A swimming pool having an automatically timed pump and filter system has a precisely determined amount of liquid chlorine injected into its water at the cyclical rate of pump operation. A chlorine dispensing chamber is entirely immersed in a supply of chlorine and includes a flexible diaphragm dividing the chamber into feed and drive compartments. The feed compartment is connected by means of an inlet conduit fitting and check valve to the chlorine supply and also by means of an outlet fitting conduit and check valve to a point in the recirculating system downstream of the filter. The drive compartment is connected solely to the high pressure side of the pump so that pressure in the drive compartment when the pump is operating will move the flexible diaphragm to decrease the volume of the feed compartment and expel the chlorine into the swimming pool. When the pump stops operating, water in the drive compartment returns to the pool, and a weight on the diaphragm returns it to its initial position, concomitantly refilling the feed compartment from the supply.

12 Claims, 3 Drawing Figures
APPARATUS FOR CHEMICAL TREATMENT OF SWIMMING POOLS

BACKGROUND OF THE INVENTION

1. Field of the Invention
The present invention relates to chemical treatment of closed recirculating liquid systems, and more particularly relates to an automatic precision chlorine dispenser for swimming pools.

2. Description of Prior Art
Liquids of varying types are mixed with each other in many different types of situations, in many applications and for a wide variety of purposes. Among the many liquid treatment applications, the bacteriocidal treatment of closed recirculating aqueous systems, and, in particular, the chlorination of swimming pools, are common. In most such treatment systems, a number of criteria must be fulfilled. Chlorine must be added to the main liquid system in precise amounts. The apparatus must be reliable and long lasting in the presence of corrosive materials and environments. It must present few hazards. It should be self-operating or semi-automatic, requiring a minimum of service and yet be simple and inexpensive to manufacture and maintain.

Automatic swimming pool chlorination systems presently on the market employ chlorine in powder or solid form which is mixed with the water of the swimming pool in a separate compartment to provide a highly chlorinated slurry that is then continuously mixed with the swimming pool water as the water is recirculated. These devices include sensitive float operated valves that are readily jammed in either open or closed position by minute particles or debris that are often found in swimming pool water. Should the input valve to the chlorinating slurry chamber become stuck in closed position, the chamber can be emptied of its slurry, thereby pulling air into the pump and causing serious damage to this device.

Another disadvantage of these systems is that they require the handling of the solid or powdered chlorine, thus, creating hazards due to the fumes spreading in and about the chlorine dispenser. Further, chlorine in solid or powder form is more expensive than in liquid form.

The prior art devices feed the chlorinated slurry in amounts dependent upon the pressure in the pool recirculating system. As is well known, in the course of the filtering of the water, the filter provides increasing restriction to the recirculating flow thereby the recirculating pressure and quantities of recirculating water decrease. Therefore, as the conventional filter of the swimming pool becomes dirty, the amount of chlorination provided decreases in these prior systems.

Other types of solid chlorinating systems include various devices for feed pre-selected quantities of powdered chlorine into the recirculating pool water. None of these devices provide precision metering since the actual amount of chlorine added, whether in solid form or in powdered form, is not precisely controllable and further, adjustment of the chlorination rate is not readily controlled. In many of the prior devices, the treatment chemical input, in the form of water having excessively high concentration of chlorine, is passed through much of the recirculation equipment (e.g. through the pump filter and heater) before it is mixed with the main body of pool water. Thus, these relatively expensive devices are subjected to the exceedingly harsh environment and adverse effects of the high chlorine concentration.

Other fluid proportioning systems such as those shown in U.S. Pat. No. 549,479 to Hall and U.S. Pat. No. 2,618,510 to Mills, employ liquid expulsion chambers, but these are not automatically cycilicable, require complex valving systems, waste the drive water, or are not otherwise applicable to closed recirculating swimming pool systems.

Accordingly, it is an object of the present invention to provide a swimming pool chlorination method and apparatus that is effective, simple and reliable and yet, avoids or minimizes most of the defects of present systems.

SUMMARY OF THE INVENTION

In carrying out principles of the present invention in accordance with a preferred embodiment thereof, a liquid treatment chemical is added to a recirculating system at a fixed rate and in amounts substantially independent of pressure variation of the recirculating system by employing the pressure of the recirculating system to empty into the body of the system, the contents of a chamber that is substantially completely filled with the treatment liquid. This step is repeated each time recirculation starts, and each time the recirculation stops, the substantially emptied chamber is once again filled with the liquid treatment chemical. In a specific embodiment, a liquid treatment chemical feed compartment is substantially emptied by a movable wall that operates in response to recirculating pressure to drive the liquid chemical treatment from the feed compartment. Means are provided to return the movable wall to a refilling position when the pressure of recirculation diminishes or ceases to thereby refill the feed compartment.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of a swimming pool and recirculation system therefor showing the connection of a chlorine dispenser constructed in accordance with principles of the present invention, and FIGS. 2 and 3 show details of the chlorine dispenser of FIG. 1.

DETAILED DESCRIPTION

Referring now to FIG. 1, a tank such as a conventional swimming pool 10 is provided with a recirculation, filtering and heating system comprising a pump 12, filter unit 14 and heater 16, connected in a conventional manner to provide for filtering and heating of the water of the swimming pool as it is recirculated. Recirculating water may bypass the heater if deemed necessary or desirable by means of conventionally arranged flow lines and valves (not shown). Also conventional is a timer 18 that is set to automatically turn pump 12 on and off at preset times during each day of pool operation. Preferably, the timer is set to turn the pump on and off at least one time each day and, preferably, at the same time each day. For other operations, the timer may be set to turn the pump on and off two or three times each day, but in general, always at the same time. Thus, the pump may be turned on at 9:00 a.m., 12:00 noon and 3:00 p.m. each day and turned off at 11:00 a.m., 2:00 p.m. and 5:00 p.m. each day. As another example, the pump may be turned on each 9:00 a.m. and turned off each 8:00 p.m. Obviously, the tim-
ing of the pump cycles is widely variable, the pump may even be caused to be inoperable on alternate days, and may be selected as deemed necessary or desirable. Nevertheless, it is preferred for the practice of the invention that the timer be set to provide at least one complete cycle of pump operation each day, one complete cycle being the turning on of the pump and thereafter the turning off of the pump, until the time of the next turn on.

In accordance with the present invention, means are provided that are automatically operable in response to the regular automatically timed cycling of the recirculating system to dispense fixed amounts of a liquid treatment chemical, such as liquid chlorine, into the pool at fixed intervals. The arrangement is such that the overall rate of addition of the liquid treatment chemical is precisely fixed and is fully and completely independent of pressure of the recirculating system. Accordingly, whether the filter is clogged with dirt or in its condition of maximum flow, the pressure operated chlorination of the present invention will continue to provide a precise metering of a substantially fixed quantity of the liquid dispensed. Since an exactly predetermined quantity of liquid chlorine is dispensed upon each cycle of pump operation, and since the number of cycles of pump operation per day (e.g. the cyclic rate) is the same each day, the overall rate of the chlorination is both precisely determined and substantially invariable, unless adjusted as described below.

The apparatus for dispensing the liquid treatment chemical namely, liquid chlorine, in accordance with a preferred embodiment of the invention, is shown in FIG. 1 to comprise a positive displacement pump having a dispensing chamber 20 positioned at the bottom of a container 22 that is substantially filled with a liquid treatment chemical 24. Chamber 20 has an input and output pressure conduit fitting 26 connected via a conduit 28 to a fitting 30 formed on a removable cover 32 of the container 22. Fitting 30 is connected via a conduit 34 and gate valve 36 to the output pressure line 38 of pump 12 at a point between the pump and the input to filter 14.

Chamber 20 is also provided with an output pressure fitting 40 that is connected by a conduit 42 to a fitting 44 on container cover 32. Fitting 44 is connected via a conduit 46 and gate valve 48 to the recirculating system at a relatively low pressure point thereof, in particular, at a point downstream of the pump operating equipment including the pump, filter and heater. This is illustrated as point 50 in FIG. 1. The several fittings are readily disconnectable, at least at the cover 32.

Chamber 20 has a third fitting in the form of an inlet or supply port 52 of a relatively short extent, so that this supply fitting may continue to be immersed in the body 24 of the liquid treatment chemical supply even when the level in container 22 is lowered. For similar reasons, the chamber 20 is formed of a flattened configuration, having a greater horizontal dimension than vertical dimension. It may be noted at this point, as will be described more particularly below, that the particular flattened configuration of chamber 20 has the additional advantage of allowing for a greater displacement of volume of the fluid compartment of dispensing chamber 20 upon a shorter distance of travel of the movable wall thereof.

As shown in greater detail in FIGS. 2 and 3, chamber 20 is made of two mating molded plastic bodies collectively providing a configuration substantially similar to an oblate spheroid. A first half 54 is threadedly engaged with a second half 55 of the chamber 20 and the interior is separated into two compartments by a flexible diaphragm 56. Diaphragm 56 extends completely across the large dimension of the chamber and is formed with an integral bead or O-ring 58, that is secured to and between the mating halves 54, 55 of the chamber 20. Thus, the chamber is separated into two sealed compartments, an upper or feed compartment 60 and a lower or drive compartment 62. Although it is convenient to form the two halves of the chamber 20 in the illustrated mating threadedly secured arrangement, it will be readily appreciated that the two parts may be secured to each other in any other fashion as by the welding or heat sealing of plastic flanges or the like. Further, the chamber need not be made in substantially similar parts but can be made with a sealing top or cover plate or other arrangement that will provide access to the interior for the mounting and securing of the dividing and separating flexible membrane prior to sealing of the chamber and the two compartments thereof.

Membrane 56 has secured to the midpoint of a bottom portion thereof of a massive body such as a lead weight 64. Although the weight 64 may be secured to the membrane in many different fashions as will be readily apparent to those skilled in the art, a preferred arrangement is shown in detail in FIG. 3. As illustrated in this Figure, the central portion of the membrane is provided with a reinforcing layer 66 of limited extent. A continuous closed depending circular flange or lip 68 projects downwardly from the membrane into the drive chamber 62. Flange 68 is formed with a continuous circular bead 70 on the depending outer edge thereof. Lead weight 64 is formed with an exterior periphery that mates with the interior periphery of the circular flange 68 but having a somewhat larger diameter. The weight has a continuous peripheral groove 72 that mates with and receives the bead 70 of the depending circular flange 68. The circular flange is resiliently stretched to receive the lead weight so that the latter is securely and firmly affixed to the flexible diaphragm by the resilience of the depending flange and the interengagement of the bead 70 and groove 72.

Pressure inlet and outlet fitting 26 of the chamber 20 is in fluid communication with a conduit 74 that is formed in the lower half 55 of the chamber. Conduit 74 is in fluid communication with the drive chamber 62.

Supply inlet fitting 52 is integrally formed in the upper half 54 of the chamber 20 and includes a silicon rubber check valve 80 that is held in place by a valve stop 82 secured to the inlet fitting 52. The check valve allows chlorine to flow into compartment 60 but prevents flow from the compartment through this one-way valve.

Outlet fitting 40 comprises a valve body 84 threaded in an integral boss 86 of the upper half 54 of housing 20. Mounted in the valve body 84 is a valve poppet 88 that is urged against the valve seat of valve body 84 by means of a spring 90 that is held in place by a valve adjusting retainer 92. Retainer 92 is adjustably and threadedly received within the bore of the valve body 84. Valve body 84 is formed with a lower valve adjustment or abutment surface 94 that provides an adjustment stop for the chlorine dispenser. Valve body 84 is provided with adjustment handles 96 and valve retainer
3,867,290

92 is provided with an adjustment handle 98 whereby each of these members may be threadedly engaged with and moved axially with respect to its threaded mate.

Because of the use of the described apparatus in the corrosive environment of liquid chlorine, all the parts described above are preferably made of material resistant to such environment. Flexible diaphragm 50 is preferably formed of a silicon rubber and may be of a thickness in the order of 0.040 inches. Preferably, all of the parts including the housing providing the chamber halves 54, 56, the various valve parts and valve seats are also made of silicon rubber, excepting only the lead weight (which may be about one-fourth to one-half pound) and the valve springs.

In an exemplary arrangement, container 22 has a capacity in the order of 5 gallons, although larger or smaller containers may be readily employed. The chamber 20 for use with such a five gallon container will have a maximum horizontal dimension of approximately eight inches and a maximum vertical dimension of 5 to 6 inches. Accordingly, the apparatus will continue to operate as long as there is chlorine within the container 20 to a depth of slightly more than 5 to 6 inches.

In operation of the device, the chamber 20 is inserted into the container 22 and the latter is substantially filled with chlorine, although the chamber, of course, may be inserted into a previously filled container of chlorine. Conduits 34 and 46 are connected as indicated in FIG. 1, and the apparatus is then ready for operation. The pump is off when connection is made to the fittings 30 and 44 and valves 36 and 48 are closed. Accordingly, the high recirculating pressure at the pump outlet is absent from pressure fitting 26 and conduit 74 and weight 64 will move (or hold) the flexible diaphragm 56 to (or in) its lowest position illustrated in solid lines in FIG. 2. Before the pump is turned on and valve 36 opened, valve 48 is opened and pressure of the body of supply chlorine 24 will fill the feed compartment 60 through the inlet check valve 52, with air being displaced from the feed compartment through the check valve 40 and via the now-opened valve 48. Alternatively, chamber 60 may be filled before the dispenser is connected. Valves 36 and 48 are both open for normal dispensing operation. Presuming the pump is in operation, or when the pump is turned on by the timer 18, high pressure at the pump outlet in conduit 38 is communicated to the drive compartment 62. The feed compartment 60 is in communication with a relatively decreased pressure at point 50, there being a significant pressure drop across filter 14, either alone or in addition to the pressure drop across heater 16, it being understood that the water is recirculating in the direction of the arrows. The pressure differential across the flexible diaphragm 56 drives the latter (together with the weight 64) to a second or uppermost position illustrated in dotted lines in FIG. 2, which position is limited by abutment of the central portion of the diaphragm 56 against the lower face 94 of adjustable valve housing 84. The drive compartment 62 fills with pool water via conduits 74, 28, 34. As the diaphragm moves to its second or upper position, the chlorine in feed compartment 60 is expelled therefrom through the valve 40, through valve 48 and mixed with the recirculating water of the pool at point 50.

The amount of chlorine dispensed into the pool upon this single operation of the device (e.g. the motion of the flexible diaphragm from the lowermost position to its uppermost position) is precisely determined by the difference between (a) the volume of the feed compartment 60 with the diaphragm in its lowest position and (b) the volume of the feed compartment with the diaphragm in its uppermost position. This difference may be adjusted by varying one or both of these positions. As shown in the described embodiment, it is convenient to adjustably vary the upper of these two positions to either increase or decrease this difference and thereby increase or decrease the precisely metered quantity of chlorine dispensed upon each cycle of operation.

As long as the pump continues to operate and high pressure is provided via conduit 74 to drive compartment 62, the movable wall or piston that is formed by the flexible diaphragm 56 is and will remain in its uppermost position. A precisely predetermined quantity of liquid chlorine has been mixed with the pool water, being fed directly into the main body of water where it is diluted before it is recirculated through the pump filter and heater.

Thereafter, when the pump is shut off (by operation of the timer or otherwise), and only then, the pressure differential across the flexible diaphragm 56 is removed there being an absence of the high recirculation pressure at the pump outlet. The force exerted by the lead weight is no longer countered by the high pump pressure in drive compartment 62. Accordingly, the diaphragm and weight move downwardly to the lower position under the urging of the weight 64 and water in the drive compartment is returned to the system via conduits 74, 28, 34, since there no longer is a pressure in these lines sufficient to counter the force of weight 64. Concomitantly, the decreased pressure in feed compartment 60, which occurs as the volume of this compartment expands, opens check valve 52 and feed compartment 60 is once again filled from the body of the supply chlorine 24 confined in container 22.

The apparatus remains in this condition, the feed compartment 60 being filled and the diaphragm 56 in its lowest position as long as the pump remains off. When the pump turns on again, pressure is again provided to drive chamber 62 which fills with pool water, and the diaphragm is driven to its uppermost position, thus ejecting precisely the same quantity of liquid treatment chemical from the feed compartment 60. If adjustment of the quantity of dispensed liquid treatment chemical is desired, valve housing 84 is rotated in its threaded engagement with boss 86 to thereby cause the stop face 94 of the housing to protrude a further amount or a lesser amount into the feed compartment 60 to thereby vary the effective "stroke" of the piston-like flexible diaphragm 56.

As the level of liquid treatment chemical in container 22 decreases to a point above but adjacent the uppermost point of the supply inlet conduit 52, the cover 32 may be removed and the supply replenished. If deemed necessary or desirable, a visual or other gauge may be provided to readily display the quantity of supply chlorine chemical remaining within the container 22. Where a swimming pool is to be provided with one pint of liquid chlorine each day, which is an amount sufficient for treatment of a 20,000 gallon swimming pool under common conditions, and which is sufficient to
bring the chlorination of such a pool to a concentration of one part per million, a 5 gallon supply container will require a refill approximately each 30 days, presuming there is one full cycle of pump operation each day so that each day precisely one pint of chlorine is dispensed into the pool. Obviously, larger or smaller containers may be employed. If deemed necessary or desirable, instead of retaining container 22 in place and simply refilling it, the container together with the chamber 20 may be provided as a replaceable unit, such that periodically the apparatus would be serviced simply by replacing the near-empty container 22 (with its dispensing chamber 20 therein) with a freshly-filled container 22 also having a dispensing chamber 20 therein. The emptied container 22 may be removed to some convenient location for refilling and servicing if appropriate.

It will be readily appreciated that the described apparatus provides simple, precision and substantially automatic treatment of a body of recirculating water with exactly predetermined quantities of treatment chemical at a rate that is not dependent upon a fixed pressure in the recirculating system. In fact, as the filter becomes more clogged and pressure increases, a more positive assurance of chemical dispensing action is obtained in the described apparatus. Thus, the system is independent of flow rate or pressure of the normal recirculating system, provided only that there is sufficient pressure to overcome the weight of the lead mass 64 and drive the flexible diaphragm to its upper position.

Further, as previously noted, the particular flattened configuration of the chamber 20 provides for a greater diameter of diaphragm and a decreased distance of travel for a given volume of displacement. Thus, the diaphragm needs to flex less since it is displaced through a shorter distance and will, therefore, experience a longer life. The flattened configuration allows use of a greater quantity of the content of the container 22 and, further, provides for a greater head of the supply liquid to enhance the refilling of the feed compartment 60.

The drive compartment uses pressure of the recirculating system, but wastes none of its water since this compartment has connection only to the recirculating system and returns its contents each time the pump stops.

The foregoing detailed description is to be clearly understood as given by way of illustration and example only, the spirit and scope of this invention being limited solely by the appended claims.

What is claimed is:

1. In combination with a swimming pool having water recirculating means including a first intermittently operable pump for recirculating the water of the pool, a positive displacement pump for dispensing a metered amount of chlorine in response to operation of said first pump comprising a chamber adapted to be filled with chlorine, piston means mounted within the chamber and movable between first and second positions, means responsive to said first pump for driving said piston means to said first position when said first pump is in operation and for driving said piston means to said second position when said first pump is not in operation, means for filling said chamber with chlorine as said piston means moves to said second position, and means for flowing chlorine from said chamber to said swimming pool as said piston means moves to said first position.

2. The chlorine dispenser of claim 1 wherein said piston means comprises a flexible diaphragm separating said chamber into drive and feed compartments, wherein said means responsive to said pump comprises a conduit interconnecting a first one of said compartments to a first point of said recirculating means and a second conduit connecting the other of said compartments to a second point of said recirculating means having a lower pressure than said first point.

3. The apparatus of claim 2 wherein said means for driving said piston means to said second position comprises a weight secured to said flexible diaphragm and operable to move the diaphragm to said second position when said first pump is not operating and the pressure in said drive compartment is decreased.

4. The apparatus of claim 2 wherein said drive compartment has communication only with said first point of said recirculating means, whereby water in said drive compartment is returned to said recirculating means when said piston means moves to said second position.

5. The apparatus of claim 3 wherein flexible diaphragm includes a continuous flange depending therefrom into said first compartment and wherein said weight comprises a solid body resiliently retained within said flange, said flange and solid body having inter-engaging locking bead and groove means for retaining the body within the flange.

6. The apparatus of claim 2 wherein said means for filling said chamber comprises a container confining a body of chlorine, said dispenser being immersed in said body of chlorine and having a fill conduit with an input port immersed in said body of chlorine.

7. Water treatment apparatus comprising a positive displacement pump for dispensing a metered amount of a treatment chemical in response to operation of a recirculating pump, said positive displacement pump comprising a sealed housing defining a chamber therein, a flexible diaphragm separating the chamber into drive and feed compartments, said diaphragm extending substantially horizontally across said chamber and said chamber having a horizontal dimension considerably greater than its vertical dimension, whereby said diaphragm may be displaced through a relatively small distance to effect a relatively large change in the volume of said feed compartment, a recirculating water system including a water treatment device having an input line and an output line, said water system including an intermittently operating recirculating pump, a first conduit connecting said drive compartment to the input line of said treatment device, a second conduit connecting said feed compartment to the output line of said treatment device, and a third conduit connecting said feed compartment to a supply of liquid chemical.

8. The apparatus of claim 7 including a continuous flexible flange secured to and depending from said diaphragm into said drive compartment, and a weight resiliently secured to and within said continuous flange.

9. The apparatus of claim 7 including a container, liquid chlorine confined within said container, said housing being immersed within the chlorine in the container.
and said third conduit connecting said feed compartment to the chlorine in said container.

10. For use with a swimming pool water recirculation system having a first pump, a positive displacement pump for dispensing a metered amount of chlorine in response to operation of said first pump, said positive displacement pump comprising a relatively flattened housing defining a chamber having a horizontal extent substantially greater than its vertical extent.

a flexible diaphragm extending across said chamber and having its periphery continuously fixed and sealed to the chamber and dividing the chamber into drive and feed compartments, adjustable means for limiting displacement of said flexible diaphragm, a common inlet and outlet conduit fitting connected with said drive compartment, an outlet conduit fitting connected with said feed compartment, and having a check valve therein, a supply conduit fitting connected with said feed compartment and having a check valve therein, a container adapted to receive a quantity of liquid chlorine, said housing being positioned within and substantially at the bottom of the container and immersed within chlorine confined within the container, said supply fitting having an input port adjacent the top of said housing whereby a decreased height of chlorine in the container will cover said input port,

said diaphragm having a flange secured thereto, a weight secured to said flange, said weight comprising a solid body having a substantially continuous peripheral groove, said flange comprising a closed depending wall formed with an integral bend that mates with and is received within the groove of said solid body to firmly and resiliently secure the solid body to the flexible diaphragm.

11. In combination with a swimming pool having a first pump and filter for recirculating and filtering the water thereof and a timer for cyclically turning the pump on and off to cyclically provide recirculating pressure and provide the absence of recirculating pressure, a positive displacement pump responsive to operation of said first pump for feeding a fixed quantity of liquid water treatment chemical to the pool repetitively at the cyclical rate at which the first pump is turned on and off by the timer, said displacement pump comprising a compartment having a wall movable between a first position in which said compartment has a relatively large volume of fixed magnitude and a second position in which said compartment has a relatively small volume, an outlet conduit connecting the compartment to said swimming pool, a supply of liquid treatment chemical connected with said compartment, means for urging said movable wall to said first position, and means responsive to said recirculating pressure for countering said urging means to drive said movable wall to said second position, whereby a fixed quantity of liquid chemical is expelled from said compartment into said pool when the first pump is turned on and whereby the compartment is refilled with the liquid chemical from said supply when the first pump is turned off.

12. The combination of claim 11 including means for selectively varying one of said positions of said movable wall so as to selectively adjust the difference between said relatively large and small volumes.