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(54) DRY CLEANING AND LAUNDRY APPARATUS

(71) I, MASAJI SHIBATA, a Citizen of Japan of 23, No. 30, Kamishima-cho, Kadoma-City, Osaka, Japan, do hereby declare the invention, for which I pray that a Patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to dry cleaning and laundry apparatus.

It is an object of the present invention to provide improved cleaning apparatus which can be used for both dry cleaning and laundring.

According to the invention there is provided dry cleaning and laundry apparatus comprising the combination of a liquid-tight tank, a drum rotatably mounted in said tank and having an apertured side wall for passing cleaning fluids therethrough, means for supplying selected fluids to the interior of said tank, means for discharging fluids from the interior of said tank, and at least two substantially parallel series of cylindrical brushes mounted within said drum and spaced apart for holding articles to be cleaned between the two series of brushes, said brushes being rotatable with said drum and also individually rotatable relative to said drum, said brushes also being elongated in the direction of the axis of rotation thereof and longitudinally movable relative to said drum whereby said brushes may be withdrawn from said drum to facilitate the placement of articles to be cleaned between said series of brushes.

A preferred embodiment of the invention will now be described, by way of example, reference being made to the accompanying drawings, in which:—

Figure 1 is a perspective view of a mobile unit which includes dry cleaning and laundry apparatus in accordance with the invention;

Figure 2 is an enlarged perspective of the rear portion of the apparatus of Figure 1 with the door open and with fragments broken away to show the internal structure;

Figure 3 is an enlarged side elevation of part of the apparatus of Figure 1, with the

outside housing and the end portions of the interior drum shown in section;

Figure 4 is an enlarged rear end elevation of the apparatus of Figure 3 with the rear end plate of the cylindrical tank removed;

Figure 5 is the same enlarged rear end elevation as in Figure 4 with the entire cylindrical tank removed;

Figure 6 is an enlarged fragmentary view of a portion of the cleaning elements in the apparatus of Figure 1, with the lower cleaning elements partially withdrawn from the drum;

Figure 7 is a schematic end elevation of the drum and cleaning elements in the apparatus of Figure 1 in a first operative position;

Figure 8 is a schematic end elevation of the drum and cleaning elements in a second operative position; and

Figure 9 is a schematic diagram of the fluid supply and discharge system.

Referring to Figure 1, a truck T has cleaning equipment C embodying the present invention mounted on the back thereof to provided a mobile and dry cleaning apparatus. The cleaning equipment C includes a cylindrical tank 1 containing an open-ended drum 2 mounted for rotation concentrically within the tank 1 and forming an annular cavity 3 between the walls of the tank 1 and the drum 2. The drum 2 is fixed to and supported by a longitudinal shaft 10 which is journaled in a bearing assembly 15 on the inside of the rear wall of the tank 1, and which extends through the front wall of the tank 1 where the front end 11 of the shaft is journaled in a front bearing assembly 12. To permit the passage of fluids radially through the drum 2, the walls 4 thereof are apertured at regular intervals as at 5, and the ends 6 and 7 of the drum are completely open, except for two transverse mounting bars 8 and 9, to permit the passage of fluids axially therethrough. The mounting bars 8 and 9 extend diametrically across the open front and rear ends, respectively, of the drum 2 and are rigidly secured to the side walls of the drum 2. The two transverse bars 8 and

9 are secured to the shaft 10 by means of a pair of hubs 8a and 9a, respectively.

For the purpose of rotating the drum 2 within the stationary tank 1, the front end 11 of the shaft 10 is secured to a pulley 41 which is driven via belt 25 (Figure 9) by a hydraulic motor 24. The hydraulic motor 24 in turn is supplied with pressurised hydraulic fluid from a hydraulic pump 23 which is driven by a belt 42 connected to a main drive shaft 22 powered by the engine (not shown) of the truck T.

At least two substantially parallel series of brushes are mounted within the drum and spaced apart for holding articles to be cleaned between the brushes, with the brushes being rotatable with the drum and also individually rotatable relative to the drum. The brushes are also elongated in the direction of the axis for rotation thereof and are longitudinally movable relative to the drum so that the brushes may be withdrawn from the drum to facilitate the placement of the articles to be cleaned between the brushes. In the illustrated embodiment, three parallel groups of elongated brushes are arranged in concentric semi-circular series 51, 52 and 53 in one half of the drum 2, and three similar parallel groups of brushes are arranged in concentric semi-circular series 54, 55 and 56 in the other half of the drum 2. The three series of brushes in each half of the drum are spaced apart from each other so that the spaces between adjacent series of brushes can be used to hold the articles to be cleaned. To permit rotation of the individual brushes within each series, such as the brushes 51a, 51b, 51c, etc. in brush series 51, each of the individual brushes is journaled in two semi-circular mounting bars at opposite ends of the drum 2. Thus, each of the individual brushes within the series 51 is journaled in a pair of semi-circular mounting bars 16a at opposite ends of the drum 2. Similarly, the brushes in series 52 to 56 are journaled in mounting bars 16b to 16f, respectively. Thus, each of the individual brushes is independently rotatable relative to the drum 2.

In addition to being rotatable relative to the drum, all of the brushes in the six series 51 to 56 are also rotated along with the drum 2. For this purpose, each of the semi-circular mounting bars 16a to 16f for the six series of brushes are connected to the two transverse mounting bars 8 and 9. Thus, as the drum 2 is rotated within the tank 1, all of the longitudinally elongated brushes in the six series 51 to 56 are rotated along with the drum, and at the same time are free to rotate individually relative to the drum.

In order to facilitate the insertion of articles to be cleaned into the semi-circular spaces between adjacent brush series, and also to facilitate subsequent removal of the articles

from such spaces, each of the six brush series is mounted for sliding longitudinal movement relative to the drum 2. Thus, as can be seen most clearly in Figures 5 and 6, each of the six pairs of semi-circular mounting bars 16a to 16f is connected to a pair of longitudinal rods which interconnect the semi-circular mounting bars 16 associated with each brush series. The pair of mounting bars 16a that carry the brush series 51 are connected to a pair of longitudinal rods 18a and 20a which extend longitudinally through the drum 2 to interconnect the two semi-circular bars 16a. To permit longitudinal movement of the rods 18a and 20a, and thus of the entire brush series 51, relative to the drum 2, each of the longitudinal rods 18 and 20 is telescoped within an elongated tubular member 19 extending between and connected to the two transverse mounting bars 8 and 9. The open rear end of each tubular member 19 registers with a complementally formed opening in the rear mounting bar 9, and each such opening also includes a slot 19a extending to one of the edges of the bar 9 so as to permit the connection between the semi-circular mounting bar 16 and the rod 18 or 20 to pass through the bar 9. Consequently, as illustrated in Figure 6, any of the brush series 51 to 56 can be withdrawn through the open rear end of the drum 2 when the rear door 26 of the tank 1 is open, and when the brush series to be withdrawn is positioned in the lower half of the drum. As can be seen in Figure 6, withdrawal of the brush series positioned in the upper half of the drum is blocked by the transverse mounting bar 14 which extends diametrically across the end of the tank 1 for supporting the bearing assembly 15. In Figure 6 the two brush series 54 and 55 are shown partially withdrawn from the drum 2, and it can be seen this exposes the space between the two brush series to facilitate the placement of articles A to be cleaned therein. After the placement of articles A between the brush series 54 and 55, the brush series are then returned within the confines of the drum 2 and after the cleaning operation has been completed they are withdrawn again to facilitate removal of the cleaned articles.

Each series of brushes is also mounted for reciprocating movement in response to rotation of the drum 2 so that the individual brushes rotate back and forth against the surfaces of the articles to be cleaned to enhance the cleaning action. Thus, as can be seen in Figures 4 to 6, the tubular member 19 and the register openings in the bars 8 and 9 at one end of each pair of semi-circular series of brushes is circumferentially elongated so that the corresponding brush-supporting rod 20 is free to reciprocate back and forth through the distance H (Figure 6). As the drum 2 is rotated, the centrifugal

forces acting on each brush series, as well as the variation in gravitational forces acting on the brush series during each drum rotation, causes each brush series to reciprocate back and forth at one end, thereby pivoting the brush series about its other end, i.e., the end fixed to rod 18 which is not free to move in the circumferential direction. The resulting reciprocating movement of the brush series causes each individual brush in that series to move back and forth over a limited distance in both the circumferential and radial directions. As the brushes are reciprocated, the surfaces of the brushes slide back and forth on the surfaces of the articles being cleaned, thereby causing rotation of the individual brushes relative to the drum 2 and providing enhanced cleaning action.

As illustrated, each pair of opposed parallel series or brushes is mounted so that the two opposed brush series reciprocate in opposite directions in response to rotation of the drum so that the individual brushes in each opposed pair of brush series rotate in opposite directions. Thus, as can be seen in Figures 4 to 8, the reciprocating or movable end of each brush series 51 to 56 is located adjacent a fixed end of the next adjacent brush series. For example, the movable end of brush series 51 connected to rod 20a is located adjacent the fixed end of the opposed brush series 52 connected to rod 18b, and conversely the movable end of brush series 52 connected to rod 20b is located adjacent the fixed end of the opposed brush series 51 connected to rod 18a. Accordingly, when the brush series 52 moves from the inboard position illustrated in Figure 7 to the outboard position illustrated in Figure 8, the individual brushes rotate relative to the drum 2 and rub against the articles being cleaned, thereby improving the scrubbing action on the articles positioned between the two brush series 51 and 52. As the drum 2 continues to rotate, the brushes in series 51 undergo the same effect, as do the brushes in all the other series 53 to 56.

As mentioned previously, the cleaning apparatus provided by this invention is suitable for use for both dry cleaning and laundering. Accordingly, the fluid system associated with the tank 1 and drum 2 is adapted to supply selected dry cleaning or laundry fluids to the interior of the drum 2, and to remove the same therefrom. This fluid system is shown in Figure 9, and includes a tank 29 containing dry cleaning solvent which is supplied to the interior of the tank 1 through a line 70, being conducted by compressed air from a compressor 30. Inside the tank 1, the dry cleaning solvent is discharged through apertures formed in an internal extension of the pipe 70 (see Figure 3) so that the solvent is sprayed into the open front end of the drum 2. The solvent spray is

drawn longitudinally through the interior of the drum 2 by means of a vacuum pump 35 connected to an exhaust line 35a at the rear end of the tank 1.

For dry cleaning applications where the solvent spray is not preferred, a second tank 32 contains dry cleaning solvent which is conducted through a pipe 71 and discharged into the top of the tank 1 when a valve 33 in the pipe 71 is open. This solvent flows downwardly through the drum 2 and out through a drain line 72 positioned near the rear end of the tank 1. Thus the dry cleaning solvent must flow from the top of the front end of the tank 1 to the bottom of the rear end thereof, and in the process the solvent is distributed throughout the articles being cleaned by the rotating drum 2 and the cleaning elements contained therein. When the tank 32 is not in use, the valve 33 in the pipe 71 and a second valve 34 in the drain-line 72 are closed.

In order to use the equipment for laundry, a valve 31 in a line 73 is opened to discharge water from a tank 28 into the top of the tank 1 at the top of the front end thereof. The valve 34 in the drainline 72 is opened so that the water flows longitudinally from the front to the rear of the housing 1, being distributed throughout the articles being laundered by the rotating drum 2 in the process. The cleanser or detergent to be used in the laundry process is fed into the tank 1 through a port 39 having a hinged lid 40. After the washing cycle of the laundry operation is completed, and all the water has been drained from the tank 1, a blower 36 is turned on so as to draw warm air through a heater 37 and on through a pipe 38 into the front end of the housing 1. This warm air passes longitudinally through the drum and is withdrawn through line 35a by the vacuum pump 35. This circulation of warm air through the drum dries the laundered articles therein, and it is normally desirable to leave the port 39 open during the drying operation for exhausting steam from the interior of the drum 2.

As can be seen from the foregoing detailed description, this invention provides improved cleaning apparatus which can be used for both dry cleaning and laundering and which is very suitable for use on mobile units. Due to the unique arrangement of cleaning brushes, an improved cleaning action is provided automatically as the drum is rotated. This equipment is particularly suitable for use in cleaning bedding materials such as mattresses and is simple and economical to operate and maintain.

WHAT I CLAIM IS:—

1. Dry cleaning and laundry apparatus comprising the combination of a liquid-tight tank, a drum rotatably mounted in said tank



forces acting on each brush series, as well as the variation in gravitational forces acting on the brush series during each drum rotation, causes each brush series to reciprocate back and forth at one end, thereby pivoting the brush series about its other end, i.e., the end fixed to rod 18 which is not free to move in the circumferential direction. The resulting reciprocating movement of the brush series causes each individual brush in that series to move back and forth over a limited distance in both the circumferential and radial directions. As the brushes are reciprocated, the surfaces of the brushes slide back and forth on the surfaces of the articles being cleaned, thereby causing rotation of the individual brushes relative to the drum 2 and providing enhanced cleaning action.

As illustrated, each pair of opposed parallel series or brushes is mounted so that the two opposed brush series reciprocate in opposite directions in response to rotation of the drum so that the individual brushes in each opposed pair of brush series rotate in opposite directions. Thus, as can be seen in Figures 4 to 8, the reciprocating or movable end of each brush series 51 to 56 is located adjacent a fixed end of the next adjacent brush series. For example, the movable end of brush series 51 connected to rod 20a is located adjacent the fixed end of the opposed brush series 52 connected to rod 18b, and conversely the movable end of brush series 52 connected to rod 20b is located adjacent the fixed end of the opposed brush series 51 connected to rod 18a. Accordingly, when the brush series 52 moves from the inboard position illustrated in Figure 7 to the outboard position illustrated in Figure 8, the individual brushes rotate relative to the drum 2 and rub against the articles being cleaned, thereby improving the scrubbing action on the articles positioned between the two brush series 51 and 52. As the drum 2 continues to rotate, the brushes in series 51 undergo the same effect, as do the brushes in all the other series 53 to 56.

As mentioned previously, the cleaning apparatus provided by this invention is suitable for use for both dry cleaning and laundering. Accordingly, the fluid system associated with the tank 1 and drum 2 is adapted to supply selected dry cleaning or laundry fluids to the interior of the drum 2, and to remove the same therefrom. This fluid system is shown in Figure 9, and includes a tank 29 containing dry cleaning solvent which is supplied to the interior of the tank 1 through a line 70, being conducted by compressed air from a compressor 30. Inside the tank 1, the dry cleaning solvent is discharged through apertures formed in an internal extension of the pipe 70 (see Figure 3) so that the solvent is sprayed into the open front end of the drum 2. The solvent spray is

drawn longitudinally through the interior of the drum 2 by means of a vacuum pump 35 connected to an exhaust line 35a at the rear end of the tank 1.

For dry cleaning applications where the solvent spray is not preferred, a second tank 32 contains dry cleaning solvent which is conducted through a pipe 71 and discharged into the top of the tank 1 when a valve 33 in the pipe 71 is open. This solvent flows downwardly through the drum 2 and out through a drain line 72 positioned near the rear end of the tank 1. Thus the dry cleaning solvent must flow from the top of the front end of the tank 1 to the bottom of the rear end thereof, and in the process the solvent is distributed throughout the articles being cleaned by the rotating drum 2 and the cleaning elements contained therein. When the tank 32 is not in use, the valve 33 in the pipe 71 and a second valve 34 in the drain-line 72 are closed.

In order to use the equipment for laundry, a valve 31 in a line 73 is opened to discharge water from a tank 28 into the top of the tank 1 at the top of the front end thereof. The valve 34 in the drainline 72 is opened so that the water flows longitudinally from the front to the rear of the housing 1, being distributed throughout the articles being laundered by the rotating drum 2 in the process. The cleanser or detergent to be used in the laundry process is fed into the tank 1 through a port 39 having a hinged lid 40. After the washing cycle of the laundry operation is completed, and all the water has been drained from the tank 1, a blower 36 is turned on so as to draw warm air through a heater 37 and on through a pipe 38 into the front end of the housing 1. This warm air passes longitudinally through the drum and is withdrawn through line 35a by the vacuum pump 35. This circulation of warm air through the drum dries the laundered articles therein, and it is normally desirable to leave the port 39 open during the drying operation for exhausting steam from the interior of the drum 2.

As can be seen from the foregoing detailed description, this invention provides improved cleaning apparatus which can be used for both dry cleaning and laundering and which is very suitable for use on mobile units. Due to the unique arrangement of cleaning brushes, an improved cleaning action is provided automatically as the drum is rotated. This equipment is particularly suitable for use in cleaning bedding materials such as mattresses and is simple and economical to operate and maintain.

WHAT I CLAIM IS:—

1. Dry cleaning and laundry apparatus comprising the combination of a liquid-tight tank, a drum rotatably mounted in said tank

and having an apertured side wall for passing cleaning fluids therethrough, means for supplying selected fluids to the interior of said tank, means for discharging fluids from the interior of said tank, and at least two substantially parallel series of cylindrical brushes mounted within said drum and spaced apart for holding articles to be cleaned between the two series of brushes, said brushes being rotatable with said drum and also individually rotatable relative to said drum, said brushes also being elongated in the direction of the axis of rotation thereof and longitudinally movable relative to said drum whereby said brushes may be withdrawn from said drum to facilitate the placement of articles to be cleaned between said series of brushes.

2. Dry cleaning and laundry apparatus according to claim 1 wherein said brushes are arranged in at least two pairs of semi-circular series.

3. Dry cleaning and laundry apparatus according to claim 1 or claim 2 wherein said series of brushes are mounted for radial reciprocating movement in response to rotation of said drum so that the individual brushes rotate against the surfaces of the articles to be cleaned to enhance the cleaning action.

4. Dry cleaning and laundry apparatus according to claim 3 wherein each pair of opposed parallel series of brushes is mounted so that the two opposed series of brushes reciprocate in opposite directions in response to rotation of said drum whereby the individual brushes in each opposed pair of series rotate in opposite directions.

5. Dry cleaning and laundry apparatus according to claim 3 wherein each pair of opposed parallel series of brushes is mounted so that each series of brushes reciprocates

back and forth through a limited distance in both the circumferential direction of the drum and the radial direction of the brush.

6. Dry cleaning and laundry apparatus according to any one of the preceding claims wherein said brushes are arranged in curved series substantially concentric with said drum and at least one end of each series is mounted for limited reciprocating movement whereby each brush series is automatically reciprocated in response to rotation of said drum.

7. Dry cleaning and laundry apparatus according to claim 6 wherein each brush series of each pair of opposed parallel brush series is mounted for reciprocating movement only at one end which is opposite from the reciprocating end of the other brush series of that pair.

8. Dry cleaning and laundry apparatus according to any one of the preceding claims wherein the means for supplying selected fluids to said tank includes means for supplying cleaning fluids to said tank for flow of said cleaning fluids both axially and radially through said drum.

9. Dry cleaning and laundry apparatus according to claim 8 which includes means for conducting heated air through said drum for drying the cleaned articles after the discharge of said cleaning fluids from said tank.

10. Dry cleaning and laundry apparatus substantially as hereinbefore described with reference to the accompanying drawings.

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