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APPARATUS FOR DETERGENT-SOLVENT DEGREASING

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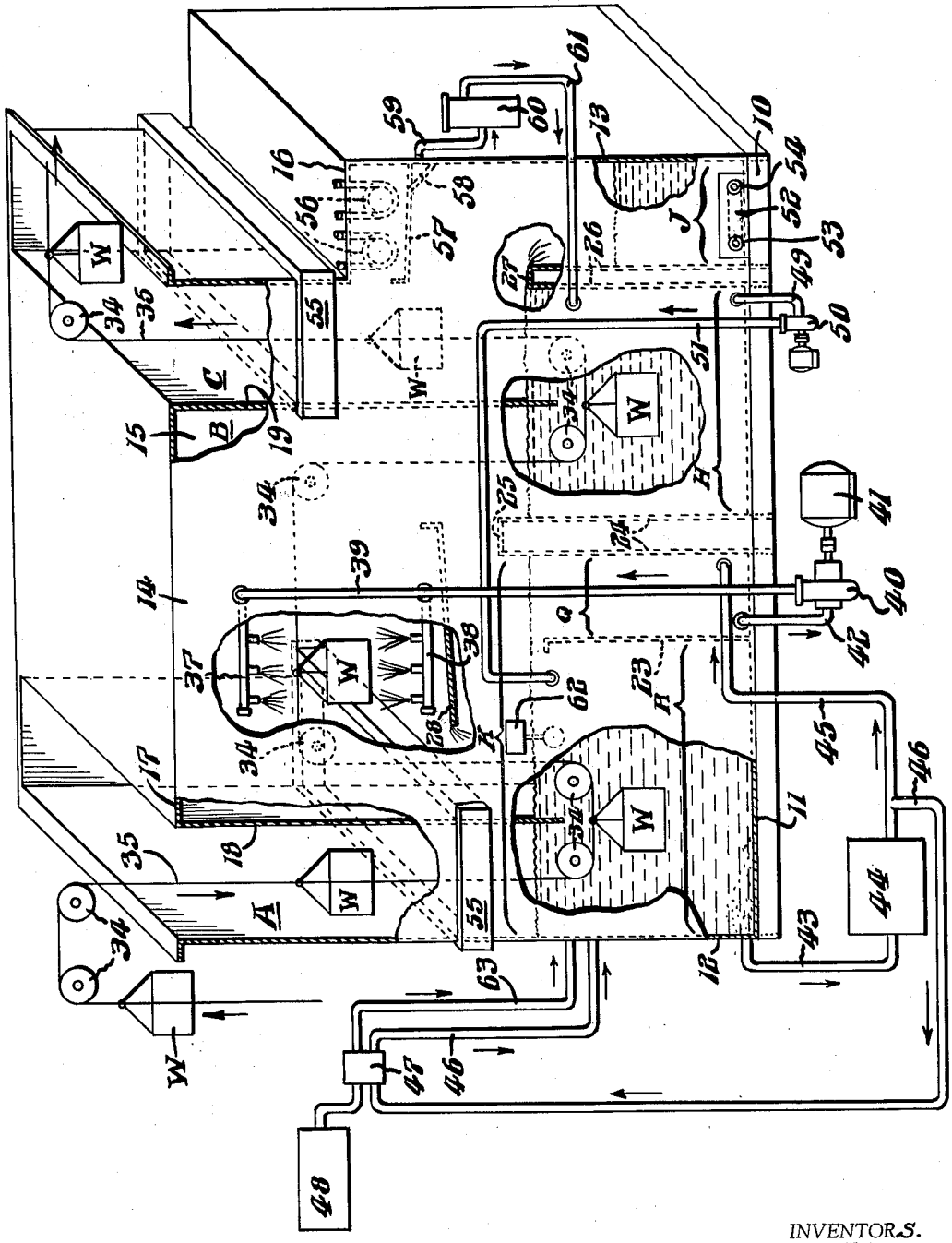

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3,120,853

APPARATUS FOR DETERGENT-SOLVENT DEGREASING

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This invention relates to cleaning equipment, and more particularly it relates to cleaning equipment designed to clean articles having non-porous surfaces such as metallic and ceramic articles, and the like. There have existed for many years industrial cleaning requirements where solvent degreasing equipment utilizing chlorinated hydrocarbons such as trichloroethylene, perchloroethylene, methylene chloride and the like, has been used because of the inherent advantages of hydrocarbon solvent degreasing, e.g., small size equipment, economical cleaning and the production of hot dry work. In some instances, however, this cleaning method leaves a slight film of residual soil that is inert, and is not wetted out by the chlorinated hydrocarbon solvent. Examples of such inert soils are the smut produced on cold rolled steel; the residual soil from the use of polishing, buffing and lapping compounds; and conventional water soluble soils such as stains, finger prints, etc. At present, some of these cleaning problems are attacked by using combinations of solvents, emulsions, alkaline compounds, multiple rinses, de-ionized water rinses, and complex and expensive drying systems. A specific attempt to accomplish the complete cleaning requirements in such cases is the "di-phase" cleaning method, wherein a water layer superposed on a solvent layer is utilized by dipping the work through the water layer and into the solvent layer, when cleaning occurs, and then withdrawing the work through the water layer. This procedure practically eliminates the possibility of cleaning ferrous work because of the inherent risk of rusting. In any event, this system requires an additional drying system to evaporate the adhering water film.

It is an object of this invention to provide apparatus wherein it is possible to remove both water and solvent soluble soils including inert materials, while maintaining a system which provide the advantages of a chlorinated hydrocarbon solvent vapor rinse and drying cycle.

Another object of this invention is to provide apparatus wherein dry, inert types of soils such as rouge, buffing compounds, polishing compounds and residual smut, may be removed by wetting such soil and dispersing it in a liquid cleaning bath.

Another object of this invention is to incorporate within a single apparatus enclosure a sealed spray zone wherein articles to be treated can be sprayed with liquid at high pressures, and to provide for distribution within said apparatus of the off-fall from said spraying step so as to provide a place for the settling of inert soil, while forming a constant supply of fresh liquid to be sprayed, and likewise providing a separate supply of fresh liquid for vaporization purposes.

Referring now to the drawing, there is shown diagrammatically a tank comprising a base portion 10, a bottom wall 11, side walls 12, 13, a front wall 14 and a back wall 15. Side wall 13 has formed thereon an offset providing a horizontal shelf 16. A horizontal cover 17, which

has depending partitions 18, 19 at each end thereof, divides the tank apparatus into an entrance throat A, an inverted downwardly opening enclosure B and an exit throat C. Rising from the bottom wall 11 and within the apparatus is a partition 23, a hollow divider 24 having a top edge 25, and a hollow dam 26 having a top edge 27. An inclined shed pan 28 extends transversely between the front wall 14 and back wall 15, and longitudinally throughout a substantial portion of the distance between the partitions 18 and 19. The partition 23, divider 24, dam 26 and shed pan 28 are juxtaposed so as to form a sump K having a settling section R and a clear section Q; a rinse sump H; and a boil sump J. A series of rotatably supported rollers 34 and a continuous flexible cable 35 provide continuous conveying means for a plurality of work objects W. A pair of opposed spray headers 37, 38 are juxtaposed on opposite sides of the path of the flexible cable 35 and within the inverted enclosure B, and supported thereat by conventional structure (not shown). Spray headers 37, 38 are supplied with spray liquid through a conduit 39 from the outlet of a pump 40 which is in turn driven by a motor 41 and supplied by a conduit 42. The conduit 42 communicates into the interior of the clear section Q of sump K through the front wall 14.

A conduit 43 communicates through side wall 12 into the settling section R of sump K, providing thereby a connection with a combined filter and pump means 44. A conduit 45 communicates from the filter and pump means outlet into the clear section Q of sump K through the front wall 14. A bypass conduit 46 communicates from conduit 45 into a control instrument 47, a second portion of conduit 46 communicating with the sump K through side wall 12. A container 48, disposed without the tank apparatus of this invention also communicates with the control instrument, and is adapted to supply liquid thereto through conduit 63.

A conduit 49 communicates from the rinse sump H into the inlet of a motor driven pump 50. The outlet of pump 50 is attached to a conduit 51 which communicates in turn into the sump K. A stem coil 52 is located on the bottom wall 11 within the boil sump J, and includes an inlet 53 and an outlet 54.

Conventional water jacket condensing means 55 are provided about the walls of entrance throat A and exit throat C including partitions 18, 19, and walls 12, 13, 14, 15, as shown in the drawings. A pair of helical condensers 56 are suspended from the shelf 16 by conventional means (not shown). A condensate pan 57 is supported below the helical condenser 56. A sump 58, formed in the condensate pan 57, communicates through wall 13 into a conduit 59 which in turn enters a conventional water separator 60, the decanted effluent from the separator being carried off by a conduit 61, which communicates into the rinse sump H. A float switch 62 is operably positioned adjacent the sump K.

To operate the apparatus of this invention, the rinse sump H and the boil sump J are filled to the levels shown with a chlorinated hydrocarbon degreasing solvent such as trichlorethylene, perchlorethylene or the like. The sump K is filled to the level shown with the same degreasing solvent, to which has been added one or more additional solvents such as kerosene, alcohol, water, and the like, which additional solvents are capable of dispersing or dissolving inert soils which are not wettable by the chlorinated hydrocarbon degreasing solvent. Steam is ad-

mitted to the inlet of the steam coil **52** whereby the solvent contained in boil sump J, is vaporized. A coolant is circulated through the water jackets **55** and the helical condensers **56**, whereby vapors arising from the solvent in boil sump J are condensed on the walls of the exit throat C and on the surfaces of condensers **56**. Condensate which falls from the condensers **56** is caught by the condensate pan **57** and passed to the water separator **60** wherefrom the solvent is returned to the rinse sump H through conduit **61**. The cable **35** is caused to move continuously and work objects W attached thereto, as shown in the drawing. The pump motors and control instruments including the float switch **62** are energized. As a work object W passes down the entrance throat A it enters the solvent contained in sump K, passing under partition **18** and upwardly out of the solvent into the enclosure B, whereupon it passes between the opposed spray headers **37, 38**. At this point, solvent from sump K is sprayed thereon, effecting conventional degreasing and dispersing inert non-wettable soil in the combination of solvents contained in the spray, the off-fall of said spray collecting on the shed pan **28** and being directed into the sump K to one side of the partition **23**, specifically in the settling section R. The inert settleable solid soil cleaned from the work object is allowed to settle within the settling section R, a constant stream of the solvent with settled materials being withdrawn by the filter and pump means **44**, through conduit **43**, the filtrate therefrom returning through conduit **45** into the clear section Q of sump K. That portion of the filtrate which circulates through conduit **46** is exposed to a humidity sensing element within the control instrument **47**, and necessary moisture is automatically added to the solvent in the sump K from the container **48** through conduit **63**. It will be apparent, that the partition **23** insures the maintenance of a practically clear solvent within section Q, that solvent which may overflow the top of partition **23**, which is of less height than the divider **24**, being relatively free of dispersed soil because of such arrangement of parts. Therefore, relatively clean solvent is utilized to effect the spray cleaning from the spray headers **37, 38**.

After this spray cleaning, the work object is passed into the solvent contained in the rinse sump H, then under the partition **19** and upwardly through the surface of the solvent contained in rinse sump H directly below the exit throat C, whereupon the rinsed solvent is contacted with hot solvent vapors from the boil sump J, which circulates below the water jacket **55**, thereby effecting a hot vapor rinse of the work objects. As the work objects then pass through the portion of exit throat C, cooled by the water jacket **55**, condensation on the surface of the work object is effected, and drying occurs throughout the remainder of the exit throat C by reason of the heated object being exposed to the atmosphere.

The float switch **62** operates so as to actuate motor driven pump **50**, whereby clear solvent is transferred from sump H to sump K when the combined-solvent level in sump K falls below a predetermined height.

It may therefore be seen that we have provided in the apparatus of this invention continuous solvent cleaning apparatus including, in combination, a container for liquid solvent, enclosure means comprising a downwardly opening structure having closed side walls and a closed top wall, said side walls extending within said container to a level below that of the normal liquid level thereof, a pair of opposed side walls thereof being spaced apart from the adjacent wall structure of said container, continuous conveyor means adapted to convey a plurality of work objects downwardly into said container, under a first opposed sidewall, then upwardly into said enclosure, then downwardly under the second opposed sidewall, and finally upwardly out of said container, spraying means for liquid solvent mounted within said enclosure and adapted to impinge sprayed liquid solvent through a zone traversed by said conveyor means within said enclosure,

a first vertical partition means within said container, said first vertical partition means being adapted to divided said container into a first and second liquid sump whereby said first sump surrounds the path of said conveyor means under said first sidewall and upwardly into said enclosure, and said second sump surrounds the path of said conveyor means downwardly under said second sidewall and upwardly out of said container, a second vertical partition means within said container having a height less than that of said first vertical partition means, said second partition means being adapted to divide said first liquid sump into a settling section and a clear section, solvent collecting means positioned within said enclosure and adapted to collect the liquid solvent spray which falls by gravity after impingement upon said work objects, and further adapted to direct said collected solvent into said settling section, and a liquid pumping system adapted to withdraw liquid solvent from said clear section and to pump said liquid solvent through said spraying means; and wherein there is additionally provided means for withdrawing liquid solvent adjacent the bottom of said settling section, continuously filtering said solvent and returning said filtered solvent into said clear section; and wherein there is additionally provided means for transferring liquid solvent from said second sump into said first sump; and wherein a third vertical partition means within said container is adapted to divide said second sump into a rinse section and a boil section, whereby said boil section is formed without said enclosure and in juxtaposition to the path of said conveyor means upwardly out of said container, solvent heating means disposed within said boil section and vapor condensing means defining a vapor barrier throughout a horizontal section of adjoining walls of said enclosure and said container surrounding the path of said conveyor means upwardly out of said container.

Having thus described our invention, we claim:

1. Continuous solvent cleaning apparatus including, in combination, a container for liquid solvent, enclosure means comprising a downwardly opening structure having closed side walls and a closed top wall, said side walls extending within said container to a level below that of the normal liquid level thereof, a pair of opposed sidewalls thereof being spaced apart from the adjacent wall structure of said container, continuous conveyor means adapted to convey a plurality of work objects downwardly into said container, under a first opposed sidewall, then upwardly into said enclosure, then downwardly under the second opposed sidewall, and finally upwardly out of said container, spraying means for liquid solvent mounted within said enclosure and adapted to impinge sprayed liquid solvent through a zone traversed by said conveyor means within said enclosure, a first vertical partition means within said container; said first partition means being adapted to divide said container into a first and second liquid sump whereby said first sump surrounds the path of said conveyor means under said first sidewall and upwardly into said enclosure, and said second sump surrounds the path of said conveyor means downwardly under said second sidewall and upwardly out of said container, a second vertical partition means within said container having a height less than that of said first vertical partition means, said second partition means being adapted to divide said first liquid sump into a settling section and a clear section, solvent collecting means positioned within said enclosure and adapted to collect the liquid solvent spray which falls by gravity after impingement upon said work objects, and further adapted to direct said collected solvent into said settling section, and a liquid pumping system adapted to withdraw liquid solvent from said clear section and to pump said liquid solvent through said spraying means.

2. The apparatus of claim 1 wherein there is additionally provided means for withdrawing liquid solvent adjacent the bottom of said settling section, continuously

filtering said solvent and returning said filtered solvent into said clear section.

3. The apparatus of claim 2 wherein there is additionally provided means for transferring liquid solvent from said second sump into said first sump.

4. The apparatus of claim 3 wherein a third vertical partition means within said container is adapted to divide said second sump into a rinse section and a boil section whereby said boil section is formed without said enclosure and in juxtaposition to the path of said conveyor means

upwardly out of said container, solvent heating means disposed within said boil section and vapor condensing means defining a vapor barrier throughout a horizontal section of the adjoining walls of said enclosure and said container surrounding the path of said conveyor means downwardly into and upwardly out of said container.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,120,853 February 11, 1964

Thomas J. Kearney et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 40, for "stem" read -- steam --; column 4, line 2, for "divided" read -- divide --.

Signed and sealed this 30th day of June 1964.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents

UNITED STATES PATENT OFFICE
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