Jan. 10, 1939. M. BUSI 2,142,995

DRY CLEANING SYSTEM

Filed March 24, 1933 2 Sheets-Sheet 1

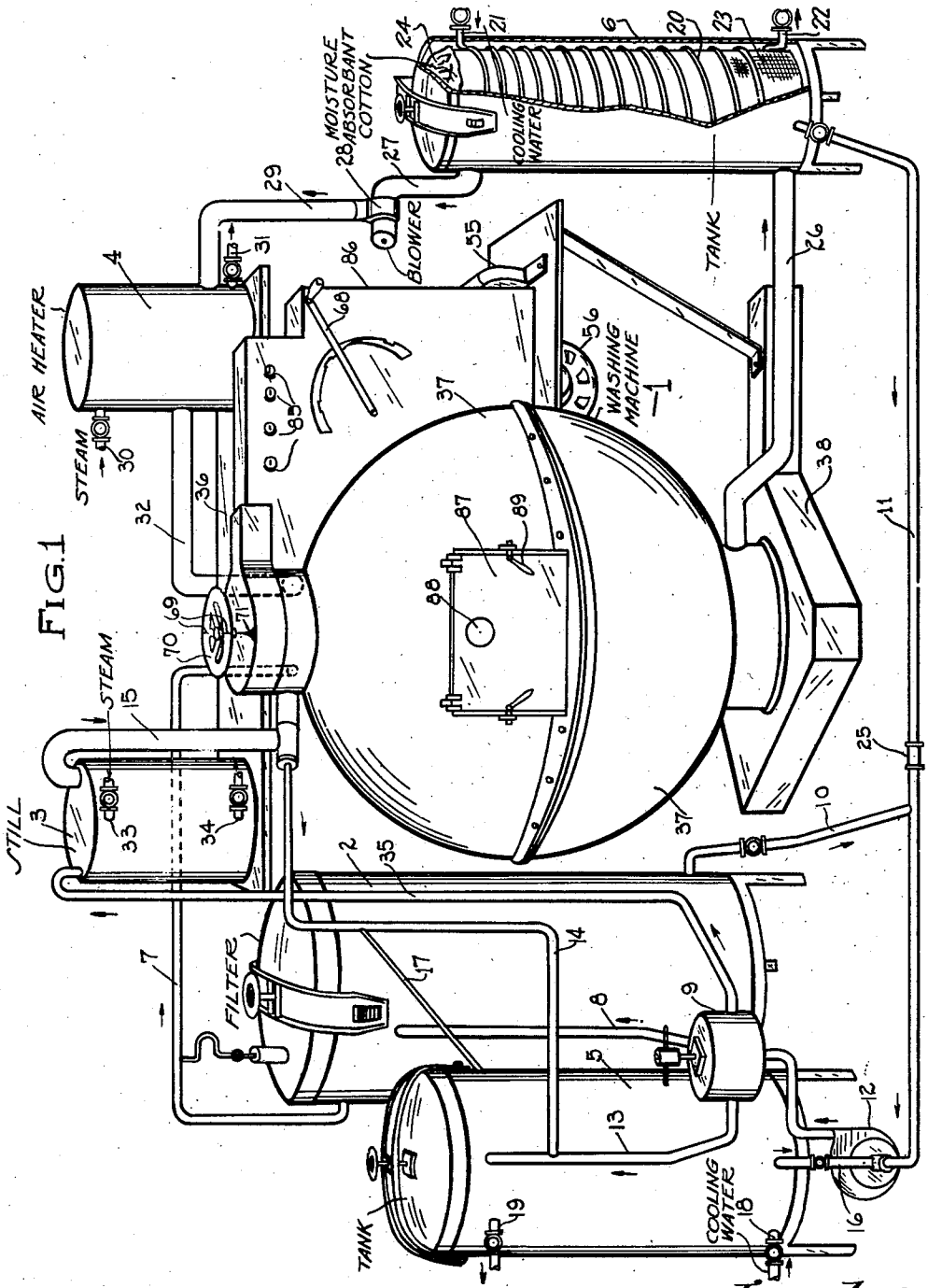

FIG. 1

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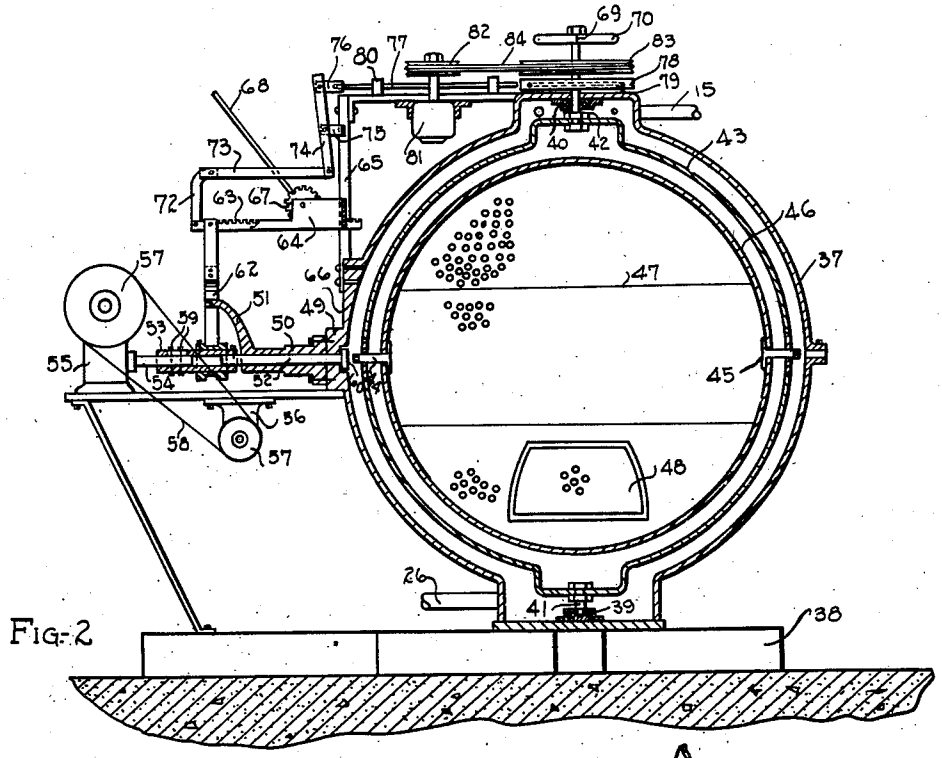

FIG. 2

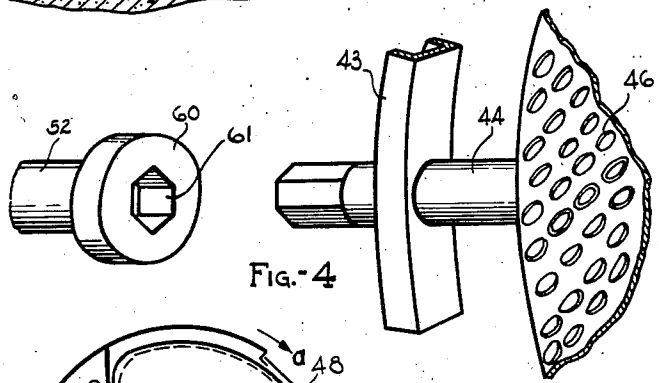

FIG. 4

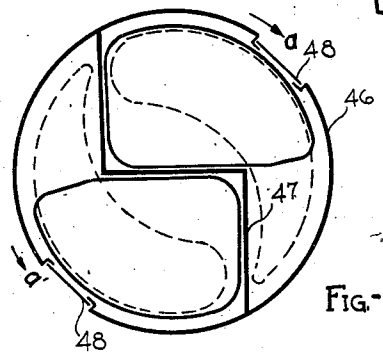

FIG. 3

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UNITED STATES PATENT OFFICE

2,142,995

DRY CLEANING SYSTEM

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Application March 24, 1933, Serial No. 662,490

8 Claims. (Cl. 68—23)

This invention relates in general to the treating of garments and other articles to restore them to their original condition, and in particular to the removing of dirt, grime, grease and other soiling matters from garments and other articles by dry-cleaning.

In my copending application filed Sept. 21, 1931, Serial Number 564,005, I have disclosed a dry-cleaning machine in which the entire dry-cleaning process may be carried out without at any time opening the machine to the atmosphere and without the necessity of distilling the fluid, which articles treated naturally hold, either by directly applied heat or by heat applied through the medium of a current of air. The present invention contemplates a novel dry-cleansing process and novel apparatus especially suited for carrying out the novel process.

The novel process is particularly distinguished from the prior processes by reason of the fact that at no time are the articles treated moved through a liquid body of fluid. Thus during the washing step the articles are set in motion while dry and the fluid passed to them in the form of a coarse spray after their normal washing movement is established. For this reason the power required to start and carry on the washing step is only a small fraction of that required with the prior processes, and I am able to operate a machine having the capacity equal to that of the largest machines at present available with a motor of about ¼ H. P. whereas said present available machines when operating in accordance with the prior processes require motors of from 3 to 5 H. P.

The capacity of the dry-cleaning machine of this invention is much greater than that of my said copending application by reason of a partition which subdivides the bowl thereof into a plurality of compartments. The partition not only increases the capacity of the machine but also, when the bowl is rotated from different ends of its axis of suspension provides different paths for the articles during the washing step so that two degrees of intensity of movement of the articles treated may be had without changing the speed of rotation of the bowl.

With the improved dry-cleaning machine I have associated a minimum number of containers so inter-connected with each other and with the machine that several of them serve a plurality of purposes; thus I reduce the size, cost and weight of the system. I have designed one of these containers to act as a very efficient lint and moisture trap so that the ordinary troubles arising from lint and moisture do not occur in the use of my system. By reason of the novel washing step the amount of fluid required for washing is only a small fraction of that usually required and I can successfully carry on my novel process with minimum expenditure for fluid.

It is an object of this invention to provide a dry-cleaning process of such a nature that at no time during the carrying on of which are the articles treated immersed in or moved through a liquid body of fluid, and during the washing step of which the articles treated are subjected to a coarse spray of fluid as they are moved or otherwise agitated to free them from dirt.

It is a further object of this invention to provide a dry-cleaning system which includes a minimum of parts some of which are adapted to serve a plurality of purposes, one of said parts being adapted to serve as a lint and moisture trap and to effectively remove lint and moisture from the system.

It is a still further object of this invention to provide a dry-cleaning machine which includes a subdivided spherical bowl of large material to be treated capacity per unit volume which bowl may be driven from either end of its axis of suspension so that a plurality of degrees of intensity of movement of the articles treated may be had during washing without change in speed of rotation of the bowl.

Further objects and advantages of the invention will be apparent from a consideration of the description which follows taken with the accompanying drawings, in which

Fig. 1 is a perspective view of my novel dry-cleaning system,

Fig. 2 is a part sectional view of the dry-cleaning machine showing its construction and its driving arrangements,

Fig. 3 is a sectional view of the bowl taken on line 3—3 of Fig. 2, and

Fig. 4 is an enlarged detailed view of part of the driving arrangement for the bowl.

The novel system as shown in Fig. 1 comprises a dry-cleaning machine, a filter 2, a distilling vessel 3, an air heater 4, a tank 5 and a tank 6. Filter 2 is of well-known construction and includes an outlet near its top which is connected by line 7 to the top of machine 1, an inlet also near its top which is connected by line 8 to one of the outlets of plug type multi-outlet valve 9, and an evacuating outlet near its bottom which is connected by valved line 10 and line 11 to the inlet of motor operated fluid pump 12. Filter 2 as well as tanks 5 and 6, includes a readily openable top which is normally held in closed position by means of the

well-known construction shown. By means of the tops just mentioned ready access may be had to the inside of filter 2 and tanks 5 and 6 for cleaning, inspection and repair. A valved vent line connects the top space of filter 2 to line 7 so when desired or necessary the air which from time to time collects in the top space of filter 2 may be evacuated therefrom.

Tank 5 has an opening near its top which connects it through line 13 to one of the outlets of valve 9. Line 13 also connects to line 14 which opens in large line 15. Tank 5 also has an opening in its bottom which connects it through valved line 16 to the inlet of pump 12. A vent line 17 also connects tank 5 to line 14. Tank 5 houses a cooling coil not shown which is supplied with cold water through valved water inlet 18. A valved outlet 19 allows the cooling water to leave the coil of tank 5.

Tank 6 is similar in construction to tank 5 and as shown includes a cooling coil 20 which closely nestles to its sides. Cooling water enters coil 20 through valve inlet 21 and leaves it through valved outlet 22. Within tank 6 is an open ended cylinder 23 made of foraminous material. Cylinder 23 has its sides in close proximity with the coils of coil 20. In the open top of cylinder 23 is a bag 24 of moisture absorbent material such as cotton or wool fibre. Valved line 11 connects an opening adjacent to the bottom of tank 6 with the inlet of pump 12. Line 11 includes a check valve 25 between its valve and its connection with line 10. Check valve 25 is so arranged that it prevents the flow of fluid from either line 16 or line 10 to the bottom of tank 6. Also adjacent to the bottom of tank 6 is an enlarged opening which connects through air line 26 to the bottom of dry-cleaning machine 1. Adjacent to the top of tank 6 is a second enlarged opening which connects through air line 27 to the inlet of the air blower 28. The outlet of blower 28 is connected through air line 29 to air heater 4.

Air heater 4 houses a steam coil, not shown, which is supplied with steam through valved inlet 30. The condensate leaves the steam coil through valved outlet 31. A baffle, not shown, is provided in heater 4 to increase the length of the air path and assure proper contact of the air with the steam coil. A second enlarged opening in heater 4 connects through air line 32 to the top of dry-cleaning machine 1. Distilling vessel 3 also houses a steam coil, not shown, which is supplied with steam through valved inlet 33 and from which the condensate flows through valved outlet 34. A large vapor line 15 connects the top of vessel 3 to the top of dry-cleaning machine 1. A line 35 also connects one of the outlets of valve 9 to the top of vessel 3. Vessel 3 and heater 4 are supported on a support 36 which may be fastened to the wall of the enclosure which houses the system.

Dry-cleaning machine 1 includes an outer spherical container 37 made up of similar united hemi-spherical halves. Container 37 is fastened to a suitable footing 38 which if desired may be fastened to the floor of the housing of the system. In the top and bottom of container 37 are fastened ball bearings 39 and 40, ball bearings of the self aligning type being preferred, in which are journalled shafts 41 and 42 that are connected to ring 43. At right angles to the axis defined by shafts 41 and 42 ring 43 is provided with bearings, preferably ball bearings, in which are journalled the shafts 44 and 45 that are fastened to spherical container or bowl 46. Spherical container 46 is perforated throughout and has fastened within it a partition member 47, also perforated and of a shape approximating a Z, which divides perforated container 46 into similar halves. Doors 48 are provided for access to each of the halves of perforated container 46. Suitable means, not shown, are provided for holding doors 48 closed during the operation of the machine. The ends of shafts 44 and 45 which extend outside of ring 43 are formed in the shape of a hexagon for a purpose hereinafter explained.

A bushing 49 forms part of container 37 and has fastened thereto a second bushing 50 that includes fulcrum defining member 51. A shaft 52 is journalled in bushings 49 and 50. One end of shaft 52 is pinned to a sleeve 53. Sleeve 53 also encircles shaft 54 of speed reducer 55. Speed reducer 55 is driven by motor 56 through pulleys 57 and belts 58. Sleeve 53 includes a pair of elongated slots between the ends of which are bolts 59 fastened to shaft 54. Bolts 59 serve to transmit the rotation of shaft 54 to sleeve 53 and shaft 52, also they serve to limit the longitudinal movement of sleeve 53 relative to shaft 54. The other end of shaft 52 terminates in a socket member 60 having a hexagonal recess 61 therein in which are adapted to fit the hexagonal ends of shafts 44 and 45.

On fulcrum member 51 is pivoted a Y shaped lever 62 whose ends are provided with rollers, not shown, that fit in the groove of sleeve 53. The upper end of lever 62 is pivoted to one end of a rack 63 which is supported for movement in member 64. Member 64 is fastened to angle irons 65, one only being shown in Fig. 2, which in turn are fastened to extension 66 of container 37. A pinion 67 mounted for rotation in member 64 moves with rack 63. One end of the shaft on which pinion 67 is fixed carries a lever 68. Thus by movement of lever 68 pinion 67 rotates and moves rack 63. Rack 63 in turn moves lever 62, sleeve 53 and shaft 52 so that socket 60 may be moved into and out of engagement with either of shafts 44 and 45. To assure ready alignment of shafts 52 and shafts 44 and 45 two markers 69 are placed on wheel 70, which is fastened to the end of shaft 42 and through which ring 43 may be manually rotated, so that by bringing either of markers 69 into registry with index 71 shafts 52, 44 and 45 will be aligned.

To one end of rack 63 is fastened a member 72 to which is pivoted one end of link 73. The other end of link 73 is pivoted to lever 74 which is fulcrumed intermediate its ends on support 75. Lever 74 is also pivoted to a member 76 in which is journalled the middle of U shaped rod 77. The ends of the U extend to disc 78 and are adapted to enter bores 79 therein. Rod 77 is maintained horizontal by reason of a plurality of supports 80 through which it passes.

Upon movement of lever 68 for engagement of socket 60 and either of shafts 44 and 45 or rod 77 will move towards disc 78.

The linkage described which operates rod 77 is so arranged that upon initial movement of lever 68 rod 77 will contact with the periphery of disc 78 and prevent further movement of lever 68 unless the position of bowl 37 is such that one of the other of markers 69 are in registry with index 71. By this means the movement of socket 60 at times when shafts 44 and 45 are not aligned with shaft 52 is prevented. Of course when shafts 44 and 45 are aligned with shaft 52 rod 77 enters a bore 79 and allows the movement of lever 68 to

continue as required to engage socket 60 and either shaft 44 or 45.

Ring 43, and consequently bowl 46, is rotated about the axis of shafts 41 and 42 by means of a motor 81 which drives shaft 42 through pulleys 82 and 83 and belt 84.

The circuits of the various motors have not been shown as they are too well known. However switches 85 for individually opening and closing the circuits of the motors are shown in Fig. 1 as mounted on the guard 86 which covers the driving elements of dry-cleaning machine 1. For convenience guard 86 has been omitted from Fig. 2.

It is to be noticed that no matter which of shafts 44 and 45 are brought into engagement with socket 60 perforated bowl 46 always rotates in the same direction relative to container 37. However since the position of bowl 46 when socket 60 engages shaft 44 is turned through 180° relative to its position when socket 60 engages shaft 45, the effect of driving through one of the shafts represents a rotation of bowl 46 in the opposite direction to its direction of rotation when the drive is through the other shaft. Thus as best seen in Fig. 3 when the drive is through the one of shafts 44 and 45 to give rotation *a* the material in bowl 46 moves through the solid line paths and has substantially one major drop per revolution, whereas when the drive is through the other of the shafts bowl 46 has rotation *a'* and the material moves through the dotted lined paths and has substantially two major drops. Hence with rotation *a'* the agitation action is about double that obtained with rotation *a*. Because of this I am able to obtain 2 degrees of intensity of agitation without changing the speed of the drive or reversing the rotation of shaft 52.

To carry out my novel dry-cleaning method filter 2 is first completely filled with dry-cleaning fluid, preferably trichlorethylene, and the amount of fluid which the maximum load of material treated will soak up and retain, plus a few gallons excess, put in tank 5. The door 87 of container 37 is then opened by movement of closure means 89 and bowl 46 rotated about shafts 41 and 42 and/or shafts 44 and 45 until one of doors 48 is accessible. This door is then opened and its compartment loaded. The door mentioned is then closed. Due to the weight just added bowl 46 will rotate to make the other door 48 accessible. Material is then placed in the second compartment and its door 48 closed. No particular care need be taken to balance the load in the compartments as the machine is self-balancing when bowl 46 is rotating about the vertical axis and will work satisfactorily even with material in one compartment only. Door 87 is then closed and made vapor-tight by movement of closure means 89.

Wheel 70 is then rotated to bring the desired one of markers 69 into registry with index 71, after which lever 68 is moved to cause engagement of socket 60 with the one of shafts 44 and 45 adjacent to it. The circuit of motor 56 is then closed by the manipulation of its one of switches 85. It is to be noted that the material to be washed is set in motion and brought up to its maximum rotation while dry, thus the starting load on motor 56 is a minimum and I am able to operate a machine of as large a capacity as that of the largest machine of the prior art with a motor 56 of only a small fraction of the horse-power of the corresponding motors of the machines of the prior art.

The valve in line 11 is then opened as well as the valve in line 16 and the handle of valve 9 moved to place line 8 in communication with the outlet of pump 12. The proper switch 85 is then manipulated to set the motor of pump 12 in operation. Thus the fluid in tank 5 will through line 16 pass to the inlet of pump 12 and from the outlet of pump 12 through valve 9 and line 8 to the inlet of filter 2, filter 2 being always full of fluid. From the outlet of filter 2 the fluid will pass through line 7 to the top of container 37 and fall on the rotating bowl 46. Due to the perforated character of bowl 46 the major portion of the fluid will pass to the interior thereof as a coarse spray. Hence the material to be treated during the washing step is continuously agitated in a space always filled with an ever-changing body of coarse spray of the cleaning fluid. The material will thus continuously receive and reject cleaning fluid. In carrying out the washing step just described the material treated is at no time carried through a body of liquid as such, with the result that the load on washing motor 81 is never great.

The fluid after having passed through the material falls to the bottom of container 37 and exits therefrom into tank 6 through line 26. From tank 6 it will pass through line 11 to the inlet of pump 12. When the required amount of fluid, that is the amount of fluid which the particular load of material treated will absorb and retain, and an excess sufficient for circulation has been withdrawn from tank 5 the valve in line 16 is closed. This can be observed by looking through glassed peep-hole 88 in door 87. When the materials have been completely washed the circuit of motor 56 is again opened and the fluid allowed to drain from the material. The handle of valve 9 is then manipulated to connect line 13 with the outlet of pump 12 so that the fluid draining from the material is returned to tank 5.

Lever 68 is then moved to disengage socket 60 from shaft 44 or 45 and the switch of motor 81 closed. Ring 43 and bowl 46 will then rotate about the axis of shafts 41 and 42 to centrifuge substantially all of the remaining fluid from the material treated. As previously stated bowl 46 is self-balancing, that is, since it is suspended in ring 43 by shafts 44 and 45, it will always place itself so that the load is below its center and during the centrifuging the load will always properly distribute itself automatically.

The proportions of pulleys 82 and 83 and the speed of motor 81 are such that the periphery of bowl 46 at shafts 44 and 45 will attain a speed sufficiently high to throw out from the material substantially all of the retained fluid so that at the end of the centrifuging substantially only vapors of the fluid remain in the material. Pump 12 is operated from time to time during the centrifuging to pass the separated fluid into tank 5.

At the completion of the centrifuging the circuits of motor 81 and the motor of pump 12 are opened and the valve of line 11 closed. The valves of steam inlet 30 and condensate outlet 31 are then opened and the circuit of the motor that drives blower 28 closed. The valves in lines 21 and 22 are then opened to allow cooling of the air passing through tank 6. Wheel 70 is then rotated to again align one of markers 69 with index 71, after which lever 68 is moved to engage socket 60 with one or the other of shafts 44 and 45. After this is done the circuit of motor 56 is closed to set bowl 46 in rotation to tumble the material treated as the air heated in heater 4 is circulated through them.

Since the materials at this time contain only a very small amount of fluid and that in substantially vapor-form, heater 4 is so regulated to just

mildly heat the air. The thus heated air in passing through the materials picks up the vapors of the fluid and the moisture which the materials reject at the temperature of the heated air. The thus laden air passes through line 26 into tank 6. Since as previously stated the coils of coil 20 are nestled against the side of tank 6 and the foraminous cylinder 23 touches the coils, the air cannot pass directly up through tank 6 and makes at least 2 passages through foraminous cylinder 23 and in so doing gives up its lint. An amount of lint also drops in cylinder 23 due to the fact that the movement of the air therein is comparatively slow due to the large cross section of cylinder 23. Substantially all of the fluid content of the air is condensed in the lower portion of tank 6 whereas the moisture rises higher. This moisture is absorbed by the bag 24 filled with animal or vegetable fibre such as wool or cotton fibre, having a definite affinity for moisture.

The air is allowed to circulate and the materials tumbled until all of the residual cleaning fluid is removed from the material. It is to be noted that since the moisture given off by the material treated is absorbed by bag 24 undissolved water is never present in the cleaning fluid. The thus dry-cleaned materials are then removed from dry-cleaning machine 1 and are not only thoroughly cleaned and devoid of water stains but at worst have no more than just a faint trace of the odor of the cleaning fluid. With the process above disclosed since at no stage is the temperature of the materials raised to such an extent that albumen or tannin spots are fixed, the usual spotting operation may be performed either before or after the dry-cleaning.

From time to time it becomes necessary to distill the dry cleaning fluid in order to restore it to its original condition. To do this steam is passed through distilling vessel 3 by opening the valves in lines 32 and 34. Valve 9 is then manipulated to connect line 35 to the outlet of pump 12 and the valve in line 16 opened. Pump 12 is then set in operation to pass a proper amount of fluid into vessel 3. The vapors issuing from vessel 3 pass through line 15 into container 37. Some of these vapors also pass through lines 13 and 14 into tank 5. The vapors as they descend into container 37 condense by reason of the heat interchange with the walls. Because of the large surface of container 37 the condensation of the vapors usually takes place at a sufficiently rapid rate. However in the event that by reason of high external temperature the dissipation of heat through the walls of container 37 is not sufficient, blower 28 will be set in operation, the valves in line 30 and 31 of the air heater 4 being closed, to conduct the vapors in contact with the coil of tank 6.

When the fluid has been entirely removed from tank 5 the valves in lines 16 and 11 will be closed and that in line 10 opened so that the fluid will now flow from the filter to the inlet of pump 12. From time to time as the fluid collects in the bottom of container 37 and tank 6 the valve in line 10 will be closed and the valves in line 11 will be opened, valve 9 being manipulated to connect the outlet of pump 12 with line 13, so that the fluid may be removed from the bottoms of container 37 and tank 6 into tank 5. After this is done the various valves will again be arranged to allow the passage of fluid from filter 2 to distilling vessel 3. At the end of the distilling operation the separated ends are removed from distilling vessel 3, by means not shown, and the system again arranged for dry-cleaning.

It is to be noticed that container 37, tanks 5 and 6, and the air circulating system perform a plurality of functions that is, they serve as condensers during the distillation and they serve their usual function during the dry-cleaning.

I claim:

1. A dry-cleaning machine comprising an outer container, a ring supported in said outer container for rotation about an axis, an inner container within said ring, aligned shafts fixed to said inner container and extending through said ring defining a second axis of rotation, means for rotating said ring and said inner container about said first mentioned axis, means for rotating said inner container about said second axis, said rotating means last mentioned including movable means adapted to engage either of said shafts, and partition means dividing said inner container into a plurality of compartments, said partition means being such that when said movable means engages one of said shafts tumbling paths for articles are provided and when said movable means engages the other of said shafts tumbling paths of different form are provided.

2. A dry-cleaning machine comprising an outer container, a ring supported in said outer container for rotation about an axis, an inner container within said ring, aligned shafts fixed to said inner container and extending through said ring defining a second axis of rotation, means for rotating said ring and said inner container about said first mentioned axis, means for rotating said inner container about said second axis, said rotating means last mentioned including movable means adapted to engage either of said shafts, and partition means parallelly disposed to said shafts dividing said inner container into a plurality of similar compartments, said partition means being such that when said movable means engages one of said shafts tumbling paths for articles are provided and when said movable means engages the other of said shafts tumbling paths of different form are provided.

3. A dry-cleaning machine comprising an outer container, a ring supported in said outer container for rotation about an axis, an inner container within said ring, aligned shafts fixed to said inner container and extending through said ring defining a second axis of rotation, means for rotating said ring and said inner container about said first mentioned axis, means for rotating said inner container about second axis, said rotating means last mentioned including movable means adapted to engage either of said shafts, and a Z shaped partition dividing said inner container into a plurality of compartments.

4. A dry-cleaning machine comprising an outer container having a top and bottom, a ring in said container, aligned shafts fixed to said ring defining an axis of rotation for said ring, one of said shafts being journalled at the bottom of said container and the other of said shafts being journalled at the top of said container and extending therethrough, means connected to said last mentioned shaft for rotating said ring about said axis, a perforated spherical inner container within said ring, aligned shafts fixed to said inner container and extending through said ring defining a second axis of rotation for said inner container, means for rotating said inner container about said second axis, said rotating means last mentioned including movable engaging means adapted to engage either of said sec-

ond mentioned aligned shafts, and partition means dividing said inner container into a plurality of compartments, said partition means being such that when said movable engaging means engages one of said second mentioned aligned shafts tumbling paths for articles are provided, and when said movable engaging means engages the other of said second mentioned aligned shafts tumbling paths of different form are provided.

5. A dry-cleaning machine comprising an outer container having a top and a bottom, a ring in said container, aligned shafts fixed to said ring defining an axis of rotation for said ring, one of said shafts being journaled at the bottom of said container and the other of said shafts being journalled at the top of said container and extending therethrough, means connected to said last mentioned shaft for rotating said ring about said axis, a perforated spherical inner container within said ring, aligned shafts fixed to said inner container and extending through said ring defining a second axis of rotation for said inner container, means for rotating said inner container about said second axis, said rotating means last mentioned including movable engaging means adapted to engage either of said second mentioned aligned shafts, partition means dividing said inner container into a plurality of compartments, said partition means being such that when said movable engaging means engages one of said second mentioned aligned shafts tumbling paths for articles are provided and when said movable engaging means engages the other of said second mentioned aligned shafts tumbling paths of different form are provided and means movable with said movable engaging means adapted to prevent rotation of said ring when either of said second mentioned aligned shafts are in alignment with said movable engaging means and adapted to prevent movement of said movable engaging means when neither of said second mentioned aligned shafts are in alignment with said movable engaging means.

6. In a combined washing, extracting and drying machine, comprising a stationary outer container, an inner container surrounded by said outer container and mounted for rotation about a pair of different axes without shifting the position of said inner container, means for rotating said inner container about one of said axes, means operatively connected to said first named means for locking said inner container against rotation about said other axis prior to initiation of rotation about said first axis, said axes of rotation extending through said inner container at an angle to each other.

7. A dry-cleaning machine comprising an outer container, a perforated inner container adapted for rotation within the outer container, a pair of trunnions projecting outwardly upon opposite sides of the inner container and defining the axis of rotation of said inner container, means for introducing a cleaning fluid into and removing it from the outer container, means rotatable in one direction adapted to be selectively coupled to either of the trunnions for rotating the container in either direction, and a partition of stepped form within the inner container, the step of said stepped partition extending substantially parallel to the axis of rotation of said inner container.

8. A dry-cleaning machine comprising an outer container, a perforated spherical inner container, a pair of trunnions projecting radially outwardly upon opposite sides of the inner container and defining the axis of rotation of said inner container, means for introducing a cleaning fluid into and removing it from the outer container, means rotatable in one direction adapted to be selectively coupled to either of the trunnions for rotating the container in either direction, and a partition of stepped form within the inner container, the step of said stepped partition extending substantially parallel to the axis of rotation of said inner container.

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