United States Patent

[11] 3,608,567

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Continuation-in-part of application Ser. No. 727,594, May 8, 1968, now Patent No. 3,526,237.

[54] FILTER CLEANING PROCESS AND APPARATUSES

3 Claims, 12 Drawing Figs.

[52] U.S. Cl. 134/58, 134/10, 134/33, 134/99, 134/109, 134/138, 134/141, 134/152

[51] Int. Cl. B08b 3/02, B03b 11/00

[50] Field of Search 134/10, 33, 34, 58, 99, 102, 109, 138, 140, 141, 143, 152, 153; 210/167

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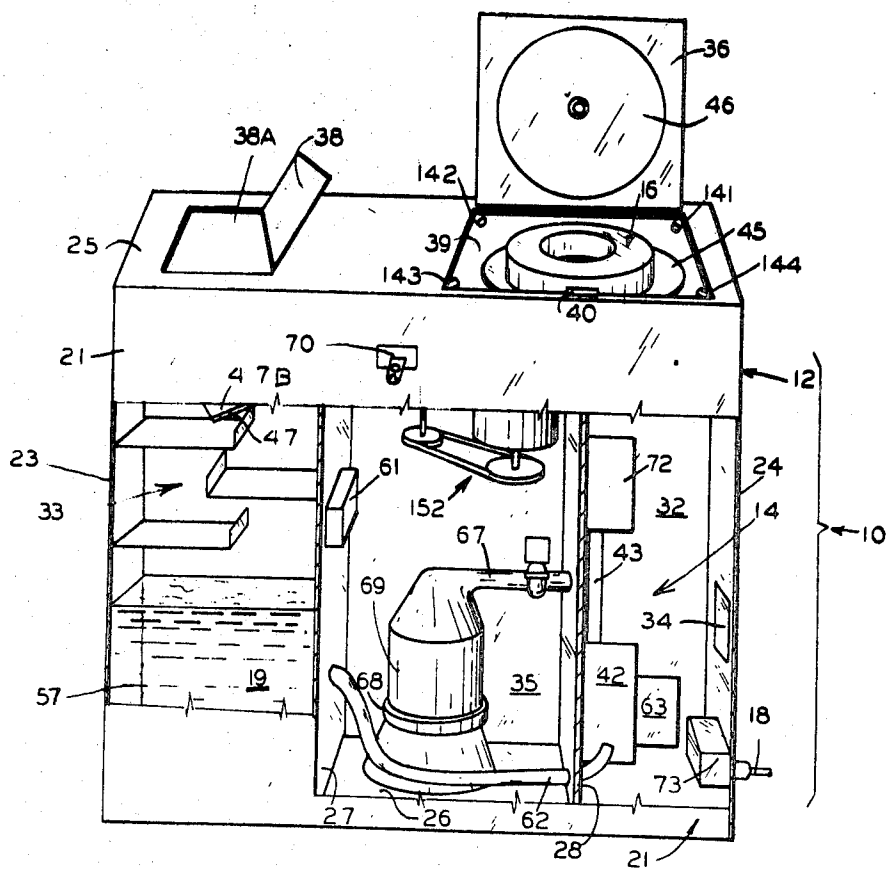
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ABSTRACT: A process organized to successively apply a jet of cleansing liquid to the exterior surface of each successive portion of a complex-shaped thin-walled dirty-air-permeable air filter while the interior surface of that thin-walled portion is concurrently supported from collapse by the mechanical action of said jet.



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SHEET 1 OF 6

FIG. 1

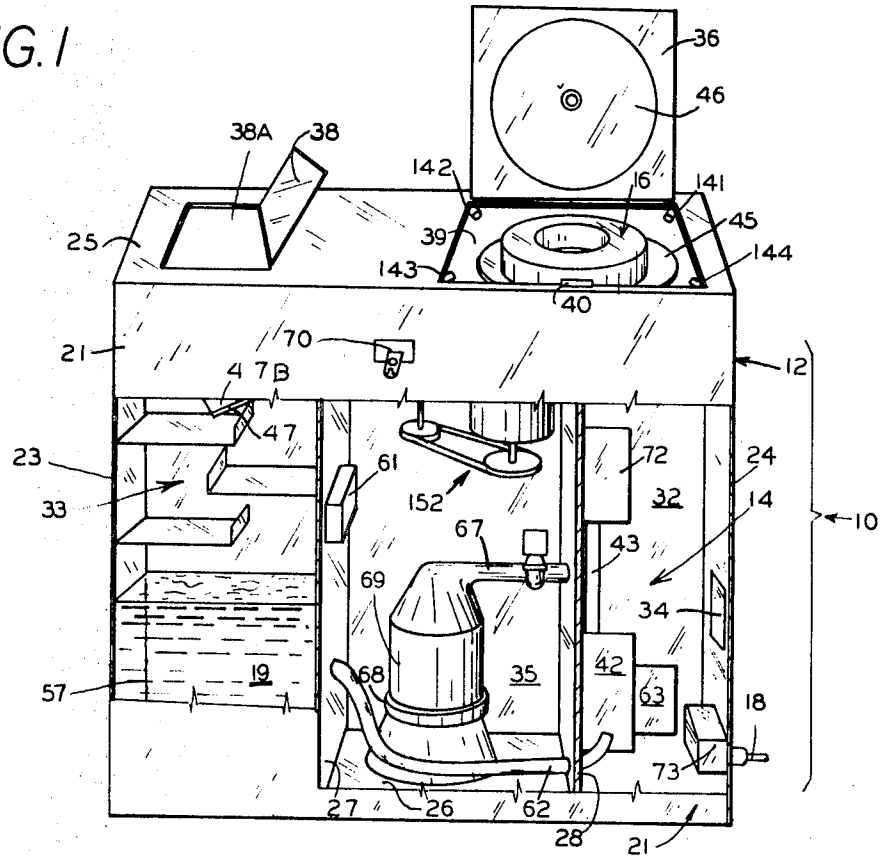
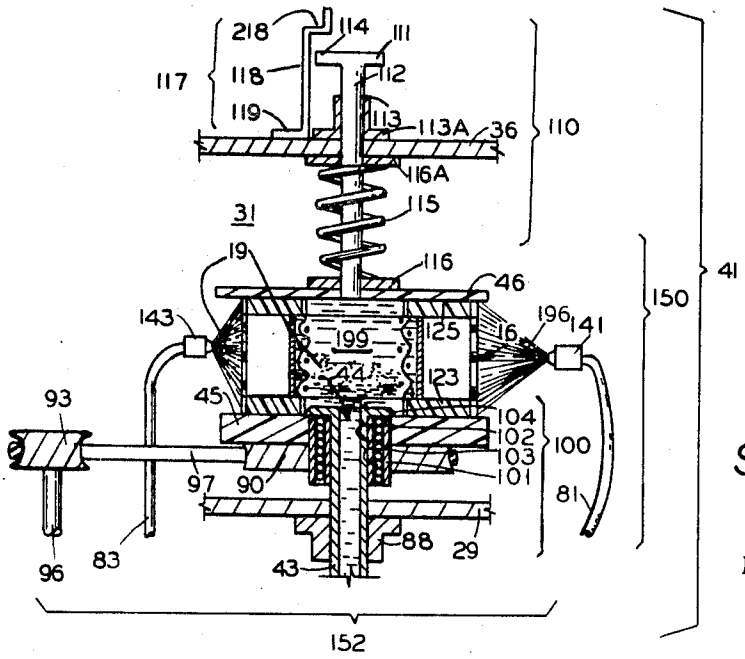


FIG. 2

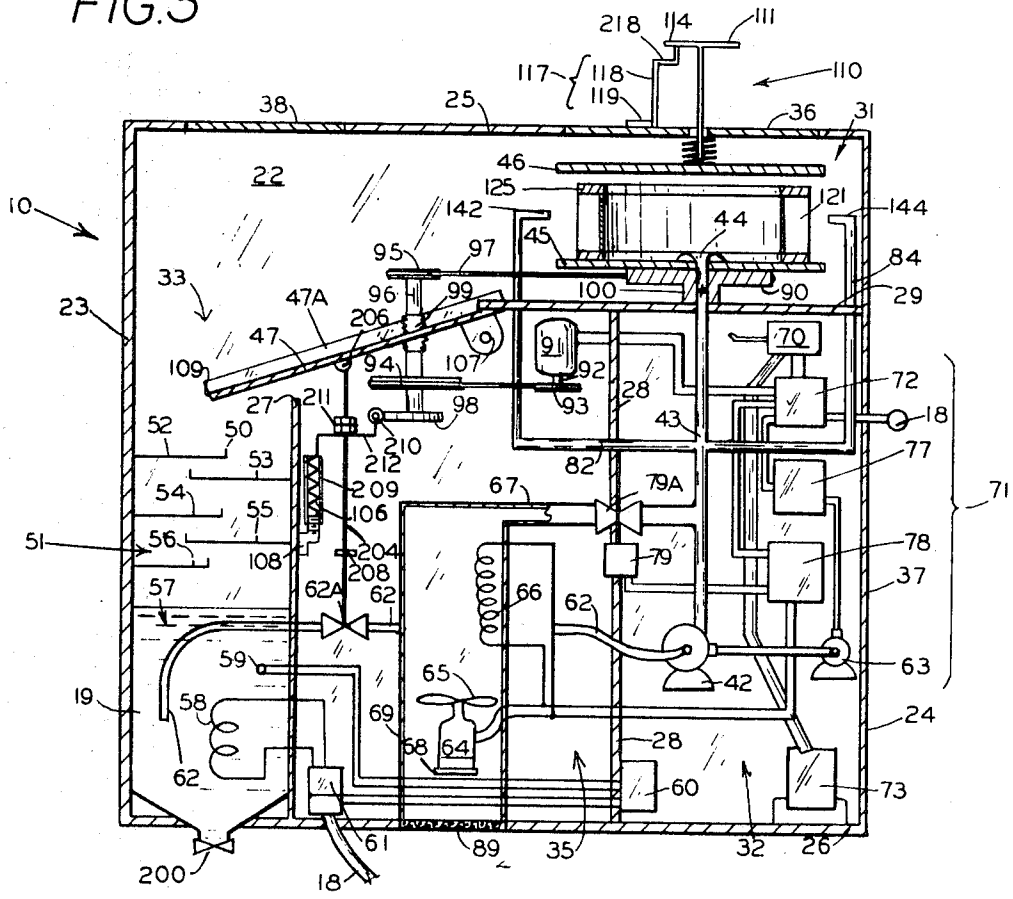


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FIG. 3



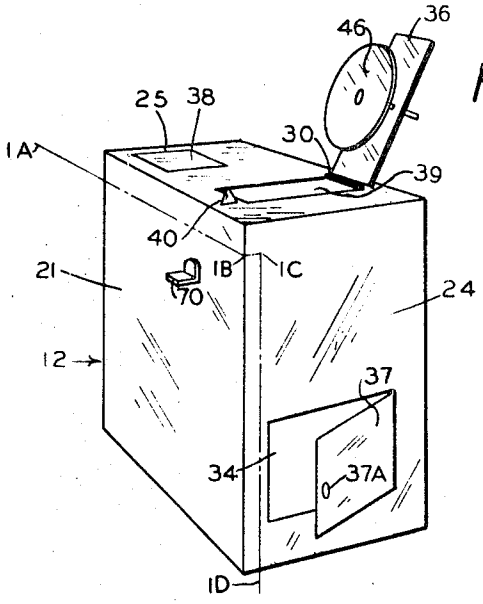


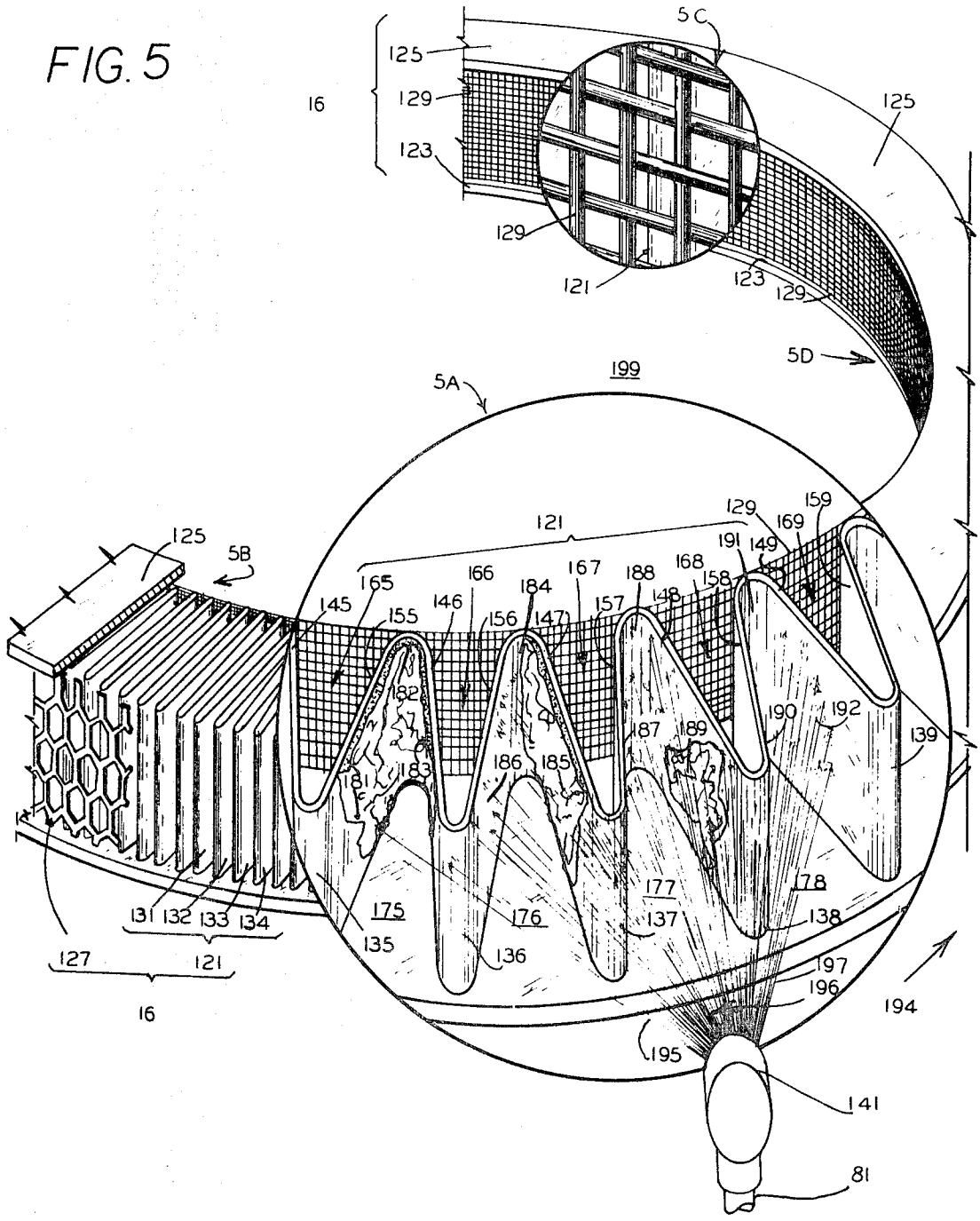
FIG. 4

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FIG. 5



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FIG. 6

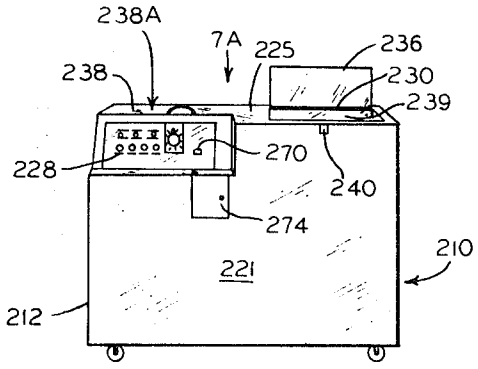
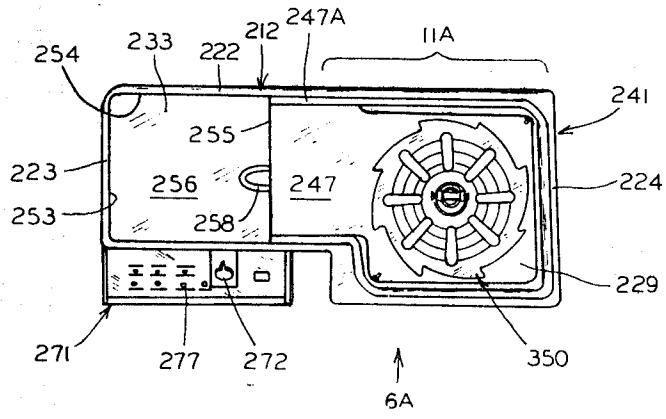


FIG. 7



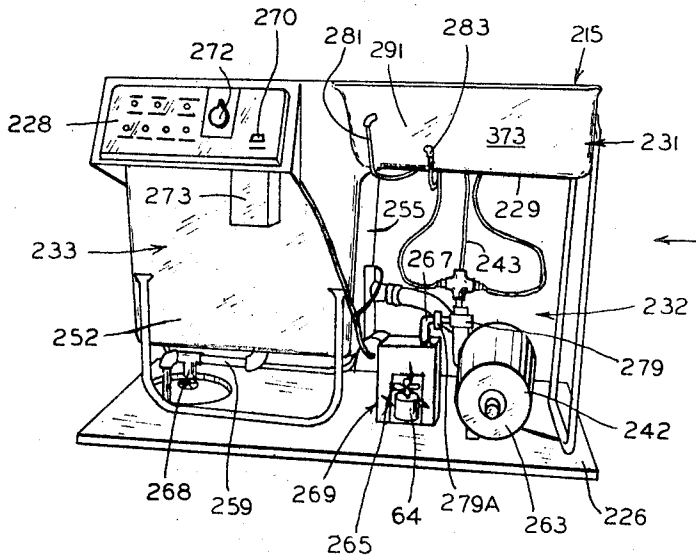


FIG. 8

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FIG. 9

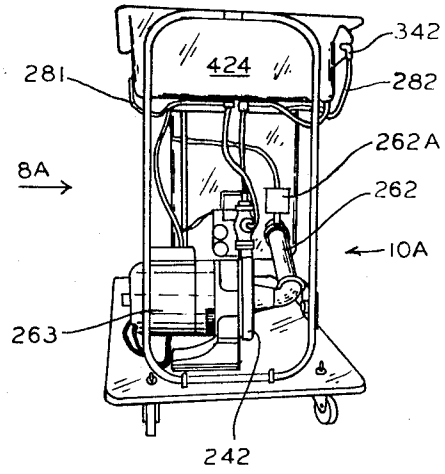
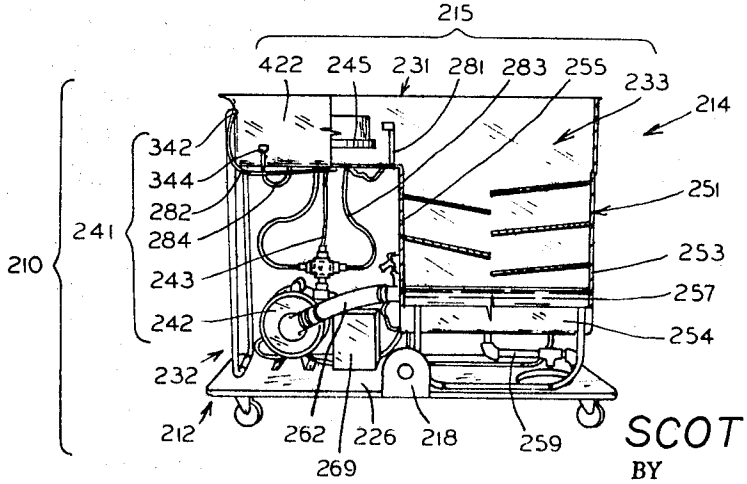


FIG. 10



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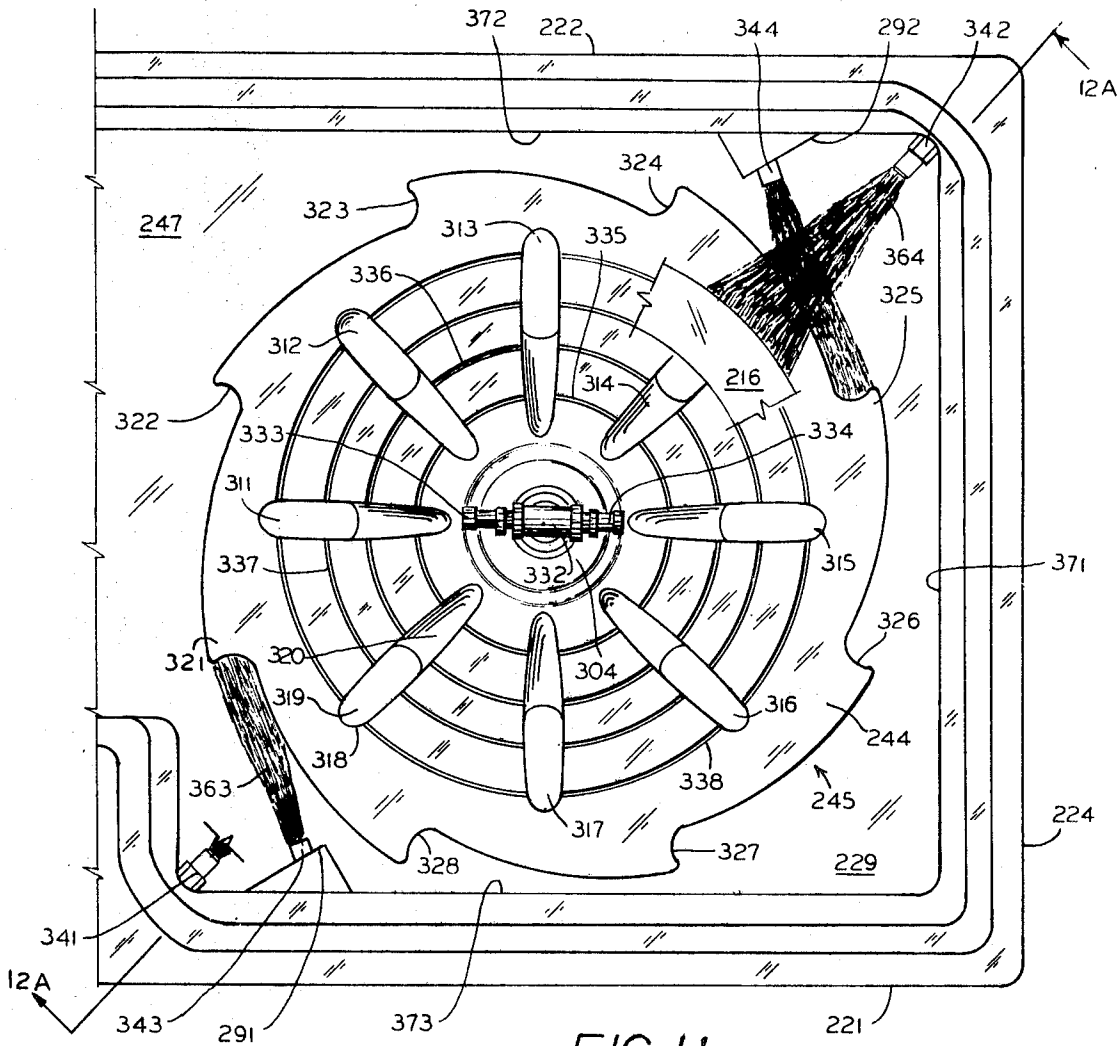


FIG. 11

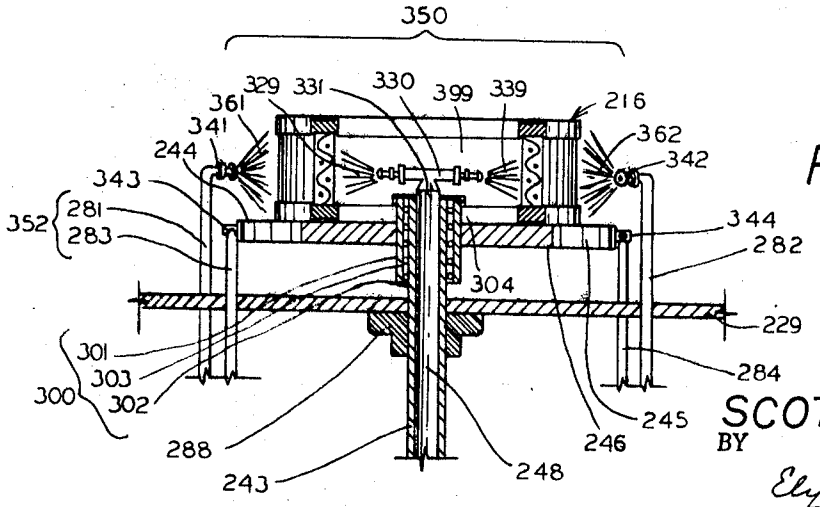


FIG. 12

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FILTER CLEANING PROCESS AND APPARATUSES

CROSS REFERENCE TO RELATED APPLICATION

This is a continuation in part of my copending patent application Ser. No. 727,594 filed May 8, 1968, now U.S. Pat. No. 3,526,237, dated Sept. 1, 1970.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The field of this invention is the application of liquid cleansing material to an implement having cavities and work-handling apparatus and process 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 1 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 3 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 reused; this provides that no separate continuous water addition facility and continuous dirty water drain is required. The apparatus are 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, the apparatuses 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 improved apparatuses 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 form 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 zones **5A** and **5C** thereof shown at a greater enlargement 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**.

FIG. **6** is a top view of another embodiment of apparatus, **210**, according to this invention as seen from the front thereof which direction of view is shown by the direction of arrow **6A** of FIG. **7**.

FIG. **7** is a top view of apparatus **210** as viewed along the direction of the arrow **7A** of FIG. **6**.

FIG. **8** is a front view of the apparatus **210** shown partially disassembled, i.e. with the rear, sidewall and front wall panel **221** thereof removed to show the interior structure thereof.

FIG. **9** is a view of the apparatus shown in FIG. **8** as seen along the direction of the arrow **9A** of FIG. **8**.

FIG. **10** is a view of the apparatus **210** as shown in FIG. **8** and also broken away in part to show details of the interior thereof; this view is taken along the direction of the arrow **10A** of FIG. **9**.

FIG. **11** is an enlarged view of the zone **11A** of FIG. **7** to show the filter support plate **245** and structures in the neighborhood thereof.

FIG. **12** is a diagrammatic vertical sectional view of the portion of apparatus **210** shown in FIG. **10** along section **12A—12A** of FIG. **11**.

FIGS. **6–11** are pictorial and hence to scale.

TABLE I

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

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 jointed 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 absorption 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 inches) 7 inches i.d. and 8 inches 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 one-eighth inch (±one thirty-second inch) 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 spaces 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 on 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 one-eighth inch wide about 1 ½inch to 2 inches high and about 1 inch to 2 inches deep and in the usual operation of used automotive air filters, filthy on its inside, as shown by accumulations 181, 182, 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 late 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 drainboard 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 watertight 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 one-eight inch to one-fourth inch wide (i.e. about the same as the horizontally measured width of the recess which it usually treats) and 2 inches 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 support 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 r.p.m., 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 sidewalls, 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 if 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 past 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** and extends to the left of the right-hand free edge of plate **54** and to the left 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 watertight 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 inches inside diameter of filter **16** there are about 38.6 square inches of water under the plate **46**. This amounts to only about one-fourth 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 normal operation of the apparatus the plates **45** and **46** and handle **111** rotate at a steady 18 r.p.m., 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** and 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 one-eighth inch wide and perhaps 2 inches 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 eight 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 one-half cup per 30 gallons of water; Weight of one-half cup=1.5 ozs.=45 grams±5 percent.

The temperature of the water in sump 57 is kept at about 60–70°*A* 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 one-half cup per 15 gallons of water, of limited detergent power; it produces for example substantially no suds or foams. 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 to 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 115–120 V.). 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 3 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 along 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 2 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 inches 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 one-eighth inches to one-half inch 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 1 ½ 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 removes 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 are 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. No. 2,031,827 and the "hexametaphosphate" is the glassy variety sometimes called Graham's salt which is described in U. S. Pat. No. 1,956,515.

The material (TIDE) also contains, as brought out in U.S. Pat. No. 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.

Drainboard **47** is a rigid imperforate waterproof board, it extends from a watertight contact with the left edge of wall **29** downward and (as shown on FIGS. **1** and **3**) leftward. It is provided with a flexible seal **47A** that joins the rear edge of plate **47** in watertight fashion to wall **22** and s similar seal **47B** that joins the front edge in watertight 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 connect 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 or 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 inches, 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 or 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**.

It is within the scope of this invention that the process thereof hereinabove described be also performed by the apparatus **210** hereinabove described be also performed by the apparatus **210** hereinbelow described and dimensions of which are set out in table II herebelow.

TABLE II

Assembly **212**	Depth—(walls **221–222**)	21"
	Height (ground to **225**)	35½"
	Width—(walls **423–424**)	42"
	Plate **246**—diameter	15"
	Door **236**	18"×18"
Assembly **216**	Outside diameter	9½"
	Inside diameter	7½"
	Height	1½"
Assembly **214**	Pump **42**—3 hp.	
		Output pressure =15 p.s.i.g.
		Capacity
	Sump **57**	Capacity 40 gals.
	Nozzles **341–444** as in U.S. Pat. No. 3,104,829	

The apparatus **210** comprises, in operative combination, a shell assembly **212**, a mechanism assembly **214** and a chamber assembly **215**. An automobile car filter, **216**, is treated by mechanism **214** and releasably located in part of the assembly **215**. A power source **218** is operatively connected to the mechanism assembly **214**. Filter **216** is identical to filter **16** hereinabove described in regard to apparatus **10** process and apparatus.

The housing or shell assembly **212** is generally a rectangular box, the walls of which have openings and closures for the openings and chambers within the box. Assembly **212** comprises a rigid vertical rectangular front flat wall **221**, a rigid vertical rectangular flat rear wall, **222**, parallel to and the same size as the front wall **221** with the control panel **228** included in the front wall area size, a rigid vertical rectangular flat exterior left wall **223**, and a rigid vertical exterior rectangular flat right wall **224**, a flat rectangular top wall **225** and a rigid floor **229**. The walls are firmly jointed at their edges to form a firm shell and definitely attached to floor **226**.

A wash chamber **231** of assembly **215** is located between and in part bounded by the walls **221**, **222**, **224** and **225**. A pump chamber **232** of assembly **215** is located below the floor **229** and between walls **221**, **222**, **224** and **255** and is bounded by such walls; this pump chamber has a pump therein. A liquid clarification chamber **233** of assembly **215** is bounded by walls **252**, **253**, **254**, **255** and **256**. A rigid flat imperforate wash chamber door, **236**, is located in a matching opening **239** therefor in the top wall **225** and is hingedly affixed by hinges **230** at the rear side of that opening. A clarification chamber door **238** is hingedly located in a corresponding hole **238A** therefor on the top wall **225** and provides access to and closure of the chamber **233**.

The mechanism assembly **214** comprises a wash assembly **241**, a clarification assembly **251** and a control assembly **271**.

In operation of the apparatus **210** an air filter **216** is located in the wash chamber **231**.

Wash assembly **241** is located in chambers **231** and **232** and comprises a rotatable filter support and interior wash assembly **350** and a filter support drive and exterior wash assembly **352** and a pump **242**, liquid conduits and nozzles, all cooperatively combined.

Wash chambers **231** comprises end wall **371**, rear wall **372**, front wall **373**, and floor **229** operatively connected to form, with cover plate **236** and the supports for nozzles **341–344** and line **243**, a sturdy watertight chamber open at one side to clarification chamber **233**.

Rotatable filter interior support and wash assembly **350** comprises line **243**, plate **245**, journal **300**, wash lines **281** and **282**, nozzles as **341** and **342** and centrifugal pump **242** with its rigid vertical outlet line **243**. The outlet line **243** feeds into a hole **248** in the center of a rotatable circular rigid flat-topped rotatable filter plate **245** which serves to rotatably support the bottom of an annular air filter as **216** (**216** is the same structure as **16**).

A drainboard **247** with a smooth flat top surface is continuous with and extends from the left-hand (as shown in FIG. 7) edge of floor panel **229** over the top of wall **255** and extends into the top, upper, portion of clarification chamber **233**.

The upper end of the line **243**, which is a rigid pipe conduit firmly attached to the horizontal floor panel **229**. The pipe **243** continues upward into a cylindrical bearing **300**. The bearing **300** is formed of an outer cylindrical sleeve and race **301** and an inner cylindrical sleeve and race **302**, sleeves **301** and **302** are coaxial with each other and with the center of the line **243**. Conventional roller bearings **303** are located between the sleeves and races **301** and **302**; watertight annular cover plate **304** extends over the top of elements **301**, **302** and **303** to surface **244**.

Line **243** from the pump **242** is provided with several branch lines as **281**, **282**, **283** and **284**; each branch line **281**, **282**, **283** and **284** has a nozzle **341**, **342**, **343** and **344** respectively, at its discharge end. Each of the nozzles **341** and **343** is located in chamber **231** with its axis in a flat horizontal plane above surface **244** of plate **245** at equal heights and below top of filter **216** and radially of plate **245** and diametrically opposite (180° apart) from each other. Each nozzle axis is directed horizontally and centrally toward the upward projection of the central vertical axis of line **243** with which axis the central longitudinal axis of the annular filter **216** is also coaxial when located between plate **245** and cover **236**.

Nozzles **341** and **342** are arranged so that their spray is about 2 inches to 4 inches high (i.e. about the same as the vertically measured height of the filter which it usually treats) and 2 inches to 3 inches wide. Drive and wash assembly **352** comprises pump **242** and hydraulic lines **283** and **284** and nozzles **343** and **344**. Nozzle **343** is supported on bracket portion **291** of wall **373**, nozzle **344** is firmly supported on bracket portion **292** of wall **372**. Nozzles **343** and **344** discharge water in form of cones with the longitudinal axes of the cones of discharge liquid in the same flat plane, which plane is halfway between the top surface **244** and bottom surface **246** of plate **245** and coplanar with vanes **321–8**.

A pump inlet liquid line **262** is operatively connected to the inlet of pump **242**. The pump **242** is operatively connected to the pump motor **263** and driven thereby. The pump motor **263** is operatively connected to a switch **277** therefor and through that switch to power source **218** via coin collector switch **272**.

A fan **265**, like **65**, and its motor as **64** may be located in the pump chamber **232** of assembly **212**. Such motor is firmly fixed to and supported by floor **226**. An electrical air heater coil as **66** is located in a heating chamber **269** identical to **69** and which has imperforate sidewalls, an open bottom with sides that act as a skirt for the fan and extends radially thereof, and **267**, an upper outlet duct (as **67**) which operatively connects to the line **243** through valve as **279A** (like **79A**).

Placement of coins in a standard slot machine coin collector **270** and actuation of the collector actuate switch as **272** of a sequence control assembly **271**. Switch **272** is operatively connected to power source **218**. The coins collected go into the coin collector box **273**; collection box **273** is located near chamber **233** and reached through hole **274**, the switch **272** is thus actuated by placement of a coin in the coin collector **270**. The switch **272** also includes a timer assembly. The timer assembly is operatively connected to an air control relay switch as **78** which is operatively attached to a relay as **279** (powered by **218**) which controls a valve **279A** 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 as **64**, which motor actuates the air fan as **65** to draw up air through holes (as **89**) in the bottom floor **226** and force it through the duct **267** and line **243** to interior of filter **216**.

The clarification assembly **251** comprises a front vertical wall **252**, rear vertical wall **254**, outer vertical wall **253**, inner vertical wall **255**, and bottom wall **256**; these walls **252–256** are operatively combined into a watertight chamber **233**. An outlet line **259** at the bottom of the tank provide for its emptying (controlled by a valve **268**) while the pump inlet line **262** is connected to the wall **255** at a sufficiently elevated height to provide a sump **257** which provides an efficient settling zone in chamber **233** below such connection of line **262** to wall **255**. Above **257**, the interior of chamber **232** includes a vertically spaced series of laterally overlapping lipped clarification plates (as **52**, **53**, **54**, **55** and **56** above described) 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 **252**, the other, rear edge is fixed to wall **254**: one side edge is fixed to wall **255** or to wall **253** and the free edge, (as right-hand free edge **50** of plate **52**) extends between walls **252** and **254** and is located between walls **253** and **255**. The right-hand edge (as **50** of plate as **52**) extends over and to the right of the left-hand free edge of plate **53**, the free left-hand edge of plate **53** extends over and to left of the right-hand free edge of plate **54**; and left-hand free edge of plate **55** extends under and to the left of the right-hand free edge of plate **54** and over and to the left of the right-hand free edge of plate **56**. Sump **257** is located below those plates and a heater coil **258** and a thermostat sensor as **59** are located therein and are supported on wall **255**. The thermostat sensor is operatively connected to a standard electrical relay at **61** which is connected to the power source **218** and to the coil **258**.

The plate **245** comprises a rigid flat disc with a horizontal top surface **244**, a horizontal bottom surface **246**, a plurality of narrow radial slots (**311–318**) and radially extending vanes **321–328**; the plate **245** is rotatably supported on bearing **300**. A tee **330** has a vertical portion **331** that is operatively connected to line **243** and a horizontally extending portion **332**; nozzles **333** and **334** are supported on the lateral ends of portion **332**; each of nozzles **333** and **334** has a longitudinally extending axis and forms a spray of generally conical shape with a horizontally extending axis. The axis of nozzle **333** and the axis of nozzle **334** lie in the same straight line, coaxial with portion **332**.

The upper surface **244** of the plate **245** is perforated by a group of equal sized and shaped, radially extending, radially equispaced slots **311–318**. Each the slots, as **318**, has a radial portion as **319** that extends vertically completely through the plate **245** and a central sloped portion **320** that slopes radially and downwardly from surface **244** to surface **246**.

A concentric series of circular grooves **338**, **335**, **336**, **337** facilitate and expedite locating cylindrical filters on the plate **245** coaxial with the pipe **243** and the plate **245**.

The pump motor **263** drives the pump **242** and water from pump **242** via line **243** and tee **330** to form conical jets **329** and **339**: these impinge upon the interior surface of filter **216**. A portion of each jet passes below the bottom filter wall and through the slots **311–318**; a suction action is thereby actuated that holds the filter **216** against the plate **245**.

The water from line **243** also passes to line **281** and nozzle **341** forming jet **361**; to line **282** and nozzle **342** forming jet **362**; to line **283** and nozzle **343** forming jet **363**; and to line **234** and nozzle **344** and forming jet **364**: jets **361** and **362** strike the exterior surface of the filter **216** and act to cleanse it as above described for the jets or sprays **196** and **197**. Jets **363** and **364** strike the vanes as **321–328** and rotate filter **216** on plate **245** about its central vertical axis at a rate of speed sufficiently high to withstand the pressure of the water applied thereto by the exterior jets **361** and **362**. The jets **329** and **339** apply water to the interior of the filter **216** that, by centrifugal force developed by the very rapidly rotating plate **245**, provide a centrifugal force on the walls of the filter that is the equivalent of the effect of the water pressure provided in embodiment **10** forcing the filter wall radially to resist the centrally directed stream or jets as **361** and **362**.

In operation of the apparatus **210** liquid **19** from sump **257** moves upwards from the line **243** into chamber **399** of filter **216** (corresponding to the chamber **199** formed by the filter wall **121**, annular support rings **123** and **125** in filter **16**) above top surface of plate **245** as jets **329** and **339**.

In the normal operation of the apparatus **210** plate **245** and filter **216** thereon rotate at a steady 250 r.p.m.; accordingly all of the lateral projections of the filter **216** (such as in filter **16**, the junctions of wall **146** and **156** and the junctions of walls **147** and **157** and the junction of walls **148** and **158**) move at a steady velocity past the nozzles **341** and **342** wherein the action is as for **141** shown in the diagrammatic enlarged view (NOT TO SCALE) in the enlarged portion 5B of FIG. **5** and above described.

The full force of the liquid pressure in each nozzle as **341** is confined to a band only 2 inches to 3 inches wide and perhaps 4 inches high: each such stream strikes the surface of the filter wall as **121** as above described with considerable scrubbing force, the stream of water from each nozzle as **341** 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 the chamber **399** of filter **216**, being a freely flowing fluid and of considerable centrifugal force, contacts and supports all the interior surfaces of interior recess chambers (as **165, 166, 167, 168** and **169** of filter **16**) and all the like surfaces notwithstanding that these recess chambers are thin and elongated, thus the force of each jet as **361** is largely met by the mechanical support of the portion of the thin wall as **121** provided by the liquid as **19** in the chamber **399** and the recesses continuous therewith and the pressure thereof due to the centrifugal force applied to such liquid provided by the rapid rate of rotation of the plate **245**. Liquid **19** provides thereby a strong scrubbing action on the exterior of the wall of each recess as **177** and the dirt accumulations there located without damage to the wall **121** for the (3 min.) operation period of apparatus **210**.

The detergent used in liquid **19** in apparatus **210** is "TIDE" (registered trademark of Proctor and 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 eight 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 one-half cup per 30 gallons of water; weight of one-half cup=1.5 ozs.=45 grams±5 percent.

The temperature of the water in sump **257** is kept at about 60–70°*A* F., in cold outdoor weather (with apparatus **210** located out of doors warning of liquid **19** is required). The 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 one-half cup per 15 gallons of water, of limited detergent power; it produces for example substantially not suds or foam. However, it does serve, as a jet, to dislodge dirt and debris from exterior recess spaces in filter **216** (as **175, 176, 177, 178**) and keeps such debris of filter **216** suspended in the turbulent liquid as at **188** and serves to carry such debris to the clarification chamber **233**. However, the dirt suspending power of such liquid is limited and, as the suspension of debris and liquid reaches sump **257** the debris settles out and the liquid is returned via pump **242** to chamber **231**. Periodically the large sump discharge valve **268** at the bottom of sump chamber **257** is opened to discharge debris therefrom, and additional water added to chamber **233** via opening **238**.

In operation of the apparatus **210**, the to-be-treated filter as **216** is placed in chamber **231** with the door **236** open to locate filter **216** therein with the central longitudinal axis of the filter **216** coaxial with the vertical axis of pipe **243** and the axis of rotation plate **245**.

The location of rings **335–8** allows this to be done with adequate accuracy by visual observation in the standard apparatus described hereinabove and in table II. The door **236** is then closed. A releasable spring latch **240** in wall **221** near edge of opening **239** engages the free edge of door **236** and holds it in closed position. Source **218** is operatively connected to a source of nominal 110-volt alternating current (usually 115–120 v.). A coin is then placed into collector **270**, and the coin collector activated by being pushed inward; the coin is collected and switch **272** activates pump motor **263**. The liquid **19** from sump **257** is driven vigorously against the outer surface of the filter **26** and at angle to those surfaces from nozzle **341** and **342** through jets **361** and **362** while the liquid within chamber **399** of filter **216** helps support the filter element walls against the action of such jets. The washing action of the liquid jets **361, 362, 329, 339**, dislodges the filter dirt without harm to the filter wall. This action is continued automatically for 3 minutes, then the timer in assembly **271** cuts off the connection of power to motor **263**. The rotation of plate **245** at about 250 r.p.m. and the action of two to four jets as **361** and **362** on each portion of the filter wall (as **121**) most adjacent to each nozzle, as **341** and **342**, effects removal of debris from the exterior surface of such wall, as **121**, of filter **216**; also there is some slight washing action of liquid **19** to remove some small amount of accumulation through powers of wall **121**. However, the greater amount of accumulation of clogging debris is removed from the outer surface of the filter rather than through the interior thereof by the centrifugal pressure.

Upon completion of the washing action in apparatus **210** at above 40° F. ambient air temperature the latch **240** is released and the filter **216** is removed from chambers **231**. Most of the water in the chamber **399** and on the peripheral surface of wall **121** drains along board **247** to chamber **233**. 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 **216**, water adherent to or carried by the filter **216** 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 **210** is colder than 40° F., the heater and fan in **269** are placed into operation by switch as **78** after pump motor **263** is disconnected from power source **218**. Such fan (**265**) and heater (as **66**) operate for 2 minutes to dry out the filter and avoid "icing" of the engine.

The usual geometry of location of the jets as **341** and **342** is, as shown to scale in FIG. **11**, at a (11 inch) distance from the axis of conduit line **243** that is greater than the radius of plate **245** (about 7 ½inches in the particular embodiment **210**) 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 as **121** (about one-eight inch to one-half inch width between walls as **155** and **146**) provides that each of the liquid jets, as that shown issuing from nozzle **341**, strikes the wall **121** of the filter **216** at angle from 0° to about a maximum of 15° for its full height usually 1 ½to 2 inches).

The TIDE composition used, above briefly described, also contains 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 for apparatus **210** and also to break up and remove such similar salts that may develop on the filter wall **121**.

The dimensions of filter **216** are only those of an exemplary filter, as the size thereof varies from one user of apparatus **210** to the next.

Drainboard **247** is a rigid imperforate waterproof board; it extends from a watertight contact with the left edge of wall **229** downward and (as shown on FIGS. **7** and **8**) leftward. It is provided with a flexible seal **247A** that joins the rear edge of plate **247** in watertight fashion to wall **372** and a similar seal **247B** that joins the front edge in watertight fashion to wall **373**. Board **247** may be, as in embodiment of apparatus **210**, pivotally supported at its right end on a rigid pin or rod as **107** and accordingly, as above described for board **47**, on unduly heavy flow of water over plate **247** the inlet valves **262A** to pump **242** is choked and the rate of flow to chamber **399** from pump **242** is reduced and the pressure on nozzles **341–344** concurrently reduced.

It is also within the scope of this invention that board **247** be firmly, as shown in FIGS. **7–10**) fixed in a downward and leftward sloping position and a standard plug valve be used in the place of valve **262A**.

The bottom of line **262** extends downward from sump **47** and has its inlet a foot from the bottom thereof. In this position the liquid that is drawn off by line **262** is free of sediment that collects at the bottom of the sump **257** and is also free of the matter than collects at the top of the liquor in the liquid reservoir or sump **257**.

While the apparatuses **10** and **210** are disclosed as intended for cleansing of air intake filters as **16** the apparatuses **10** and **210** and their operation are also intended as applicable for similarly cleansing automotive and other internal combustion engine exhaust filters of like structure and permitting the reuse of such filters and thereby making the use of such exhaust filters a less expensive use then when such filters are only used once and then discarded. Such treatment of such filters by apparatuses **10** and **210** improves the operating efficiency of such filters and the ecological acceptability of internal combustion engine automotive exhaust gases passing therethrough.

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, and a liquid reservoir means located within said enclosure, the housing and frame assembly enclosing the mechanism assembly therein,

b. said mechanism assembly comprising a wash assembly, a liquid clarification assembly and a control assembly, said wash assembly comprising a rotatable filter support and wash chamber,

said rotatable filter support comprising a rotatable filter support plate within said wash chamber and rotatable about an axis of rotation thereof, a plate jet liquid inlet means extending through said filter support plate,

a liquid pump means with a discharge outlet thereof connected to said plate jet 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 first nozzle located in said enclosure peripherally to and above said filter support plate, the outlet of said nozzle directed toward the axis of rotation of said rotatable filter support plate, the outlet of said pump being connected to the inlet of said nozzle,

a second nozzle located above said filter support plate, said second nozzle directed away from the axis of rotation of said rotatable filter support plate, the outlet of a pump being connected to the inlet of said second nozzle,

a clarification assembly comprising a baffled liquid clarification chamber located below said nozzles and above said liquid reservoir means,

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

said wash assembly comprising, in said wash chamber, said rotatable filter support plate and projecting vane means projecting radially from said rotatable filter support plate, and plate drive nozzles supported on said housing and frame assembly, said plate drive nozzles located peripherally of said filter support plate within said wash chamber, the outlet of each of said plate drive nozzles being directed toward said vane means and the inlet of each of said plate drive nozzles being connected to the outlet of said pump.

2. Apparatus as in claim **1** wherein each of said first and second nozzles are one of a plurality of such nozzles and said nozzles are radially equispaced about the axis of said filter support plate and connected to the same 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 motor for said pump and controlled by said timer.