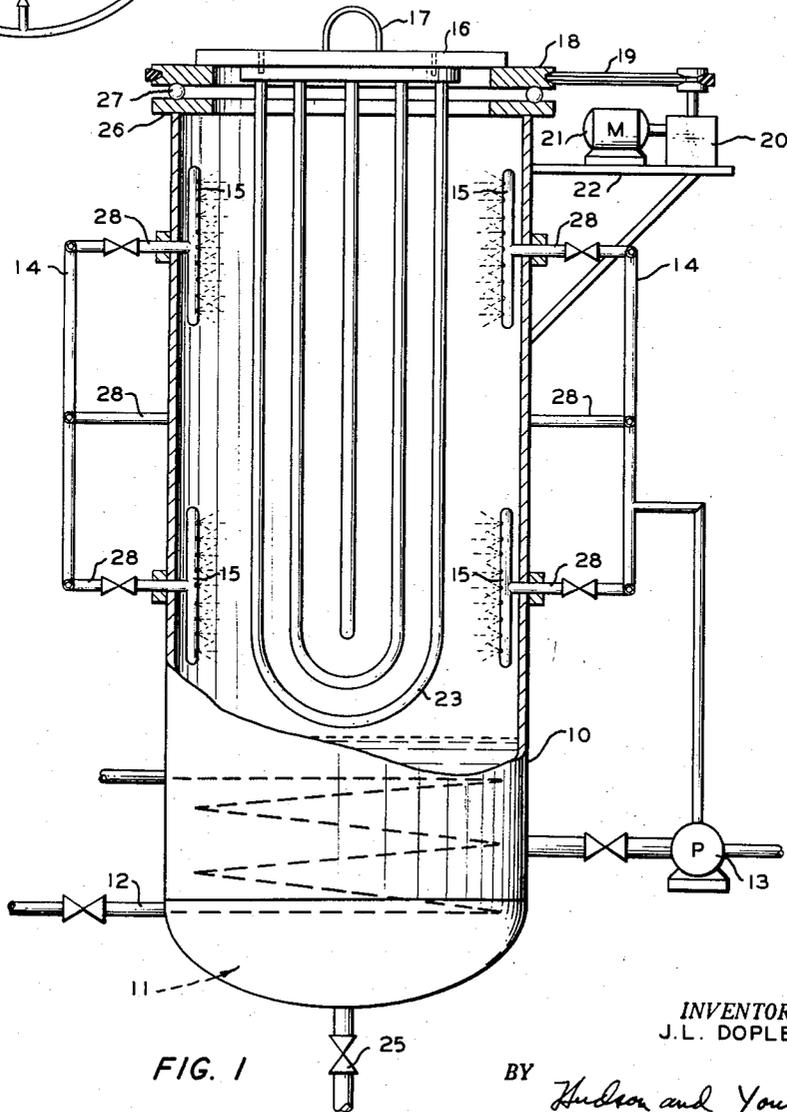
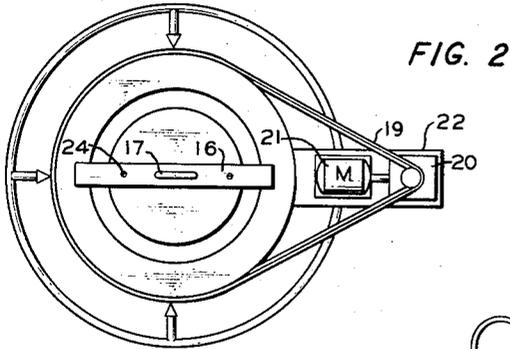


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J. L. DOPLER  
CHEMICAL CLEANING APPARATUS

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INVENTOR.  
J. L. DOPLER

BY *Hudson and Young*

ATTORNEYS

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## CHEMICAL CLEANING APPARATUS

John L. Dopler, Phillips, Tex., assignor to Phillips Petroleum Company, a corporation of Delaware

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9 Claims. (Cl. 134—108)

This invention relates to chemical cleaning apparatus. In one aspect, it relates to apparatus for cleaning heat exchanger bundles.

Various types of apparatus have been suggested for cleaning articles ranging in size from cooking utensils to large processing equipment, such as heat exchangers, tanks, etc. Particularly, when cleaning large articles of equipment, having a wide variety of sizes and shapes, the problem of handling becomes of major importance and it is difficult to provide a cleaning apparatus which will successfully handle such equipment and provide the cleaning desired.

It is an object of this invention to provide an improved chemical cleaning apparatus.

Another object of this invention is to provide an improved apparatus for cleaning large pieces of processing equipment.

Still another object of this invention is to provide an improved apparatus for cleaning heat exchanger bundles.

These and other objects of the invention will become more readily apparent from the following detailed description and discussion.

The apparatus of this invention comprises a vertical cleaning tank having mounted thereon rotatable means adapted to hold an article suspending in said tank. Also, provided are driving means for actuating the rotating means and means for introducing a cleaning chemical in contact with the suspended article.

The apparatus of this invention is best described by reference to the accompanying drawings of which Figure 1 is a front elevation in cross-section of the cleaning apparatus of this invention, and Figure 2 is a top elevation of the same apparatus.

Referring to the figures, the cleaning apparatus comprises a vertically disposed cylindrical tank 10 having a top flange 26 and a turntable assembly 18 resting on said flange and separated therefrom by ball bearings 27 mounted on stub shafts, adapted to rotate in a horizontal plane. In conjunction with the turntable assembly, there is provided a holding bar 16 which rests on the turntable, the article to be cleaned, in this instance a heat exchange bundle 23 being bolted or clamped or held by other suitable means to said bar. Attached to the top side of the holding bar is an eye or hook 17 by means of which the heat exchange bundle and bar can be lifted from or lowered into the cylindrical tank 10. A drive assembly comprising a motor 21, a gear reducer 20 and a V-belt drive 19 provide rotation of the turntable. The drive assembly is mounted on a side bracket 22 which is affixed to the outside wall of tank 10. Sprays 15, adapted for dispensing a cleaning fluid are spaced in vertical alignment adjacent to the inner periphery of tank 10. These sprays communicate with conduits 28 which pass through the walls of the tank, terminating in headers 14 which communicate with the discharge of pump 13. The suction of pump 13 in turn communicates with the bottom portion of tank 10 in such a manner as to provide flow of accumulated liquid in the tank to the suction of the

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pump. Disposed within the bottom of the cleaning tank is a heating coil 11 from which heat is transferred to cleaning chemical entering the suction of pump 13. Also disposed in the bottom of the tank is a drain line containing a valve 25 through which cleaning chemical is removed from the tank.

In operation, the heat exchange bundle or other apparatus to be cleaned is attached by means of bolting or clamping or other suitable means to the holding bar 16. The assemblage is then hoisted by a crane or other suitable means and suspended in the cleaning tank 10, with the holding bar resting on turntable assembly 18. The driving means is then actuated to rotate the exchanger bundle within the cleaning tank at the desired rate of speed. An amount of cleaning fluid, such as acid, sufficient to provide a liquid level in the cleaning tank above the heating coil but below the lowermost portion of the heat exchanger is introduced to the cleaning tank through the bottom drain or into the suction of pump 13. After or during this operation, steam or other suitable heating fluid is introduced to the heating coil in sufficient quantity to heat the cleaning fluid to the temperature desired for the cleaning operation. Control of the cleaning fluid temperature can be provided by suitable instrumentation means (not shown) such as a thermocouple mounted in contact with the heated fluid actuating a control valve in conduit 12 to control the quantity of steam entering coil 11. Pump 13 is then started up, delivering cleaning fluid from the bottom of the tank to header 14 and thence through conduits 28 and spray nozzles 15. The cleaning chemical leaving the spray nozzles is deposited over the parts of the heat exchange bundle and flows from the bundle downwardly, accumulating in the bottom of the cleaning vessel. As necessary, spent cleaning material can be removed from the cleaning vessel through valve 25 and fresh chemical can be introduced either through the same valve or to the suction of pump 13. If desired, after the cleaning operation is terminated, a rinsing or washing can be provided by removing the cleaning chemical from the system and introducing a washing or rinsing fluid thereto. The cleaned apparatus is then hoisted from the cleaning tank and disconnected from the holding bar 16.

The afore-described apparatus provides a number of advantages over apparatus previously used in the art. For example, the driving means for the turntable, being above the liquid level in the cleaning tank does not need to be sealed to the same extent as in apparatus where the driving means is inside or below the cleaning tank. Also, objects or articles of different size and shape can be easily accommodated in the apparatus of this invention. In other apparatus, the articles to be washed are limited in size and shape by the shape of the turntables provided and by the receptacle provided in said turntables. In the apparatus of this invention, however, the article to be washed is clamped to the turntable or suspended therefrom, therefore, the object need be of no particular shape as long as it is capable of being so clamped. Again, by virtue of top loading of the tank, it is possible to easily handle large and heavy objects or articles which could be handled in conventional apparatus only with the greatest difficulty or not at all.

The preceding embodiment of the invention has been described in conjunction with a specific apparatus arrangement, however, it is not intended that this in any way limit the scope of the invention. For example, types of equipment other than heat exchange bundles can be cleaned in the apparatus of this invention. Also, various apparatus features equivalent to those shown in the drawing can be used in carrying out the invention. If it is desired to seal the cleaning tank during the cleaning operation, a plate can be substituted for the holding bar

16, said plate having on the underside thereof a gasket to provide a seal between the holding plate and the turntable assembly. Also the bearings between the turntable and the top flange of the cleaning tank can be sealed by appropriate means to provide a closed system. Although the level of chemical cleaning fluid in the specific embodiment described is carried below the article to be cleaned, it is within the scope of the invention to maintain the cleaning tank substantially full of liquid and providing agitation of the liquid in the tank by suitable means such as by a mixer, appropriately introducing the cleaning fluid, or by a combination thereof.

Having thus described the invention by providing a specific example thereof, it is not intended that any limitations or restrictions be drawn by reason thereof and that many variations and modifications are within the scope of the invention.

I claim:

1. Apparatus comprising in combination a vertical cylindrical cleaning tank open at the top adapted to contain a liquid cleaning chemical having mounted thereon a turntable superposed by a removable holding means which rests on said turntable and is adapted to hold the article to be cleaned suspended in said tank, drive means for actuating the turntable, means for introducing a cleaning chemical in contact with the article to be cleaned and means for withdrawing spent chemical from said tank.

2. The apparatus of claim 1 in which an indirect heating means for increasing the temperature of the cleaning chemical is disposed in the bottom of said tank below the level of said cleaning chemical.

3. The apparatus of claim 1 in which the cleaning chemical is introduced in contact with the article to be cleaned through sprays and means are provided for recirculating cleaning chemical from the bottom of the cleaning tank to said sprays.

4. Apparatus comprising in combination a vertical cylindrical cleaning tank open at the top adapted to contain a liquid cleaning chemical having mounted thereon a turntable superposed by a removable holding means which rests on said turntable and is adapted to hold the article to be cleaned suspended in said tank above the level of the liquid cleaning chemical, drive means for actuating the turntable, spray means for introducing the cleaning chemical in contact with the article to be cleaned, heat exchange means disposed in the bottom of the cleaning tank below the level of the cleaning chemical, pumping means for recirculating cleaning chemical from the bottom of the cleaning tank to the spray means, and means for withdrawing spent chemical from the cleaning tank.

5. The apparatus of claim 4 in which the spray means comprises spray nozzles which are disposed in vertical alignment adjacent to the inner periphery of the cleaning

tank whereby sprayed cleaning chemical is distributed in contact with the article to be cleaned.

6. Apparatus comprising in combination a vertical cylindrical cleaning tank open at the top adapted to contain a liquid cleaning chemical having mounted thereon a turntable superposed by a removable holding bar which rests on said turntable and is adapted to hold the article to be cleaned suspended in said tank above the level of the liquid cleaning chemical, motor and belt drive means for actuating the turntable, spray nozzles for introducing the cleaning chemical in contact with the article to be cleaned, a heat exchange coil disposed in the bottom of the cleaning tank below the level of the cleaning chemical, pumping means for recirculating cleaning chemical from the bottom of the cleaning tank to the spray means and means for withdrawing spent chemical from the cleaning tank.

7. The apparatus of claim 5 in which instrumentation means is provided to control the temperature of the cleaning chemical in the cleaning tank by regulating the quantity of heating fluid passing through the indirect heat exchange means.

8. Apparatus comprising, in combination, a vertical, cylindrical cleaning tank open at the top having mounted thereon a rotatable turntable superposed by a removable holding bar which rests on said turntable, said holding bar being adapted to hold an article to be cleaned suspended in said tank, drive means for actuating the turntable, means for introducing a cleaning chemical in contact with the article to be cleaned and means for withdrawing spent chemical from said tank.

9. Apparatus comprising, in combination, a vertical, cylindrical cleaning tank open at the top having mounted thereon a rotatable turntable superposed by a removable holding bar which rests on said turntable, said holding bar being adapted to hold an article to be cleaned suspended in said tank, lifting means attached to said holding bar whereby said bar and the article to be cleaned can be introduced to and removed from the cleaning tank as one unit, drive means for actuating the turntable, means for introducing a cleaning chemical in contact with the article to be cleaned and means for withdrawing spent chemical from said tank.

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