Sept. 29, 1970 J. A. BERG ET AL 3,530,511

AUTOMATICALLY EXTENSIBLE AND RETRACTABLE POOL CLEANING APPARATUS

Filed Dec. 9, 1968

FIG. 1

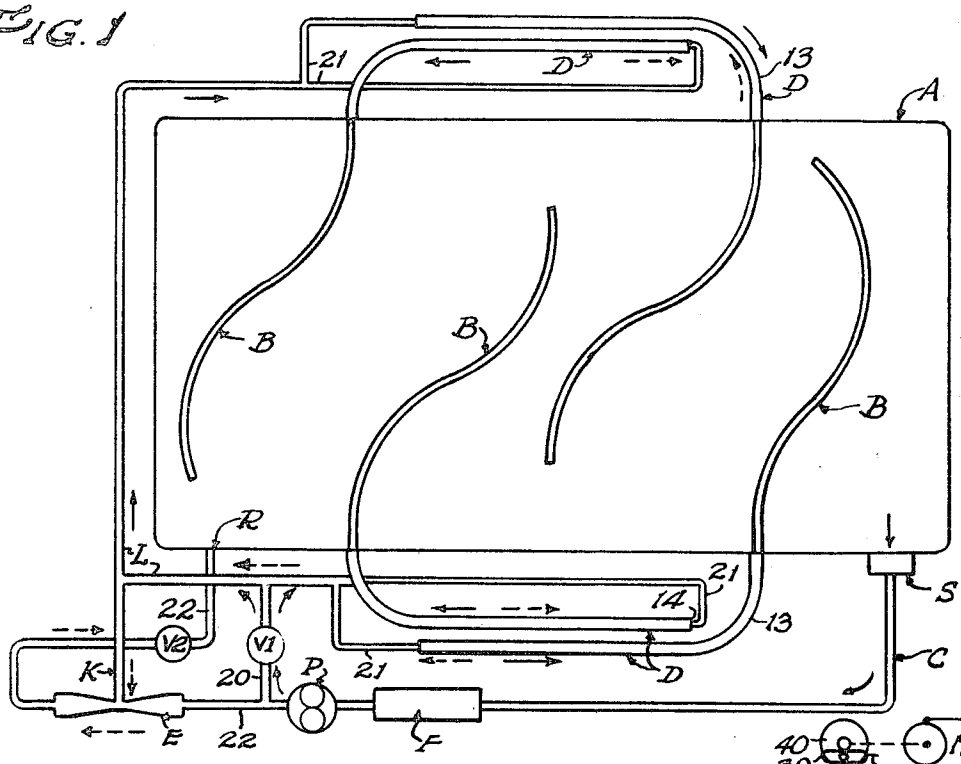


FIG. 4

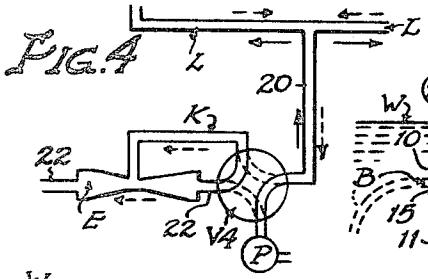


FIG. 2

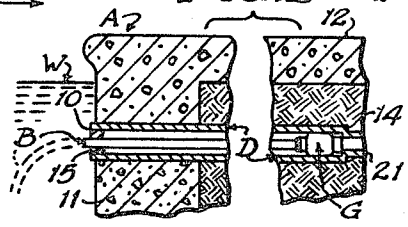
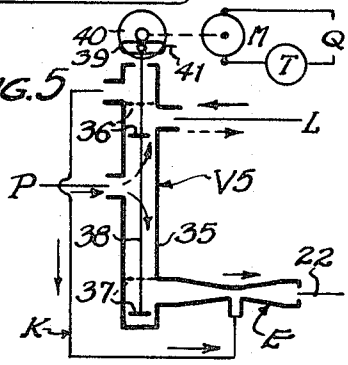


FIG. 5



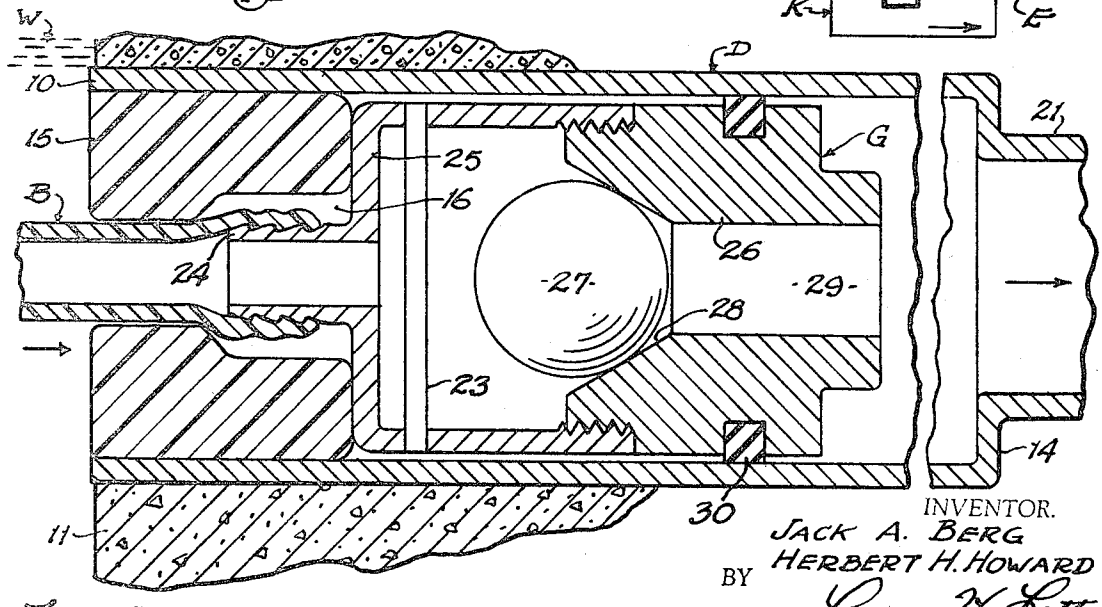


FIG. 3

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AUTOMATICALLY EXTENSIBLE AND RETRACTABLE POOL CLEANING APPARATUS

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Int. Cl. E04h 3/16
U.S. Cl. 4—172.15 11 Claims

ABSTRACT OF THE DISCLOSURE

A fully automatic pool cleaner wherein one or more cleaning hoses, sweeping over the interior surface of a pool under the reaction of sediment-scouring jets discharged by them, are automatically extended from housing cylinders by the discharge from the pool circulation pump when applied to the cylinders, and are automatically retracted into the cylinders by differential of atmospheric pressure, acting on the pool surface, over vacuum applied to the cylinders by aspirating action of an ejector operated by pump discharge.

BACKGROUND OF THE INVENTION

Automatic swimming pool cleaners utilizing one or more hydraulic jet hoses operable by jet propulsion to scour the bottom of a pool with a random undulating movement designed to stir up the sediment deposited on the pool bottom, simultaneously with operation of the pool cleaning system to draw off the sediment into the filter apparatus, have been in use for a number of years. Varian Pat. No. 3,074,078 discloses a cleaner of this type utilizing a single long hose intended to cover the entire pool area over a period of operation. Berg 3,168,896 and Ruston 3,217,886 disclose multiple hoses branching from a trunk line which supplies them with water under pressure. These cleaners leave the hoses and trunk line exposed in the pool, and considerable time and effort is required to remove the apparatus from the pool and to replace it back in the pool.

An automatic cleaner disclosed in Whittaker Pat. No. 3,278,949 utilizes the flow of water in opposite directions through a plurality of cleaner hoses to extend and retract these hoses into the pool and back into concealed housings in which the hoses are retained when not in use.

SUMMARY OF THE INVENTION

Our invention utilizes the pressure of water pumped by the pool's circulating and filtering system, against pistons on the ends of cleaner hoses in concealed housing cylinders, to extend the hoses into the pool and then to force water through the hoses to effect sediment-scouring action; and upon reversal of flow, the differential of atmospheric pressure against the pool surface, over pump suction applied to the hose pistons, will draw the hoses back into their cylinders with a positive hydrostatic pressure operation. The invention is particularly characterized by the use of a check valve in each piston to prevent reverse flow through the cleaner hose and to utilize the full pressure differential developed by the filter system pump for retracting the hoses.

The invention is further characterized in that the hose-retracting differential is developed by aspirating action of an ejector energized by pump discharge through it, thereby developing suction which is applied to the rear ends of the hose-housing cylinders while atmospheric pressure is applied to the forward ends of the cylinders.

OBJECTS OF THE INVENTION

The principal object of the invention is to provide for automatic extension and retraction of a cleaner hose with

reliable operation, in order to overcome a most difficult problem that has been encountered in the development of a fully automatic cleaner, namely, the tendency of the cleaner hose to "hang up" and fail to retract in response to reverse flow in the system.

Other objects will become apparent in the ensuing specification and appended drawing, in which

FIG. 1 is a schematic diagram of an automatic cleaner system embodying the invention;

FIG. 2 is a fragmentary vertical sectional view of a swimming pool installation of the invention;

FIG. 3 is a detail sectional view on an enlarged scale, showing the piston and housing assembly;

FIG. 4 is a fragmentary diagram of a modified control valve arrangement; and

FIG. 5 is a diagram of another modified control valve.

DESCRIPTION

Referring now to the drawing in detail, and in particular to FIG. 1, we have shown therein, as an example of one form in which the invention may be embodied, a system for automatic scouring of a pool A by a plurality of water jets delivered through flexible cleaner hoses B, in response to flow delivered by the pool's circulating pump P, through the pool's skimming and filtering circuit C including a filter F, a skimmer outlet S, and through a plurality of housing cylinders D which are connected in parallel to the outlet of pump P through a trunk line L and a valve V1 when the latter is open. The system also includes an ejector E through which the pump discharge is directed to the conventional pool return R during normal skimming and filtering operation of the circuit C, the return being directed through a valve V2 when open. The ejector E functions, with an aspirating action, to develop suction in a suction line K which is connected to the cylinder trunk line L so as to apply vacuum thereto, whereby atmospheric pressure against the surface of the water in pool A, assisted by the water pressure head from the pool surface down to the level of cylinders D, will be utilized to draw hoses B into their housing cylinders, clearing the pool interior of the cleaning hoses.

Each hose has, at its rear end, a piston G slidable in cylinder D for extending and retracting the hose in response to pressure differentials applied thereto.

Referring now to FIG. 2, each hose B of flexible tubing, preferably of synthetic resin plastic material and transparent or translucent so as to be only slightly noticeable when operating in the bottom of the pool. The hoses are of smaller diameter than housing cylinders D and may be as small as ¼" inside diameter so that ¾" ID tubing may be employed for cylinders D.

Cylinders D have open ends **10** extending through the pool wall **11** near the pool rim where it merges with deck **12**. The body of each cylinder may extend into the earth behind the pool wall, either at right angles to the pool wall or, as shown in FIG. 1, lying alongside the pool wall beneath the deck and connected to the pool wall by a broadly-curved elbow **13**. At its rear end, each cylinder may be necked down or otherwise provided with an internal annular shoulder **14** to function as a retraction-limiting stop for engaging piston G when the hose B is fully retracted (FIG. 2). Secured in the open forward end of each cylinder D is a bearing bushing **15** of suitable material such as Teflon, nylon or equivalent bearing material, through which the hose B slides during extending and retracting movements, and to which the forward end of piston G is sealed (FIG. 3) when the hose is fully extended.

The open end of cylinder D is below the normal water level of the pool and hence is submerged in the body of pool water, so that atmospheric pressure, applied

against the surface of the pool, will be transmitted through the open end **10** of the cylinder and applied to the forward end of piston G through bushing **15**.

The outlet of pump P is connected to a flow line **20** having valve V1 in series therein, leading directly from the pump to the cylinder trunk line L, from which four branch lines **21** extend to the four cylinders D. The pump outlet is also connected, in parallel with line **20**, to a return line **22** leading to pool return R. Ejector E is disposed in return line **22**, in series, so that return flow therethrough will create suction in its venturi throat, which suction is applied to suction line K when the pump discharge is directed to the pool return R.

Each piston G comprises a body cup **25** having a tubular hose fitting **24** projecting from its bottom and connected to its hose B; an annular valve seat element **26** which is attached to the cup rim by any suitable means (e.g. a threaded connection as shown); and a ball valve **27** adapted to seat against an internal conical valve seat **28** when suction is applied to the back side of the piston through a port **29** in element **26**. When pressure is applied in port **29** the valve **27** will drop into the annular chamber defined in cup **25**, a blocking pin **23** being provided to prevent obstruction of the hose fitting **24**, so that free flow from the cylinder D through the piston G and hose B, for scouring the internal pool surface may take place.

A piston ring **30** is mounted in a groove in valve seat element **26** and seals the piston to cylinder D so that adequate pressure differentials for extending and retracting the hose B, may be developed across the piston. When the pump discharge is applied behind the piston, the flow resistance of hose B and the relatively small port through hose fitting **24** will develop a back pressure such that a substantial proportion of pump discharge pressure will be applied against piston G to extend hose B into the pool. When suction is applied to cylinder D behind piston G, valve **27** will be drawn to closed position and the differential of atmospheric pressure applied through bushing **15** against the forward end of the piston, over the vacuum (suction-induced low pressure) applied to the rear end of the piston by ejector E, will be effective to draw the piston to the rear end of cylinder D, until it stops against shoulder **14**, whereupon the hose B will be fully retracted into housing cylinder D.

Bushing **15** has an enlarged throat **16** in its rear end which is engaged by piston G when hose B is fully extended. Throat **16** receives the enlarged end of hose B where it is stretched over fitting **24**, with adequate clearance to avoid wedging of the end of the hose in the bushing, and to leave the hose and piston free to retract from the bushing **15** in response to reverse flow in the system.

For hoses and cylinders such as those specified above, we find that pump discharge pressure of 15 p.s.i. (gage pressure), coupled with a flow of 25 gallons per minute, will be adequate to effect extension in the manner hereinafter described, in systems having up to six cleaning hoses. For retraction, the same pump pressure and flow may be utilized to produce a vacuum of approximately 21 inches of mercury, suitable for developing the required pressure differential.

The requirements for satisfactory operation are determined as against parameters including

(a) the number of hoses to be actuated;
(b) the distance from the pump to the pool. In filling the requirements, selection of
  (1) cleaner hose B diameter and
  (2) size of ejector E, is made so as to satisfy these parameters.

OPERATION

For cleaning operation, valve V2 is opened, directing the pump discharge, as indicated by the solid arrows,

through flow line **20**, cylinder line L and branch lines **21** to the rear ends of cylinders D, in which the pump pressure is applied to pistons G so as to extend the hoses B into the pool. We find that the extending movements usually occur sequentially, the resistance to extension varying somewhat as between the several hose-piston-cylinder assemblies, and the movement of a hose causing some pressure drop in cylinder line L. As each hose reaches fully extended position, the pressure drop caused by its movement will disappear, causing a slight build-up of pressure in cylinder line L (the full back pressure of its hose B being applied to the cylinder line when its piston G seals against its respective bushing **15**) and this pressure buildup will be applied as an increased push against other hose units (one or more of which may have started to extend) and finally all of the hoses will be fully extended. Full pump pressure will then be applied to the cylinder line L, causing respective cleaning jet flows through the hoses B, for scouring sediment from the interior pool surface.

For normal skimming and filtering operations, valve V1 is closed and valve V2 is opened, directing the pump discharge, as indicated by dotted arrows, through the ejector E and return line **22** to pool return R, with an aspirating action in the venturi throat of ejector E which applies suction through line K to cylinder line L and thence to cylinders D. The differential of atmospheric pressure applied to the forward ends of pistons G, over the low pressure existing in cylinders D, will then be effective to retract the hoses B into their cylinders D which then function as housings in which the hoses are retained, out of sight, until a cleaning operation is again initiated by reversal of valves V1, V2. Here again, the hoses may retract sequentially, those with the lease resistance to the retracting differential being retracted first and the others following.

Instead of the two separate valves V1, V2, a single four-way, two-position reversing valve V4 (FIG. 4) can be employed to close line **22** while opening line **20** and vice versa. In one position (shown in full lines) the valve V4 will connect pump discharge through line **20** to trunk line L and at the same time will short-circuit and isolate ejector E in an inoperative condition. In its other position, valve V4, as indicated in dotted lines, will connect pump P to ejector-operating line **22** and at the same time will connect the ejector's suction line K to trunk-line, flows being as indicated by dotted arrows, as in FIG. 1.

FIG. 5 illustrates an alternative double valve V5, schematically, wherein pump P discharges into a piston valve housing cylinder **35** having axially-spaced connections to ejector E and its suction line K respectively, and an intermediate connection to trunk line L adjacent the connection to suction line K, and the inlet connection to the discharge of pump P, which is located intermediate the connections to suction line K and trunk line L respectively. Valve pistons **36** and **37**, on a plunger stem **38** having an operating handle **39**, are operable when in positions shown in full lines, to direct flow from pump P through the valve inlet into the housing cylinder **35** and thence through ejector E to pool return line **22**, creating suction which is applied to suction line K for retracting the hoses B, as indicated by full-line arrows; and when in positions shown in broken lines, are operable to direct flow from the inlet to the trunk line K for extending the hoses and causing them to deliver their scouring jets.

Handle **39** may be such as to be utilized as a handle for manual operation; or it can be provided with a slot in which a crank pin on an eccentric **40** is operable, when rotated by a motor M through a half rotation, to shift the valve pistons **36**, **37** from normal filtering position to jet-cleaning position (broken-line position of FIG. 5), and in a subsequent half revolution, to shift the valve pistons back to normal positions (full line position). Control may be provided for by operation of a timer T to close the motor circuit to a current source Q at specified times

during the period of operation of the pool's filtering system and with cut-off of motor operation at the ends of the half revolutions, suitable limit switches (not shown) actuated by a suitable moving part (e.g. a projection **41** on valve stem handle **39**).

The invention provides a relatively simple automatic cleaning system wherein both hose-scouring circuit and filtering circuit are alternately brought into operation by reversal of a pair of valves or a single quadruple-port valve, and wherein no additional operational circuit is required. The same circuit (normal filtering circuit) is operative, in two stages, first to retract the hoses and then to confine the flow to the normal filtering flow. This is made possible by using the pump discharge (instead of its inlet suction) to energize the ejector E to create a vacuum behind pistons G for hose retraction, and by utilizing valves **27** to close pistons G against reverse flow through hoses B, thus allowing a high vacuum to be drawn behind pistons G, such that substantially full atmospheric pressure transmitted through the pool water W, is effective against the forward sides of pistons G for hose retraction.

Valve control and circuitry are reduced to a minimum of simplicity through the use of the pump discharge simultaneously to create the retracting vacuum and to return the filtering flow into the pool; and, in the alternate cycle, the use of the same pump discharge to create the jet-scouring flows through hoses B. The ejector E is operative simultaneously to pass the pump discharge to the pool return R and to create the vacuum for hose-retraction.

In making it possible to utilize a simple four-way valve (e.g. as in FIG. 4 or in FIG. 5) the invention is readily adaptable to fully automatic control by timer or other automatic control device, such that it is not necessary to manually reverse the valving.

An improved aspect of the operation of our system is the transition from hose-extending and jet-scouring operations to hose-retracting and normal cleaning operations promptly upon valve reversal from one phase to the other and vice versa, the pump inlet being connected to the filter at all times. The normal filtering circuit is set up when the two valves are set for hose retraction, and normal filtering operation is resumed as soon as the hoses are retracted and retracting flow in the cylinders is cut off with consequent application of the full pumping differential and capacity to the normal filtering flow.

The valve **27** solves the problem of developing a sufficiently high pressure differential to retract its associated hose. Also, it prevents air flow into and through the hose into the pump (which would cause the pump to lose its prime) in the event the valves should be suddenly reversed during violent whipping of the hose on the pool surface, which can easily occur and has occurred in this type of system.

We claim:

1. Automatic cleaning apparatus for a pool having a wall for containing a body of water, comprising:

a housing cylinder having an open end anchored in said wall and communicating with the pool interior at a level below the normal surface level of said body of water;

a flexible cleaner hose normally housed in said cylinder and extensible therefrom into the pool, said hose having an open forward end normally disposed in said open end of the cylinder and operable to deliver a sediment-scouring water jet along the interior pool surface when the hose is extended;

a piston on the rear end of said hose, slidable in said cylinder to extend and retract the hose in response to perssure differentials acting in said cylinder against the rear and forward ends of said piston respectively;

a pump and circulating means for delivering a flow of water under pressure;

said piston being tubular, having a throat extending axially therethrough for passage of said flow through the piston and through said hose so as to deliver said scouring jet when said flow is directed into the rear end of said cylinder, said piston having an effective pressure-responsive rear end area adequate for extending the hose into the pool in response to the net pump pressure thereagainst during passage of said flow through said hose;

a check valve associated with said piston, operable to close said throat to prevent reverse flow through said hose and piston into said cylinder in response to application of vaccum in said cylinder behind said piston, and responsive to said pressure flow to open said throat for said flow through the hose; and

means for applying to the rear end of said cylinder, a vacuum operable to close said check valve and then to develop a differential of atmospheric pressure and of the water head above said cylinder open end, over said vacuum, effective against the forward end of said piston, to retract said hose into said housing cylinder.

2. Pool cleaning apparatus as defined in claim **1**, including:

valve means selectively operable;

(a) to direct said pressure flow to the rear end of said cylinder for extension and jet operation of said hose, while rendering said vacuum-applying means inoperative; and

(b) to cut off said pressure flow from said cylinder while rendering said vacuum-applying means operative for retracting said hose, and directing the pump discharge flow into a return to said pool.

3. Apparatus as defined in claim **2**, wherein said vacuum-applying apparatus includes an ejector operable by aspirating action to develop said vacuum in response to flow of the pump discharge therethrough to said pool return.

4. Apparatus as defined in claim **3**, including

a constantly open aspirating connection from said ejector to the rear end of said cylinder;

a valve-controlled pressure-flow connection from the discharge side of the pump to said cylinder rear end;

and a valve-controlled return line from the discharge end of said ejector to said pool return.

5. Apparatus as defined in claim **4**, including a constantly-open connection from said pump discharge side to the inlet end of said ejector and in parallel with said pressure flow connection.

6. Apparatus as defined in claim **1**, including a bearing bushing in said open end of the cylinder, through which said hose is extended with a loose sliding fit with clearance such as to communicate the pressure of said body of water to the forward end of the piston externally of said hose when said vacuum is applied.

7. Apparatus as defined in claim **1**, including a bearing bushing in said open end of the cylinder, through which said hose is extended with a loose sliding fit with clearance such as to communicate the pressure of said body of water to the forward end of the piston externally of said hose when said vacuum is applied;

said piston having a forwardly projecting fitting to which said hose has a coupled connection;

said bushing having in its rear end an annular recess in which said coupled connection is freely receivable and such as to permit unrestrained separation of said coupled connection therefrom for retraction of said piston and hose;

the rear end of said bushing, around said annular recess, being engageable with said piston to limit forward extension thereof and to seal the piston to said bushing so as to concentrate the pump discharge pressure on the flow through said piston and hose.

8. Apparatus as defined in claim **1**, wherein said check valve is a ball valve disposed within said piston;

and said valve includes a frusto-conical valve seat defining a portion of said throat, and an annular cham-

ber at the larger end of said valve seat, into which said ball is movable to a position in which it does not obstruct said flow through said throat.

9. Pool cleaning apparatus as defined in claim 1, including:

(1) a valve for directing flow of the pump discharge to said cylinder when opened, and cutting off said flow when closed; and

(2) a separate valve for applying said vacuum to said cylinder when opened and for cutting off said vacuum when closed.

10. Apparatus as defined in claim 1, including a four-way, two-position valve operable, in its respective positions:

(a) to direct said pressure flow to the rear end of said cylinder for extension and jet operation of said hose, while rendering said vacuum-applying means inoperative; and

(b) to cut off said pressure flow from said cylinder while rendering said vacuum-applying means operative for retracting said hose, and directing the pump discharge flow into a return to said pool.

11. Apparatus as defined in claim 1, including a four-way, two-position valve operable, in its respective positions:

(a) to direct said pressure flow to the rear end of said cylinder for extension and jet operation of said hose,

while rendering said vacuum-applying means inoperative; and

(b) to cut off said pressure flow from said cylinder while rendering said vacuum-applying means operative for retracting said hose, and directing the pump discharge flow into a return to said pool;

and automatic means for actuating said four-way valve intermittently and successively to said jet operation position and then to said hose-retracting position.

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LAVERNE D. GEIGER, Primary Examiner

H. K. ARTIS, Assistant Examiner

U.S. Cl. X.R.

15—1.7; 210—169

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,530,511 Dated September 29, 1970

Inventor(s) JACK A. BERG and HERBERT H. HOWARD

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

In column 1, line 4, the name of Jack A. Berg as co-inventor should be deleted as follows:

Delete "Jack A. Berg and".

Signed and sealed this 1st day of May 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.