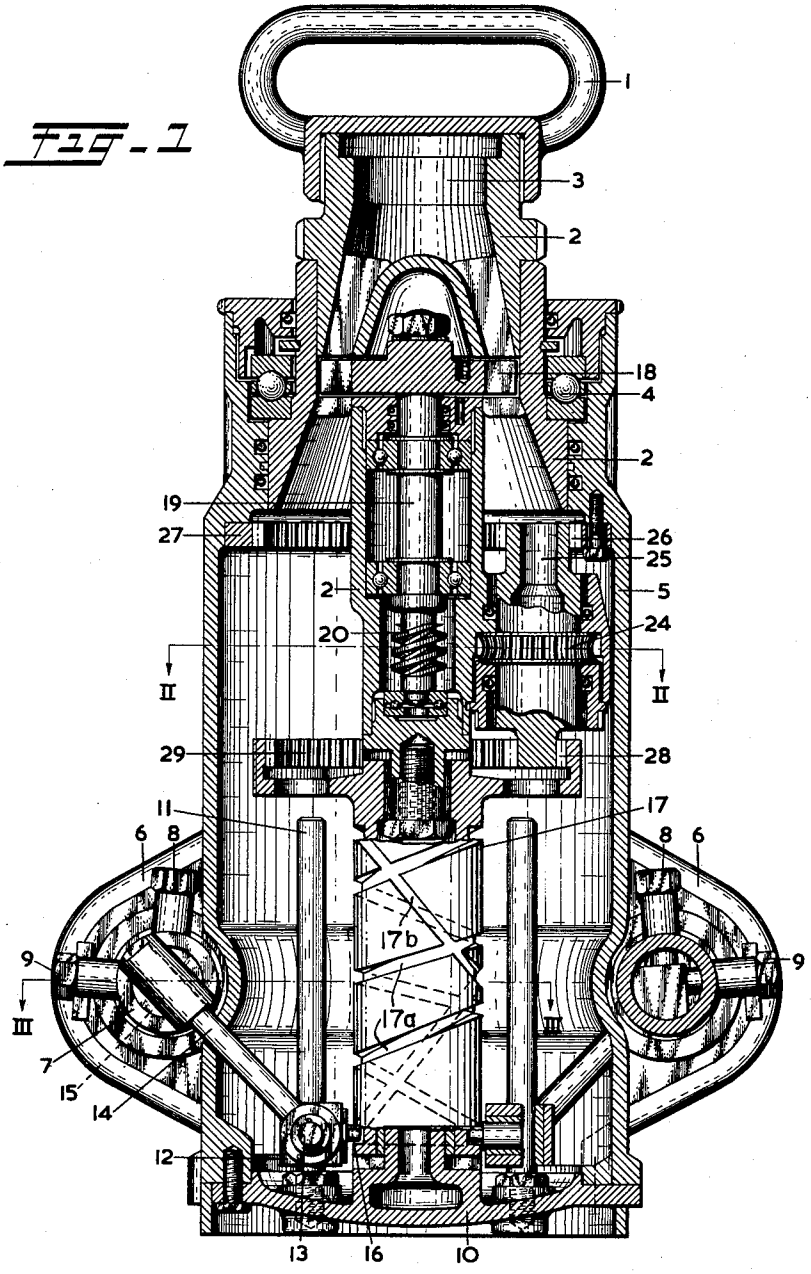
July 4, 1961 C. IN 'T VELD ET AL 2,991,203

METHOD AND APPARATUS FOR CLEANING THE INTERIOR OF A TANK

Filed Oct. 28, 1958 3 Sheets-Sheet 1

Fig. 1




INVENTORS
CORNELIS IN 'T VELD
BY JOHANNES IN 'T VELD
ATTORNEY

July 4, 1961 C. IN 'T VELD ET AL 2,991,203

METHOD AND APPARATUS FOR CLEANING THE INTERIOR OF A TANK

Filed Oct. 28, 1958 3 Sheets-Sheet 2

Fig. 2

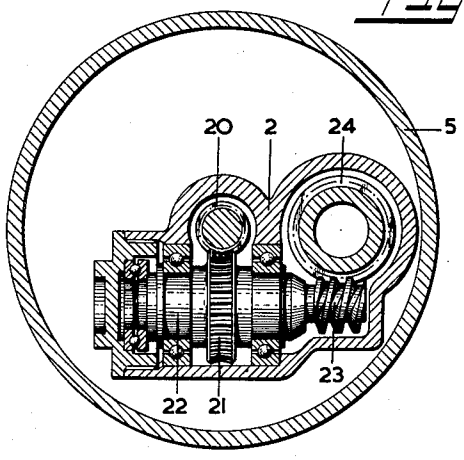



Fig. 4

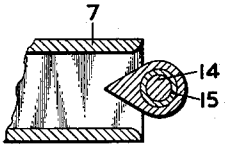
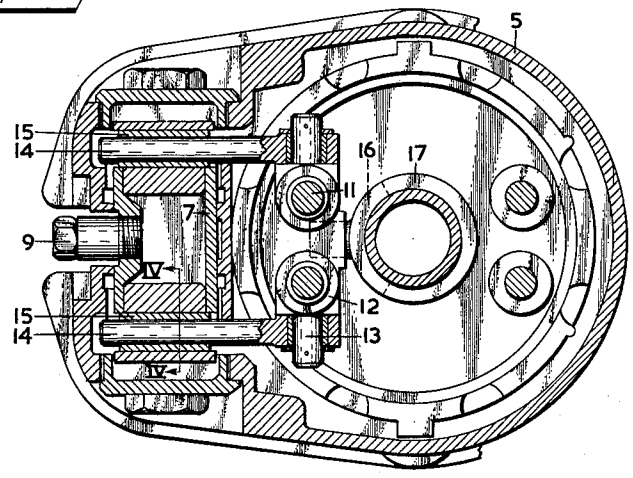



Fig. 3




INVENTORS
CORNELIS IN 'T VELD
JOHANNES IN 'T VELD
BY
ATTORNEY

July 4, 1961 C. IN 'T VELD ET AL 2,991,203

METHOD AND APPARATUS FOR CLEANING THE INTERIOR OF A TANK

Filed Oct. 28, 1958 3 Sheets-Sheet 3

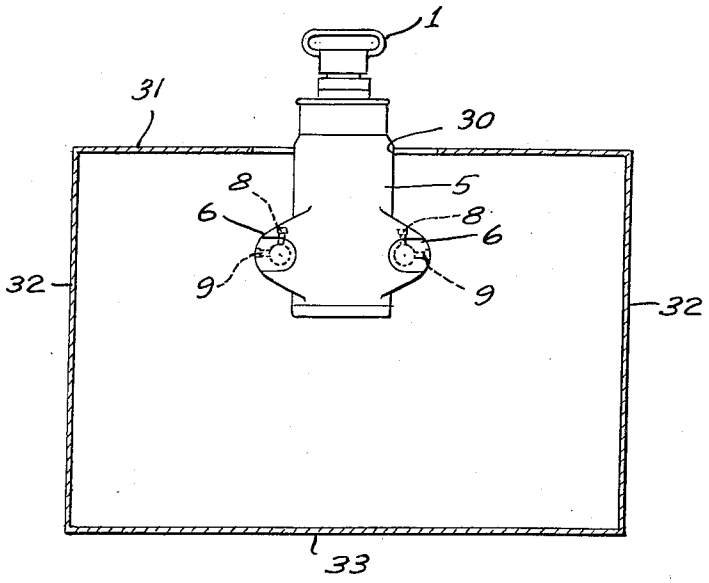



Fig. 5.

INVENTORS
CORNELIS IN'T VELD
JOHANNES IN'T VELD
BY
ATTORNEY

United States Patent Office

2,991,203

Patented July 4, 1961



2,991,203

# METHOD AND APPARATUS FOR CLEANING THE INTERIOR OF A TANK

Cornelis in 't Veld, 12 Burg. Luijerinksingel, and Johannes in 't Veld, 13 Burg. Luijerinksingel, both of Vlaardingen, Netherlands

Filed Oct. 28, 1958, Ser. No. 770,168
Claims priority, application Netherlands Oct. 31, 1957
7 Claims. (Cl. 134—24)

The invention concerns a method and an apparatus for cleaning the interior of a tank of, for instance, a tanker, a shore installation or the like, according to which a cleaning liquid is ejected from nozzles which are rotatable about a horizontal transverse axis, said nozzles forming part of an apparatus which itself is rotatable about a vertical axis. A similar method and apparatus are known from the Dutch patent specification No. 32,888, according to which two nozzles rotating in parallel vertical planes about a horizontal axis perform at the same time a movement about a vertical axis of rotation. In this treatment the cleaning liquid is delivered in equal quantities towards the top and the bottom. Because the body of revolution of these rotating nozzles here described with each revolution has as points of intersection the points perpendicularly below and above the apparatus, relatively large quantities of liquid are sprayed on and about these points of intersection. In such tanks, however, the largest amount of dirt is to be found on the lower part of the side-walls of the tank and in the corners, in particular the lower corners near the bottom, towards which parts relatively small quantities of cleaning liquid are sprayed by the known method. The cleaning liquid usually employed is hot water under a pressure of about 12 atm. Quantities of about 80 tons/hour are required for this, and it will be evident that such a quantity of hot water under high pressure is an expensive liquid, for the production of which a good deal of power is needed. If the cleaning of the tanks of a steam-driven tanker has to be carried out during navigation, the amount of power required for this is frequently so great that the tanker cannot sail on normally, but has to reduce its speed considerably.

Now the invention has for its object to furnish a method and apparatus by means of which it is possible to carry out the cleaning of a tank in a way which is more efficient and also involves a saving of liquid.

According to the invention this object is achieved by the fact that for the duration of one cycle of treatment the nozzles, performing a given number of revolutions about the vertical axis, are simultaneously adjusted only once from the top to the bottom. Whilst therefore according to the known methods the jets act upon the walls of the tank according to curved lines extending side by side from the top to the bottom, in accordance with the invention the action upon the walls takes place according to a spiral line on the top and bottom surfaces and according to helical lines on the side-walls of the tank. According to the invention it is possible to control the nozzles in such a way during their adjustment about the horizontal axis that the action of the jets is shorter on those surfaces which are less dirty and longer on those which are dirtier. According to the invention the adjustment of the nozzles about the horizontal axis may therefore take place with varying speed, a slower adjustment in particular taking place in those ranges of



adjustment where the jets act in the corners of the tank, which is desirable if the dirt is to be removed effectively.

The tanks are least dirty on the upper surface and the dirtiness increases via the corners along the side-walls downwards. In the known method the apparatus has to be entirely adjusted to the dirtiest place, so that too much cleaning liquid is sprayed in all other less dirty places. This excessive use of cleaning liquid can be avoided by the method according to the invention because in consequence of a ready adjustment of the nozzles the jets can move quickly over the less dirty surfaces and according to the invention the adjustment in the corners takes place more slowly, In fact, in these corners greater demands are made on the cleaning in connection with the relative increase of the area to be cleaned and the presence of additional surfaces, connected with the construction of the tank.

Further it is no longer necessary to use the same nozzle in the upper range of the tank and in the lower range, so that nozzles of different diameters can be employed for these ranges, which involves a further saving of cleaning liquid. Even apart from the better cleaning in the corners which is possible with the method according to the invention, a saving of about f3,000.— is obtained during the cleaning of a tanker, so that the cost of the apparatus for carrying out the method is already amply recovered in one treatment.

The apparatus for carrying out the method according to the invention may be formed by a casing adapted to rotate about a vertical axis relative to its suspension through which casing the cleaning liquid is fed, while on the outside it is fitted with one or more nozzles rotatable about a horizontal transverse axis, which nozzles are connected with means for adjusting these nozzles. In order to obtain different quantities of liquid for the treatment of the upper and the lower part of a tank respectively, according to the invention near each horizontal transverse axis two nozzles connected with each other and with the operating means may be provided, which nozzles include an angle of about 90° with each other and can be adjusted over a corresponding angular range. The nozzle which then covers the upper part of the tank may have a smaller outlet opening than the other nozzle.

According to the invention each nozzle or each set of nozzles may be connected with a vertically adjustable body engaging the helical threads of a member driven so as to rotate about a vertical axis, the helical threads of said member, which bring about the downward adjustment of the nozzles, having a variable pitch, while further a return thread with a considerably greater pitch running in the opposite direction is present. The helical threads of different pitch cause the nozzles in given ranges to be adjusted more slowly than in other ranges, while at the end of the cycle an accelerated return to a new starting position takes place. Owing to this variable pitch the nozzles can move more quickly over the upper side and lower surfaces of the tank and act for a longer time upon the angular ranges of the tank.

According to the invention, in the casing there may be mounted a turbine driven by the flow of the liquid, which turbine drives, via a reduction gear, the casing rotating about the vertical axis and also, via a second reduction gear, the member provided with helical threads. This type of drive provides for the rotation about the vertical axis of rotation and for the slow adjustment of

the nozzles about the horizontal axis as well as the readjustment to the new starting position, upon which the cycle may be repeated again, if necessary.

The invention will now be explained more fully with reference to the drawings, which illustrate an embodiment of the apparatus for carrying out the method according to the invention.

FIGURE 1 is a vertical cross-section of the apparatus according to the invention.

FIGURE 2 is a horizontal cross-section along the line II—II in FIGURE 1.

FIGURE 3 is a horizontal cross-section along the line III—III in FIGURE 1.

FIGURE 4 is a cross-section of a part of FIGURE 3 along the line IV—IV.

FIGURE 5 is a vertical section on a smaller scale of a tank and cleaning apparatus embodying the invention.

The apparatus shown in the drawings consists of a protective protective cap and handle **1**, a casing **2**, which is provided with a connection (not shown) for feeding cleaning liquid to the interior **3** of said casing. On this casing **2**, which is stationary during the operation of the apparatus, via a ball bearing **4** the casing **5** of the apparatus is rotatably suspended.

Near the lower end this casing **5** is constructed to have rubber-lined laterally extending lugs **6**, near which a sleeve **7** is rotatably supported, from which sleeve extend two nozzles **8** and **9** respectively, which nozzles practically include an angle of 90° with each other, but are placed the former at a small angle inwards towards the vertical and the latter at a small angle upwards towards the horizontal. This is necessary in order to prevent certain surfaces not being sprayed and to obtain overlapping.

The casing **5** is closed at the bottom by a cover **10**, on which are fixed columns **11** directed vertically upwards. These columns **11** serve as guides for blocks **12** movable along them, which blocks are fitted with stub axles **13**, arms **14** extending into bushings **15** of the sleeve **7**, rotatable about a horizontal transverse axis, being supported on said stub axles. When the blocks **12** are moved upwards along the columns **11**, the rods **14** will move in the bushings **15**, with the simultaneous rotation of the sleeve **7** and consequently of the nozzles **8** and **9**. The blocks **12** are fitted with a member **16** meshing with a helical thread of a member **17** rotatable about a vertical axis. The helical threads of this member **17** have a variable pitch, in the sense that the pitch is greater at the lower and the upper ends where the nozzles are in registration with the flat wall surfaces than in the central section where the nozzles are in registration with the more remote corner sections of the tank. The return thread **17*b*** is of greater pitch than the thread **17*a*** so that the nozzles are returned at a more rapid rate for repeating the cycle.

Both the casing **5** and the member **17** fitted with threads are power-driven, for which purpose in the upper part of the casing **2** a turbine **18** is mounted, which drives a shaft **19** supported in the innermost part of the casing. This shaft **19** carries a worm screw **20**, also shown in FIGURE 2, and this worm screw drives a worm wheel **21** of a shaft **22**, on which a second worm **23** is mounted. This worm **23** meshes with a worm wheel **24** of a shaft **25**, at the upper end of which is located a gear wheel **26** meshing with an internal gear **27** of the casing **5**. In this way the casing **5** is driven with great reduction, so that it rotates about the vertical axis and thus also imparts a similar rotation to the nozzles. At the lower end of the shaft **25** is located a second gear wheel **28**, also meshing with an internal gear **29**, which is connected with the member **17** fitted with helical threads, by which means the latter is driven. This drive results in the upward movement of the blocks **12** and accordingly in the rotation of the nozzles.

The cleaning liquid flows through the hollow interior of the casings **2** and **5**, and can enter via the ends of the sleeve **7** into the interior of the latter and leave it via the nozzles fitted on the sleeve. To this end the bushings at the ends near the guide bushing **15** for the rod **14** are shaped in the way indicated in FIGURE 4. The nozzles are adjusted over an angle which is slightly greater than 90°, so that sufficient overlapping is obtained.

It will be evident that instead of the driving mechanism for the adjustment of the nozzles it is also possible to use other mechanisms or even manual operation, by means of which the adjustment is effected by hand in a simple way, from the top.

It is further to be noted that after each cycle of treatment the next cycle starts in another point, so that upon repetition of the treatment the lines described on the walls differ from those of the preceding cycle.

The apparatus above described is shown in FIG. 5 as positioned for cleaning a tank having a top wall **30** provided with an opening **31** through which the apparatus is inserted and having side walls **32** and a bottom wall **33**. The nozzles are so disposed that one set of nozzles cleans the top wall **30** and the upper portion of the side wall **32**, while the other set of nozzles cleans the lower portion of the side wall **32** and the bottom wall **33**.

What we claim is:

1. The method of cleaning deposits from the interior walls of a tank or the like having top, bottom and side walls, which comprises spraying onto the interior surfaces of said walls a cleaning liquid from a plurality of nozzles within said tank, said nozzles extending normal to a horizontal axis and being spaced laterally from a given vertical axis while rotating said set of nozzles about said vertical axis at a uniform rate and simultaneously oscillating said nozzles about said horizontal axis in such an arc that liquid from certain of said nozzles impinges on the top and upper side walls of said tank and liquid from others of said nozzles impinges on the bottom and lower side walls of said tank and discharging a larger quantity of said liquid from the last mentioned nozzles than from the first mentioned nozzles to compensate for the greater quantity of deposit to be removed from the lower portion of said walls.

2. The method set forth in claim 1 in which said nozzles are arranged in pairs displaced relatively by about 90° with respect to said horizontal axis and are oscillated in an arc of the order of 90°.

3. Apparatus for cleaning deposits from the interior surfaces of a tank or the like having top, bottom and side walls, comprising a casing to be disposed within said tank and mounted to rotate about a vertical axis, a plurality of sets of nozzles mounted on said casing to be oscillated about horizontal axes, said nozzles extending normal to said horizontal axes and being displaced from said vertical axis, means for oscillating certain nozzles of each set in an arc adapted to cause the liquid therefrom to contact the top and upper side walls only of said tank and means for oscillating other nozzles of each set in an arc adapted to cause the liquid therefrom to contact the bottom and lower side walls only of said tank, and means simultaneously rotating said casing about said vertical axis for thereby causing said liquid to contact said walls around the entire periphery of said tank.

4. An apparatus as set forth in claim 3 in which said last mentioned nozzles are adapted to discharge a greater quantity of liquid than said first mentioned nozzles to compensate for the greater quantity of deposit to be removed from the lower portion of said walls.

5. An apparatus as set forth in claim 3 in which said nozzles are arranged in pairs, the nozzles of each pair being relatively displaced by about 90° with respect to said horizontal axes and wherein means is provided to cause said nozzles to oscillate about said horizontal axes through an arc of the order of 90°.

6. An apparatus as set forth in claim 5 wherein means is provided to cause the nozzles to oscillate at a greater rate at the extremities of their path of travel than at the center portion of their path of travel.

7. An apparatus as set forth in claim 3 wherein said means for oscillating said nozzles includes means to feed said nozzles downwardly at a predetermined rate and means for returning said nozzles upwardly at a predetermined faster rate.



**References Cited in the file of this patent**

UNITED STATES PATENTS

| | | |
|---|---|---|
| 479,105 | Franklin | July 19, 1892 |
| 1,307,634 | Morse | June 24, 1919 |
| 1,806,740 | Butterworth | May 26, 1931 |
| 2,177,219 | Lewis | Oct. 24, 1939 |
| 2,714,080 | Kennedy | July 26, 1955 |
| 2,800,366 | Scruggs | July 23, 1957 |