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[54] **FILTER CLEANER**
3 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **134/58,** 134/10, 134/33, 134/99, 134/109, 134/143, 134/152

[51] **Int. Cl.** **B08b 3/02,** B08b 11/00

[50] **Field of Search** ..... 134/10, 33, 58, 99, 102, 109, 140, 143, 152, 153; 210/167; 55/(No Search)

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ABSTRACT: A machine organized to successively apply a jet of cleansing liquid to the exterior surface of each successive portion of a complex shaped thin-walled dirty air-permeable air filter while the interior surface of that thin-walled portion is concurrently supported from collapse by the mechanical action of said jet, and is constructed to permit sufficient ready insertion of the filter into its treatment position and removal therefrom to permit public commerical coin operation thereof and is organized to provide for re-use of the treating liquid.

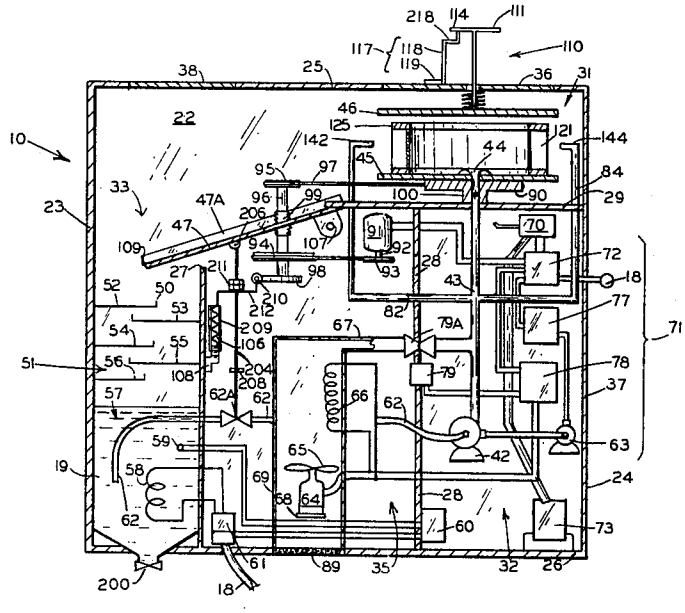


FIG. 1

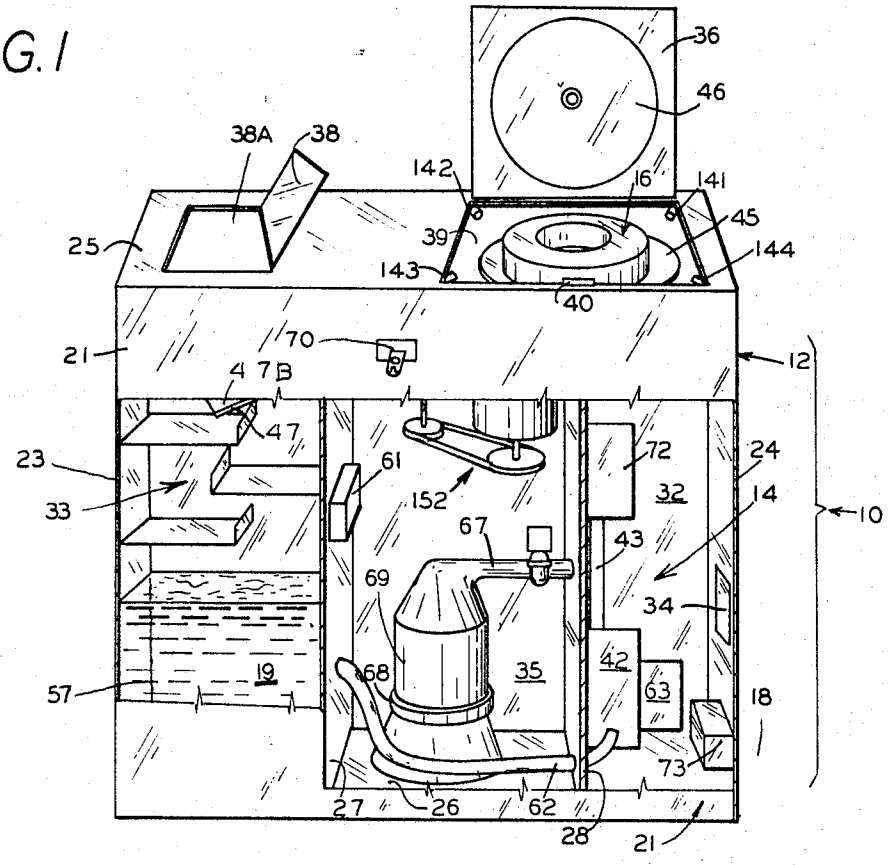
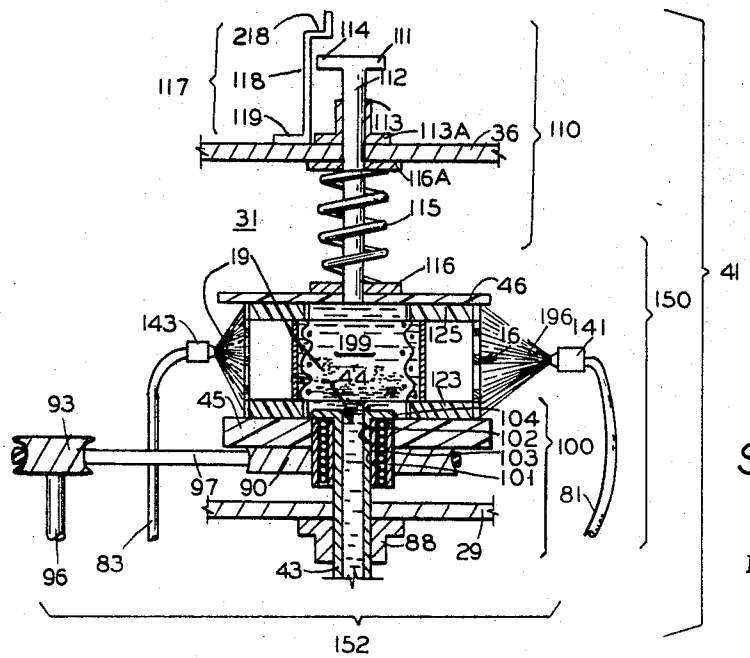


FIG. 2



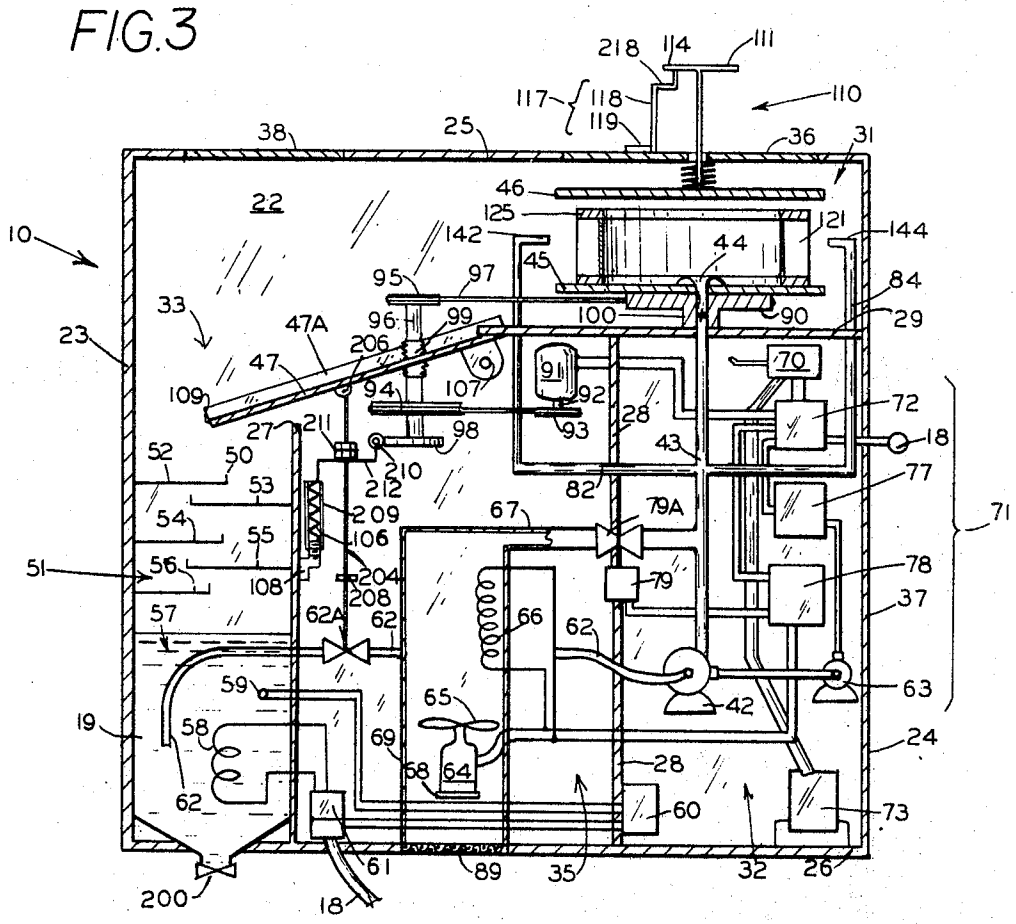
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FIG.3



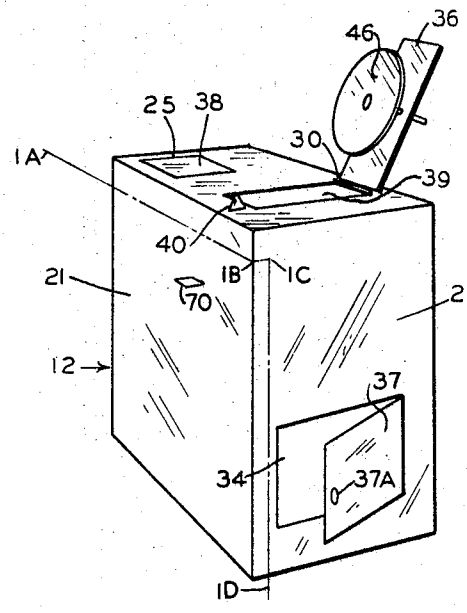


FIG.4

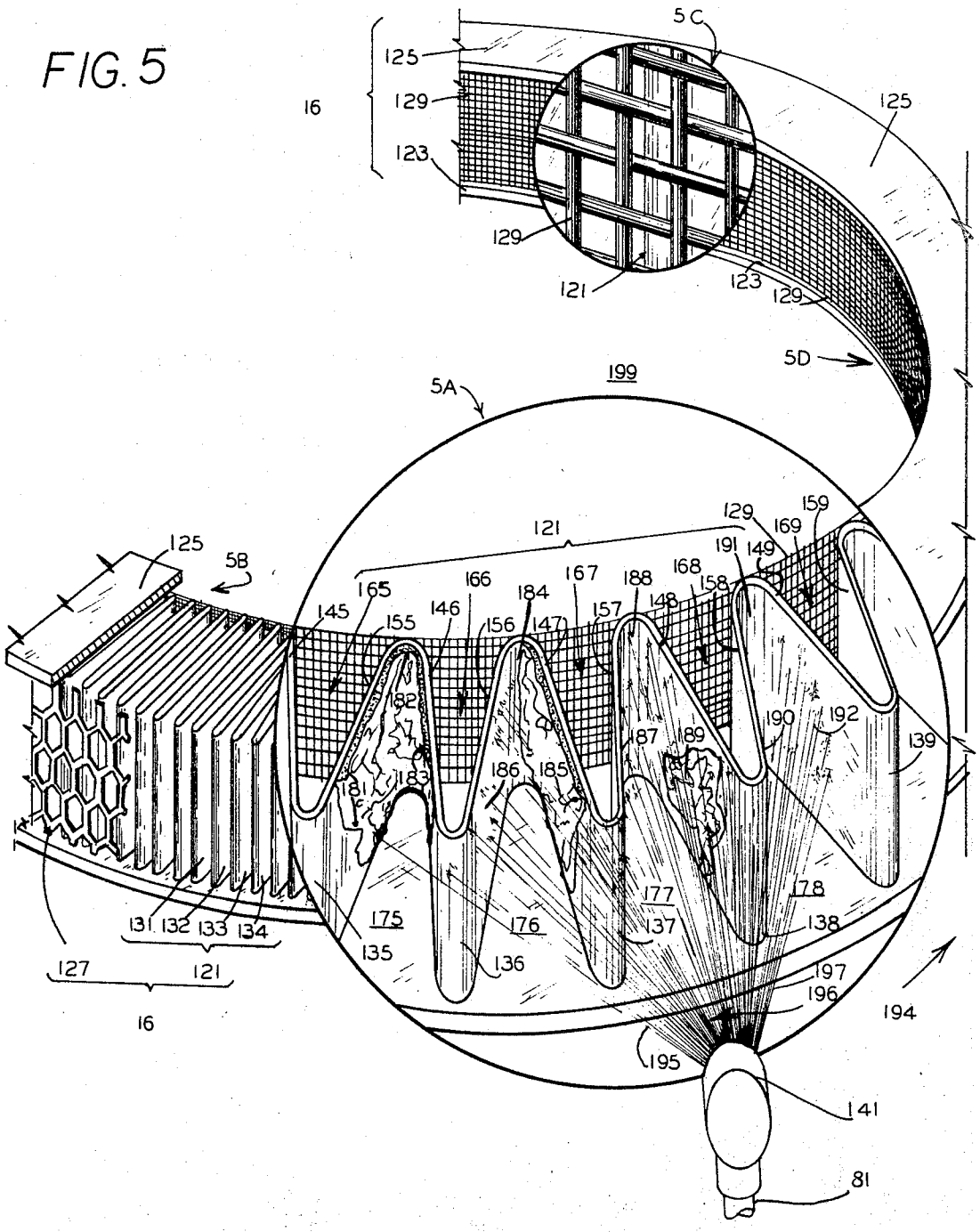
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FIG. 5



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FILTER CLEANER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The application of liquid cleansing material to an implement having cavities and a work handling apparatus for such application.

2. Description of the Prior Art

While air filters are necessary to protect the mechanical parts of the internal combustion engines they are required to be sufficiently freely permeable to air and permit about one cubic foot of air per second to pass therethrough to an automobile carburetor. As such filters become clogged with debris they reduce the efficiency of the internal combustion engines (whether rotary or reciprocating piston) and the combustion efficiency of the average automotive engine is impaired, especially at high speed or acceleration, to the extent of a loss of efficiency of about three miles per gallon in a car usually performing at about 18 miles per gallon.

Cleansing of automotive air filters has been usually attempted by hand held rapping and/or forceful but brief air blast with hand manipulation of the air filter during such manipulation: such air blasts are frequently so violent as to rupture the filter element; such use of air blast and mechanical rapping are not reliable and neither serves to dislodge any but the most loosely held material. Replacement of clogged filters is the usual remedy. Other machines available for strainer cleaning dependent upon flow of the cleansing solution through the filter element (e.g. U.S. Pat. No. 2,170,081) increase the pore size of the element and, with an oleophyllic surface, as is developed in most air filters, the use of water is ineffective and oil cleansing requires impractical pressures.

SUMMARY OF THE INVENTION

This invention provides a solution to the problem of cleaning the outer surface of a filter wall, where most of the dirt and debris is located, by applying to the outer surface of a thin dirty air filter wall a liquid jet of sufficient force to dislodge and remove increments of dirt and debris from the outer surface of that wall without causing any damage to that wall by providing mechanical support to the complexly shaped inner surface of that thin wall, while the outer surface thereof is thus forcefully scrubbed, the jet striking the surface at an angle.

The liquor used is provided sufficient detergent action to loosen the increments of dirt from the filter wall when used as a jet but not enough chemical activity to keep the dirt stably suspended. This results in that the liquor used to dislodge the debris and dirt from the filter surface may be separated by the apparatus of this invention from such debris and dirt and be re-used; this provides that no separate continuous water addition facility and continuous dirty water drain is required. The apparatus is also constructed to permit ready location, by the average member of the public, of a filter of any of a large variety of sizes and shapes in the apparatus and ready removal of the treated filter.

Further still, this apparatus and process uses the operation of the internal combustion engine in which the air filter is used to assist in completely drying the treated filter: the structure of the apparatus and steps of the process are adapted to the "do-it-yourself" public that presently uses coin-operated machinery such as coin-operated automatic car washes, automatic clothes washers and dryers and the like.

One object of this invention is to provide an improved apparatus for cleaning automobile air filters.

Another object of this invention is to provide an improved process for cleaning automobile air filters.

Other objects will become apparent to those skilled in the art on study of the below description of apparatus and the hereto appended drawings, which drawings for a part of the description of apparatus and in which drawings the same referent numeral refers to the same part throughout.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a partly broken away front view of one embodiment of apparatus, **10**, of this invention with work chamber door **36** and clarification chamber door **38** open.

It is broken away along section 1A—1B—1C—1D of FIG. **4**.

FIG. **2** is a diagrammatic diametral vertical transverse section through the wash assembly **41** of the apparatus **10**.

FIG. **3** is a diagrammatic longitudinal view of the interior of the apparatus **10** piping and wiring and components.

FIG. **4** is a perspective top and front and side view of the exterior of apparatus **10** with pump chamber door **37** open.

FIG. **5** is a diagrammatic enlarged partly broken away perspective view of portions of the filter **16**, with the zone **5A** and **5C** thereof shown at a greater enlargment than is provided for the adjacent zones **5B** and **5D** of FIG. **5**.

Table I gives dimensions and characteristics of components of one embodiment of the apparatus **10**.

TABLE I

Assembly 12:	
Depth (walls 21–22), inches	24
Height, inches	40
Width (walls 23–24), inches	48
Plate 46 (diameter), inches	14
Door 36, inches	18 x 18
Assembly 16:	
Outside diameter, inches	9½
Inside diameter, inches	7½
Height, inches	1½
Assembly 14:	
Spring 115, Force of closure, lbs	10
Motor 91, H.P	1/100
Pump 42, 3 H.P.:	
Output pressure, p.s.i.g	15
Capacity, H.P	1
Sump 57, Capacity, gallons	40

DESCRIPTION OF THE PREFERRED EMBODIMENT

The apparatus **10** comprises, in operative combination, a housing and frame assembly **12**, a mechanism assembly **14** and a power source **18**. An automobile car filter, **16**, is treated by mechanism **14** and releasably held by part of the mechanism **14** and part of the housing **12**: power source **18** is operatively connected to the mechanism assembly **14**.

The assembly **12** is generally a rectangular box, the walls of which have openings, and closures for said openings and chambers within the box. Assembly **12** comprises a rigid vertical rectangular front flat wall **21**, a rigid vertical rectangular flat rear wall, **22**, parallel to and the same size as the front wall **21**, a rigid vertical rectangular flat exterior left wall **23**, and a rigid vertical exterior rectangular flat right wall **24**, a flat rectangular top wall **25**, and a rigid floor **26**. The walls are firmly joined at their edges to form a hollow firm shell. The interior of the assembly **12** is provided with a left interior vertical wall **27** and a right interior vertical wall **28**; walls **27** and **28** are each fixed to the front wall **21** and the rear wall **22** and provide for definition and separation of chambers lateral thereto and therebetween. A rigid horizontal wall **29** is located between the walls **21** and **22** and is firmly fixed to the interior surfaces of walls **21** and **22** and **24** and to the top of wall **28**.

A wash chamber **31** of assembly **12** is located between and bounded by the walls **29**, **24**, **22** and **21**. A pump chamber **32** of assembly **12** is located below the wall **29** and between walls **21**, **22**, **24** and **28** and is bounded by such walls; this pump chamber has various electrical timing elements and a pump therein. A liquid clarification chamber **33** of assembly **12** is bounded by walls **23**, **22**, **21** and **27**. A rigid flat imperforate wash chamber door, **36**, is located in a matching opening **39** therefor in the top wall **25** and is hingedly affixed by hinges **30** to the rear side of that opening.

A rigid rectangular pump chamber door **37** is hingedly located in a corresponding rectangular hole **34** in the wall **24**. A lock **37A** is provided for this chamber as coin collector **73** is

located therein. A clarification chamber door **38** is hingedly located in a corresponding hole **38A** therefor on the top wall **25** and provides access to and closure for the chamber **33**.

The mechanism assembly **14** comprises a wash assembly **41**, a clarification assembly **51** and a control assembly **71**.

In operation of the apparatus **10** an air filter **16** is located in the wash assembly **41**.

The filter **16** comprises an annular filter wall **121**, an imperforate annular lower ring **123**, an upper imperforate annular ring **125**, an outer perforate expanded metal grid **127** and an inner rigid highly perforated grid **129**. The wall **121** is formed of a very air-permeable porous yet substantially water-repellent water-impermeable paper which permits air to pass therethrough and catches dirt and dust particles mechanically as well as by chemical absorption or adsorption at the outer surface of such material. The wall is formed in a series of similar radially extending vertical denticulated folds as **131, 132, 133, 134, 135, 136, 137, 138** and **139**. Folds **135—139** are shown enlarged in zone FIG. 5B to show details of the treated filter **16**.

Each of folds as **131—139** of the filter wall **121** is firmly fixed at its top and bottom edges to the top and bottom annular rings **125** and **123** respectively. The surface of walls **127** and **129** are about 90 percent perforations or openings and 10 percent solid support element and are firmly fixed at their top and bottom to rings **125** and **123**; such rings are usually (±2") 7 in. I.D. and 8 in. O.D. Each of the folds as **131, 132, 133, 134** is formed similarly to folds **135—139**. There is, for each of folds **135, 136, 137, 138, 139** a left side element **145, 146, 147, 148** and **149** respectively and a right side element **155, 156, 157, 158,** and **159** respectively.

Each of the pairs of fold sides forming a fold as **145** and **146** encompass between them a narrow recess **165** open to the interior of the filter, the similar walls **146** and **156** bound an interior recess space **166** open on the interior to the cylindrical space within the filter **16**; similarly walls **147** and **157** bound a similar recess space **167**, walls **148** and **158** bound interior recess space **168** and walls **149** and **159** bound an interior recess space **169**. Each of interior recess spaces **165, 166, 167, 168** and **169** are similar and are vertically elongated and have substantially the same shape and size from the top to the bottom; at the top, ring **125** bounds each recess space: at the bottom, ring **123** bounds each recess space. Space **165** is separated from the exterior of the filter by the walls **145** and **155**: space **166** is cut off from the space exterior to filter **16** by the walls **146** and **156** and correspondingly for spaces **167, 168** and **169**. Each of the spaces **165, 166, 167** and **168** is quite thin, being about ⅛" (±1/32") wide and extending radially the full radial width of the annular portion of the ring of the filter, which is about 1 to 2 inches long, measured radially.

Between interior recess spaces **165** and **166** is located an exterior recess space **175** open to the exterior of the filter; between interior recess spaced **166** and **167** is located an exterior recess space **176** open to the exterior of the filter; between interior recess spaces **167** and **168** is located an exterior recess space **177** open to the exterior of the filter; between interior recess spaces **168** and **169** is located an exterior recess space **178** open to the exterior of the filter. Each of the spaces **175, 176, 177** and **178** is, in actual operation of the apparatus about ⅛" wide, about 1½" to 2" high and about 1" to 2" deep and in the usual operation of used automotive air filters, filthy on its inside, as shown by accumulations **181, 182,** and **183** (on outer surfaces of walls **155** and **146**) in **175**; **186, 184, 185**, in **176**; **187, 188, 189**, in **177**; and **190, 191, 192**, in **178**; to such an extent that even a bright light is not visible therethrough.

Assembly **41** comprises a top plate locator assembly **110** and a rotatable filter support and wash assembly **150** and a rotatable filter drive assembly **152**, cooperatively combined.

The rotatable filter support and wash assembly **150** comprises line **43**, plate **45**, pulley **90**, wash lines as **81, 82, 83,** and **84**, and nozzles as **141, 142, 143,** and **144**, in operative combination.

The assembly **150** comprises a centrifugal pump **42** with a rigid vertical outlet line **43**. The outlet line **43** feeds into hole **44** in the center of a rotatable circular rigid flat-topped imperforate (except for the hole) rotatable filter base **45** which serves to rotatably support the bottom of an annular air filter as **16**. The top edge of the filter **16** is covered by and supports a circular axially rotatable rigid flat bottomed imperforate filter cover plate **46**. A drain board **47** with a smooth flat top surface is continuous with and extends from the left hand (as shown in FIG. 3) side of panel **29** to over the top of wall **27** and extends into the top upper portion of clarification chamber **33**. Assembly **150** also comprises plate **45** and nozzles **141—144**.

The upper end of the line **43** is a rigid pipe; it is firmly located by a bracket **88** therefor which bracket in turn is firmly supported by the horizontal panel **29**. The pipe **43** continues upward into a cylindrical bearing **100**. The bearing **100** is formed of an outer cylindrical sleeve and race **101** and an inner cylindrical sleeve and race **102**, sleeves **101** and **102** are coaxial with each other and with the center of the line **43**. Conventional roller bearings **103** are located between the sleeves and races **101** and **102**, a water-tight annular cover plate **104** extends over the top of elements **101, 102** and **103**.

Line **43** from the pump **42** is provided with several lateral branch lines as **81, 82, 83** and **84**; each branch line **81, 82, 83** and **84** has a nozzle **141, 142, 143,** and **144** respectively at its discharge end. Each of these nozzles is located in chamber **31** in a position in a flat horizontal circle coaxially disposed about the center of plate **45** at equal heights radially of plate **45** and equispaced 90° apart from each other. Each nozzle is directed horizontally and centrally toward the upward projection of the central vertical axis of line **43** with which axis the central longitudinal axis of the annular filter **16** is also coaxial when located between plates **46** and **45**.

Each nozzle as **141**, is arranged so that its spray is about ⅛" to ¼" wide (i.e. about the same as the horizontally measured width of the recess which it usually treats) and 2" high. The filter drive assembly **152** comprises motor **91**, its switch control **72**, and pulleys **93, 94, 95** and **90** and their belts. Electrical drive motor **91** is firmly located on a bracket which is firmly fixed to rear wall **22**. A horizontal rotatable pulley **93** is supported by and attached to the vertical drive shaft 92 of the motor **91** and drives a rotatable horizontal pulley **94** rotatably supported on a bracket **98**, which bracket **98** is firmly supported on the walls **21** and **22**. The horizontal rotatable pulley **94** is connected by a vertical shaft **96** to a horizontally disposed rotatable pulley **95** the top of which is at the level of the bottom of the plate **45**. A lower plate pulley **90** is firmly fixed to the bottom of the plate **45** and to bearing **100**. Pulley **90**, the bottom plate **45**, bearing **100** and plate **46** are coaxial. A standard V-belt **97**, functionally and operatively connects the pulley wheel **95** with the pulley wheel **90**; thereby the motor **91** serves to drive, at a steady rate of about 18 rpm. the plate **45** through the train of pulleys **93, 94** and **95**. The pulley **95** is located roughly halfway between the walls **21** and **22** and between the openings **39** and **38A**.

A pump inlet liquid line **62** is operatively connected to the inlet of pump **42**. The pump **42** is operatively connected to the pump motor **63** and driven thereby. The pump motor **63** is operatively connected to a switch **77** therefor and through that switch to power source **18** via coin collector switch **72**.

A fan **65** and its motor **64** are preferably located in electrical chamber **35** of assembly **12**. The motor is firmly fixed to and supported by brackets **68**; each such bracket is fixed to the walls **21** and **22**. An electrical air heater coil **66** is located in a cylindrical heating chamber **69** which has imperforate side walls, an open bottom with sides that act as a skirt for the fan and extends radially thereof, and an upper outlet duct **67** which operatively connects to the line **43** through valve **79A**.

Placement of coins in a standard slot machine coin collector **70** and actuation of the collector actuate switch **72** of a sequence control assembly **71**. Switch **72** is operatively connected to power source **18**. The coins collected go into the

coin collector box 73; collection box 73 is located in chamber 32 and reached through hole 37; the switch 72 is thus actuated by placement of a coin in the coin collector 70. The switch 72 also includes a timer assembly. The timer assembly is operatively connected to an air control relay switch 78 which is operatively attached to a relay 79 (powered by line 18) which controls the valve 79A in the heater line 67 and opens it when the switch 78 is actuated; switch 78 also operates as a relay to then actuate the fan motor 64, which motor actuates the air fan 65 to draw up air through holes 89 in the bottom floor and force it through the duct 67 and line 43.

The clarification assembly 51 comprises a vertically spaced series of laterally overlapping lipped clarification plates 52, 53, 54, 55 and 56 each with a smooth imperforate flat top surface; each such plate has three fixed edges and a free edge; one front edge is fixed to wall 22, the other rear edge is fixed to wall 21; one side edge is fixed to wall 23 or to wall 27 and the free edge, as right hand free edge 50 of plate 52, extends between walls 21 and 22 and is located between walls 23 and 27. The right hand edge of plate 52 extends through the left hand free edge of plate 53, the free left hand edge of plate 53 extends to left of the right hand free edge of plate 54; the left hand free edge of plate 55 extends to the right of the right hand free edge of plate 54 and to the right of the right hand free edge of plate 56. A sump 57 is located below plates 52—56 and walls 23, 27, and walls 24 and 26. A heater coil 58 and a thermostat sensor 59 are located therein and are supported on wall 27. The thermostat sensor is operatively connected to the thermostat control 60. The control 60 is operatively connected to a standard electrical relay 61 and relay 61 is connected to the power source 18 and to the coil 58.

A flexible water tight seal 99 surrounds the shaft 96 and is securely connected with the top of plate 47, it permits that the plate 47 may move upward and downward about the pin 107 provided in the right end thereof which permits the left end of plate 47 to pivot up and down depending upon the weight of water thereon and actuate a valve 62A in line 62 to decrease flow therethrough as weight of liquid on plate 47 increases. Shaft 96 moves in a slot elongated from left to right as shown in FIG. 4 in the otherwise imperforate plate 47 so that the geometrical relationships between the pulley 93, 94, 95 and 90 remain unchanged notwithstanding movement up and down of the left end 109 of the plate 47. Top plate locator assembly 110 comprises axially rotatable rigid flat bottomed imperforate cover plate 46, a rigid horizontal bar handle 111, a shaft 112, a sleeve 113 for the shaft 112, a spring 115, a spring base 116, a brace 117 with a foot 119 and brace upright 118. The shaft 112 is a rigid cylindrical shaft, the handle 111 is a rigid bar and is firmly attached at the center thereof to the top of the shaft 112 and forms a T shape therewith. The sleeve 113 is firmly located in cover 36 by a bracket plate 113A. The interior of the sleeve 113 has a smooth sliding fit around the shaft 112. A helical compression spring 115 is wound around the shaft 112 and extends from the base 116 to the bottom of the cover 36. A base 116 is fixed to top of plate 46 and to bottom of shaft 112; it forms a seat for the spring 115 and provides for continuous and even compression of the spring 115 between the top of the rotating plate 46 and the bottom of the plate 36. A rigid L-shaped arm 218 extends horizontally from top of portion 118. Base 119 is rigidly and firmly fixed to the top of cover 36. The top of the arm 218 is concave upward and the shaft 112 is located a lesser distance from end of arm 218 than the distance from the center of the shaft 112 to one end, as 114, of the handle 111. Accordingly, as shown in FIGS. 1 and 4, in the stage of operation where the cover 36 is raised, one end, as 114, of the handle 111 stably rests in a concave recess in 218 atop of upright 118. This location of the handle 111 is effected by compressing the spring 115 by drawing the handle 111 away from the base 36; this raises the plate 46 from any filter as 16 in chamber 31 and moves the plate 46 close to the cover 36. This structure also permits the cover 36 with plate 46 supported thereon to be closed without any contact between the plate 46 and the filter element 16 in chamber 31 until after the cover 36 is in position with the longitudinal axis of shaft 112 coaxial with annular filter 16 and latch 40 closed as in FIG. 3. Handle 111 may be then released from its support by the upright 118 and the plate 46 be then, by the force of the spring 115, brought into a firm yet yieldable contact with the upper edge of the filter 16, as shown in FIG. 2.

In operation of the apparatus 10 liquid 19 from sump 57 moves upwards from the line 43 into the chamber 199 formed by the filter wall 121, annular support rings 123 and 125 the top surface of wall 45 and the bottom surface of wall 46.

The liquid 19, which is under pressure and passes the pump 42 and through the hole 44 in the plate 45 is restrained from escape past the edges of rings 123 and 125 and through wall 121 of the filter 116. The downward pressure of the plate 46 on filter 16 is provided by the compressive force of the spring 115. The compression of the spring effects a force between the cover 36 in the plate 46 of about 10 lbs. the result of this is that, with a 7 in. inside diameter of filter 16 there are about 38.6 square inches of water under the plate 46. This amounts to only about ¼ of a pound per square inch gauge pressure against the flow of the water from the line 43 to raise the plate 46; nevertheless this small resistance to flow plus the rate of flow into chamber 199 does provide that the water entering through the hole 44 fills all portions of the space 199 including the interior recess spaces as 166, 167, 168 and 169 of filter 16.

In the normal operation of the apparatus the plates 45 and 46 and handle 111 rotate at a steady 18 rpm; accordingly all of the lateral projections of the filter 16, such as the junctions of wall 146 and 156 and the junctions of wall 147 and 157 and the junction of walls 148 and 158 move at a steady velocity past the nozzles 141, 142, 143 and 144 of which 141 is shown in the diagrammatic enlarged view (Not to scale) in the enlarged portion 5B of FIG. 5. As shown in FIG. 5 the left edge 195 of the spray of water which first contacts the filter wall 121 strikes one wall such as 156; it clears away from the surface 186 some of the debris corresponding to 181 in the space 175. As the filter surface 121 moves in the clockwise direction shown by the arrow 194 in FIG. 5 the water spray is then able to strike the debris accumulated at the bottom or inner portion of the same exterior recess space 176; this action is shown for the striking of accumulation 188 in the cavity 177; as the water which reaches portion 188 passes along the outer portion of the surface 157 it provides several vortices in the region 188 and such vortices clean out some of the dirt there remaining; there is however a cutting jet action and not a direct compression against accumulations as 189 on surface 148. As the filter moves to the next position, (from the position shown as 177 in FIG. 5 to the position shown for cavity 178 in FIG. 5,) the right hand portion 197 of the spray 196 contacts the remaining accumulation of dirt 192 on the outer portion of the wall 149 and the force of the spray is then also obliquely applied to 192 and 149 at that time and position. The full force of the liquid pressure in each nozzle as 141 is confined to a band only a total ⅛'' wide and perhaps 2'' high; each such stream strikes the surface of wall 121 as above described with considerable scrubbing force, the stream of water from each nozzle as 141 impinges upon the outer surfaces of wall 121 and the debris located there with the full force of the velocity resulting from the immediate relief of the pressure in the nozzle, with the transformation of that pressure energy (about 15 lbs. per square inch gauge) against the portions as 155, 146, 156, 147, 157, 148, 158, 149 and 159 of the wall 121 of the filter. While such walls are constructed to let air pass rapidly therethrough for the efficient operation of an internal combustion engine to which that filter is attached, the water in chamber 199, being a freely flowing fluid, contacts and supports all the interior surfaces of interior recess chambers as 165, 166, 167, 168 and 169 and all the like surfaces notwithstanding that these recess chambers are thin and elongated, thus the force of each jet as 141 is largely met by the mechanical support of the portion of the thin wall 121 provided by the liquid 19 in the chamber 199 and the recesses continuous therewith and the pressure thereof due to the

restriction to free flow out of chamber **31** provided by spring **115** and plates **45** and **46** in rings **123** and **125**. Liquid **19** provides thereby a strong scrubbing action on the portion of the wall of the recess as **177** and the dirt accumulations there located without damage to the wall **121** for a period of 3 minutes.

The detergent used in liquid **19** is "Tide" (registered trademark of Proctor & Gamble) the composition thereof is, generally, an anionic synthetic detergent and, more particularly, a mixture of water-soluble salts of sulfuric acid reaction products of alkyl and substituted alkyl compounds, containing 8 to 18 carbon atoms in the alkyl group characterized by their high solubility in water, described in U.S. Pat. Nos. 2,712,529; 2,618,608 and 2,396,278. It is used in liquid **19** in the amount of ½ cup per 30 gallons of water; weight of ½ cup = 1.5 ozs. = 45 grams ±5 percent.

The temperature of the water in sump **57** is kept at about 60–70° F., in cold outdoor weather (with apparatus 10 located out of doors warming of liquid **19** is required). This amount and type and temperature of detergent is, because the detergent is intended for use in hot water of at least 120°F., and at usual concentration of ½ cup per 15 gallons of water, of limited detergent power; it produces for example substantially no suds or foam. However, it does serve, as a jet, to dislodge dirt and debris from exterior recess spaces as **175, 176, 177, 178** and keeps such debris of filter **16** suspended in the turbulent liquid as at **188** and serves to carry such debris to the clarification chamber **33**. However, the dirt suspending power of such liquid is limited and, as the suspension of debris and liquid reaches sump **57** the debris settles out and the liquid is returned via pump **42** to chamber **31**. Periodically the large sump discharge valve **200** at the bottom of sump chamber **57** may be opened to discharge debris therefrom, and additional water added to chamber **33** via opening **38A**.

In operation of the apparatus **10** the to-be-treated filter as **16** is placed in chamber **31** with the door **36** open to locate filter **16** therein with the central longitudinal axis of the filter **16** coaxial with the vertical axis of pipe **43** and the axes of rotation of plate **45**, and plate **46** and shaft **112**.

The location of orifice **44** allows this to be done with adequate accuracy by visual observation in the standard apparatus described hereinabove and in Table I. The door **36** is then closed. A releasable spring latch **40** in wall **25** near edge of opening **39** engages the free edge of door **36** and holds it in position as shown in FIG. **3**; the handle **111** is then pulled upward from door **36** turned and released from its engagement with the recess in the top of arm **218**, which arm **218** is rigidly attached to portion **118** of brace **117**. The spring **115** then urges the bottom of plate **46** into contact with the top of the filter **16**; the shaft **112** then being coaxial with the longitudinal axis of plate **46**; line **18** is operatively connected to a source of nominal 110 volt alternating current (usually 115—120v). A coin is then placed into collector **70**, and the coin collector activated by being pushed inward; the coin is collected and switch **72** activates pump motor **63** and plate drive motor **91** as above described. The liquid **19** from sump **57** is driven vigorously against the outer surface of the filter **16** and at an angle to those surfaces from the several nozzles, as **141, 142, 143** and **144** while the liquid within chamber **19** helps support the filter element walls against the action of such jets. The washing action of the liquid **19**, at an angle to the surfaces on which the accumulations of dirt had grown, serves to dislodge the accumulations without harm to the filter wall. This action is continued automatically for three minutes, then the timer in assembly **71** cuts off the connection of power to motors **63** and **41**. The rotation of plates **45** and **46** at about 18 r.p.m. and the action of two to four jets as **141** and **142** on each portion of the filter wall **121** most adjacent to each such jet serves to effect a removal of debris from the exterior surface of wall **121** of filter **16**; also, there is some slight washing action of liquid **19** to remove some small amount of accumulation from the pores of wall **121**. However, the greatest amount of accumulation of clogging debris is removed from the outer surface of the filter rather than from the interior volume thereof.

Upon completion of the washing action in apparatus **10** at above 40°F. ambient air temperature the latch **40** is released and the filter **16** removed from chamber **31**. Most of the water in the chamber **199** and on the peripheral surface of wall **121** drains away long wall **29** to chamber **33**. The thus washed filter is then replaced on the automobile from which it came; operation of the engine of that automobile with the filter in its normal position for operation of the automobile therewith draws air through the filter wall and, as the engine operates and draws air through filter **16**, water adherent to or carried by the filter **16** is evaporated and otherwise drawn away therefrom leaving a washed and dried air filter. The above description of operation applies where the temperature of the air is above 40°F.

When the ambient air in the neighborhood of apparatus **10** is colder than 40°F., the heater **66** and fan **65** are placed into operation by switch **78** after the pump motor **63** and drive motor **91** are disconnected from power source **18**. The fan **65** and heater coil **66** operate for two minutes to dry out the filter and avoid "icing" of the engine.

The usual geometry of location of the jets as **141—144**, at a distance from the axis of conduit line **43** that is greater than the radius of plates **45** and **46** (about 7 in. in the particular embodiment **10**) and the size of the usual filter (about 5 inches maximum outside radius) and the number and spacing of folds or denticulations in the filter wall **121** (about ⅛ in. to ½ in. width between walls as **155** and **146**), provides that each of the liquid jets, as that shown issuing from nozzle **141**, strikes the wall **121** of the filter as **16** at angle from 0° to about a maximum of 15° for its full height (usually 1½ to 2 inches).

An annular wear plate **116A** is provided between the top of spring **115** and bottom of door **36** to minimize effect of wear on door **36** of rotation of plate **46**, against which (plate **46**) spring **115** bears and which rotates together with filter **16** and the plate **45** during the operation of apparatus **10**.

The Tide composition used, above briefly described, also contain sequestering agents, as calcium sequestering phosphates which serve to prevent deposits of salts from hard water, used for liquid **19**, from depositing on the surface of the filter wall **121** and remaining there after the cleansing treatment thereof as above described and also to break up and remove such similar salts that may develop on the filter wall **121**.

By calcium sequestering phosphates is meant water-soluble salts of phosphoric acids which are poorer in water of constitution than orthophosphoric acid, such as tetrasodium pyrophosphate, pentasodium triphosphate (sometimes referred to as tripolyphosphate), "hexasodium tetraphosphate," and "hexasodium hexametaphosphate," as well as the various corresponding acid salts, such as disodium dihydrogen pyrophosphate, or the products of adding small amounts of free acid to the completely neutralized salts. These salts are deemed capable of repressing calcium ions in aqueous solutions: "hexasodium tetraphosphate" and "hexasodium hexametaphosphate" are placed in quotation marks to indicate that the salts so designated may be mixtures rather than the pure chemical compounds. The "tetraphosphate" is that compound or mixture which is described in U.S. Pat. 2,031,827 and the "hexametaphosphate" is the glassy variety sometimes called Graham's salt which is described in U.S. Pat. 1,956,515.

The material (Tide) also contains, as brought out in U.S. Pat. 2,712,529, a corrosion inhibitor some 4 percent to 25 percent (by dry weight of the detergent) of solubilized silicate solids such as sodium silicate having a SiO_2/Na_2O ratio of 1.8 to 2.6 to protect the interior parts of the pump and other parts of assembly **10** and also to avoid corrosion of the metal parts of a filter as **16**.

The dimensions of filter **16** are only those of an exemplary filter, as the size thereof varies from one user of apparatus **10** to the next.

Drain board **47** is a rigid imperforate water-proof board, it extends from a water-tight contact with the left edge of wall **29** downward and (as shown on FIGS. **1** and **3**) leftward. It is pro-

vided with a flexible seal **47A** that joins the rear edge of plate **47** in water-tight fashion to wall **22** and a similar seal **47B** that joins the front edge in water-tight fashion to wall **21**. Board **47** is, in the preferred embodiment, of apparatus **10**, pivotally supported at its right end on a rigid pin or rod **107**. Rod **107** extends from wall **21** to wall **22** and is supported thereon. A rigid Z-shaped bracket **108** is firmly fixed to wall **27**. An ear **206** is firmly fixed to the bottom of board **47**. A rigid rod **204**, threaded at its upper end, is pivotally fixed to the ear **206**. Rod **204** is operatively connected to and operates adjustable valve **62A** in line **62**. Rod **204** passes through a hole in control arm **212**. The rod **204** operates the adjustable valve **62A** in line **62** to close it on downward motion of the rod **204**. This occurs when edge **109** of plate **47** moves too far down. The lower portion of rod **204** is slidably supported in a bracket **208** that is supported in its front and rear in walls **21** and **22**. A rigid pivot support rod **210** extends from wall **21** to wall **22** and is supported thereon. A light rigid control arm **212** is pivotally supported on rod **210** at its right end (as shown in FIG. **3**) and on calibration spring **106** on its left end. Control arm **212** has some substantial width, about 2", and has a hole vertically therethrough, through which the rod **204** passes. Spring **106** is slidably located in a light rigid support sleeve **209**.

The height of the sleeve **109** is adjustably located on threads provided on the Z-shaped bracket **108**. A lock nut **211** is attached to the upper, threaded portion of rod **204** and that nut is supported on arm **212** above the hole in the arm **212** and thereby adjusts and holds the height of the plate **47** relative to the arm **212**.

Accordingly, on unduly heavy flow of water over plate **47** the inlet valve **62A** to pump **42** is choked and the rate of flow to chamber **199** from pump **42** is reduced; the pressure on nozzles **141—144** is concurrently reduced. The sleeve **209** and nut **211** are adjustable to provide for such degree of compression as is desired in the spring **106** for any desired rate of flow through the valve **62A**.

It is also within the scope of this invention that board **47** be firmly fixed in a downward and leftward sloping position; then adjustment control valve **62A** may be removed and a standard plug valve be used in its place. The bottom of line **62** extends downward into sump **47** and has its inlet a foot from the bottom thereof. In this position the liquid that is drawn off by line **62** is free of sediment that collects at the bottom of the sump **57** and is also free of the matter that collects at the top of the liquor in the liquid reservoir or sump **57** within the housing and frame assembly **12**.

Although, in accordance with the provisions of the patent statutes, particular presently preferred and exemplary embodiments of this invention have been described in the best mode in which it is now contemplated applying such principles, it will be understood that the operations and constructions shown and described are illustrative and that my invention is not limited thereto.

I claim:

1. Apparatus for cleansing filters comprising:

in operative combination, a housing and frame assembly, a mechanism assembly and a power source;

a. the housing and frame assembly comprising an enclosure with a roof thereon, an opening in said roof above and to a wash chamber therein, a door pivotally located in said opening above said wash chamber, and a liquid reservoir means located within said enclosure, the housing and frame assembly supporting the mechanism assembly therein; and

b. said mechanism assembly comprising a wash assembly, a liquid clarification assembly and a control assembly, said wash assembly comprising a rotatable top plate locator assembly and a rotatable filter support and wash assembly;

the rotatable top plate locator assembly comprising a shaft, a sleeve, and a filter cover plate, the shaft rotatably located in said door in said roof and frame assembly, the filter cover plate attached to and located rotatably at the bottom of the shaft and rotatable about an axis, and means operatively attached to said plate urging said shaft and plate to extend away from said door, a bracket on said housing and frame assembly, an arm on said shaft engaging said bracket and opposing said means for extending said shaft and plate;

said rotatable filter support and wash assembly comprising a rotatable filter support plate within said wash chamber and rotatable about an axis coaxial with said axis of said filter cover plate, a plate liquid inlet means extending through said filter support plate, said filter plate and said cover plate being imperforate except for said plate liquid inlet means, a liquid pump means with a discharge outlet thereof connected to said plate liquid inlet means, a pump liquid inlet means to said pump means, said pump liquid inlet means connected to said liquid reservoir means, a motor operatively connected to said pump means, a nozzle located in said enclosure peripherally to and above said filter support plate and below said filter cover plate, the outlet of said nozzle directed toward the axis of rotation of said filter support plate, the outlet of said pump being connected to the inlet of said nozzle;

a clarification assembly comprising a baffled liquid clarification chamber located between said nozzle and said liquid reservoir means; and

power control means supported on said frame housing and frame assembly and operatively connected to said motor connected to said pump means.

2. Apparatus as in claim **1** wherein:

a. said rotatable filter support and wash assembly comprises also a rotatable filter drive assembly, said rotatable filter drive means comprising, in operative connection, a filter drive motor means, an energy source operatively connected and attached to said motor means, a switch means controlling said motor means, and means operatively connecting said motor and said rotatable filter support plate and wherein

b. a plurality of like nozzles are located peripherally of said filter support plate within said wash chamber, the outlet of each of which nozzles is directed toward the axis of rotation of said plate and the inlet of each of which said nozzles is connected to the outlet of said pump.

3. Apparatus as in claim **2** wherein said power control means on said housing and frame assembly comprises, in operative connection, a coin collector assembly and a timer and a switch assembly, said coin collector assembly controlling said timer and switch assembly, said switch assembly controlling said motors for said pump and controlled by said timer.