Jan. 11, 1938. LE BARON B. JOHNSON 2,105,458

APPARATUS FOR CLEANING CONTAINERS

Filed Dec. 20, 1934 3 Sheets-Sheet 1

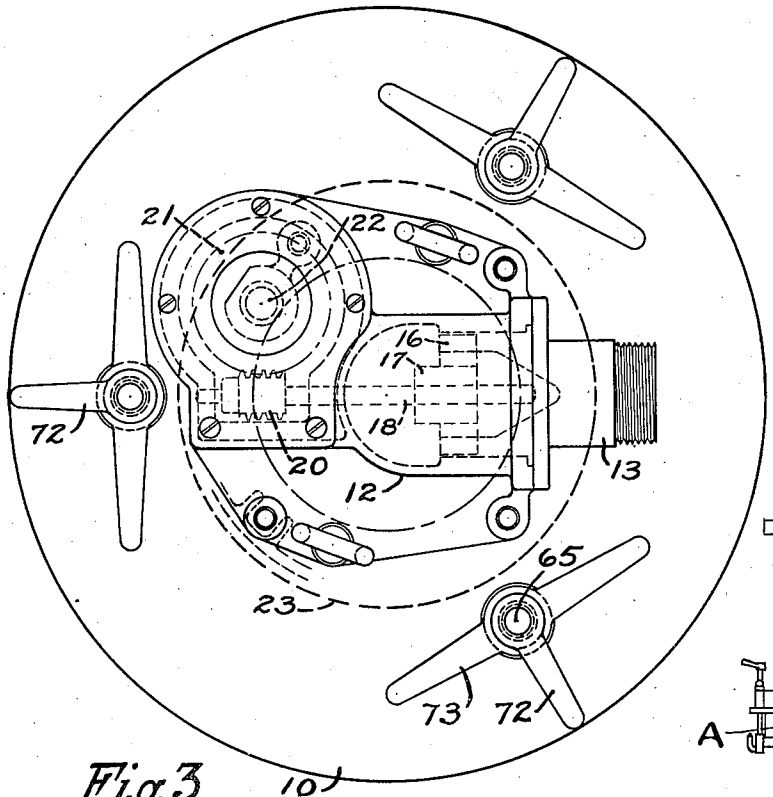

Fig. 3

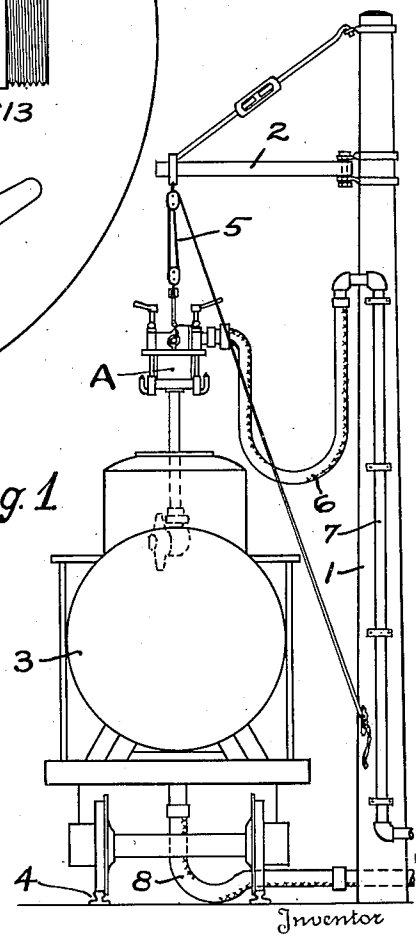

Fig. 1

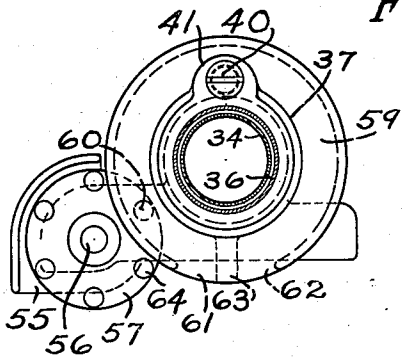

Fig. 6

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Jan. 11, 1938. LE BARON B. JOHNSON 2,105,458

APPARATUS FOR CLEANING CONTAINERS

Filed Dec. 20, 1934 3 Sheets-Sheet 2

Fig. 2

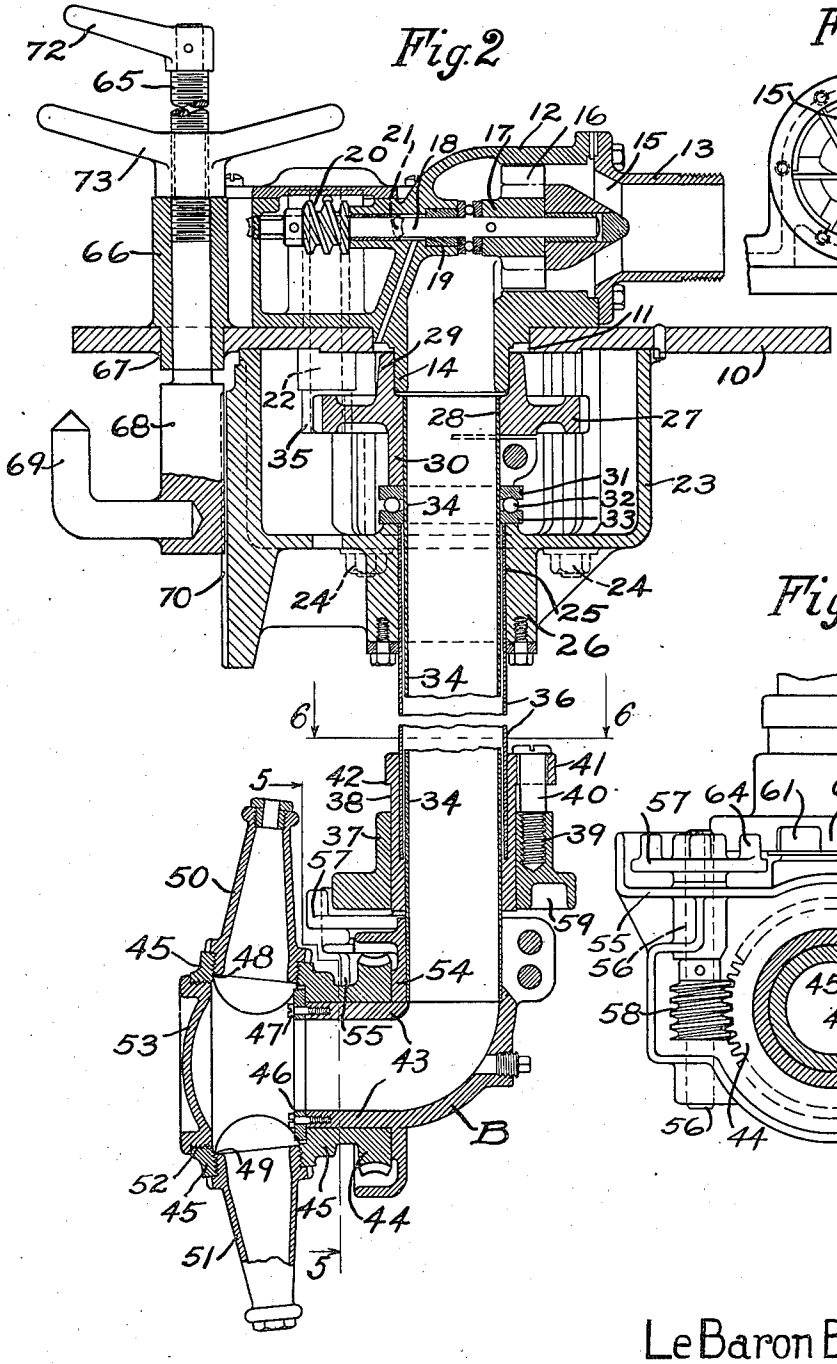

Fig. 4

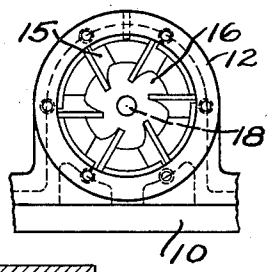

Fig. 5

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Jan. 11, 1938. LE BARON B. JOHNSON 2,105,458

APPARATUS FOR CLEANING CONTAINERS

Filed Dec. 20, 1934 3 Sheets-Sheet 3

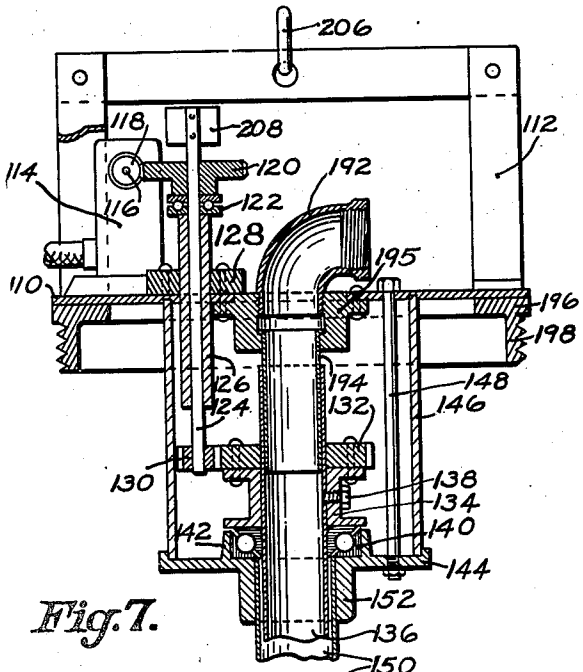
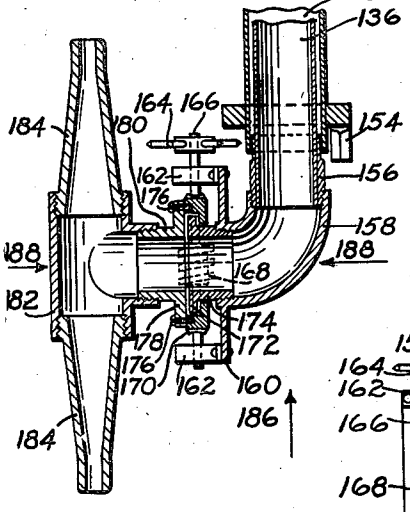


Fig. 7.



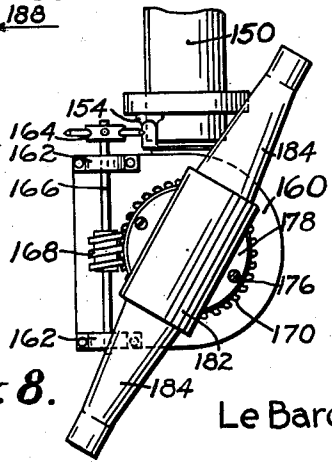


Fig. 8.

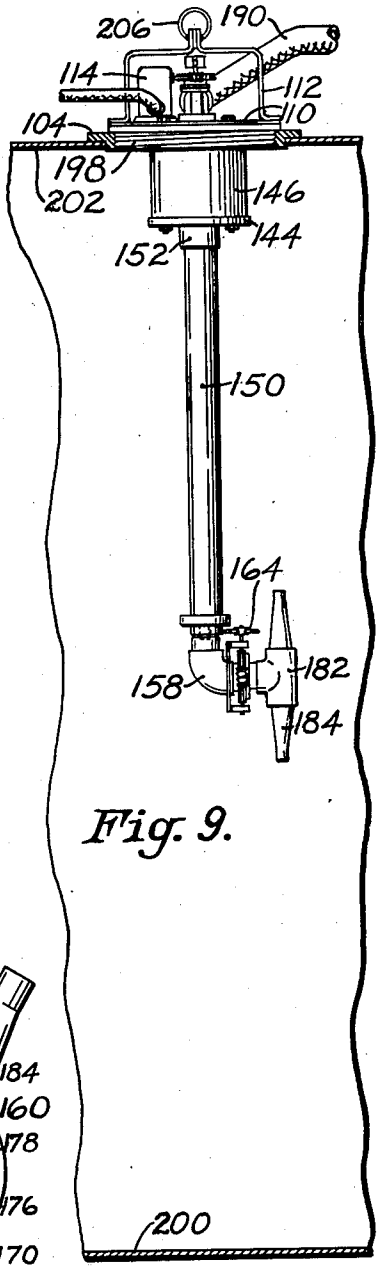


Fig. 9.

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UNITED STATES PATENT OFFICE

2,105,458

APPARATUS FOR CLEANING CONTAINERS

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Application December 20, 1934, Serial No. 758,511

13 Claims. (Cl. 299—67)

This invention relates to an improved apparatus for cleaning the inside surfaces of tanks, containers and the like.

More particularly it relates to a specific means for removing from the interior surfaces of oil tanks and oil tank cars the heavy viscous deposits which form thereon after a period of usage.

Devices for cleaning the interior of oil tanks and tank cars and adapted for insertion in the opening in the tank have been known for some time. Some of these have been provided with rotating nozzles by means of which the cleaning fluid, usually kerosene, is directed against the interior surfaces. The use of such known arrangements, however, has been accompanied by certain disadvantages. In the first place, they were adapted only for relatively small tanks and could not be used for cleaning stationary oil tanks having a capacity of 55,000 barrels and upwards. Moreover, the movement of the nozzles in such arrangements was such that the paths of the streams projected therefrom overlapped and criss-crossed in such a way as to spatter portions of the dirt or viscous deposits back and forth over portions of the surface which had already been cleaned.

A further disadvantage present in the prior arrangement was the length of time required for cleaning and the necessary presence of skilled operators. Because of the methods and apparatus used it was not possible to effect a complete cleaning without the expenditure of considerable time and the use of a considerable amount of cleaning fluid, and even though the rotation of the nozzles was very rapid the cleaning was not efficacious. Moreover, in devices provided with nozzles which rotated at high speeds the use of a lubricant has been necessary. Such arrangements consequently were not adapted to project a very hot cleaning solution since the heat of the solution would have a tendency to destroy the lubricant used and eventually result in injury to the device.

Prior art structures also presented other disadvantages not the least of which was lack of satisfactory means for quickly and securely clamping the cleaning units to the rim around the tank openings. Such devices embodied no efficient means for compensating for tank openings of different sizes and structures.

The present invention provides a means for cleaning the interior of tanks of all sizes, and in such a way as to avoid all of the disadvantages present in prior known methods and apparatus. According to the invention two streams of a hot cleaning solution are directed against the interior surfaces of a tank in such a way that two circular automatic movements are combined to cut a succession of parallel paths, the adjacent paths being connected by curved steps which extend at an obtuse angle relative to the parallel paths so that the continuous path is substantially spiral in appearance. In this way all portions of the tank are directly hit by the streams without crossing or complete overlapping. The gummy dirt or heavy viscous deposit on the interior of the tank being cleaned is removed by being constantly pushed along in front of the stream. The movement is very slow and portions of the tank which have been cleaned are not again dirtied as would be the case with streams which cross and overlap.

The principal object of the invention is the provision of a means for cleaning the interior surfaces of tanks of all sizes, completely, quickly and automatically. The turning of the nozzles in a circle about a vertical axis and the rotation of the nozzles at the same time but at greatly reduced speeds about this horizontal axis is entirely automatic.

The invention has for a further object the provision of means for effectively cleaning the interior of tanks even with hot non-solvent cleaning solutions.

Still another object of the invention is the provision of a light movable cleaning apparatus which may be easily and detachably mounted in tank cars having manhole covers of various sizes and shapes, or which may be transported to any portion of the interior of a large stationary oil tank by means of block and tackle.

A further object of the invention is the provision of an arrangement in which the cleaning fluid passage is unobstructed except by the turbine where a fluid motor is placed in the inlet passage, or which is totally unobstructed where the device is operated by a motor other than a motor of the fluid type.

Still a further object of the invention is the provision of a cleaning arrangement in which the stream movement progresses slowly and the dirt or heavy viscous deposit to be removed is driven in front thereof so as to effect a quicker and more complete cleaning. The invention thus provides means for turning the nozzles about a horizontal axis during each revolution about their vertical axis by a distance not greater than the diameter of the streams issuing from the nozzles as these streams strike the surface to be cleaned. That is, each step by step movement of the noz-

zles results in a movement of the striking area of the streams issuing therefrom a distance not greater than the diameter of said striking area and preferably a distance not quite as great as the diameter of the striking area.

The invention has for a further object the provision of an arrangement which does not require the use of lubricants and therefore can handle a hot non-solvent cleaning solution which would tend to destroy lubricants or render them ineffective.

These and further objects will become more apparent from the following description when read in connection with the accompanying drawings and appended claims.

In the drawings:

Fig. 1 shows one form of the invention being moved into position for use in a cleaning operation.

Fig. 2 is a vertical cross section through the nozzle portion of the device.

Fig. 3 is a top plan view of the same.

Fig. 4 is a front view of the driving motor.

Figs. 5 and 6 are cross sections on the lines 5—5 and 6—6 respectively of Fig. 2.

Fig. 7 is a front elevation of a modification of the device partially in cross section.

Fig. 8 is a front elevation of the lower portion of the arrangement shown in Fig. 7, the nozzles having been turned 90° about a vertical axis from the position shown in Fig. 7, and

Fig. 9 is a side elevation of the modification of Figs. 7 and 8 illustrating the manner in which it may be inserted in the manhole of a tank car.

Referring now to Fig. 1, the reference numeral 1 represents a pole or support having mounted thereon an arm 2 adapted to swing in a horizontal plane out over a tank car 3 riding on tracks 4. Supported by this arm 2 by a block and tackle arrangement generally indicated by the reference numeral 5 is the cleaning unit A of the invention. The cleaning unit A may be raised or lowered by the block and tackle arrangement 5 so as to be inserted or withdrawn from the tank car. 6 is a flexible inflow hose connecting the cleaning unit A to the supply pipe 7 which leads to a source of cleaning fluid under pressure (not shown). A return flow flexible hose 8 is detachably connected to the tank car bottom to carry off the dirt and used cleaning solution. The used cleaning solution, if other than hot water, may be reclaimed and returned to the source of supply for further use.

In Fig. 2 which shows the cleaning unit A in greater detail, the reference numeral 10 represents a plate provided with a central circular opening 11. The plate supports the housing 12 of a fluid motor, said housing having an inlet passage 13 provided with threads or other means whereby the flexible inflow tube 6 (shown in Fig. 1) may be attached thereto. The inflow passage in the housing 12 is in the form of an elbow having a downwardly depending annular portion 14 which fits into the circular opening 11 in the plate 10.

Mounted in the inlet portion of the housing are radially disposed vanes 15 which are gradually curved inwardly to the right to direct the incoming cleaning fluid in a clockwise direction. These vanes 15 are better shown in Fig. 4. Also disposed in the housing 12 are rotatable vanes or blades 16 comprising a turbine, the hub portion 17 of which in turn is keyed or otherwise secured to the shaft 18. Suitable bearings are provided and suitable packings such as 19 may be used to prevent possible leakage of the cleaning solution from the housing. The other end of the shaft 18 is provided with a worm 20 which is adapted to turn a gear 21 fixed on a vertically disposed shaft 22. Apertures are provided in the base of the housing 12 and in the plate 10 to permit the shaft 22 to pass therethrough.

Depending from the lower surface of plate 10 is a second housing 23 which may be secured in place by any suitable means such as the bolts 24. The lower portion of the second housing 23 is provided with a central aperture 25 having a downwardly extending annular flange 26. Reference numeral 27 indicates a gear provided with a central opening having upwardly and downwardly extending annular flanges 29, 30. The upwardly extending flange 29 is adapted to surround the depending annular portion 14 of the first housing 12. The downwardly depending flange 30 on the gear member 27 is provided with an annular ball race member 31. Ball bearings 32 are disposed between this race member 31 and a second annular race member 33 mounted on the housing 23 about the opening 25 therein. The gear 27 is thus supported from below by the housing 23. Secured to the central opening 28 of the gear member 27 and depending therefrom is a cylindrical tube 34. The gear member 27 is driven from a pinion 35 keyed or otherwise secured to the lower end of shaft 22.

From this description it will be apparent that when cleaning fluid under pressure enters the inlet passage 13 of the housing 12 it will be directed by the vanes 15 in a clockwise movement against the rotatable blades 16 of the fluid turbine. As these vanes 16 are turned, the shaft 18 is consequently rotated. The worm gear 20 on the end of shaft 18 turns the gear 21, the shaft 22, and the pinion 35 on the lower end of this shaft. Since the pinion 35 is connected with the gear 27 disposed within the second housing 23, this gear 27 is rotated about its vertical axis. In its rotation the gear 27 is guided by the upwardly extending annular flange 29 which concentrically surrounds the depending portion 14 on the first housing. The ball bearings 32 between the race members 31 and 33 facilitate this rotation. Since the cylindrical tube 34 is secured to the walls of the central opening 28 in the gear member 27, the tube also will rotate. The lower portion of the tube 34 is surrounded concentrically by a stationary cylindrical tube 36 which is secured to the walls of the downwardly depending annular flange 26 of the second housing 23.

Secured to the lower end of the cylindrical tube 34 is a nozzle assembly B. The rotary motion transmitted to the cylindrical tube 34 is in turn transmitted to the nozzle assembly B so that this assembly rotates about the vertical central axis of the cylindrical tube. Just above the nozzle assembly B is a sleeve-like casting 37 which is fitted over a collar or bushing 38 which in turn is secured to the stationary tube 36. The sleeve-like casting 37 is slidable vertically on the collar or bushing 38.

The casting 37 is provided with an internally threaded bore 39 which receives the threaded end of a headed bolt 40. The collar 38 is provided with a laterally extending lug 41 having an aperture therein in which the bolt 40 slides when the casting 37 is raised or lowered. The upward sliding movement of the casting 37, the purpose of which will be later described, is limited by a shoulder 42 on the collar 38, while the downward

movement is limited by the head of the bolt 40 when the head strikes the lug 41.

The nozzle assembly B is in the form of an elbow and is secured to the lower end of the cylindrical tube 34. Concentrically disposed on the horizontal portion 43 of the elbow so as to be rotatable thereon is a gear member 44. This gear member has an integral portion 45 forming a nozzle hub and is locked on the horizontal portion of the assembly B by means of an annular ring 46 secured to the end of said horizontal portion 43 such as by bolts 47. The nozzle hub portion 45 is provided with screw threaded aperture 48, 49 adapted to receive nozzles 50, 51. It is also provided with a central aperture 52 whose axis is in alignment with the axis of horizontal portion 43. This aperture 52 is screw threaded to receive a closure member 53. The gear 44, portion 45, nozzles 50, 51, and closure 53 are all adapted to rotate as a unit about the horizontal portion 43.

The vertically disposed portion 54 of the elbow is provided with a laterally extending member 55 having an aperture therein which rotatably receives a shaft 56. The upper end of the shaft has secured thereto a six toothed sprocket 57 while a worm gear 58 is secured to the shaft 56 near its lower end. The worm gear is operatively connected to the gear 44. This is clearly shown in Fig. 5.

Reference is now had to Fig. 6 which is a view on the line 6—6 of Fig. 2. From this figure and from Fig. 2 it will be apparent that the lower surface of the casting 37 is provided with an annular groove or race 59 which is of a width slightly greater than the diameter of anyone of the six teeth on the six toothed sprocket 57. Fig. 6 shows one of the teeth 60 of the sprocket disposed in the race or groove 59. The reference numerals 61 and 62 indicate peripheral openings which are separated by a web member 63 also shown in Fig. 5. As the nozzle assembly B is rotated with the cylindrical tube 34 in clockwise direction, a tooth 60 of the sprocket, for example, will strike the stationary web 63 to rotate partially the sprocket 57 and the shaft 56. The tooth 60 passes out through opening 61 and the next tooth 64 of the sprocket will enter the opening 62 to be disposed in the race or groove 59. The clockwise movement of the assembly B thus turns the sprocket and consequently the shaft 56 to which it is secured. This in turn causes the worm gear 58 to rotate the gear 44 resulting in a step by step rotation of the nozzles about the axis of the horizontal portion 43.

The contact of the web 63 with the teeth of the sprocket causes a rotation of the sprocket wheel and the shaft 56 to the extent of ⅙ of a revolution and this rotation of the sprocket wheel 57 causes the worm gear 58 to turn gear 44 about its horizontal axis.

The entire operation is automatic, and the speed ratio for proper and efficient operation is very important. Every time the nozzle unit B revolves about the vertical axis of the cylindrical tube 34 the sprocket is turned 60°. The speed reduction between the web 63 and the sprocket 37 as mentioned above is 6 to 1, and a further speed reduction of 50 to 1, is obtained by the worm 58 and the gear 44. Thus the entire speed reduction is from 300 to 1. Therefore, every time the unit B turns once about the vertical axis of the cylindrical tube 34 the nozzles 50 and 51 turn 1/300 of a revolution about their horizontal axis. While the rate of movement of the rotating cylindrical tube 34 of course varies with the speed and force of the inflowing cleaning fluid solution, the most efficient cleaning occurs when the speed of rotation of the cylindrical tube 34 is 5 R. P. M. and the rotation of the nozzles about the horizontal axis is approximately 1/60 R. P. M.

For a clearer understanding of the operation of the device it is perhaps advisable to trace the travel of the inflowing cleaning solution. It enters the cleaning unit through the passage 13 in the housing 12 and after being guided by the stationary vanes 15 in a clockwise direction strikes the vanes 16 of the fluid turbine to rotate them. It then passes down through the depending annular flange 14 of the housing, through the cylindrical tube 34, into the nozzle assembly B, and the horizontal portion 43 thereof to the nozzle hub portion 45 and out through the nozzles 50 and 51. The cleaning fluid used may be of any type. Since the parts revolve so slowly no lubricant is required and it is possible to use in this arrangement an extremely hot cleaning solution of a non-solvent nature. It will be noted that in this embodiment of the invention the only obstructions in the passageway for the cleaning solution are the stationary vanes 15 and the rotating vanes 16, of the fluid turbine.

Aside from these the passageway for the fluid is free and of substantially equal cross sectional area so that the speed of the fluid is not reduced after leaving the turbine.

As previously stated, the casting 37 is slidable vertically on the sleeve or collar 38 but within specified limits. When the casting is raised manually, its lowermost surface is raised above any of the teeth of the sprocket 57. Consequently the sprocket can be turned rapidly and the nozzles may be rotated to permit them to be set quickly in any desired starting position. After setting the casting 37 is permitted to assume its lower position with one of the sprocket teeth in the race or groove 59.

In this embodiment illustrated in Figs. 1 to 6, adjustable means have been illustrated for attaching the arrangement securely to the rim of an opening in the tank car. This attachment means shown is mounted on the plate 10 and comprises a plurality of screw threaded shafts 65 passing through cylindrical tubes 66 rigidly secured in apertures 67 in the plate 10. The tubes 66 are not screw threaded internally. Their internal diameter is greater than the diameter of the shafts 65 and consequently they slidably receive said shafts. The lower ends of the shafts have enlarged portions 68 provided with hook members 69 which are adapted to rise together with the shafts until they abut against the under surface of the top of the tank car immediately surrounding the manhole opening therein. The enlarged portions 68 are slidably supported by a track member 70 which may be integral with the housing 23 or rigidly secured thereto. The upper ends of the shafts 65 are provided with handle members 72 rigidly secured thereto, and these handle members 72 are always disposed in a position similar to the position of the hook members 69 so that they serve to indicate the position of the hook members. After the hook members have been drawn against the under side of the tank car top, they are secured in place by tightening the lock nuts 73.

All tank cars do not have manhole openings of the same size and this arrangement permits the cleaning unit to be rigidly but detachably se-

cured in tank cars regardless of the size of the manhole openings therein.

A second embodiment of the invention is illustrated in Figs. 7, 8, and 9 of the drawings. In this embodiment the step by step movement of the nozzles described in connection with the first embodiment is obtained by a slightly different arrangement and the turning of the nozzle assembly is effected by an electric or other motor entirely independent of the incoming cleaning fluid.

Referring now to Fig. 7, the reference character 110 indicates a plate on which is mounted a framework or yoke 112. A motor 114 which may be electric or operated by any suitable power is mounted on the plate 110.

The driven shaft 116 of the motor is connected directly to a worm gear 118 which meshes with the gear 120. This gear 120 is supported by a thrust bearing 122 and is pinned or keyed to the shaft 124 which turns freely in the bearing sleeve 126. This bearing sleeve 126 passes through an aperture in the plate 110 and is braced by an apertured block 128. A pinion 130 mounted on the lower end of the shaft 124 which extends below the bearing sleeve 126 meshes with the gear 132. The ratio between the pinion and the gear is such that a speed reduction of 5 to 1 is effected.

The gear 132 is secured by means of cap screws to a split collar 134 which in turn is clamped to a cylindrical tube 136 by means of the bolts 138 or any other suitable means. When the motor is operated, this tube 136 is caused by the gear train to rotate slowly about its vertical axis. The entire weight of the rotating unit held by the cylindrical tube 136 is supported by a radial thrust bearing 140 held by an annular ridge 142 on a circular plate 144. This plate 144 also serves as the base of a housing the sides of which are formed by a cylindrical member 146. The housing is held in position by means of bolts 148 connecting the plate 110 and the plate 144.

Reference character 150 represents an outer stationary tube which is co-axial with the tube 136 and is held by an annular flange 152 which extends downwardly from the plate 144. This outer stationary tube 150 supports a cam 154 and also tends to minimize any side thrust of the rotating unit. A threaded sleeve 156 brazed to the rotating cylindrical tube 136 at its lower end passes up in between this rotating tube 136 and the stationary tube 150 to form a bearing. An elbow 158 is screw threaded or otherwise secured on the lower end of the sleeve 156. This elbow is provided with a laterally extending flange 160 on which is mounted two bearings 162 in which the shaft 166 is rotatably mounted. A six toothed sprocket 164 is pinned to the shaft 166 at its upper end. Reference numeral 168 represents a worm gear also pinned on the shaft 166 to mesh with gear 170. As the sprocket is turned this gear 170 forms a thrust bearing with the shoulder 172 on the fitting 174. The gear 170 is held in place by bolts 176 which secure it to the shoulder 178 on fitting 180. Secured to this fitting 180 by means of screw threads or in any other suitable manner is a T-joint 182 into which the nozzles 184 are screwed. Nozzles having tips disposed angularly from the axis of the stream have been found to retard the speed of the stream. The tips of the nozzles in this arrangement are therefore made co-axial with the path of the stream.

From the description given above it should be apparent that when the motor is driven to rotate the cylindrical tube 136 about its vertical axis, the elbow 158, fittings 174 and 180, shaft 166, T-joint 182 and the nozzles 184 will also rotate with the tube about this vertical axis which is indicated by the reference character 186. Moreover, each time the nozzle unit rotates about this axis, one of the six teeth of the sprocket 164 strikes the knife edge of the cam 154. This contact causes a rotation of the sprocket wheel to the extent of ⅙ of a revolution, as in the first embodiment, and this rotation of the sprocket wheel causes the worm gear 168 to turn gear 170 about its horizontal axis 188 which is also the horizontal axis of the nozzles 184. The entire operation in this embodiment is also automatic.

Also as in the first embodiment each time the nozzle unit revolves once about the vertical axis 186 of the tube 36 the sprocket is turned 60°. The speed reduction between the cam 154 and the sprocket 164 is 6 to 1 and a further speed reduction of 50 to 1 is obtained by the worm 168 and the gear 170. Thus the entire speed reduction is from 300 to 1. Therefore, each time the unit turns once about the vertical axis 186 the nozzles turn 1/300 of a revolution about the horizontal axis 188. The approximate rate of movement of the rotating tube 136 is 5 R. P. M., while the rotation of the nozzles about the axis 188 is approximately 1/60 R. P. M.

The cleaning fluid used may be of any type. The parts revolve very slowly, as in the first modification, and therefore require no lubrication. It is thus possible to use an extremely hot cleaning solution of a non-solvent nature. The fluid is pumped from a tank (not shown) under a pressure of from 75 to 125 pounds and enters the arrangement by means of a flexible tube 190 (see Fig. 9) which is screw threaded or otherwise detachably secured to the elbow 192. Entering this elbow the fluid passes down through a stationary sleeve 194 which forms a sliding fit with the rotating cylindrical tube 136. The sleeve 194 is secured to the block 195 secured to the plate 110. The solution continues through the rotating tube 136 which may be of any convenient length, through the elbow fitting 158, through fittings 174, 180 and joint 182, and thus into the nozzles 184.

It will be noted that the passageway for the fluid is unobstructed and of substantially equal cross sectional area so that the speed of the fluid is not reduced by the device.

Most all tank cars are provided with threaded man-holes of standard size. In the drawings of this embodiment the device is shown as adapted for insertion into such a manhole. As shown in Fig. 7 the plate 110 has secured thereto by suitable means an annular ring 196 having a downwardly extending flange 198 provided with threads. Fig. 9 illustrates how this feature operates. The reference numeral 200 represents the bottom of the tank of a tank car while the top is indicated by 202. The aperture in the top is edged by an annular ring 104 provided with screw threads adapted to receive the threads of the ring 196. Where the holes on tank cars are not of standard size, clamps or other adjustable arrangements such as that shown in Figs. 1, 2, and 3 may be used to secure the device.

So that the arrangement may be moved about easily provision may be made for attaching the arrangement to a block and tackle. As shown in Figs. 7 and 9, a tackle ring 206 is supported

by the frame 112 which, as mentioned, is secured to the plate 110.

When cleaning stationary tanks of large size it is frequently possible to string one or more cables across the tank directly under the cover and to move the arrangement from one part of the tank to another by means of such cables. Large tanks often have several manhole openings in the top thereof and where this is the case cleaning of the tanks by the invention is further facilitated.

In prior known arrangements no provision was made for changing the position of the cleaning apparatus at will. Thus, it was impossible to clean large stationary tanks thereby. The surfaces in such tanks are often from 100 to 150 feet apart and streams eminating from one point within the tank are naturally inadequate. With the present invention the unit may be moved, by means indicated above, to various points of suspension within a tank. The first proper point is beneath the center of the roof of the tank, the second at the end of any diameter of a round tank, on the outer circular wall where it joins the roof; and the third at the base of the outer wall directly under the second point. Each point of suspension may be attached to the unit by a light block and tackle by the simple manipulation of which the machine may be set in any position, relative to the surfaces to be cleaned.

In circular tanks the invention described will clean a circle of from 800 to 1500 square feet at one setting of the blocks. Even with tanks having a capacity of from 50,000 to 85,000 barrels, only the services of two men are required to effect a complete cleaning. The operation consists in leaving the machine at the first location (usually cleaning a 30 foot diameter circle on the roof), until the circle is clean and then in moving it to the next location and so on until all surfaces of the tank are clean. A labor saving of about 50% may thus be effected.

Obviously a suitable track (not shown) or other suitable means may be provided upon which the arrangement can be moved within a tank.

It is sometimes an advantage to provide an indicator for the purpose of counting the revolutions of the shaft 124. Any suitable indicator may be provided such as the one illustrated in Fig. 7. This is comprised of a plate 202 which is secured to the top of shaft 124 and each side of which is provided with a contrasting color. When motive power is used which is controlled by means of a needle valve or other variable means, the speed of the equipment can be readily ascertained and therefore controlled by counting the revolutions of the indicator mentioned. Under normal operating conditions its speed should be about 15 revolutions per minute. Such a counting mechanism can also be used with the embodiment shown in Figs. 1–6 inclusive.

So slow is the rotation of the cylindrical tube 186 about its axis 186 and the rotation of the nozzles 84 about the horizontal axis 188, that no lubricant is required. Consequently as mentioned above, it is possible in this arrangement to utilize a very hot cleaning solution which in faster operating devices would be extremely detrimental since it would destroy the lubricant.

When the device has been positioned in a container or tank to be cleaned, it will be apparent that regardless of the position of the nozzles of both embodiments the two streams of solution directed therefrom will clean separate paths about the interior of the container or tank. After one revolution of the nozzles about the vertical axis, the sprocket is moved and the nozzles are revolved to the extent of 1/300 of a revolution. As the rotation about the vertical axis continues, one of the two nozzles will then clean a path slightly higher than previously, and the other nozzle will clean a path slightly lower than previously. Because of this very slight change in the position of the nozzles about the horizontal axis, the areas covered by each successive concentric circle formed by the ejected streams overlap each other.

As a practical example of this operation, suppose that either of the arrangements shown is lowered into a tank car, and that the nozzles are in a vertical position when so lowered. Inasmuch as they are somewhat removed from the center of the equipment, the first revolution will cause them to clean two small circles, one at the top of the tank car and one at the bottom. After the first revolution, the nozzles are inclined slightly from the vertical because of the action of the web 63 on the sprocket 57 in the first embodiment and the action of the cam 154 on the sprocket 164 in the second, and the second path of cleaning streams is slightly larger in diameter. This continues until the nozzles are in a horizontal position at which point both streams follow the same path about the interior of the tank car. Since each path has overlapped the previous one, the entire interior surface of the tank car is covered by this wiping action. In other words, the device directs two streams in continuous circular paths which constantly increase in size, the path of each stream always overlapping the preceding path while also covering a new area which has not been cleaned. This action is most important where a water cleaning solution is used. On the first revolution the water cleaning solution thins and partially emulsifies the heavy oily deposit, and this deposit on the succeeding revolution is entirely removed or pushed forward by the streams.

For the first time my invention produces an arrangement in which the nozzles can and are turned about a horizontal axis during each revolution about their vertical axis by a distance not greater than the diameter of the streams issuing from the nozzles as those streams strike the surface to be cleaned.

It has been found that tanks of any size can be cleaned much more quickly by using the arrangements and method described above. Where very viscous oils and greases are encountered, it is impossible to remove this tenacious film of scum by streams that continually cross each other as directed by prior art arrangements. In the present device this type of dirt or scum is entirely removed by the two streams because it is literally pushed off the metal surface being cleaned on the same principle as that employed in cleaning a surface by pushing a putty knife thereover and prying the deposit loose. Also analogous to the present method is the cleaning of a street or floor with a hose. If the spray from the hose is directed haphazardly over the surface to be cleaned, no effective cleaning can be accomplished since dirt and scum which may be loosened is pushed backward and forward over portions of the surface already cleaned. If, however, the stream is directed systematically in such a manner that it moves from side to side and progressively forward, the dirt is pushed ahead of

the stream and a complete cleaning is thereby effected.

Practical tests have shown that with the method and apparatus described above wherein the path of the stream is moved comparatively slowly, the entire surface may be cleaned much more quickly and satisfactorily than in arrangements employing fast moving nozzles. Moreover, the present arrangement is the first one by means of which the entire interior surface of a tank of any size may be effectively cleaned.

The automatic efficient apparatus described to illustrate the invention is only by way of example and the invention is not to be limited except as by the appended claims.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:

1. Apparatus for cleaning the interior surfaces of tanks and the like comprising, a plurality of nozzles radially extending from a central point and disposed in a common plane, a passageway connected to said nozzles for delivering fluid under pressure thereto, means for slowly rotating said nozzles about an axis spaced from but parallel to their common plane, and means for rotating said nozzles more slowly about an axis disposed substantially at right angles to said first mentioned axis, the relationship between the two rotary movements being such that said nozzles define a substantially spiral path.

2. Apparatus for cleaning the interior surfaces of tanks and the like comprising, a pair of oppositely directed nozzles, a passageway for cleaning fluid connected to said nozzles, means for slowly rotating said nozzles about an axis parallel to the plane of the nozzles but spaced therefrom, and means for rotating said nozzles more slowly about an axis disposed substantially at right angles to said first named axis, the relationship between the two rotary movements being such that said nozzles define a substantially spiral path.

3. Apparatus for cleaning the interior surfaces of tanks and the like comprising, a pair of oppositely directed nozzles, a passageway connected to said nozzles for delivering cleaning fluid under pressure thereto, fluid turbine means disposed in said passageway to be driven by the incoming cleaning fluid, means connected with said fluid turbine means for slowly rotating said nozzles about an axis parallel to the plane of the nozzles but spaced therefrom, and means for rotating said nozzles more slowly about an axis disposed substantially at right angles to said first named axis, the relationship between the two rotary movements being such that said nozzles define a substantially spiral path.

4. Apparatus for cleaning the interior surfaces of tanks and the like comprising, a pair of oppositely directed nozzles, a pasageway connected to said nozzles for delivering cleaning fluid under pressure thereto, means independent of said cleaning fluid for slowly rotating said nozzles about an axis parallel to the plane of the nozzles but spaced therefrom, and means for rotating said nozzles more slowly about an axis disposed substantially at right angles to said first named axis, the relationship between the two rotary movements being such that said nozzles define a substantially spiral path.

5. Apparatus for cleaning the interior surfaces of tanks and the like comprising, a tube adapted to be lowered into a tank, a pair of oppositely directed nozzles disposed in a plane parallel to that of the axis of said tube and connected thereto by a passageway, means for rotating said nozzles slowly about the longitudinal axis of said tube, and means for rotating said nozzles more slowly about an axis substantially at right angles to the axis of said tube, the relationship between the two rotary movements being such that said nozzles define a substantially spiral path.

6. Apparatus for cleaning the interior surfaces of tanks and the like comprising, a plurality of nozzles radially extending from a central hub and whose axes are disposed in a common plane, means for supplying a cleaning fluid under pressure to said hub, means for slowly rotating said nozzles about an axis spaced from but substantially parallel to their common plane, and means for rotating said nozzles more slowly about the axis of said hub, the relationship between the two rotary movements being such that said nozzles define a substantially spiral path.

7. Apparatus for cleaning the interior surfaces of tanks or the like comprising, a tube, means connecting said tube with a source of supply of cleaning solution under pressure, means for rotating said tube about its longitudinal axis, a pair of oppositely directed nozzles disposed in a plane parallel to the axis of said tube, means connecting said nozzles to said tube to be rotated therewith about said axis, and means operative upon each rotation of said nozzles about said axis to rotate said nozzles partially about an axis substantially at right angles to said first mentioned axis, the relationship between the two rotary movements being such that said nozzles define a substantially spiral path.

8. Apparatus for cleaning the interior surfaces of tanks or the like, comprising, a tube, means connecting said tube with a source of supply of cleaning solution under pressure, means for rotating said tube about its longitudinal axis, a pair of oppositely directed nozzles disposed in a plane parallel to the axis of said tube, means connecting said nozzles to said tube to be rotated therewith about said axis, and automatic means operative upon each rotation of said nozzles about said axis to rotate said nozzles partially about an axis substantially at right angles to said first mentioned axis, said means comprising a stationary element, a sprocket adapted to be turned by said element upon each rotation of said nozzles about the axis of said tube, a worm driven by said sprocket, and a gear driven by said worm, the axis of said gear being co-axial with said second axis and secured to said nozzles.

9. Apparatus for cleaning the interior surfaces of tanks and the like comprising, a support, a motor mounted on said support, a cylindrical inlet tube supported in an aperture in said support and extending downwardly therefrom, a cylindrical tube co-axial with said first tube and surrounding the same to form a sliding connection, a gear secured to said second tube, a gear train driven by said motor and connected to said gear for rotating said second cylindrical tube, a housing suspended from said plate, thrust bearings in said housing for supporting said gear and said second mentioned tube, a third tube depending from said housing and surrounding said rotatable tube, a cam mounted on said third tube, an elbow secured to the lower end of said rotatable tube, a fitting secured to said elbow, said fitting having an annular flange at its outer end, a second fitting disposed adjacent said first fitting, said second fitting having an annular flange on its inner end adjacent the flange on said first fitting, said second flange being of greater diameter than said

first flange, a ring gear surrounding said first flange and secured to said second flange, said ring gear having an inwardly extending ring adjacent that side of the first flange nearest said elbow, a T-joint secured to said second fitting, a pair of oppositely disposed nozzles mounted in said T-joint, said nozzles being in a plane parallel to the longitudinal axis of said rotatable tube, and extending radially from an axis substantially at right angles to said first mentioned axis, and sprocket means supported by said elbow and actuated by said cam upon rotation of said rotatable tube, for tuning said ring gear to turn said nozzles slowly about said second mentioned axis.

10. Apparatus for cleaning the interior surfaces of tanks and the like comprising, a support, a motor mounted on said support, a cylindrical inlet tube supported in an aperture in said support and extending downwardly therefrom, a cylindrical tube co-axial with said first tube and surrounding the same to form a sliding connection, a gear secured to said second tube, a gear train driven by said motor and connected to said gear for rotating said second cylindrical tube, a housing suspended from said plate, thrust bearings in said housing for supporting said gear and said second mentioned tube, a third tube depending from said housing and surrounding said rotatable tube, a cam mounted on said third tube, an elbow secured to the lower end of said rotatable tube, a fitting secured to said elbow, said fitting having an annular flange at its outer end, a second fitting disposed adjacent said first fitting, said second fitting having an annular flange on its inner end adjacent the flange on said first fitting, said second flange being of greater diameter than said first flange, a ring gear surrounding said first flange and secured to said second flange, said ring gear having an inwardly extending ring adjacent that side of the first flange nearest said elbow, a T-joint secured to said second fitting, a pair of oppositely disposed nozzles mounted in said T-joint, said nozzles being in a plane parallel to the longitudinal axis of said rotatable tube, and extending radially from an axis substantially at right angles to said first mentioned axis, and sprocket means supported by said elbow and actuated by said cam upon rotation of said rotatable tube, for turning said ring gear to turn said nozzles slowly about said second mentioned axis, said inlet tube, second cylindrical tube, third tube, elbow, fittings and T-joint being unrestricted and having substantially equal cross-sectional areas.

11. Apparatus for cleaning the interior surfaces of tanks or the like comprising, a tube adapted to be lowered into the tank, means for rotating said tube about its longitudinal axis at the rate of 5 R. P. M., a pair of oppositely directed nozzles disposed in a plane parallel to the axis of said tube and connected to said tube by a passageway, said nozzles extending laterally from an axis substantially at right angles to the axis of said tube, and means controlled by the rotation of said nozzles about the axis of said tube for rotating said nozzles about said other mentioned axis at the rate of 1/60 R. P. M.

12. Apparatus for cleaning the interior surfaces of tanks and the like comprising, a support, a yoke mounted on said support, a ring secured to said yoke, a rotatable tube disposed beneath said support, a fluid inlet passing through said support and connected with said tube, a motor mounted on said support for rotating said tube, an elbow secured to the lower end of said tube, a fitting secured to said elbow, said fitting having an annular flange at its outer end, a ring gear surrounding said flange and having an inwardly directed flange disposed on the outside of said first flange nearest to said elbow, a second fitting disposed adjacent said first fitting and co-axial therewith, said second fitting having a flange of larger diameter than the flange on said first fitting, means for connecting said gear to the flange on said second fitting, a pair of nozzles extending radially from the axis of said fittings and disposed in a plane parallel to the axis of said rotatable tube, a stationary cam, a pair of bearings secured to said elbow and disposed laterally to said fittings, a worm gear adapted to mesh with said ring gear and mounted on a shaft mounted in said bearing, a sprocket mounted on said shaft, said sprocket being adapted upon rotation of said nozzles said fittings and said elbow about the axis of said rotatable tube to be moved by said cam, whereby said nozzles are rotated about the axis of said fittings.

13. Apparatus for cleaning the interior surfaces of tanks and the like comprising a nozzle radially extending from a central point, a passage-way connected to said nozzle for delivering fluid under pressure thereto, means for slowly rotating said nozzle about an axis substantially perpendicular to the axis of said nozzle and more rapidly about an axis substantially perpendicular to said first axis, the relationship between the two rotary movements being such that said nozzle defines a substantially spiral path.

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