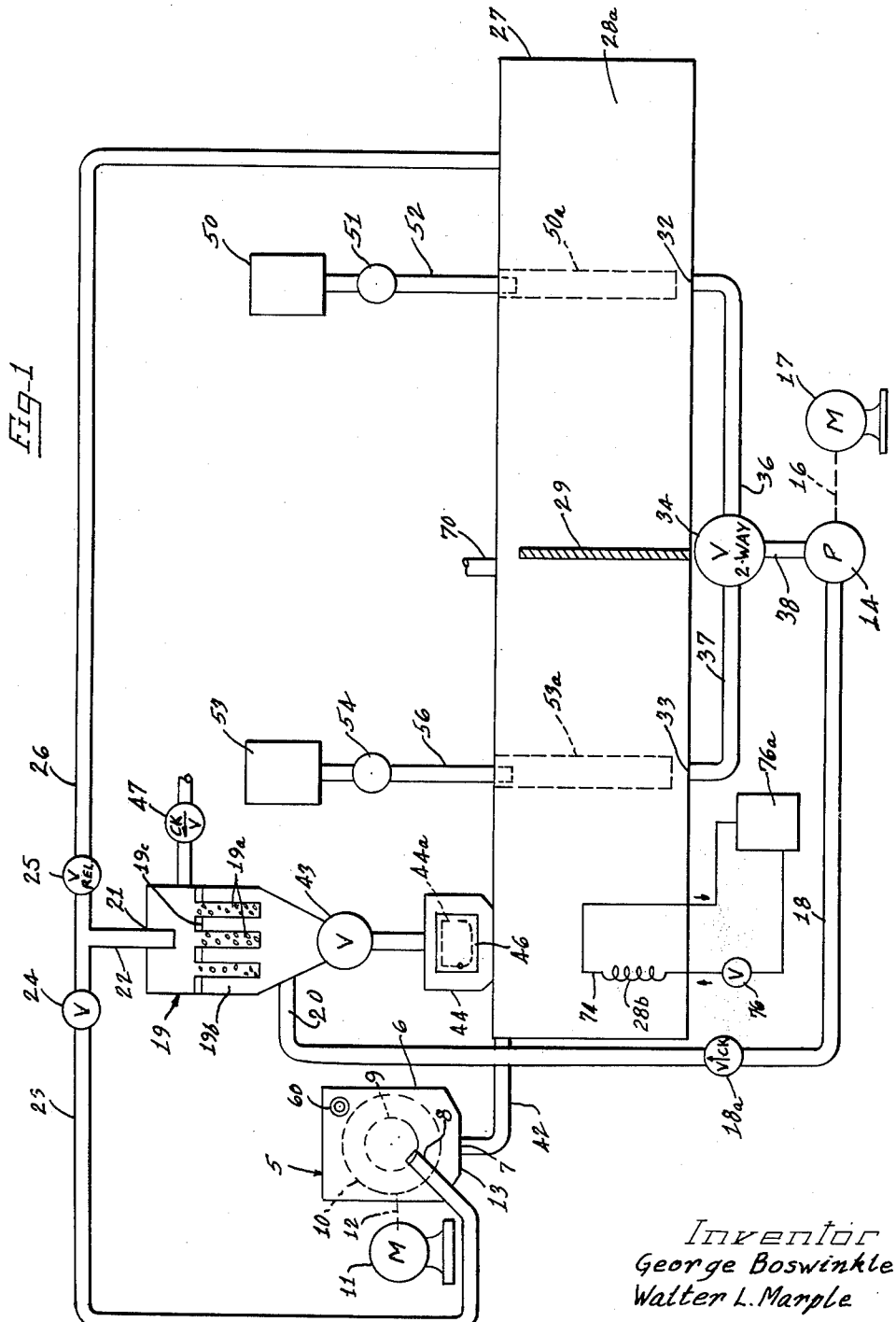
Dec. 4, 1962 G. BOSWINKLE ET AL 3,066,519

DRY CLEANING APPARATUS

Filed April 18, 1960 3 Sheets-Sheet 1

Fig-1



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DRY CLEANING APPARATUS

Filed April 18, 1960

3 Sheets-Sheet 2

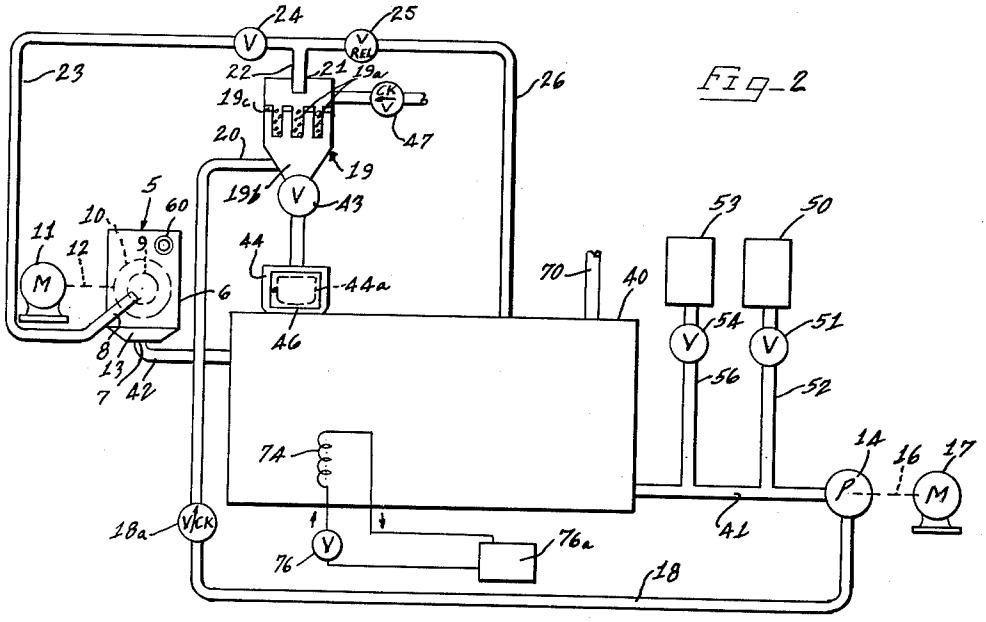
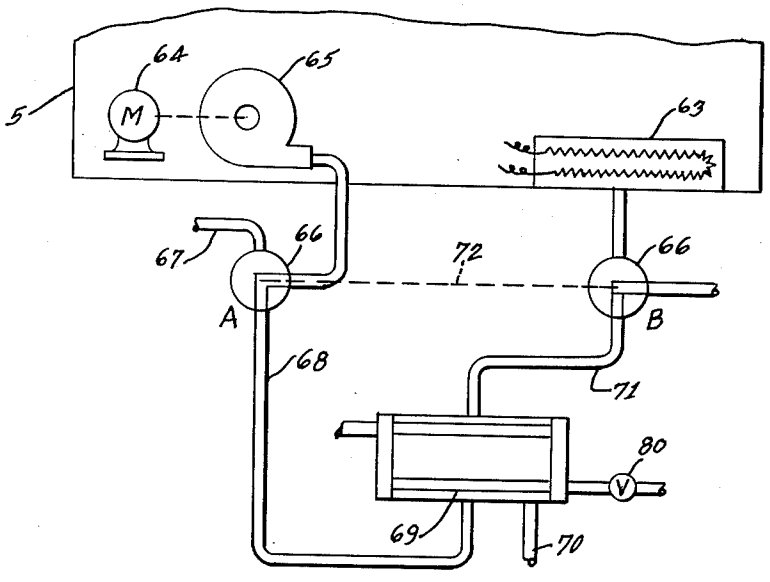


Fig. 2

Fig. 5



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DRY CLEANING APPARATUS

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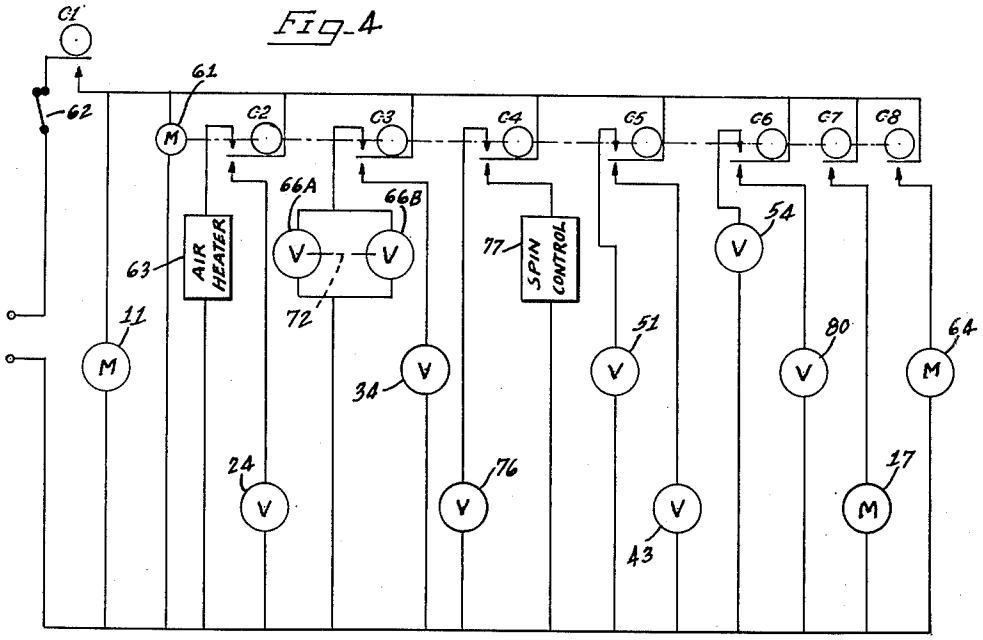
Fig. 3

ELEMENT	CAM	PRE-DRY					WASH						EXTRACT					DRY										DEODORIZE			OFF
MACHINE DRIVE MOTOR	1																													
TIMER MOTOR	1																													
AIR HEATER	2T																													
SPRAY VALVE	2B																													
OUTSIDE AIR VALVES	3T																													
PUMP TWO WAY VALVE	3B																													
SOLVENT COOLER	4T																													
SPIN CONTROL	4B																													
FILTER PRE-COAT DISPENSER	5T																													
DUMP VALVE	5B																													
ADSORBENT ADDITION DISPENSER	6T																													
CONDENSER COOLER	6B																													
PUMP MOTOR	7																													
BLOWER MOTOR	8																													
INTERVAL		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33

Fig. 4



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3,066,519

DRY CLEANING APPARATUS

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22 Claims. (Cl. 68—12)

This invention relates generally to a cleaning apparatus and method and more particularly relates to an improved hydraulic circuitry for a dry cleaner apparatus wherein a dry cleaning operation can be effected in a programmed sequence and wherein the solvent is not only continuously filtered during a cleaning operation, but is further renovated during subsequent operating periods in the program so that the hydraulic circuitry of the machine is conditioned for a new programmed sequence of operation.

"Dry cleaning" is actually a form of chemical cleaning wherein dirt and stains are removed from materials by organic solvents or by special soaps and detergents. Generally, the theory of operation in so-called dry cleaning is that greasy and resinous substances collected by wearing apparel, house furnishings and other articles are first dissolved and then by the use of an insoluble soil removed mechanically or by detergents. The process was first employed in France about the middle of the nineteenth century and for that reason has sometimes been termed "French cleaning." Since the introduction of dry cleaning, elaborate machinery has been developed and the machines heretofore provided require not only considerable operating skill but require exceptional capital investment.

As is well known in laundering operations, water causes fibers to become limp and in many cases to alter in shape and size. For this reason, liquids employed in dry cleaning are inert towards textile fibers and materials requiring preservation of careful fits or accurate shapes can ordinarily be successfully cleaned only by a dry cleaning method.

Many dry cleaning fluids are inflammable and unless proper precautions are observed, static electrical discharges ignite the volatile fluid and cause serious injury to life and property. Non-inflammable chlorinated hydrocarbons have been used as cleaning solvents, however, and such materials include carbon tetrachloride, perchloroethylene and trichloroethylene, all of which are used as dry cleaning solvents.

In accordance with contemporary prior art processes and apparatus, articles to be dry cleaned are generally placed in a mechanically revolved container with a suitable dry cleaning solvent. Such operation is followed by several rinsings in fresh dry cleaning solvents whereupon the articles are freed from most of the solvent in a centrifugal extractor and are then dried in a current of warm air. After drying the materials are inspected and any remaining spots are removed by special cleaning agents. The dry cleaning solvent used in the process is reclaimed and after renovation may be used again.

In accordance with the principles of the present invention, an unusually compact machine can be provided because of the novel hydraulic circuitry employed. Specifically, it is contemplated by the present invention to employ a fluid flow system for a machine controlled by a presettable sequential control means. Thus, there is activated in programmed sequence a series of operations wherein filters are automatically precoated prior to the cleaning operation, thereby to improve the efficiency of removal of solvent immiscible components and only filtered solvent is placed in conditioning contact with the materials being dry cleaned. Clean solvent is restored

to a solvent tank within the fluid system during the extraction operation and used filter additives are gravity dumped in a back flushing operation upon termination of fluid flow through the fluid system.

The dry cleaning solvent used in the fluid system may be a suitable non-inflammable chlorinated hydrocarbon, thus eliminating fire hazards and the hydraulic circuitry may be advantageously used in connection with a cleaner such as would be suitable for a domestic laundry appliance, thereby permitting an effective apparatus to be provided with minimal capital investment and making the advantages of dry cleaning available in a completely automatic machine which is simple to operate and economical to produce.

It is an object of the present invention, therefore, to provide a simple dry cleaning apparatus which may be effectively operated by persons of little skill and which involves minimal capital investment.

Another object of the present invention is to provide an improved hydraulic fluid system for a dry cleaning apparatus wherein the dry cleaning solvent is continuously filtered during the cleaning operation and wherein the fabrics being processed are cleaned only in filtered solvent in a non-immersion process in a zone removed from the soiled solvent drained from the fabrics to thereby minimize soil redeposition on the fabrics.

Yet another object of the present invention is to provide a fluid flow system for a dry cleaner apparatus wherein clean solvent is restored to a tank means during an extraction and drying operation and wherein filtered impurities may be readily removed from the fluid flow system without substantial loss of cleaning solvent.

Another object of the present invention is to provide a dry cleaning method and apparatus having improved control means for effecting a programmed sequence of automatic cleaning and extraction periods.

Many other advantages, features and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the accompanying sheets of drawings in which a preferred structural embodiment of a dry cleaning system incorporating the principles of the present invention is shown by way of illustrative example.

On the drawings:

FIGURE 1 is a plumbing diagram of a fluid flow system for a dry cleaning apparatus provided in accordance with the principles of the present invention;

FIGURE 2 is a modified embodiment of the invention differing from the arrangement of FIGURE 1 in the use of a single solvent tank means;

FIGURE 3 is a timer schedule or program chart for controlling the operation of the dry cleaner apparatus incorporating the hydraulic circuitry of either FIGURE 1 or FIGURE 2;

FIGURE 4 is a wiring diagram illustrating the sequential control means utilized in connection with the control of the machine of the present invention operated in accordance with the principles of the methods contemplated herein; and

FIGURE 5 is a schematic diagram of the air flow system utilized in the dry cleaner of the present invention.

As shown on the drawings:

It is contemplated according to the present invention to provide a dry cleaning method and apparatus for washing, extracting and drying in one continuous operation flexible textile materials such as clothes. Moreover, all such functions are intended to be combined into a single machine preferably of the so-called horizontal drum type. Thus, there is shown in FIGURE 1 and in FIGURE 2 a horizontal drum type machine wherein materials to be dry cleaned are tumbled within a perforate drum posi-

tioned within a generally imperforate tank and rotatable therein about a generally horizontal axis. During such tumbling operation, the materials gravitationally accelerate through the treatment zone established by the rotating drum and convert the potential energy accumulated upon their elevation in the treatment zone into kinetic energy, which is then used to flex the mass of materials by abruptly changing the gravitational acceleration of the mass through impact against the inner perforate surface of the cylindrical drum wall near the lowermost portion of the treatment zone.

The machine preferably includes liquid injecting means whereby a stream of filtered dry cleaning solvent is continuously supplied into the treatment zone for conditioning contact with the materials during the cyclic manipulation thereof.

Impact of the solvent-saturated materials not only causes maximum flexure of the materials, but forces a substantial portion of the dry cleaning solvent out of the materials, thereby enabling the materials to take on a fresh supply of filtered dry cleaning solvent and replacing that displaced by impact. The action of the impact in forcing the dry cleaning solvent from the materials also flushes away the particles of dirt carried by the materials.

The dry cleaning solvent employed thus has introduced into it, within the treatment zone, solvent miscible and immiscible impurities and constituting components of the total soil contained within the materials. The dry cleaning solvent with such impurities entrained therein automatically drains from the drum containing the fabrics being cleaned and returns to a solvent reservoir included in the hydraulic circuitry of the present invention.

While the complete details of the preferred type horizontal axis dry cleaning machine are not necessary for an understanding of the present disclosure, a constructional summary of the basic components of such a machine is believed to be beneficial to the understanding of the advantages of the present invention.

Accordingly, in FIGURES 1 and 2, this machine is generally indicated at 5 and includes a generally imperforate tank or casing 6 which is provided with a drain outlet 7 and a solvent circulation injection nozzle 8 which is located on the exterior of tank 6 and which is directed in an inwardly direction so as to project cleaning solvent circulated through that nozzle 8 into an access opening 9 located in the front wall of a rotatable perforate drum 10 which, in turn, is selectively driven at tumbling and extraction speeds by motor 11 through a conventional power transmission path diagrammatically indicated by the dotted line 12 interconnecting drum 10 and motor 11. Solvent emanating from nozzle 8 passes through the access or loading opening 9, preferably in a fan-shaped stream or spray through which the elevated fabrics fall prior to their forcefully impacting in a flexing action against the solvent-free lower surface of the drum 10.

The tank 6 is provided with a sump 13 which is located below drum 10 so that all solvent draining from fabrics placed within the drum 10 will not recontaminate either the drum 10 or the fabrics themselves. It should be apparent from this brief description that the operation of this dry cleaning apparatus differs from the so-called immersion process in which fabrics are agitated in a pool of dry cleaning solvent. An important advantage of the present disclosed construction lies in the fact that soil bearing solvent draining from the fabrics is immediately drained away from the fabrics and the drum 10 to substantially reduce problems of soil redeposition on these fabrics. In this connection it will be noted that sump 13 is positioned far enough below the drum 10 so that all solvent draining from the drum 10 is constantly drained from the dry cleaning treatment zone formed by the drum 10 and gravitationally directed to a remote solvent reservoir for retreatment and refiltration prior to being again applied to the fabrics within drum 10.

In order to supply the machine 5 with a stream of dry cleaning solvent, there is provided in accordance with the principles of the present invention a pump 14 driven through mechanical connections 16 by a pump motor 17. The pump pressurizes a supply of dry cleaning solvent and drives the same in the form of a stream through a conduit 18 containing a check valve 18*a* and connected to a filter apparatus shown generally at 19.

The filter apparatus 19 is preferably of the type wherein a plurality of foraminous or porous tubes 19*a* are positioned within a filter housing 19*b* and are supported by a divider or separator plate 19*c* so that all solvent passing through the filter apparatus passes through these tubes 19*a* which may be of a conventional type to receive a coating of filter aid material such as diatomaceous earth to restrict their perforations and thereby render this filter more effective in filtering out soil particles of, for example, one micron size or below.

The filter apparatus shown in FIGURES 1 and 2 has a filter inlet 20 to which the conduit 18 is connected and a filter outlet 21 to which a conduit 22 is connected.

The conduit 22 leads to two separate branches, one of the branches being shown at 23 and containing a control valve shown generally at 24. The conduit 23 is connected to the nozzle 8 positioned on the exterior of the tank 6 to diffuse the stream of dry cleaning solvent in a spray pattern passing through the drum opening 9 and extending across the perforate cylindrical sidewall of the drum 10 for direct impingement against the materials falling downwardly within the drum 10 during the tumbling operation. This stream enters the drum 10 in the same direction as the direction of rotation of the drum and is directed near the lowermost portion of the treatment zone defined by the drum 10.

The control valve 24 may be of a type including electrically actuated controller means, thereby permitting the valve 24 to be regulated by the presettable timing apparatus or sequential control means 60 of the present invention.

A second branch connected to the conduit 22 is shown at 26, which branch 26 has contained therein a pressure relief valve 25. The pressure relief valve 25 is of the type which automatically opens as soon as an upstream pressure in conduit 22 reaches a predetermined quantitative value. Thus, whenever the valve 24 is opened, the cleaning solvent discharged through the conduit 22 will be directed through the conduit 23 to the machine 5. However, if the valve 24 is closed, the pressure exhibited in the conduit 22 will cause the pressure relief valve 25 to open whereupon the cleaning solvent discharged through the filter apparatus 19 will pass into the branch 26. Accordingly, opening and closing the valve 24 has the effect of inducing automatic opening and closing of the pressure relief valve 25 insofar as the operation of the fluid flow control system of the present invention is concerned. This construction is preferable over that in which both valves 24 and 25 are electrically controlled valves since controlled operation of branches 23 and 26 may be easily achieved by the simpler apparatus at lower cost.

The branch 26 leads to a tank means which may take two different forms in accordance with the principles of the present invention. First of all, referring specifically to FIGURE 1, it will be noted that the branch 26 is connected to discharge into a tank compartment 28*a* which for ease in identity will be referred to as a "filter solvent tank." There is further provided a separate tank compartment at 28*b*, which for purposes of ease in identification will be referred to as an "unfiltered solvent tank." The tank compartments 28*a* and 28*b* are separated from each other by a common weir 29 extending between them so that solvent from the filtered solvent tank 28*a* may overflow into the unfiltered solvent tank 28*b* when solvent within the tank 28*a* reaches a level determined by the weir 29.

Both the filtered solvent tank 28*a* and the unfiltered solvent tank 28*b* have bottom outlets as shown at 32 and

33, respectively, connected by means of a two-way valve 34 to the pump 14, whereby the pump may draw a supply of solvent for pressurization to drive the solvent in the form of a stream in the conduit 18 from either the filtered solvent tank 28*a* or the unfiltered solvent tank 28*b*. In this regard, the bottom outlet 32 of the tank 28*a* is connected to the two-way valve 34 by a conduit 36, while the bottom outlet 33 of the unfiltered solvent tank 28*b* is connected to the two-way valve 34 by a conduit 37. A conduit 38 interconnects the two-way valve 34 and the pump 14.

In the form of the invention illustrated in FIGURE 2, a single tank means is provided to function as a reservoir for receiving both the unfiltered solvent and the filtered solvent. The single tank of FIGURE 2 is shown generally at 40 and a conduit 41 is shown interconnecting the pump 14 and the tank 40 so that a supply of solvent is drawn by the pump from tank 40 for pressurization to drive the solvent in the form of a stream in the conduit 18.

Referring further to FIGURE 1, it will be noted that the sump 13, which catches cleaning solvent admixed with impurities removed from the materials being dry cleaned, drains into the unfiltered solvent tank 28*b* by way of the outlet 7 and the conduit 42.

The same arrangement is present in the modification of FIGURE 2 and hence the conduit connecting the sump 13, as shown in FIGURE 2, is given the same reference numeral 42 since the function thereof is the same in being required to gravitationally drain the cleaning solvent from the machine 5 to the tank 40.

In both forms of the invention, the filter apparatus 19 is provided with a dump valve 43 connected to a sediment trap 44 shown generally in diagrammatic form and including a removable filter basket or container 44*a* and a closure shown generally at 46, whereby the sediment contained within the trap 44 may be periodically removed. The sediment trapped within the basket 44*a* includes, as will hereinafter be more apparent, the precoat material, the soil filtered thereon and the adsorbent additive used in this apparatus. This filter basket is intended for periodic removal and, in practice, is normally removed and emptied for residual solvent recovery after every twelve complete cycles. This differs from conventional dry cleaning apparatus which normally requires emptying of sediment traps after each operational cycle.

The dump valve 43 is of the type which preferably includes electrical actuator or control means so that the valve 43 may be placed under the regulation of a presettable sequential control means 60 controlling operation of the present invention. Moreover, the dump valve 43 preferably provides a large exhaust orifice at the bottom of the conically-shaped filter apparatus 19. Accordingly, if the filter casing is completely filled with solvent and the dump valve 43 is opened after cessation of flow through the fluid flow system of the present invention, the solvent contained within the filter apparatus 19 will almost instantly dump all of the contents thereof into the trap 44. To assist in this action, the filter is provided with a dump aid atmospheric check valve shown at 47. It will be further understood that the sediment trap 44 is connected either to the unfiltered solvent tank 28*b*, as shown in FIGURE 1, or to the tank 40, as shown in FIGURE 2, so that all soils, precoat additives and adsorbents carried on the exterior surfaces of filter tubes 19*a* will be trapped within the trap 44, while the solvent thus dumped will be returned into the hydraulic system via the unfiltered solvent tank 28*b* or the tank 40.

An important feature of this invention resides in the fact that the automatic gravitationally powered backflushing of the tubes 19*a* is accomplished by a head of completely filtered solvent positioned above the separator plate 19*c* at the start of the backflushing operation. This assures that the tubes 19*a* will be in a clean condition at the end of the backflushing operation. It will also be

apparent from the nature of this backflushing operation that different types and configurations of filter surfaces may be substituted for the filter tubes 19*a* to achieve similar results.

In order to inject into the fluid flow system of the present invention certain additives which enhance and improve the cleaning operation in accordance with the principles of the present invention, there is provided dispensing means connected to the hydraulic circuit. Such dispensing means preferably constitutes two separate units. In FIGURE 1, the first unit is shown at 50 and is shown as including an electrically operated dispenser actuator 51 for regulating the admission of an additive into the filtered solvent tank 27. It may be understood that the dispenser 50 can comprise any convenient hopper-type reservoir, while the actuator 51 may comprise a screw-type dispenser having a suitable actuating motor or any other form of motorized valving device so that the additive contained within the dispenser 50 may be discharged through a conduit 52 into the filtered solvent tank 27 for injection into the hydraulic circuit. In accordance with the principles of the present invention, it is contemplated that the dispenser 50 will be charged with a supply of a filter aid material such as diatomaceous earth. When such filter aid is injected into the hydraulic circuit, it has been found that it may be advantageously utilized to precoat the filter tubes of the filter apparatus 19, thereby improving the filtering efficiency thereof insofar as removal of solvent immiscible components from the solvent stream is concerned.

A second dispenser unit is shown at 53 and is regulated by a suitable electrically controlled actuator 54, thereby to discharge an additive through a conduit 56 into the unfiltered solvent tank 28*b*. Again, the dispenser 53 may comprise a suitable reservoir, while the actuator 54 may comprise a screw-type additive dispenser suitably actuated by a motor drive or any other form of motorized valve actuator by means of which the supply of additive dispensed from the dispenser 53 through the conduit 56 may be injected into the hydraulic circuit by means of the unfiltered solvent tank 28*b*.

According to the principles of the present invention, it is contemplated that the dispenser 53 be charged with an additive suitable for improving the removal of solvent miscible components from the solvent stream. For example, activated carbon has the effect of absorbing dyes which go into solution in the solvent stream, or adsorptive magnesia is also useful in removing fatty acids from the solvent stream to thus maintain the solvent in a "sweetened" condition. The additive contained within the dispenser 53 may comprise either or both such additives and when injected into the hydraulic circuit operates to remove the solvent miscible components from the solvent stream at the filter apparatus 19.

In practice, dispenser 53 is loaded with a mixture of approximately 20% activated magnesia, 40% activated charcoal and 40% diatomaceous earth. The activated magnesia and charcoal serve to chemically treat the solvent while the additional diatomaceous earth maintains the porosity of the filter cake deposited on the filter surface of tubes 19*a* and thereby serves to reduce the "layer caking" on the filter by soil particles. It will be noted from the diagrammatic representations of the dispensers in FIGURE 1 that dispenser wells 50*a* and 53*a* are provided immediately below their respective dispensers 50 and 53 within tank compartments 28*a* and 28*b*, respectively, and that these dispenser wells 50*a* and 53*a* are in turn respectively positioned above the intake openings of conduits 32 and 33 so that filter aid material and the adsorbent additives are allowed to form a slurry for immediate deposit on the porous filter tubes 19*a* when these dispensers are operated. It will also be seen that while the dispensed material is dispensed into the solvent tank compartments in FIGURE 1, the dispensed material could also be injected directly into the conduits leading to pump

14 as is done in the alternative embodiment of FIGURE 2.

The same type of dispensing means is embodied in the arrangement of FIGURE 2 and, accordingly, like reference numerals have been applied to like units. It will be noted, however, that the dispensing means 50 and 53 are connected in position to inject the additive directly into the conduit 41 leading to the inlet of the pump 14 for delivery into the stream of solvent discharged into the conduit 18.

In FIGURES 1 and 2 and as shown diagrammatically on the machine 10, there is provided a presettable sequential controller 60. The structural and functional characteristics of the presettable sequential controller 60 are shown in the program schedule of FIGURE 3 and the wiring diagram of FIGURE 4. Thus, the sequential controller 60 is of the type incorporating a timer motor 61 which may be of the stepping-type and which operates to advance, in accordance with predetermined time increments, a series of switch cams shown at C1, C2, C3, C4, C5, C6, C7 and C8. Each of the switch cams C1–C8, inclusive, has an appropriate action surface engaging and controlling a corresponding switch blade establishing appropriate electrical connections with either an upper or top contact and a lower or bottom contact. For ease in reference, an indication of a cam number followed by either the symbol "T," or the symbol "B" will identify operation of the corresponding top contact or bottom contact, as controlled by the cam referred to. The switch controlled by cam C1 has only a single contact and is in series with a line switch 62, thereby to control energization of the main drive motor 11 of the machine 10 and the timer motor 61. It will be understood that the sequential controller 60 is connected to the usual electrical supply voltage.

Referring briefly to each of the cams incorporated in the sequential controller 60, the cam C2 controls through the upper contact energization of an air heater 63 which heater is used to temperature-condition a stream of air circulated through the machine 10 as required to dry or to deodorize the materials contained within the treatment zone prescribed by the machine 10. In this connection, a blower motor 64 is also provided, the energization of which is controlled by the cam C8 and the function of which is to drive a stream of ventilating air through the air circuitry of the machine 10 in conditioning contact with the materials being dry cleaned therein.

The bottom contact controlled by the cam C2 regulates the control valve already identified by the reference numeral 24 in the arrangement of FIGURES 1 and 2.

The top contact of the cam C3 controls the operation of air valves shown at 66A and 66B and used to control the direction of the air stream through the machine 10. The operation of the air circuitry of the machine 10 is illustrated diagrammatically in FIGURE 5 wherein the blower motor 64 drives a blower 65 discharging air through one of the valves 66, 66, indicated at A, whereupon the air stream may either be vented to atmosphere as at 67 by the two-way valve, or conducted through a conduit 68 to a solvent condenser 69 wherein any cleaner solvent contained in the air stream will be condensed for return to the hydraulic circuit via a drain pipe shown at 70 in both FIGURES 1 and 2 leading to the unfiltered solvent tank in FIGURE 1 and the tank 40 in FIGURE 2. The air stream leaves the solvent condenser via a conduit 71 and is returned to the machine 5 via the other of the two-way valves 66 indicated at B, after first being temperature-conditioned by exposure to the air heater 63. The valves 66, 66 as shown at A and B, are mechanically ganged as at 72 for simultaneous operation by a single motor. The valve B of the valves 66, 66 may be arranged to draw air from the atmosphere when the discharge of the blower 65 is vented, as during deodorizing or during the predry operation.

It will also be understood that suitable cooling means may be provided to maintain the temperature of the solvent below a designated temperature. In this regard, it has been found that an excessive amount of dye bleed may be prevented by maintaining the temperature of the solvent below 75° F. Accordingly, suitable solvent cooling means such as a cooling coil is shown at 74 in both FIGURES 1 and 2 regulated by a temperature control means shown at 76 for controlling the refrigeration unit generally shown by numeral 76*a*, it being understood that the cooling means could be a cold water system or a refrigeration system. Further, the cooling coil 74 could be in either, or both, the filtered solvent tank 28*a* or the unfiltered solvent tank 28*b*, as schematically illustrated herein.

Referring further to FIGURE 4, it will be noted that the top contact of the cam C4 regulates the solvent cooler control heretofore identified at 76, while the bottom contact of the cam C4 regulates a centrifuge or spin control shown at 77. It will be understood that the spin control 77 can constitute any speed changer mechanism or transmission required to change the speed of operation of drum 10 contained within the machine 5 from a tumbling speed to a centrifuging speed.

The top contact of the cam C5 operates to control the regulator 51 of the dispenser 50, while the bottom contact of the cam C5 controls the dump valve 43 associated with the filter apparatus 19.

The top contact of the cam C6 controls the regulator 54 of the dispenser 53, while the bottom contact of the cam 6 controls a regulator such as a valve 80 (FIGURE 5) associated with the solvent condenser 69. This condensing system could be, for example, either a cold water or refrigeration system. The cam C7 controls the energization of the pump motor 17 and as previously noted, the cam C8 controls the operation of the blower motor 64.

Having thus described the operative components of the dry cleaner of the present invention, the programmed sequence illustrated by the program schedule of FIGURE 3 may now be described.

Generally, the time operation for one complete cycle of the dry cleaner apparatus or fluid flow system of the present invention can be broken down into five distinct cycle parts or periods. Such parts are the predry, wash, extraction, dry and deodorizing periods. Whenever the dry cleaner of the present invention is started in a new cycle, all of the dry cleaning solvent will have been completely filtered and the filter elements of the filter 19 will be completely free of filter aid material constituted by the additives dispensed through the dispensing means 50 and 53. Thus, the complete cycle of the dry cleaner may be referred to in connection with the events occurring in each of the individual cycle parts:

Predry

The predry portion of the complete cycle is provided to dry out the excess moisture in woolen articles that usually make up the load to be dry cleaned. This is done to keep the moisture level at a point where a maximum relative humidity within the system of 75% will not be exceeded. It has been discovered that at relative humidities over 75%, intolerable shrinkage and wrinkling will occur in dry cleaned woolen articles.

The predry period is achieved by placing the articles in the cylinder of the machine 10 and tumbling the same while operating the air circulating system and temperature-conditioning the stream of air circulated through the treatment zone. Thus, the air flow for the predry cycle can be effected by taking air from the atmosphere through the valve 66B and passing the same over the heater 63 through the machine and out through the blower 65 for discharge through the valve 66A to the atmosphere as at 67. It will be appreciated that with a high room relative humidity, the air flow path could be changed so the air would be recirculated through a closed air circuit and through the condenser 69.

In addition to the actual drying of the load, two other important events are taking place during the predry cycle. The first event is that the pump 14 begins to take solvent from the tank means, either the filtered solvent tank compartment 28a of FIGURE 1, or the tank 40 of FIGURE 2 and the solvent thus pressurized by the pump 14 is discharged through the uncoated filter elements 19a of the filter apparatus 19 and back into the tank 27 or tank 40 through the conduit 26, as regulated by the pressure control relief valve 27. After a short interval of time, the dispenser actuator 51 of the dispenser 50 will be energized and a quantity of filter aid such as diatomaceous earth is injected into the filtered solvent tank 28a or into the conduit 41 from where it is pumped to the filter elements. Such diatomaceous earth then rapidly forms a filter aid coating on the exterior of the filter elements to improve the filtering efficiency thereof.

The second event that takes place during the predry period, is the cooling of the solvent by the cooling coil 74. By so providing, the temperature of the solvent may be maintained below the maximum level of 75°. Both of such events may take place in a relatively short time so as to be completed by the end of the predry cycle. It will be understood that the length of the predry cycle can be controlled by timer means, for example, over the length of five timer intervals, as shown in the program schedule of FIGURE 3, or by suitable humidity control means associated with the presettable sequential controller 60 in order to limit the length of the predry period to only such amount of time as may be necessary to remove the required amount of moisture from the load. This relative humidity control also provides a means for maintaining a high enough relative humidity to secure better cleansing of fabrics.

Wash

After the completion of the predry cycle, the dry cleaning machine will go into the wash cycle. At this time, the air heaters 63 are turned off and the valve 24 is opened so that the dry cleaning solvent discharged from the filter 19 through the conduit 22 will be directed through the conduit 23 into the machine 5 for conditioning contact with the load of tumbling materials in the drum 10 of the machine 5.

In the arrangement of FIGURE 1, the two-way valve is also operated so the pump 14 will draw dry cleaning solvent out of the unfiltered solvent tank compartment 28b, instead of from the filtered tank compartment 28a. With the arrangement of FIGURE 2, of course, the pump 14 always draws its supply of dry cleaning solvent from the tank 40.

Solvent collected in sump 13 of the machine 5 in the case of both FIGURES 1 and 2 will be gravitationally drained back to the tank means designated as the unfiltered solvent tank compartment 28b in the arrangement of FIGURE 1 and the tank 40 in the arrangement of FIGURE 2.

Also at the beginning of the wash cycle, the actuator 54 of the dispenser 53 is energized so that additional additive is injected into the fluid flow system. For example, activated carbon and adsorptive magnesia may be injected into the system, thereby to remove dyes and fatty acids from the solvent, which impurities are then removed from the system by the filter elements in the filter apparatus 19. Simultaneously with the addition of such adsorbents additional "body feed" such as diatomaceous earth is dispensed into the system from dispenser 53 to perserve the porosity of the filter cake or filter elements 19a. Since the drum 10 containing the load within the machine 5 is not rotating through a pool of solvent, the solvent sprayed onto the load is completely filtered solvent, thereby considerably enhancing the dry cleaning operation by minimizing soil redeposition as well as providing a rigid impact surface for the fabrics.

Extraction

After the wash cycle, the machine goes into the extraction cycle. At this moment, the drum 10 is elevated to centrifuging speed by means of the spin control 77 and the valve 24 is closed so that dry cleaning solvent is no longer injected into the drum 10. Furthermore, the cooling of the dry cleaning solvent is stopped, but the pump 14 continues to operate so that the solvent circulating through the system will be directed through the conduit 26 and back to the tank means constituting either the filtered solvent tank compartment 28a in the arrangement of FIGURE 1, or the tank 40 in the arrangement of FIGURE 2. Thus, as the machine continues the dry cleaning cycle, the solvent is being conditioned for the next subsequent cleaning operation.

During this period, if the filtered solvent tank compartment 28a becomes filled, it will overflow over weir 29 into the unfiltered solvent tank compartment 28b, while the circulation continues. To allow enough time to assure that all of the unfiltered solvent is completely conditioned and filtered, this particular phase of circulation may be continued well into the dry cycle. Moreover, it is contemplated that the heaters 63 may also be energized during the extraction cycle to preheat the system and to thereby promote a shortened drying period.

Dry

At the completion of the extraction cycle, the timer motor 61 will energize and actuate the necessary components to energize the heating element 63 and also to condition the air flow system by suitable actuation of the valves 65, 66 (A and B) to provide an air flow path through the solvent condenser 69. Thus, dry cleaning solvent may be reclaimed from the air stream and restored to the hydraulic circuit or fluid flow system of the present invention. As the solvent-laden dry air passes through the condenser 69, it will be condensed out and directed through the conduit 70 back into the tank 40 of FIGURE 2 or the unfiltered solvent tank compartment 28b in the arrangement of FIGURE 1.

After the dry cycle has progressed for a long enough period of time so that all of the solvent has been filtered and treated, the solvent circulation pump 14 is stopped by deenergization of the pump motor 17. Back flow of solvent and filter additives from the filter apparatus 19 through conduit 18 is prevented by check valve 18a in conduit 18. Thus, circulation of dry cleaning solvent through the hydraulic circuit is stopped.

At this point, the dump valve 43 at the bottom of the filter apparatus 19 is actuated. Since the filter casing is completely filled with solvent and because of a large orifice size of the filter casing drain, all of such solvent will almost instantly dump into the sediment trap 44 carrying with it the soil and the filter coatings that have been added during the predry and wash cycles. Such dumping action is effective in the preparation of the filter elements for new coatings at the beginning of the next complete dry cleaning cycle. The sediment trap 44 at the bottom of the filter 19 will allow the solvent to go back into the unfiltered solvent tank 28b (in accordance with the arrangement of FIGURE 1) or into the tank 40 (in accordance with the arrangement of FIGURE 2) and the soil and filter coatings will be trapped within the sediment container 44a for periodic removal via the access means 46. After the filter element dumping period, the machine will continue in its normal timer controlled dry cycle with no further fluid recirculation.

The effectiveness and rapidity of the gravity dumping of this filter coat may be increased by the assistance of air pressure applied within filter assembly 19 during this backflushing operation.

Reference is made to the accompanying drawings for an appreciation of this pressure assist during the dumping operation. It will be noted from these drawings that

conduit 22 extends downwardly into the filter assembly 19 through the outlet 21 well past the top wall of filter assembly 19. During the unidirectional fluid flow through conduits 18, 20 and 22 and through filter assembly 19, the cleaning fluid circulating through the filter assembly 19 will be prevent from completely filling the upper portion of filter assembly 19 by reason of the air pocket or air cushion existing at the top of assembly 19 due to the air bell effect caused by the relative positioning of the lower end of conduit 22 with respect to the top wall of the filter assembly 19. This air cushion will have little or no effect during the cleaning operation as fluid flows through the filter assembly 19 but will have a beneficial effect during the described backflushing operation when fluid flow is terminated through conduit 18.

During the backflushing operation, this cushion of air, which has been compressed to the operating fluid pressure existing during the previous filtering operation, will be released against the body of fluid retained within filter assembly 19 at the end of the filtering process with the result that the gravitational backflushing operation will be forcibly assisted by the release of the compressed air trapped within the upper portion of assembly 19. The result will be a more rapid and forceful backflushing operation of filter tubes 19*a* by the fluid forced through these filter tubes.

It should be understood, however, that while the air pressure assist produces beneficial results, the gravitational backflushing operation is completely feasible in itself and is not dependent upon this air pressure assist for satisfactory operation.

It should also be obvious that other means, such as inversely cupping the top wall of assembly 19, may be used to achieve this air bell effect with similiar results. Furthermore, this air assist concept extends to the use of a compressed air tank (not shown) communicating through a conduit with filter assembly 19 with the application of such compressed air being under the control of a solenoid operated valve which is actuated by sequential controller 60 during the backflushing operation.

Deodorizing

At the end of the dry cycle, the timer motor 61 advances the cam of the presettable sequential controller 60 into the deodorizing part of the complete cycle. When this happens, the heating elements 63 are deenergized and operation of the condenser 69 is stopped. The air flow path is changed by the valves 66, 66 (A and B) whereby air from the atmosphere is circulated through the machine and vented to the atmosphere. The deodorizing step is effective in removing undesirable odors from the load and from the machine.

The completion of the deodorizing cycle ends the complete dry cleaning cycle for the batch of materials in the machine 5. Moreover, the entire fluid flow system has been preconditioned so that a new load can be started immediately if desired.

It may be noted that the fluid flow system of the present invention may employ a so-called "charged" type of dry cleaning solvent in which the solvent includes a suitable quantity of detergent, for example, 1 to 4%. Since the detergent is completely soluble in the dry cleaning solvent, it is not filtered out and, accordingly, a rinse cycle is not needed, thereby permitting the system to go directly from a wash to an extraction cycle.

Although minor modifications might be suggested by those versed in the art, we wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of our contribution to the art.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An hydraulic circuit for a dry cleaner apparatus comprising means forming a treatment zone in which materials are to be dry-cleaned, means forming an inlet for said zone through which liquid solvent is directed into said zone, means forming an outlet at the bottom of the zone through which liquid solvent is drained from said zone, a filter upstream of said inlet, a first conduit means having a control valve therein connected to said inlet and to said filter, thereby to supply filtered solvent to said zone when said control valve is open, a second conduit means having a pressure relief valve therein and connected to said filter to automatically receive solvent driven through said filter whenever said control valve is closed, a pump having a pump inlet and a pump outlet, conduit means connecting said pump outlet to said filter, thereby to drive solvent discharged by said pump through said filter, a third conduit means including a solvent tank connected to said pump inlet and to said second conduit means, thereby to form a solvent reservoir for said pump, a fourth means connecting said zone outlet to said solvent tank, a dispenser well in said solvent tank superjacent said pump inlet, and dispenser means for injecting a filter aid material into said dispenser well for direct communication with said filter to improve the efficiency of the filter by coating the same with the filter aid material.

2. An hydraulic circuit as defined in claim 1, said filter having a dump valve controlled exhaust orifice at the bottom thereof, a sediment trap communicating with said orifice, and means for discharging liquid solvent from said trap into said solvent tank.

3. In an hydraulic circuit as defined in claim 1, said filter having a trap and dump valve means for gravity dumping soil and used filter additives off said filter elements into said trap in a back-flushing operation upon the termination of solvent flow through said filter.

4. In an hydraulic circuit as defined in claim 1, presettable sequential control means, and separate control means regulated by said sequential control means and including control means for said pump, said dispenser means, and said control valve, thereby to automatically operate said hydraulic circuit through a programmed cycle of washing and extracting periods.

5. An hydraulic circuit as defined in claim 1, said solvent tank comprising two separate compartments including a first filtered solvent tank compartment in said second conduit means and a second unfiltered tank compartment downstream of said treatment zone, means defining an overflow passageway from said first tank compartment into said second tank compartment, and conduit means including a two-way valve having separate connections with said two tank compartments and to said pump inlet for selectively discharging solvent from either of said two tank compartments.

6. In a fluid flow system for a dry cleaner, conduit means forming an hydraulic circuit for a supply of liquid solvent, a pump in said circuit for driving the liquid solvent under increased pressure in the form of a stream, dispenser means connected to the circuit upstream of the pump, and a filter having porous filter elements in the circuit downstream of the pump for removing solvent immiscible components from the stream, said dispenser means adapted to contain a supply of additive material suitable for precoating the filter elements prior to a cleaning operation, thereby to improve the efficiency of said filter, means forming a treatment zone downstream of the filter in which solvent miscible and immiscible impurities are removed during a washing operation for entrainment into the solvent, said conduit means including a bypass circuit to bypass the treatment zone, tank means upstream of said pump inlet and downstream of said filter, said bypass circuit and said treatment zone and forming a solvent reservoir for said circuit, whereby clear filtered solvent is restored to said tank means whenever said treatment zone is bypassed through said bypass circuit, said tank means comprising two separate

tanks including a first filtered solvent tank in said bypass circuit and a second unfiltered tank downstream of said treatment zone, means defining an overflow passageway into said second tank from said first tank, and conduit means including a two-way valve connected to said two tanks and to said pump for selectively discharging solvent from either of said two tanks, said dispenser means including a first dispenser connected to said first tank and having a dispenser well extending into said tank above the pump inlet to inject an additive suitable to precoat the filter elements for improving the removal of solvent-immiscible components, and a second dispenser connected to said second tank and having a dispenser well extending into said tank above the pump inlet to inject an additive suitable for adsorbing and removing solvent-miscible components from the solvent.

7. In a fluid flow system as defined in claim 6, a presettable sequential control means and control means regulated thereby to automatically operate said pump, said first and second dispensers and said two-way valve through a cycle of washing and extracting periods.

8. Dry cleaning apparatus for cleaning by programmed sequence of washing, extracting and drying cycles comprising,

means forming a closed liquid circuit for a stream of liquid solvent,

a treatment zone at one point in the circuit,

a nozzle in said circuit for directing the stream of solvent against a tumbling mass of materials to be cleaned, thereby flushing dirt and foreign particles from the materials for introduction and admixture with the solvent to entrain the dirt and foreign particles in the stream,

tank means forming a first reservoir pool at a second point in the circuit for collecting the solvent from said one point in the form of an unfiltered pool,

a pump in the circuit at a third point pressurizing a supply of solvent from the unfiltered pool to drive the stream through the circuit,

a filter at a fourth point in the circuit clarifying the stream of solvent by separating out the dirt and foreign particles from the stream,

valve means in said circuit for recycling the clarified stream to said one point,

means for bypassing the stream of clarified solvent around said one point,

said tank means forming a second reservoir pool comprising a filtered solvent pool for collecting the clarified stream,

valve means for supplying solvent for pressurization at said third point from said filtered pool,

means for overflowing excess clarified solvent collected in the fitlered pool into the unfiltered pool,

whereby the supply of solvent will be reconditioned for a new programmed sequence during the drying cycle,

and injection means in the circuit ahead of said fourth point for injecting filter additive suitable for precoating said filter and for adsorbing solvent miscible impurities, thereby to improve the separation of solvent-entrained impurities from the stream.

9. Dry cleaning apparatus as defined in claim 8, and dumping means for selectively gravity-dumping the used filter additives from said filter upon termination of flow through said circuit.

10. Dry cleaning apparatus for cleaning by programmed sequence of washing extracting and drying cycles, means forming a closed liquid circuit for a stream of liquid solvent, a treatment zone at one point in the circuit, a nozzle in said circuit for directing the stream of solvent against a tumbling mass of materials to be cleaned, thereby flushing dirt and foreign particles from the materials for introduction and admixture with the solvent to entrain the dirt and foreign particles in the stream, tank means forming a first reservoir pool at a second point in the circuit for collecting the solvent from said one point in the form of an unfiltered pool, a pump in the circuit at a third point pressurizing a supply of solvent from the unfiltered pool to drive the stream through the circuit, a filter at a fourth point in the circuit clarifying the stream of solvent by separating out the dirt and foreign particles from the stream, and valve means in said circuit for recycling the clarified stream to said one point, means for by-passing the stream of clarified solvent around said one point, said tank means forming a second reservoir pool comprising a filtered solvent pool for collecting the clarified stream, valve means for supplying solvent for pressurization at said third point from said filtered pool, and means for overflowing excess clarified solvent collected in the filtered pool into the unfiltered pool, whereby the supply of solvent will be reconditioned for a new programmed sequence during the drying cycle.

11. Dry cleaning apparatus comprising, a casing, a rotatable drum mounted within said casing for receiving and tumbling fabrics to be cleaned, drive means for rotating said drum, a solvent injection nozzle for directing solvent into said casing, filter aid dispensing means, a solvent tank for receiving a supply of solvent and filter aid material, said filter aid dispensing means having an outlet comprising a dispenser well disposed in said tank for admixing the filter aid material with the solvent, a drain opening in said casing communicating with said solvent tank for draining solvent from said casing back into said solvent tank, filter apparatus including a filter surface for filtering said solvent, first conduit means interconnecting said solvent tank and said filter apparatus, second conduit means interconnecting said filter apparatus and said solvent tank, third conduit means interconnecting said filter apparatus and said solvent injection nozzle, pump means in said first conduit means for pumping solvent and filter aid material from said solvent tank through said filter apparatus, and control means including pressure operated valve means in said second and motor operated valve means in said third conduit means and sequential control means regulating said valve means, said drive means and said filter aid dispensing means for automatically circulating solvent flowing from said filter apparatus first through said second conduit means to precoat said perforate filter surface with said filter aid material and then subsequently through said third conduit means to effect a cleansing of said fabrics with filtered solvent.

12. Dry cleaning apparatus comprising, a casing, a rotatable perforate drum mounted within said casing for receiving and tumbling fabrics to be cleaned, drive means for rotating said drum, a solvent injection nozzle for directing solvent into said casing, filter aid dispensing means, a solvent tank for receiving a supply of solvent and filter aid material, said filter aid dispensing means having an outlet in said tank a drain opening in said casing communicating with said solvent tank for continuously draining solvent from said casing back into said solvent tank to prevent accumulation of solvent in said drum thereby to provide at the bottom of said drum a substantially solvent-free rigid impact surface for said fabrics and to minimize soil redeposition on said fabrics during the cleansing of said fabrics, filter apparatus including a perforate filter surface for filtering said solvent, first conduit means interconnecting said solvent tank and said filter apparatus, second conduit means interconnecting said filter apparatus and said solvent tank, third conduit means interconnecting said filter apparatus and said solvent injection nozzle, pump means in said first conduit means for pumping solvent and filter aid material from said solvent tank through said filter apparatus, and control means including pressure operated valve means in said second and motor operated valve means in said third conduit means and sequential control means in control thereof for automatically circulating solvent flowing from said filter apparatus first through said second conduit means to

precoat said perforate filter surface with said filter aid material and then subsequently through said third conduit means to effect a cleansing of said fabrics with filtered solvent.

13. Dry cleaning apparatus comprising, a casing, a rotatable perforate drum mounted within said casing for receiving and tumbling fabrics to be cleaned, drive means for rotating said drum, a solvent injection nozzle for directing solvent into said drum, a solvent tank for retaining a supply of solvent and filter aid material, a drain opening in said casing communicating with said solvent tank for draining solvent injected into said drum back into said solvent tank, filter apparatus superjacent said solvent tank including a filter surface and a filter housing having a drain outlet communicating with said solvent tank, a dump valve at the bottom of the filter housing normally precluding communication of said filter apparatus with said solvent tank through said drain outlet, a filter aid dump container positioned beneath said filter apparatus for filtering filter aid material from solvent released from said filter apparatus through said dump valve, first conduit means interconnecting said solvent tank and said filter housing on one side of said filter surface, second conduit means interconnecting said filter housing on the other side of said filter surface and said solvent tank, third conduit means interconnecting said filter apparatus on the other side of said filter surface and said solvent injection nozzle, pump means in said first conduit means for pumping solvent from said solvent tank through said filter apparatus, a second valve in said second conduit means, a third valve in said third conduit means, and circuit control means including a presettable sequential controller sequentially controlling the operation of said second and third valves and said dump valve and said pump means to automatically circulate solvent flowing from said filter apparatus first through said second conduit means to precoat said one side of said filter surface with said filter aid material and then subsequently to circulate the solvent through said third conduit means to effect a cleansing of said fabrics with filtered solvent and then finally to terminate solvent flow through said filter apparatus to thereby automatically effect a gravitational back flushing of said filter surface and dump filter aid material coated thereon into said dump container through said drain outlet and said dump valve.

14. The invention of claim 13 in which said filter apparatus is provided with a check valve permitting the equalization of air pressure within said filter apparatus during the back flushing operation of said filter surface.

15. The invention set forth in claim 13 in which said first conduit means is provided with a check valve precluding back flow of fluid from said filter apparatus into said solvent tank.

16. The invention set forth in claim 13 further including means controlled by said sequential controller of said control means for automatically injecting filter aid material into said solvent tank.

17. The invention set forth in claim 13 in which a partition divides said solvent tank into first and second solvent receiving compartments, the first of said compartments receiving solvent from said second conduit means and the second of said compartments receiving solvent drained from said casing and said filter apparatus.

18. The invention of claim 17 in which said partition is a weir accommodating solvent overflow from one compartment to the other.

19. The invention set forth in claim 17 further including a two way valve having an outlet communicating with said first conduit means and a pair of inlets respectively communicating with said first and second solvent receiving compartments.

20. The invention set forth in claim 13 further including means for automatically applying air back pressure to said filter surface during the backflushing of said filter surface.

21. The invention set forth in claim 13 further including means for automatically trapping and compressing air within said filter apparatus during fluid flow through said first conduit means and said filter apparatus including an outlet below the level of the top of the filter housing to form an air cushion at the top of the filter housing during normal operation for subsequent release through said filter surface during the backflushing of said filter surface.

22. Dry cleaning apparatus comprising, a casing, a rotatable perforate drum mounted within said casing for receiving and tumbling fabrics to be cleaned, drive means for rotating said drum, a solvent injection nozzle for directing solvent into said drum, filter aid dispensing means, a solvent tank for retaining a supply of solvent and filter aid material, a drain opening in said casing communicating with said solvent tank for continuously draining solvent injected into said drum back into said solvent tank, filter apparatus including a filter surface and a drain outlet communicating with said solvent tank, a dump valve in said drain outlet normally precluding communication of said filter apparatus with said solvent tank through said drain outlet, a filter aid dump container positioned beneath said filter apparatus for filtering filter aid material from solvent released from said filter apparatus through said dump valve, first conduit means interconnecting said solvent tank and said filter apparatus, second conduit means interconnecting said filter apparatus and said solvent tank, third conduit means interconnecting said filter apparatus and said solvent injection nozzle, pump means in said first conduit means for pumping solvent from said solvent tank through said filter apparatus, a pressure relief valve in said second conduit means, a control valve in said third conduit means, and control means sequentially controlling said filter aid dispensing means, said control valve and said dump valve and said pump means for automatically circulating solvent flowing from said filter apparatus first through said pressure relief valve and said second conduit means to precoat said filter surface with said filter aid material and then subsequently through said control valve and said third conduit means to effect a cleansing of said fabrics with filtered solvent and then finally to terminate solvent flow through said filter apparatus to thereby automatically effect a gravitational back flushing of said filter surface to dump filter aid material coated thereon into said dump container through said drain outlet and said dump valve.

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