Dec. 5, 1961 C. E. JACKSON ET AL 3,011,922

PARTS CLEANING RACK AND METHOD

Filed June 22, 1959 2 Sheets-Sheet 1

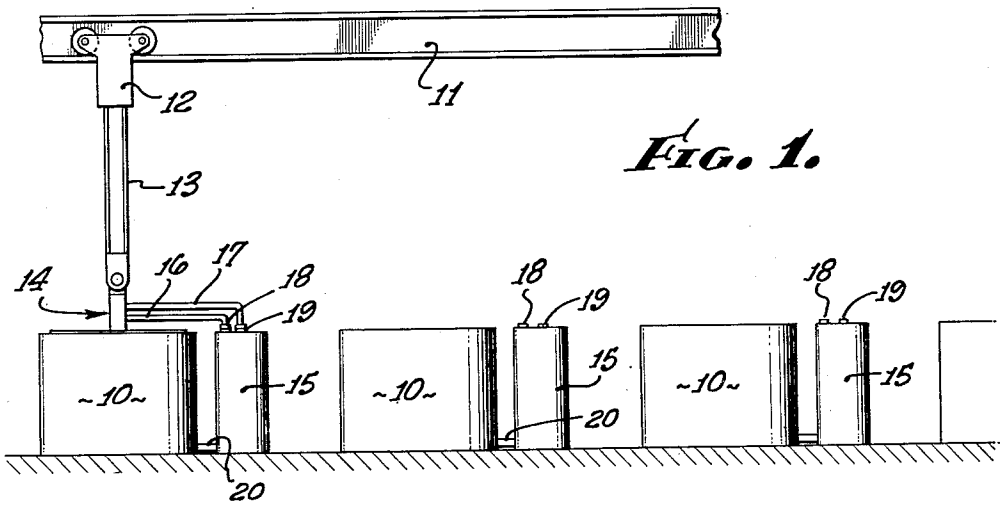


FIG. 1.

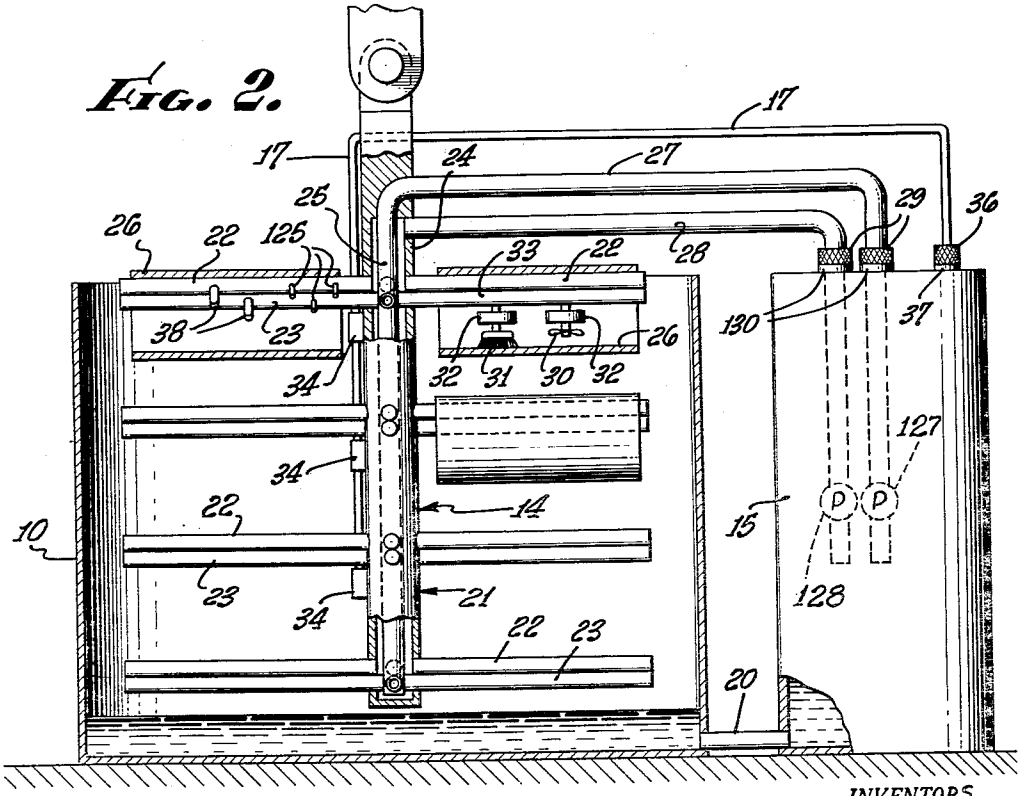


FIG. 2.

INVENTORS.
CLARK E. JACKSON,
FOREST D. VASSAR,
By White & Haefliger
ATTORNEYS.

Dec. 5, 1961 C. E. JACKSON ET AL 3,011,922

PARTS CLEANING RACK AND METHOD

Filed June 22, 1959 2 Sheets-Sheet 2

FIG. 3.

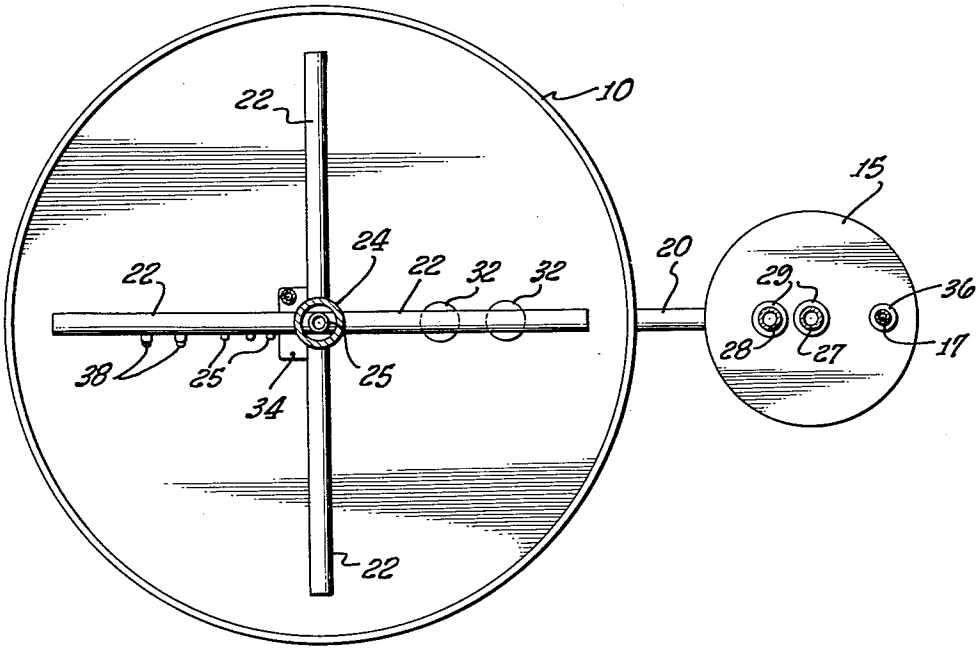
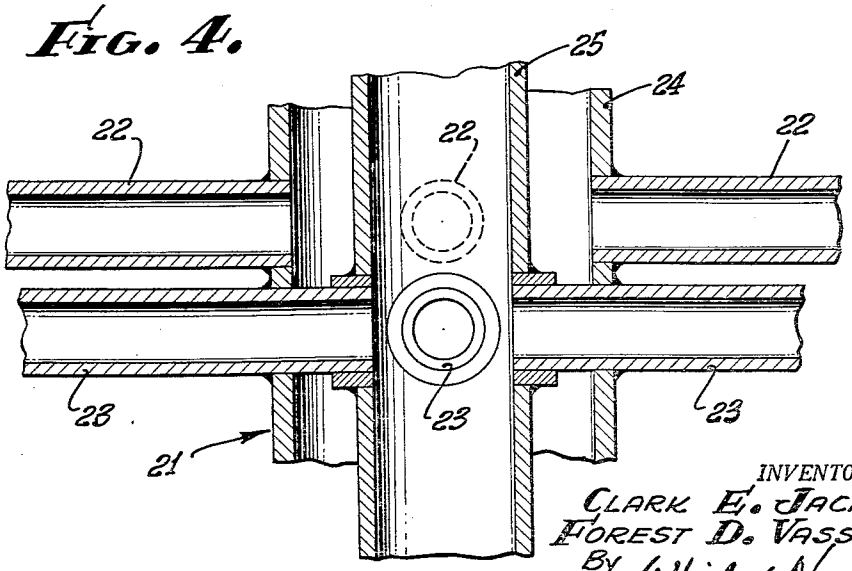


FIG. 4.



INVENTORS.
CLARK E. JACKSON
FOREST D. VASSAR
By White & Naefliger
ATTORNEYS.

United States Patent Office 3,011,922 Patented Dec. 5, 1961

3,011,922

PARTS CLEANING RACK AND METHOD

Clark E. Jackson, Rolling Hills, and Forest D. Vassar, West Covina, Calif., assignors, by mesne assignments, to Purex Corporation, Ltd., a corporation of California

Filed June 22, 1959, Ser. No. 821,939
17 Claims. (Cl. 134—1)

This invention relates generally to improvements in parts treating apparatus and the method of treating parts by subjecting them to sources of treatment activation in different treating zones. More particularly, the invention is concerned with improvements in the method and apparatus for effectively and rapidly cleaning parts, particularly carbon-fouled and oxide-fouled parts, in different cleaning zones at least some of which contain cleaning liquid, by subjecting the parts to power release from power heads subject to activation in different of the cleaning zones.

It is known that the cleaning of industrial parts in chemical solutions can be accelerated by agitating the cleaning zones, various mechanical devices being useful for producing such agitation. Conventionally these agitators, which include propellers, liquid jets, brushes, sonic and ultrasonic generators, are located at the walls or bottom of a cleaning tank into which the parts to be cleaned are introduced. It is known that the effectiveness of cleaning solution agitation is seriously limited or reduced as the distance between the parts and the source of energy increases. Also the baffling action of parts baskets and the parts therein located at the sides of the basket further limits the effectiveness of mechanical treatment by the agitators, especially the treatment of parts located within the interior of the basket. In addition, the rotation of propellers by shafts projecting through the tank wall presents difficult shaft sealing problems particularly when corrosive and high temperature liquid solutions are used.

The present invention has for its major object the elimination of most of the above problems through improvements in apparatus and method for effectively and rapidly treating parts in different treating zones by transporting with the parts the source or sources of treatment activation, such as the propellers, ultrasonic generators, liquid jets, and brushes, all remaining in desirably exposed relation to the parts, and in addition selectively activating the treatment sources in different of the treatment zones. More particularly, the invention contemplates a novel method of effectively and rapidly cleaning apparatus in different spaced apart zones, at least some of which contain cleaning liquid, the method including successively introducing the parts to be cleaned into different zones and into liquid contained therein, transporting with the apparatus power heads in desirably exposed relation thereto, and selectively activating the power heads in different of the zones to treat the parts most effectively and rapidly.

As will appear, the present new concept in industrial cleaning brings the energy for agitation into intimate contact with the parts being cleaned, this being done by using the fixture or rack means on which the parts are supported as a carrier for the power means or heads which are positioned in relatively close exposure to the parts. Typically, but not necessarily, the parts rack is made of piping and is so designed that its plumbing and electrical lines supplying the power heads automatically connect with pumps and electrical power sources located outside the cleaning receptacles as the rack is moved from one tank to the next.

These and other features and objects of the invention, as well as the details of an illustrative embodiment, will

be more fully understood from the following detailed description of the drawings, in which:

FIG. 1 shows a row of cleaning tanks and apparatus for moving the parts rack from tank to tank;

FIG. 2 is a modification of FIG. 1 in enlarged elevation showing the typical parts rack inserted in a cleaning tank in position for activation of the power heads on the rack;

FIG. 3 is a plan view of the FIG. 2 rack; and

FIG. 4 is an enlarged fragmentary elevation showing the manner in which the rack may be constructed.

Referring first to FIG. 1, a row of cleaning tanks or receptacles **10** is shown below an overhead track **11**, along which a hoist **12** is movable over the tanks **10**. Suspended from the hoist cable **13** is a parts rack **14** which may be successively introduced into the liquid contained within the tanks **10** by operation of the hoist to lower the rack **14** into each tank after the hoist has been traveled along the track **11** to a position over the tank. Associated with each tank is a power source **15** to which power lines **16** and **17** carried by the rack **14** are connectible at **18** and **19** automatically upon lowering of the rack into the tank **10**. For example, lines **16** and **17** may comprise liquid and electrical lines, the first being operable to flow liquid from the source **15** into the rack and then to power heads, as for example jets intimately associated with the parts to be cleaned. Liquid may be returned from within the tank **10** to the power source **15** through a return line **20** so as to be pumped again to line **16**. Line **17** may typically deliver electrical energy to an ultrasonic generator carried by the rack **14** in close relation to a part to be cleaned.

It will be understood from the foregoing that while the lines **16** and **17** automatically connect with the power source **15** at locations **18** and **19**, either or both of the lines **16** and **17** and the power heads associated therewith may be inactive when the parts rack is inserted within different of the tanks **10**, as desired, through predetermined inactivation or selection of the power source **15**. Thus, it may be desired to treat the parts in one tank by activating an ultrasonic generator on the parts rack, while such ultrasonic treatment may not be desired in the adjacent tank to which the parts rack **14** is next moved. Similarly, one of the tanks **10** may contain no cleaning solution, and when the parts rack is inserted water may be supplied from source **15** to jets on the rack for spray rinsing the part in that zone.

Assuming that aircraft parts were being overhauled, they would be placed in a specific location on the rack and would then pass down a process line. Upon introduction of the rack **14** in the first tank containing a precleaner solution, one of the lines **16** and **17** would automatically connect with an outlet from a pump in power source **15**, which would operate to circulate the precleaner through the parts rack and out numerous orifices or jets strategically located so as to provide a high velocity agitation over each of the parts to be cleaned. The rack with its load of parts might then pass to a carbon removing tank in which some of the more heavily carbon soiled parts may be treated ultrasonically for effective cleaning. Upon insertion of the rack in such a tank, line **17** would automatically connect with the electrical source at **19**, and strategically located ultrasonic transducers on the rack **14** would be energized to provide maximum energy coupling to the particular parts carrying ultrasonic treatment. Finally, spray rinsing of the parts in a subsequent tank might take place, rinsing liquid being supplied through the rack from the power source **15** to spray nozzles located on the rack.

Turning now to FIGS. 2 and 3, a typical tank **10** is shown with a parts rack **14** inserted downwardly therein. In the form shown, which may of course be modified, the rack includes a central vertically extending main support

or header **21** which is tubular, and vertically spaced tubular branch support pipes which are grouped in pairs **22** and **23**. The latter may be connected into the main header **21** as for example is shown in FIG. 4, wherein pipe **22** connects into an outer tubular manifold **24** and pipe **23** connects into an inner tubular manifold **25** which, along with manifold **24**, comprises the upright header **21**.

Referring back to FIG. 2, the pipes or branches **22** and **23** have spaced therealong jets or nozzles **125**, and outlets **38**, typically for jetting solvent solution or compound from pipes **22** and for jetting rinsing liquid such as water from pipes **23**. A cylindrical part **26** to be cleaned is shown supported on a pipe **22** in position such that liquid jetting from nozzles **125** sprays over the inside of the part, and along the length thereof and in a manner such as would be impossible were the spray nozzle located at the sides or bottom of the tank **10**.

FIG. 2 also shows supply lines **27** and **28** connecting into the inner header **25** and the outer header **24** of the parts rack above the top level of the tank. These lines **27** and **28** have connectors **29** at their terminal ends, positioned automatically to engage outlet fittings **130** on the housing of the power source **15**, as the parts rack is lowered into position in the tank **10**. As explained, such connection of the supply lines with the power source may automatically effect delivery of liquid through either of the lines **27** or **28** to the nozzles **125**, depending upon the cleaning operation to be carried out in the tank **10**. Thus, if it is desired to spray cleaning solution or compound on the parts **26**, lowering of the parts rack may be accompanied by automatic supply of cleaning solution from the source **15** through line **27** to manifold **24** and branch pipes **22**. Alternatively, liquid rinse may be supplied through line **28** to inner manifold **25** and to branch pipes **23**. Pumps **127** and **128** are shown in source **15** for delivering liquid through lines **27** and **28**.

Typical cleaning solutions may consist of chlorinated solvent formulations, trichloroethylene, cyclohexane, and solutions of detergents, or acids or bases, such as strong caustic solutions. Representative soils on parts such as bearings, shafts, compressor blades, sleeves and the like include oxides, greases, oils, dust, tar, sludge, rust, resin, wax, carbon, lapping and buffing compounds, and steel particles.

The invention also contemplates the provision of solution agitators on the parts rack, as for example are shown by the propeller **30** and brush **31** adapted to be driven in rotation by hydraulic motors **32** typically suspended from a hydraulic pressure fluid line **33** connected into the manifold **25**. Liquid supplied from that manifold may then be appropriately delivered to the hydraulic motors **32** for driving the brush or propeller **30** in rotation in closely exposed relation to the part **26** to be cleaned. Of course, the brushes or propellers may be located as desired on the parts rack and in relation to the parts to be cleaned for more effective and rapid cleaning as the parts and rack are moved from tank to tank.

FIG. 2 also shows a vertically spaced series of ultrasonic generators or transducers **34** carried by the parts rack in closely exposed relation to certain of the parts, as for example the part **26**. Such sonic or ultrasonic transducers or generators are well known in the art and may have many different sizes and shapes. Electrical energy supplied to an ultrasonic transducer, which may comprise a piezoelectric crystal transducer or magnetostrictive transducer, is operable to cause the transducer diaphragm crystal to vibrate at the frequency of the applied alternating voltage or current, which vibration sets up and causes transmission of sonic or ultrasonic waves in the liquid within the tank, so as to promote rapid cleaning of soils from parts suspended in the solution upon impingement of the transmitted waves against the parts surfaces. Electrical energy is supplied to the transducers **34** through a cable or line **17**, the terminal end **36** of which has automatic connection with an outlet **37** on the housing of the

power source **15** as the parts rack is lowered into final position in the tank **10**. As previously described, one or more of the transducers **34** may be selectively activated upon lowering of the parts rack into the tank **10** in any desired sequence as the parts rack is moved from tank to tank, all for the purpose of treating most effectively and rapidly the parts to be cleaned. Similarly, electrical energy may be automatically supplied to electrical motors driving agitators and brushes, as for example are shown at **31** and **30**.

The invention also contemplates that certain types of rotary nozzles **38** may be connected into branch pipes **22** or **23** for spraying or jetting treating solvent or rinsing liquid in a moving pattern as distinguished from the single jetting direction from the nozzles **25**. In addition, the transducers **34** may be replaced or supplemented by electrocleaning electrodes or other types of treatment devices advantageously located with respect to the parts to be cleaned and carried by the rack **14** so as to be transported with the parts and selectively activated within different treating tanks **10**, in a manner found most desirable for any part treating sequence or operation.

We claim:

1. In parts cleaning apparatus including receptacle means containing separate bodies of cleaning liquid, the improvement that comprises carrier means for supporting a part in location for cleaning, means for transporting said carrier means and for successively introducing said carrier means into and withdrawing said carrier means from said separate bodies of cleaning liquid, power means carried by and transportable with said carrier means and positioned in relatively close and open exposure to the part location to effect cleaning of said part in cooperation with said bodies of cleaning liquid, said power means including power heads operable to release energy into said bodies of cleaning liquid, and means for selectively activating said power heads in different of said bodies of cleaning liquid.

2. The invention as defined in claim 1, in which said power means includes lines for transmitting power to said heads.

3. The invention as defined in claim 2 in which said means for activating said power means include power sources selectively connectible in power transmitting relation with said lines for selective power transmission to different power heads.

4. The invention as defined in claim 2 in which at least one power head comprises an ultrasonic generator operable to release ultrasonic energy into liquid.

5. The invention as defined in claim 2 in which at least one power head comprises a propeller operable to displace liquid.

6. The invention as defined in claim 2 in which at least one power head comprises a movable brush.

7. The invention as defined in claim 2 in which at least one power head comprises a nozzle.

8. The invention as defined in claim 2 in which said power heads include an ultrasonic generator and a propeller, and including power sources selectively connectible in power transmitting relation with said generator and propeller.

9. The invention as defined in claim 2 in which said carrier means comprises one support carrying said lines, and other supports carrying said power heads and adapted to support parts to be cleaned.

10. The method of effectively and rapidly cleaning apparatus in different spaced apart zones at least some of which contain cleaning liquid by subjecting said apparatus to power release from power heads subject to activation in different of said zones, that includes successively introducing said apparatus into said different zones and to liquid contained therein, transporting with said apparatus said power heads in desirably exposed relation thereto, and selectively activating said power heads in different of said zones.

11. The method of effectively and rapidly removing

carbon and oxides from fouled apparatus in different spaced apart cleaning zones at least one of which contains a carbon and oxide removing solvent by subjecting said apparatus to power release from power heads subject to activation in different of said zones, that includes successively introducing said apparatus into said different zones and at least once into said solvent, transporting with said apparatus said power heads in desirably exposed relation thereto, and selectively activating said power heads in different of said zones including said solvent containing zone.

12. The method of claim 11 in which liquid is sprayed from said power heads.

13. The method of claim 11 in which said solution is agitated by said power heads.

14. The method of claim 11 in which ultrasonic energy is transmitted into said solution from said power heads.

15. The combination, comprising carrier means for supporting a part in location for cleaning, means for transporting said carrier means and for successively introducing said carrier means into and withdrawing said carrier means from different bodies of cleaning liquid, power means carried by and transportable with said carrier means, at least a portion of said power means being positioned in relatively close and open exposure to the part location to effect cleaning of said part in cooperation with said body of cleaning liquid, said power means including power heads operable to release energy, and means for selectively activating said power heads to secure release of energy transmissible into different bodies of cleaning liquid.

16. The invention as defined in claim 15 in which said power heads include electrically energizable transducers operable to generate ultrasonic energy transmissible into said liquid.

17. The invention as defined in claim 16 in which said power means includes cable means connected in electric energy transmitting relation with said transducers, said cable means being connectible with a power source spaced from and independent of said carrier means.

References Cited in the file of this patent

UNITED STATES PATENTS

843,423	Weymar	Feb. 5, 1907
1,447,304	Hauk	Mar. 6, 1923
2,416,475	Friedman	Feb. 25, 1947
2,845,045	Weiskopf	July 29, 1958
2,860,646	Zucker	Nov. 18, 1958