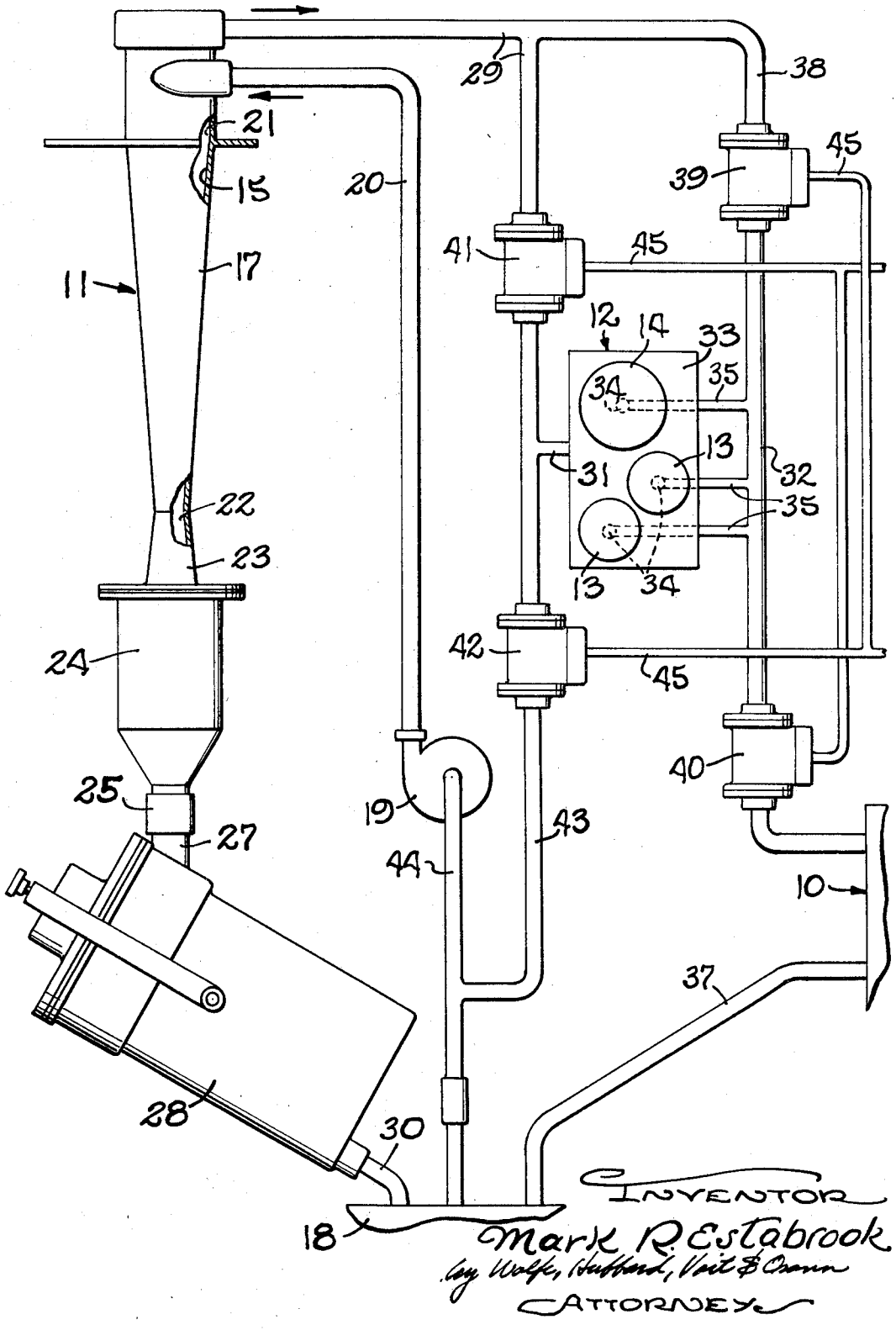
May 12, 1970 M. R. ESTABROOK 3,510,890

DRYCLEANING AND FLUID DECONTAMINATION APPARATUS AND METHOD

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Fig. 1



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Fig. 3

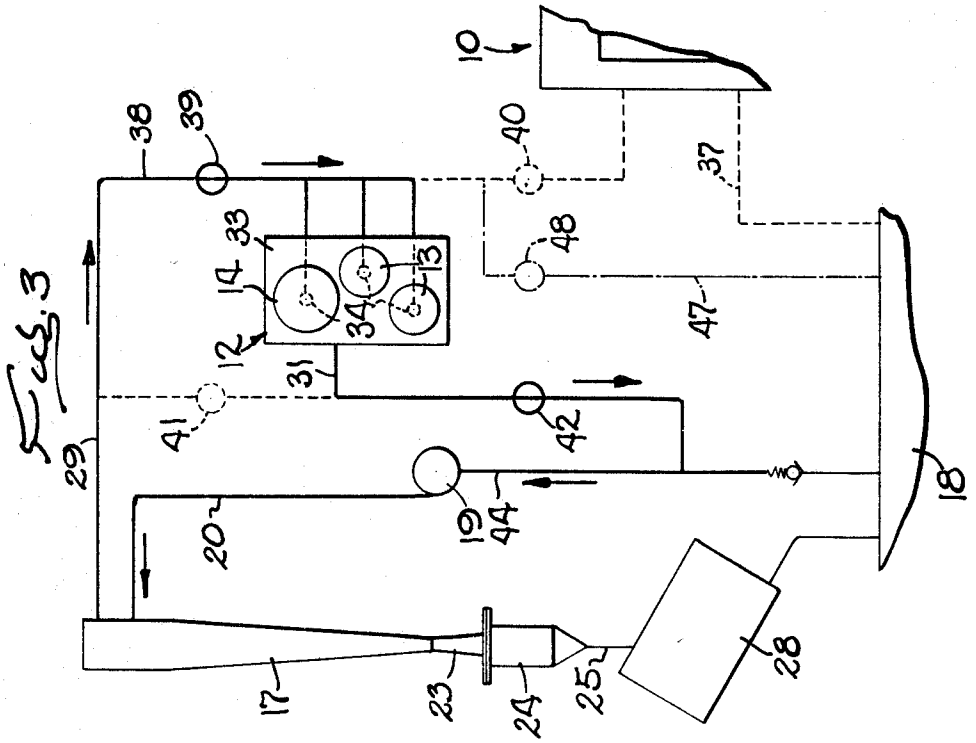
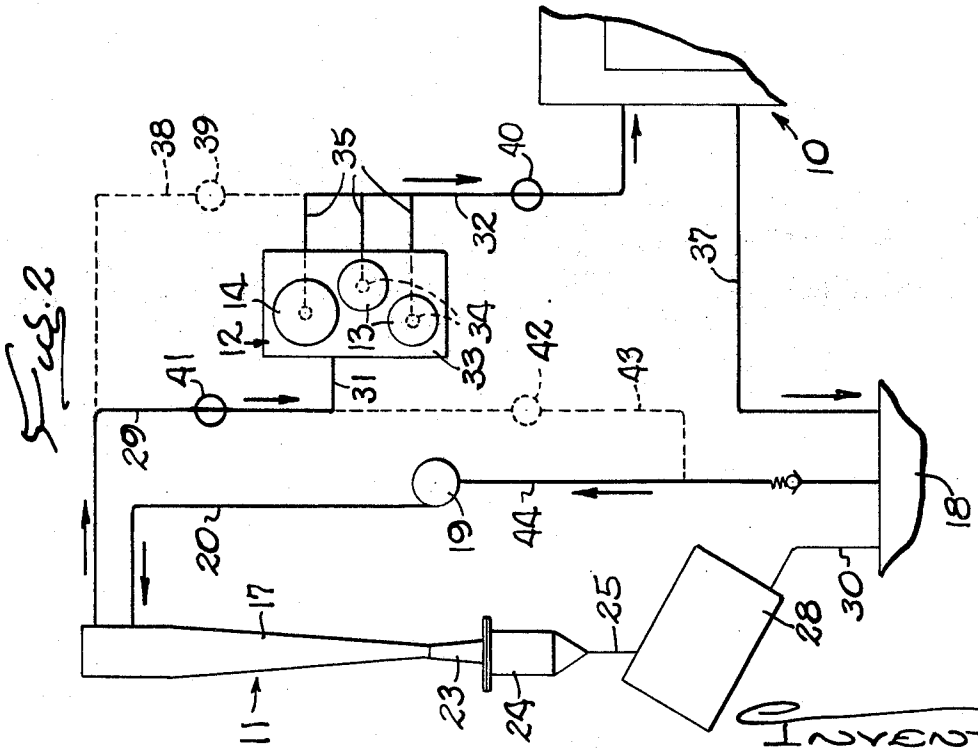


Fig. 2



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United States Patent Office 3,510,890
Patented May 12, 1970

3,510,890

DRYCLEANING AND FLUID DECONTAMINATION APPARATUS AND METHOD

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Continuation-in-part of application Ser. No. 741,522, July 1, 1968. This application Sept. 17, 1968, Ser. No. 767,036
Int. Cl. B01d *37/04;* D06f *39/10, 43/08*
U.S. Cl. 8—158 9 Claims

ABSTRACT OF THE DISCLOSURE

A drycleaning and fluid decontamination apparatus including a washer, a Hydroclone separator, a bank of filter and chemical cartridges for final cleaning of the separator, a pump, and flow control valves and pipes for routing the fluid normally from the separator forwardly through the bank to the washer and back to the separator. During unloading and reloading of the washer, fluid is routed from the separator reversely through the bank and back to the separator to backwash the cartridges and remove collected solids from the system. An option by-passes the forward flow through the bank around the washer upon resumption of forward flow through the bank for removal of solids deposited on the output sides of the cartridges.

CROSS REFERENCE TO A RELATED APPLICATION

This application is a continuation-in-part of my copending application Ser. No. 741,522, filed July 1, 1968, and now abandoned.

BACKGROUND OF THE INVENTION

This invention relates generally to the cleaning or decontamination of fluid in an apparatus in which fluid is circulated repeatedly through a work station, picks up contamination in the work station, and is cleaned prior to recirculation, and relates specifically to such an apparatus in which initial cleaning of the fluid is accomplished with a Hydroclone separator for removing larger solid particles, and final cleaning or polishing is accomplished by passing the pre-cleaned fluid through one or more final cleaners, preferably in cartridge form and including at least one filter for collecting solid particles that have been passed by the Hydroclone.

The invention has particular reference to a drycleaning apparatus in which the work station is a so-called "washer" where drycleaning fluid or solvent is passed through a batch of articles to be cleaned, and is circulated through the decontaminating portion of the apparatus for cleaning of the fluid after each pass through the washer and preparatory to recirculation through the apparatus. Filter cleaners have been used in this environment, along with chemical cleaners for removing dissolved contaminants, but the limited life of the cleaners due to clogging by collected solids has been a problem in operation, making the operating cost somewhat higher and requiring more frequent attention from the operator than had been anticipated.

SUMMARY OF THE INVENTION

The primary object of the invention is to provide a new and improved method and apparatus for decontaminating such fluid and, at the same time, substantially increasing the service life of the final cleaners used, thereby reducing both the cost of cleaners in operation and the time and labor required for replacement of spent cleaners. A more detailed object is to use the available components of the apparatus to remove collected particles periodically from the cleaners to renew the latter

for reuse, and also to remove the collected particles from the system and the circulating fluid in order to avoid rapid reclogging of the cleaners upon resumption of the normal cycle. Another object is to take advantage of normal and recurring inactive time at the work station to renew the cleaners without interfering with the normal sequence of operations.

Other objects and advantages of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary side elevational view of a drycleaning and fluid-decontaminating apparatus embodying the novel features of the present invention.

FIG. 2 is a schematic view similar to FIG. 1 and illustrating the normal routing of fluid through the apparatus.

FIG. 3 is another schematic view illustrating the alternate routing of fluid for renewal of the final cleaners.

DETAILED DESCRIPTION

As shown in the drawings for purposes of illustration, the invention is embodied in a cleaning apparatus for circulating fluid through a work station **10** such as a conventional drycleaner, hereafter called the "washer," and decontaminating the fluid after passage through the washer by passing the fluid first through a Hydroclone separator **11** for removal of larger solid contamination particles and then through one or more final cleaning elements for final cleaning and polishing of the fluid before it is recycled through the washer. Herein, the final cleaning elements are arranged in a bank **12** of cartridges including two cartridges **13** of filter paper for straining out solid particles passed by the Hydroclone, and also one chemical cartridge **14** for removing dissolved contaminants such as grease and dyes.

Hydroclones suitable for use with the invention are known in the art, the illustrative Hydroclone **11** having a conical treating chamber **15** in a body **17** into which dirty fluid from a reservoir **18** is introduced by a pump **19** through an inlet pipe **20**, herein into a cylindrical extension **21** on the larger end of the chamber **15**, to create a vortical flow of fluid toward the smaller end of the chamber. An underflow outlet at **22** opens through an inverted subcone **23** into an underflow chamber shown at **24**, this chamber being connected by a pipe **25** to the inlet **27** of an underflow pot **28**. In a manner well known in the art, the Hydroclone separates solid particles from the fluid and produces a reverse flow of clean fluid upwardly toward the larger end of the conical chamber and out through an outlet pipe **29**. The separated solid particles pass downwardly through the underflow chamber **24** to the underflow pot **28** and preferably are collected in a removable filter bag (not shown), the accompanying fluid being drained through a pipe **30** back to the fluid reservoir **18** of the apparatus.

Although Hydroclones are highly effective in removing solid particles from fluid, a relatively small percentage of the total solid contamination passes through the Hydroclone **17**, particularly particles in the smaller size ranges, and leaves the separator with the output flow in the pipe **29**. The filter cartridges **13** have papers capable of collecting virtually all particles above a selected size so that the flow out of the filters is of closely controlled cleanliness with repect to the size of any entrained solid particles. The chemical cartridge **14** has a chemical bed such as activated charcoal capable of removing dissolved contaminants from the flow through the bed, and is included for removal of free dyes from fabrics in the work chamber and other soluble contamination.

It will be seen in the drawings that the cartridge bank **12** is fed by a single branch **31** from the output pipe **29** and that the three cartridges are connected in parallel between this branch and a pipe **32** leading to the washer **10**. A manifold **33** divides the output of the Hydroclone **11** into three flows which enter the outer portions of the respective cartridges, pass through the paper or chemical therein, and then exit through center passages **34** in the cartridges connected through three outlets **35** to the pipe **32**. Thus, only part of the output flow passes through each cartridge, and all of the flows are combined to pass through the washer. It has been found that this division is practical in service use, and that the repeated cycling of the fluid through the system results in satisfactory filtering and chemical treatment of the whole body of fluid circulating in the apparatus.

After passing through the washer **10** and a batch of articles therein, the fluid returns to the reservoir **18** through a pipe **37** for recycling through the decontaminating apparatus by the pump **19**. Initially, the fluid picks up a substantial amount of contamination during each pass through the washer, but the amount becomes progressively smaller as the operation continues, until finally the articles attain the desired degree of cleanliness and the operation is terminated. This preferably is set up on a timed cycle which experience indicates is long enough to accomplish the desired result.

The service life of the filter cartridges **13** depends upon the concentration of solids in the Hydroclone output, the resultant rate of build-up of solids in cakes on the outer sides of the filter papers, and the clogging of the pores of the paper by the solids. Since part of the Hydroclone output also passes through the charcoal cartridge **14**, this cartridge also is subject to clogging by accumulated solids. It will be evident that replacement of cartridges is a substantial factor in the operating cost of the apparatus and, in a commercial drycleaning establishment, this is a primary area of concern, both as to cost of cartridges and as to labor and "down time" required for servicing of the apparatus.

The present invention contemplates a novel apparatus and method for decontaminating fluid that significantly increase the service life of the cleaners by periodically removing collected solids from the upstream sides of the cleaning elements with a reverse flow of fluid for backwashing the elements, and returning this reverse flow, together with the collected solids, through the Hydroclone **11** for separation of the solids and removal of the same from the system. Moreover, the renewal of the cleaning elements is accomplished during recurring inactive periods in the use of the apparatus, the unloading and loading periods in a drycleaning apparatus, to avoid interference with normal service use of the apparatus.

In this instance, the normal route of fluid from the Hydroclone **11** is as previously described, passing through the bank **12** of cartridges to the washer **10** and then back to the reservoir **18** for recirculation, and an alternate route is defined by a pipe **38** connecting the output pipe **29** through a normally closed valve **39** to the pipe **32** normally receiving the output of the cartridges. A normally open valve **40** is interposed in the pipe **32** between the washer and the cartridges, and a second normally open valve **41** is interposed in the output pipe **29** upstream from the inlet **31** of the cartridge bank. A normally closed valve **42** is placed in an extension **43** of the output pipe **29** beyond the cartridge bank connecting the output pipe to the intake pipe **44** extending between the pump **19** and the reservoir **18**. These four valves are selectively operable to change the fluid routing from the normal, service route to the alternate, backwashing route and back to the normal route when backwashing is completed.

As shown in FIG. 2, representing the normal routing, the valve **41** in the output pipe **29** is open and the valve **39** in the connecting pipe **38** is closed so that all fluid from the Hydroclone **11** must flow from the output pipe to the bank **12** of cartridges. The valve **42** in the extension **43** is closed, forcing all the flow through the bank to the pipe **32** to the washer **10**, and the valve **40** is open to pass this flow into the washer and thence back to the reservoir **18**.

With a fresh batch of articles to be cleaned in the washer **10** and the valves set for the normal flow, operation of the pump **19** results in a continuous flow of clean fluid through the washer, injection of dirty fluid into the Hydroclone **11**, passing of precleaned fluid through the cartridge bank **12**, and return of finally cleaned and polished fluid through the washer to continue removing contamination from the batch in a continuous and repeating cycle until the articles have been cleaned to the extent desired. Accompanying the cleaning of the articles, of course, is a continuous removal of most of the solid contamination by the Hydroclone, filtering of additional solid contamination by the filter cartridges **13**, and removal of dissolved contamination (and some incidental filtering of solids) by the charcoal cartridge **14**.

At the end of the normal cleaning cycle, for example, after a timed interval of fifteen to thirty minutes, the flow to the washer **10** is terminated, the bulk of the fluid remaining in the washer is dumped, and the remainder of the fluid is extracted by spinning so that the cleaned articles may be removed for insertion of a new batch. Herein, the termination of cleaning is accompanied by switching to the alternate fluid routing (FIG. 3), the valve **41** being closed to stop forward flow to the cartridge bank **12**, the valve **39** being opened to admit fluid through the connecting pipe **38** to the outlets **35** of the bank, the valve **40** being closed to block flow to the washer, and the valve **42** being opened to permit the reverse flow of fluid from the bank to return to the intake pipe **44** between the pump **19** and the reservoir **18**.

Since the pump **19** may continue to run, the clean output of the Hydroclone **11** is forced through the outlet pipes **35** into the center passages **34** of the cartridges to flow outwardly through all three cartridges. This reverse flow dislodges all free solids collected on the other sides of the cleaning elements and flushes the particles out through the manifold **33** and the pipe **31** to the extension **43**, and thence into the pump intake pipe **44**.

Accordingly, the collected particles removed from the cleaning elements are routed back through the Hydroclone **11** and are removed from the backwash fluid, which continues to flow reversely through the cartridge bank **12** until the valves **39**, **40**, **41** and **43** are returned to normal condition, for example, for five to ten minutes. The period of time is the normal free time during dumping, extraction, unloading and reloading, so that backwashing may be completed to a satisfactory extent by the time that the washer **10** is ready to resume operation with the valves in the condition shown in FIG. 2. Of course, the cleaning elements selected must have sufficient strength to withstand both forward and reverse flows of fluid at the output pressure of the hydroclone **11**.

An important aspect of the invention is based on the discovery that the use of the cartridges **13** with the Hydroclone **11** together with the backwashing of the cartridges materially increases the effectiveness of the Hydroclone in removing the fine particles from the fluid. Thus, as is characteristic of this type of separator, the Hydroclone **11** is quite effective in removing relatively large particles and the effectiveness of the Hydroclone decreases as regards finer particles. As a result, the very fine particles pass through the outlet of the Hydroclone and collect on the cartridges. It has been found that a significant number of these fine particles join together in groups as agglomerates which, in effect, are the same as particles of a larger size. When the cartridges are backwashed, therefore, the

agglomerates are readily removed from the fluid during the next flow through the Hydroclone.

The control valves **39, 40, 41** and **43** may take different well-known forms, one satisfactory type being pressure-actuated sleeve-type valves in which actuating fluid such as air under pressure from a common source (not shown) is introduced through pilot lines **45** (FIG. 1) to close the valves, the pressure being released to open the valves. Such valves are sold by Airmatic Valve, Inc. under the trademark "Tube-O-Matic." The pump **19** preferably is of the centrifugal type capable of delivering contaminated fluid under the optimum pressure for the particular Hydroclone **11** used. Design parameters of Hydroclones vary in known manner with the particular fluids and contaminants being handled, and do not form a part of the present invention.

It will be apparent that the reverse flow of backwashing fluid may deposit a coating of small particles on the inner sides of the cleaning elements, and that these coatings will be discharged, at least in part, toward the washer **10** when the normal flow is resumed. While such a discharge is not necessarily harmful to the dirty articles in the washer, and will be removed as the fluid again passes through the washer and the bank, an optional by-pass line may be provided to continue by-passing the washer after resumption of the normal flow through the bank until the inside coating has been cleared away. This line is illustrated in FIG. 3 in dot-dash lines at **47**, and includes a valve **48** which will be opened at the beginning of forward flow through the bank, the valve **40** remaining closed so that the initial, flushing flow is returned through line **47** to the reservoir **18**. After a short interval, the valve **47** is closed and the valve **40** is opened, thereby resuming the flow through the washer.

From the foregoing, it will be seen that the present invention provides a practical method and apparatus for significantly extending the useful life of the final cleaning elements and using the existing separator **11** of the apparatus for removing the collected solids from the system before those solids are returned to the final cleaning elements **13, 14** after resumption of normal operation. In a commercial drycleaning installation, for which the apparatus and method were designed, the result is a material reduction in operating costs without interference with normal operation and without substantial additional cost of equipment.

I claim as my invention:

1. A drycleaning apparatus having, in combination, a washer for holding a batch of articles to be cleaned, a Hydroclone separator, a final cleaning bank including at least one filter for collecting particles passed by said separator; a pump for feeding fluid to and through said separator; means defining a normal route for the fluid from said pump through said separator, then through said bank and said washer, and then back to said separator for repetitive recirculation through said apparatus; means defining an alternate route for the fluid from said pump through said separator, reversely through said bank and back through said separator, by-passing said washer; and selectively operable flow means for controlling the circulation of said fluid first along said normal route for cleaning of a batch of articles in said drycleaner, removal of solid particles by said separator, and collection of passed particles by said bank, and then along said alternate route for cleaning of said bank for reuse in a subsequent cycle and accompanying removal of collected particles by said Hydroclone before resumption of circulation along said normal route to clean another batch of articles.

2. A drycleaning apparatus as defined in claim **1** in which said flow means return the fluid from said bank directly to said pump during circulation along said alternate route.

3. A drycleaning apparatus as defined in claim **1** in which said flow means direct fluid from said bank directly to said washer upon resumption of circulation along said normal route.

4. A drycleaning apparatus as defined in claim **1** in which said flow means include a line for by-passing fluid from said bank around said washer upon resumption of forward flow through said bank, and valving for directing the fluid to said washer after a selected interval of such by-passing.

5. Apparatus for decontaminating fluid contaminated as the fluid flows through a work station, said apparatus having, in combination, a Hydroclone separator, a final cleaning bank including at least one filter for collecting particles passed by said separator, a pump for feeding fluid to and through said separator; means defining a normal route for the fluid from said pump through said separator, then through said bank and said station, and then back to said separator for repetitive recirculation through said apparatus; means defining an alternate route for the fluid from said pump through said separator, reversely through said bank and back through said separator, by-passing said station; and selectively operable flow means for controlling the circulation of said fluid first along said normal route through said station, removal of solid particles by said separator, and collection of passed particles by said bank, and then along said alternate route for cleaning of said bank for reuse in a subsequent cycle and accompanying removal of collected particles by said Hydroclone before resumption of circulation along said normal route through said station.

6. The method of drycleaning batches of articles in a drycleaning apparatus including a washer, a Hydroclone separator, a bank of final cleaning elements including at least one filter, and means for circulating fluid through said apparatus, said method including the steps of, passing fluid through said washer and a first batch of articles therein, then through said separator for removal of solid particles of contamination, and then through said bank for final cleaning including filtering of smaller particles passed by said separator; returning fluid from said bank to said washer and continuing such circulation through the apparatus until the batch is substantially clean; terminating the flow of fluid through said washer while directing the flow from said separator reversely through said bank to backwash the final cleaning elements, and returning the reverse flow through said bank to said separator for removal of solid particles from the backwashing flow; removing said first batch of articles from said washer and inserting a second batch prior to resuming the passage of fluid through the washer; and terminating said backwashing flow and resuming the initial flow to clean said second batch, remove solid particles from the fluid after passage through said washer, and final clean the fluid from said separator with said cleaning elements prior to returning the fluid through said washer.

7. The method defined in claim **6** in which said backwashing flow is initiated upon termination of the flow through said washer and continued through removal of said first batch and insertion of said second batch, and is terminated as soon as said second batch is ready for cleaning.

8. The method of decontaminating fluid in an apparatus including a work station, a Hydroclone separator, means for circulating fluid under pressure through said separator for removal of solid particles from the fluid and through said station for reuse, and a filter for final-cleaning the fluid output of said separator, said method comprising the steps of, passing fluid through said station, said separator and said filter in a continuous and repetitive cycle whereby larger solid particles of contamination from said fluid are removed by said separator, other contaminants including smaller solid particles are removed by said filter, and clean fluid is passed back through the station and then recirculated for decontamination, terminating circulation of fluid through said station, reversing the flow from said separator through said filter

to by-pass said station and wash accumulated solids from the filter, and passing the reverse flow from said filter back through said separator for removal of said accumulated solids from the fluid by the separator.

9. The method of decontaminating fluid in an apparatus including a work station, a Hydroclone separator, means for circulating fluid under pressure through said separator for removal of solid particles from the fluid and through said station for reuse, and a filter for final-cleaning the fluid output of said separator, said method comprising the steps of, passing fluid through said station, said separator and said filter in a continuous and repetitive cycle thereby separating larger solid particles of contamination from said fluid by said separator, collecting smaller solid particles by said filter, and passing clean fluid back through the station, at least some of the smaller particles collected on said filter joining together in groups to form agglomerates, terminating circulation of fluid

through said station, reversing the flow from said separator through said filter to by-pass said station and wash accumulated solids and said agglomerates from the filter, and passing the reverse flow from said filter back through said separator for removal of said accumulated solids and agglomerates from the fluid by the separator.

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U.S. Cl. X.R.

8—142; 210—73, 167, 259; 68—18