLEANING SYSTEM

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20 Claims

ABSTRACT OF THE DISCLOSURE

A timer-control pool cleaning system and method operable periodically to program a cleaning cycle and utilizing automatically extendable and retractable water-driven jets to sweep debris on submerged surfaces progressively toward a drain. The jets are activated in predetermined sequence to advance debris to the drain. The jets are rotated slowly and in the order of not more than two r.p.m. in discrete increments through the intermittent impact imparted to the nozzle by a circulating ball carried by a stream of water in route to the nozzle. The slow but positive sweeping action restricts to a bare minimum the amount of sediment placed in suspension.

This invention relates to a swimming pool cleaning system utilizing moving jets of pressurized water directed over submerged surfaces of the pool to sweep sediment settling thereon progressively toward the pool drain. One or more water jets are rotated slowly through at least one complete rotation and thereafter other jets are activated in sequence and in a manner to advance the sediment along the surface of the pool and toward the drain. Provision is included for energizing the jets successively and in time delayed sequence with a dwell period adequate to allow sediment going into suspension to settle before the next succeeding sweeping cycle. Desirably the system is under the control of a master timer operating to cycle the cleaning operation during the early morning hours and after all sediment has gravitated to the bottom of the pool. Advance of the sweeping jets is accomplished by intermittent impact action produced by a free ball caused to circulate through an undulating path by water flowing to sweeping jets.

A particularly vexatious problem attending the operation of swimming pools is that associated with the removal of sediment, grit, and debris settling to the bottom of the pool. Such foreign matter has proven most difficult to remove while avoiding placing it in suspension. Many proposals have been made heretofore for removing such sediment but all have limitations and disadvantages which are overcome by the present invention.

To this end there is provided by this invention a fully sediment and debris removal system comprising a plurality of sets of water jetting nozzles each controlled by a separate valve with each set arranged to be activated in time-delayed sequence. The nozzle bodies are designed to be embedded in the bottom surfaces of the pool and include normally retracted nozzle heads elevated automatically when activated and including water driven means for slowly advancing the water jets in a manner sweeping the sediment gradually over the submerged surface toward the drain at the deeper end of the pool. Following at least one complete rotation of one set of nozzles, the control system provides for a dwell period before the next set of nozzles is activated thereby allowing any sediment placed in suspension to settle in readiness for the next sweeping cycle. The sweeping action or the affected area of adjacent sets of nozzles, overlap one another and adjacent nozzles of a given set are desirably

rotated in opposite directions to enhance their sweeping effectiveness.

Another feature of the invention is the use of the momentum of water circulating in a circular path and of a solid member carried thereby to impart an intermittent rotary impact to the nozzle adequate to advance rotation thereof by a very small increment and at a rate in the order of not more than two revolutions per minute. This slow rotation of the water jetting from the nozzle provides a highly effective sweeping action but avoids placing the sediment in suspension. According to one preferred mode of imparting motion to the nozzles water is caused to swirl about the interior of the nozzle housing in an undulating path carrying a ball into intermittent impact with a boss mounted on the rotary nozzle head. When the nozzle is not energized with pressurized water, gravity or a spring acts to retract the nozzle until its upper end lies flush with the bottom of the pool.

Accordingly it is a primary object of the present invention to provide a unique power-operating cleaning system for a swimming pool utilizing pressurized water to direct a water jet in sweeping relation to a submerged pool surface and utilizing water driven means to advance this jet slowly across the surface being swept.

Another object of the invention is the provision of a swimming pool having normally submerged jets extendable by water pressure and effective to jet a stream of water across a submerged surface of the pool laden with sediment and including means operated by the pressurized water to move the jet stream in a manner to sweep the sediment gradually toward a drain outlet.

Another object of the invention is the provision of an automatic cleaning system for a swimming pool utilizing sets of sweeping nozzles powered by pressurized water and operating in time-delayed sequence to sweep sediment settling on submerged surfaces of the pool progressively from the shallow end toward a drain outlet in the deeper portion of the pool.

Another object of the invention is the provision of means for sweeping a submerged surface with pressurized liquid utilizing the flow of water toward the jetting means to elevate the nozzle and to rotate the same slowly to sweep the sediment along the bottom of the pool without placing the sediment in suspension.

These and other more specific objects will appear upon reading the following specification and claims and upon considering in connection therewith the attached drawing to which they relate.

Referring now to the drawing in which a preferred embodiment of the invention is illustrated.

FIGURE 1 is a schematic view of a typical embodiment of the invention installed in a swimming pool;

FIGURE 2 is a cross-sectional view on an enlarged scale taken along line 2—2 on FIGURE 1;

FIGURE 3 is a top plan view of one of the nozzle assemblies shown in FIGURE 1;

FIGURE 4 is a cross-sectional view taken along line 4—4 on FIGURE 3 showing the position of the parts with the nozzle deactivated and in retracted position;

FIGURE 5 is a view taken on line 5—5 of FIGURE 4 showing a typical position of the parts when activated; and

FIGURE 6 is a cross-sectional view taken along line 6—6 on FIGURE 5.

Referring more particularly to FIGURE 1, there is shown somewhat diagrammatically and schematically a typical embodiment of the invention, designated generally 10, installed in a swimming pool 11. The shallow end of the pool is located to the right of FIGURE 1 and includes submerged steps 12 built across one corner. The deepest portion of the pool is located adjacent the left hand

end and has a drain outlet designated generally 13 having a large diameter inlet flush with bottom 15 of the pool. Suitably supported, as on spacers 16, is an anti-vortex plate 17 having its lower side spaced approximately one inch above pool bottom 15 and having a diameter very substantially greater than that of the inlet to drain pipe 14.

The automatic cleaning system for pool 11 features a plurality of sets or groups of hydraulically-powered sediment-sweeping nozzles assemblies A, B, C, D, E and F each adapted to be connected in turn to a source of pressurized water. As herein shown by way of example, the group of nozzle assemblies A includes three separate nozzle units, each mounted flush with the tread surface of a different one of steps 12. The remaining groups B, C, D, E and F each include a pair of nozzle units arranged crosswise of the pool bottom and cooperating with one another to sweep sediment, debris and grit progressively toward the deeper end of the pool and drain outlet 13. The automatic cleaning system preferably operates independently of the main water circulating and filtering facilities.

Water for use in activating the sets of sweeping nozzles is preferably withdrawn from the pool at a level intermediate its upper and lower water levels such as by a water inlet 18 located in the riser of one of steps 12. The withdrawn water is conducted through conduit 19 and a suitable filter 20 to the inlet of a centrifugal pump 21 driven by motor 22. Typically, pump 21 is of a type capable of producing an outlet head in the range of 100 to 110 feet of water which is supplied to the water-distributing manifold 23. A separate water-distributing pipe 24, 25, 26, 27, 28, 29 extends to the respective sets of water-distributing nozzles A to F, inclusive. Each distributing pipe is provided with its own solenoid, operated valve 30, 31, 32, 33, 34, 35. Each valve is normally closed but opens fully when energized by closing the associated one of control switches 38 to 43, inclusive, connected to the main power supply 45 via a master timer 46. Also arranged to be energized simultaneously with any one of the solenoid valves is a relay 47 controlling the supply of power to pump motor 22.

Master timer 46 is of a suitable type operating to cycle the main pool pump and automatic cleaning system through a complete cleaning cycle of suitable duration during a 24 hour period. When timer 49 operates, power is constantly supplied to the cycle control motor 48 to rotate cam drum 49 through one or more cycles of a chosen duration, such as 30 minutes. Drum 49 is shown developed in FIGURE 1 in the interest of clarity and includes separate cams 50 to 55 positioned to override an associated one of the normally open switches 38 through 43 effective to hold that switch closed for a brief interval as 2 or 3 minutes. It is pointed out that the circumferential spacing between adjacent cams is selected to provide a short dwell period during which all nozzles are inactive thereby providing time for any sediment placed in suspension by the operation of one set of nozzles to settle before the next set of nozzles is activated. A dwell period of about 2 or 3 minutes has been found quite satisfactory in practice but it will be understood that both the inactive and active periods may be varied as found necessary to provide the most satisfactory results in a particular operating environment. Although not shown in FIGURE 1 it will be understood that the master timer 46 includes suitable control means for operating pump 21 as well as skimmer 60 and filter 20 at any designated time and independently of timer motor 48 and relay 47.

As is made clear by FIGURE 1, the invention pool cleaning system preferably includes means for skimming floating debris from the surface of the pool and comprises any suitable skimmer 60 located in the gutter surrounding the upper edge of the pool. The skimmer has an overflow pipe draining into an integral sump, not shown, into which drain pipe 14 opens. A pipe 61 serves to convey water from this sump back to the main pool filter and a

pipe 62 conducts clean filtered water from the main pool pump back into the pool at a level close to the surface of the pool and at a point remote from skimmer 60.

Referring now more particularly to FIGURES 3 to 6, it will be understood that each of the nozzle units 65 includes a cup-shaped main housing 66 normally closed by a cover 67 held in place by a plurality of noncorrosive screws 68. Desirably, cover 67 has an upwardly and outwardly flaring smooth-surfaced rim 69 easily separable from the concrete or other material used in the construction of pool bottom 15. Loosely and rotatably supported within a central opening 70 of cover 67 is a water-jetting nozzle means 71 having a disc-like main body 72 provided centrally with an upwardly projecting hollow nozzle 73 formed with a radial outlet port 74 opening through its side wall. When the nozzle unit is not energized, nozzle means 71 is fully retracted against shoulder 75 of a boss integral with the bottom of housing 66 thereby supporting the upper end of nozzle 73 flush with the surface of cover 67 and pool bottom 15, the nozzle being held in this position by a light compression spring 76. The lower end of this spring holds a stainless steel bearing washer 77 seated against the top surface of member 72. The contacting surfaces of washer 77 and members 67 and 72 are highly polished and the friction between these surfaces are effective to control and regulate rotation of nozzle 71 produced in a manner to be explained more fully presently.

Referring more particularly to FIGURES 3 and 6, it is pointed out that housing 66 is provided with a pair of water inlet passages 79, 80 opening into the cylindrical chamber of the housing tangentially. As shown in FIGURE 6, inlet opening 79 is closed by a plug 81 whereas inlet 80 is connected to water supply pipe 25. Accordingly, pressurized water received from the outlet of pump 21 swirls rapidly clockwise about the interior of the cup-shaped housing 66 while enroute to nozzle port 74. In so doing, the swirling water carries the stainless steel ball 83 with it, ball 83 being caused to flow in an undulating circular path by repeated glancing contact with the semi-cylindrical radially-disposed ribs molded into the bottom of housing 66. When thrown upwardly by contact with ribs 84, ball 83 impacts against one inclined face of a downwardly projecting boss 85 formed integral with the annular main body 72 of nozzle 71 and is deflected downwardly by the inclined face of this boss. Owing to the relatively small mass of ball 83, the greater mass of the rotary nozzle means 71 and the frictional drag provided by bearing washer 77, a single impact blow of ball 83 against boss 85 is relatively ineffective to impart more than a very slight rotary movement to the nozzle. However, it will be apparent that ball 83 is rotating continuously about the interior of housing 66 so long as the nozzle assembly is supplied with water and that its repeated impact with boss 85, while following an undulating circular path about the interior of the assembly repeatedly and intermittently urges the nozzle either clockwise or counterclockwise by a very small increment and at a rate many times smaller than the rate of water circulation within the housing. It is also pointed out that the ball sometimes circulates one or more times without impacting boss 85. Moreover the magnitude of the impact blow may be varied by varying the size or the specific gravity of ball 83. Accordingly, it will be recognized that the described action provides a relatively high ratio speed reduction utilizing the force of pressurized rapidly moving water to provide a very slow rotary movement to nozzle 71.

The pressurized water on initially entering housing 66 acts against the underside of nozzle means 71 quickly elevating the nozzle into its normal extended operating position shown in FIGURE 5. Outlet port 74 is then positioned to sweep across the adjacent surface of the pool to a distance of about 8 feet in a typical installation. This fast flowing submerged jet moving close to or in light contact with the bottom of the pool tends to

gently disperse the sediment, grit and debris immediately adjacent the water jet without however tending to place this material in complete suspension. Momentarily after extension to its operating position, nozzle 71 starts to rotate clockwise or counterclockwise depending upon which one of inlets 79, 80 is being supplied with pressurized water. Desirably, and as made clear by FIGURE 1, adjacent nozzles 65 of a given set or group of nozzles rotate in opposite directions and so as to sweep the sediment toward and between the nozzles and then forwardly toward drain outlet 13. It is found that the most effective sweeping action with minimum tendency to cause sediment to go into suspension is achieved if the nozzles rotate at a speed of about one-half revolution per minute and not in excess of one revolution per minute. As will be appreciated, however, different operating conditions may dictate departure to some degree from these representative rates. The rotation rate can be changed in several ways including varying the water pressure supplied to the nozzles, the size, and/or weight of ball 83, the spacing of ribs 84, as well as by the drag or friction between washer 77 and nozzle body 72 or cap 67. The latter can be varied by changing the nature of the contacting surfaces in relative rotary contact and by changing the width of bearing washer 76. It will be understood that this ball easily passes beneath the boss after striking it and that the downwardly converging opposite sides of boss 85 aid in deflecting the ball downwardly and beneath the boss after each impact blow. It will also be understood that the diameter of ball 83 is always slightly less than the vertical clearance between the underside of boss 85 and the upper edge of one of the ribs 84. Accordingly, the ball is always free to pass beneath the boss.

In the operation of the construction just described, it will be understood that the master timer always discontinues the previous cleaning operation with cam 50 of programming drum 49 in position to close switch 38 at the beginning of the next cleaning cycle. Accordingly when timer 46 energizes timer motor 48, the latter drives cam drum 49 in the direction indicated and first closes switch 38 to energize solenoid 30 as well as relay 47 controlling the power supply to pump motor 22. This pump then supplies pressurized water past the open solenoid valve 30 to the interiors of each of the nozzle assemblies in set A and located on steps 12 at the shallow end of pool 11. Each of these nozzles rotates slowly in the direction indicated by the arrows sweeping sediment therefrom and onto the bottom of the pool.

At the end of a short sweeping period as 2 minutes, cam 50 passes from beneath switch 38, opening this switch and thereby de-energizing pump motor 22 and solenoid valve 30. The pump remains de-energized for a period sufficient to allow any sediment placed in suspension to settle, a period of 2 or 3 minutes being normally adequate for this purpose. At the expiration of this dwell period cam segment 51 is in position to close switch 39 thereby energizing solenoid 31 and restarting pump motor 22 with the result that pressurized water is now supplied to set B of the nozzles located immediately forwardly of steps 12. These nozzles operate in the same manner as set A and sweep the sediment from the shallow end of the pool toward drain 13 and into the effective path of set C of the sweeping nozzles.

The system continues to operate in the manner just described until nozzle sets D, E and F have completed their individual operating cycle.

During at least the sweeping periods water and sediment are being withdrawn from drain 13 and pass through a suitable filtering device before being returned to the pool. Likewise the top surface of the pool is being cleared of floating debris by the action of skimmer 60. The latter operates in known manner utilizing the return of clean water to the surface of the pool via conduit 62 to promote gradual flow of the surface layer of water and floating

debris from the shallow end into the skimmer at the forward end of the pool.

In conclusion it will be understood that all conduits and components in contact with water are made of noncorrosive materials as copper, stainless steel or thermoplastic. As herein shown the major components of the nozzle assemblies are molded from suitable thermoplastic material. Normally all parts of the system employed in cleaning the submerged surfaces of the pool are retracted with their exposed surfaces lying flush with the adjacent surfaces of the pool.

While the particular automatically cycling swimming pool cleaning system herein shown and disclosed in detail is fully capable of attaining the objects and providing the advantages hereinbefore stated, it is to be understood that it is merely illustrative of the presently preferred embodiment of the invention and that no limitations are intended to the details of construction or design herein shown other than as defined in the appended claims.

I. Claim:

1. A swimming pool cleaning system comprising a plurality of nozzle means for jetting water across the submerged surface of a swimming pool in a direction to sweep debris and sediment toward a drain, said nozzle means being located on a generally horizontal submerged surface and spaced at different distances from said drain, and means for activating said nozzle means in succession beginning first with nozzle means remote from said drain and proceeding progressively to the nozzle means closest to said drain.

2. A pool cleaning system as defined in claim 1 characterized in that said nozzle means includes means responsive to the supply of water under pressure thereto to shift the jet of water issuing from said nozzle means progressively across the adjacent submerged surface of the pool effective to sweep sediment and debris lying on the submerged surface gently and progressively toward said drain.

3. A pool cleaning system as defined in claim 2 characterized in the provision of programming means for said nozzle means operable to activate said nozzle means in time-delayed sequence providing a dwell period during which no one of said nozzle means is active and during which debris and sediment placed in suspension by an active nozzle means can settle to the surface of the pool structure.

4. A pool cleaning system as defined in claim 1 characterized in that said nozzle means includes water jetting means for directing a stream of pressurized water across and in close sweeping contact with the adjacent pool surface, and said water jetting means including means rotatably supporting the same for rotation about an axis generally normal to the pool surface being swept by the water jet issuing from said water jetting means.

5. A pool cleaning system as defined in claim 4 characterized in that said nozzle means includes means operable in response to the supply of pressurized water thereto to rotate said water jetting means slowly and in the order of about one-half revolution per minute to advance the debris gradually across the supporting surface while placing a minimum thereof in suspension.

6. A pool cleaning system as defined in claim 4 characterized in that nozzle means is normally substantially fully retracted below the pool surface to be swept and being further characterized in that said water jetting means is responsive to the supply of pressurized water thereto to move upwardly to an extended position wherein the same is effective to jet a stream of water across a submerged surface of the pool to dislodge and sweep away sediment therefrom.

7. A pool cleaning system as defined in claim 4 characterized in that said rotary water jetting means includes means carried thereby and located in the path of an annular stream of moving pressurized water enroute to the discharge outlet of said water jetting means whereby the

moving water tends to impart low efficiency rotary movement to said water jetting means at a rate very substantially slower than the movement of the annular water stream.

8. A pool cleaning system as defined in claim 7 characterized in the presence in said annular stream of water of a ball adapted to be carried in said annular water stream and to impact against said means carried by said water jetting means and to impart a weak rotary force thereto tending to advance said water jetting means by a small increment on each impact.

9. A pool cleaning system as defined in claim 8 characterized in the provision of means in the path of said ball effective to cause said ball to follow a generally annular undulating path to facilitate imparting impact blows aiding to rotate said water jetting means.

10. In combination with a swimming pool, power operated hydraulic means for periodically sweeping sediment from submerged surfaces thereof into a drain connected to the deepest portion of the pool, said pool sweep means including sets of normally retracted rotary nozzle means at spaced intervals on the submerged generally horizontal surface and extendable when supplied with pressurized water to present an outlet for directing a stream of sediment-sweeping water across the submerged surface, and program operated means for supplying pressurized water to each of said sets of rotary nozzle means in succession from the more distant set thereof toward the set closest to said drain.

11. The combination defined in claim 10 characterized in that adjacent ones of said rotary nozzle means in a given set thereof include means for rotating the same in opposition directions and so as to cooperate with one another in sweeping sediment toward said drain.

12. The combination defined in claim 10 characterized in that said drain includes anti-vortex plate means spaced closely above the inlet to said drain and having a diameter very substantially larger than the diameter of the inlet to said drain.

13. The combination defined in claim 10 characterized in that said program operated means is operable to supply pressurized water to each said sets of rotary nozzle means for a sufficient period to provide at least one full revolution to each one thereof and to delay supplying water to the next set of said nozzle means for a period of time adequate to permit sediment stirred up by a preceding sediment-sweeping operation to settle.

14. The combination defined in claim 10 characterized in that each of said rotary nozzle means includes means for retracting the same until their upper ends are substantially flush with the adjacent surface of the pool as the water pressure falls at the end of a sediment-sweeping cycle of operation.

15. The combination defined in claim 10 characterized in that said rotary nozzle means includes a housing having an annular water-distributing chamber located below the surface of the pool to be swept, and having a nozzle projecting outwardly centrally thereof and having an outlet port closely parallel to and above the surface to be swept when said nozzle means is activated, and means for supplying water tangentially to the interior of said

water distributing chamber and selectively in either direction.

16. The combination defined in claim 15 characterized in that said water distributing chamber includes means therein for causing the water to circulate thereabout in an annular undulating path impinging against said rotary nozzle in a manner effective to promote the slow rotation thereof.

17. The combination defined in claim 16 characterized in the presence of a ball in said water distributing chamber having a specific gravity somewhat greater than water, and lug means projecting into said water chamber from said rotary nozzle and adapted to be impacted by said ball while being circulated by pressurized water enroute to the outlet of said nozzle.

18. The improvement in cleaning systems for swimming pools comprising a housing adapted to be embedded in a swimming pool at spaced intervals on a generally horizontally submerged surface and having a removable cover adapted to lie substantially flush with a normally submerged surface of a swimming pool, rotary means movably supported in said housing having a water jetting nozzle mounted thereon and projecting upwardly through an opening in said cover, means normally holding said water jetting nozzle retracted to a position flush with the upper side of said cover, means for supplying pressurized water into said housing in a manner causing the water to circulate in an annular undulating path within said housing while enroute to said nozzle, and means in said chamber carried by said circulating and undulating water to impact said rotary means and cause said water jetting nozzle to rotate slowly and not in excess of about one revolution per minute.

19. The improvement defined in claim 18 characterized in that said means for supplying pressurized water into said housing includes means selectively usable to circulate the water and said rotary means clockwise and counterclockwise.

20. The improvement defined in claim 18 characterized in that said means to cause water in said housing to flow in an undulating path includes radially disposed ribs spaced from one another circumferentially of the interior bottom portion of the housing.

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