

United States Patent

Stoeckel et al.

[15] 3,645,452

[45] Feb. 29, 1972

[54] **TANK CLEANER**

[72] Inventors: Albert L. Stoeckel, Euclid; Alfred F. Zoltai, Elyria, both of Ohio

[73] Assignee: The B. F. Goodrich Company, New York, N.Y.

[22] Filed: Apr. 27, 1970

[21] Appl. No.: 32,290

[52] U.S. Cl. 239/227, 239/265, 239/587, 134/168

[51] Int. Cl. B05b 3/02

[58] Field of Search 239/160, 162, 164, 165, 225, 239/227, 264, 265, 587; 134/167, 168

[56] **References Cited**

UNITED STATES PATENTS
3,444,869 5/1969 Guignon et al. 239/227 X

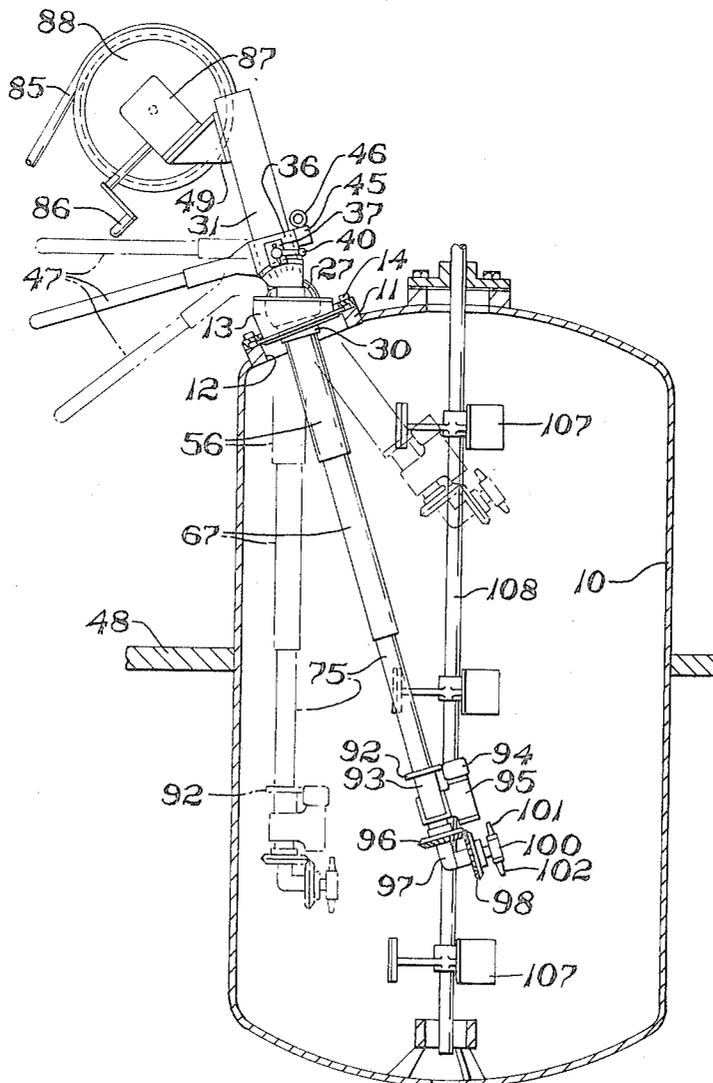
3,255,969	6/1966	Saad	239/227
2,082,330	6/1937	Frede et al.	239/227
3,074,649	1/1963	Atkinson	239/227 X
3,420,444	1/1969	Ajnefors	239/264 X

Primary Examiner—M. Henson Wood, Jr.
Assistant Examiner—Michael Y. Mar
Attorney—Joseph Januszkiewicz and W. A. Shira, Jr.

[57] **ABSTRACT**

A portable high-pressure tank-cleaning apparatus with telescopic sections adjustably secured to a base section. A cleaning head is mounted at the end of the forwardmost section and is positioned upon extension of the telescopic sections. The adjustability of the telescopic sections on the base permits the cleaning head to be positioned at different positions in the tank.

8 Claims, 7 Drawing Figures



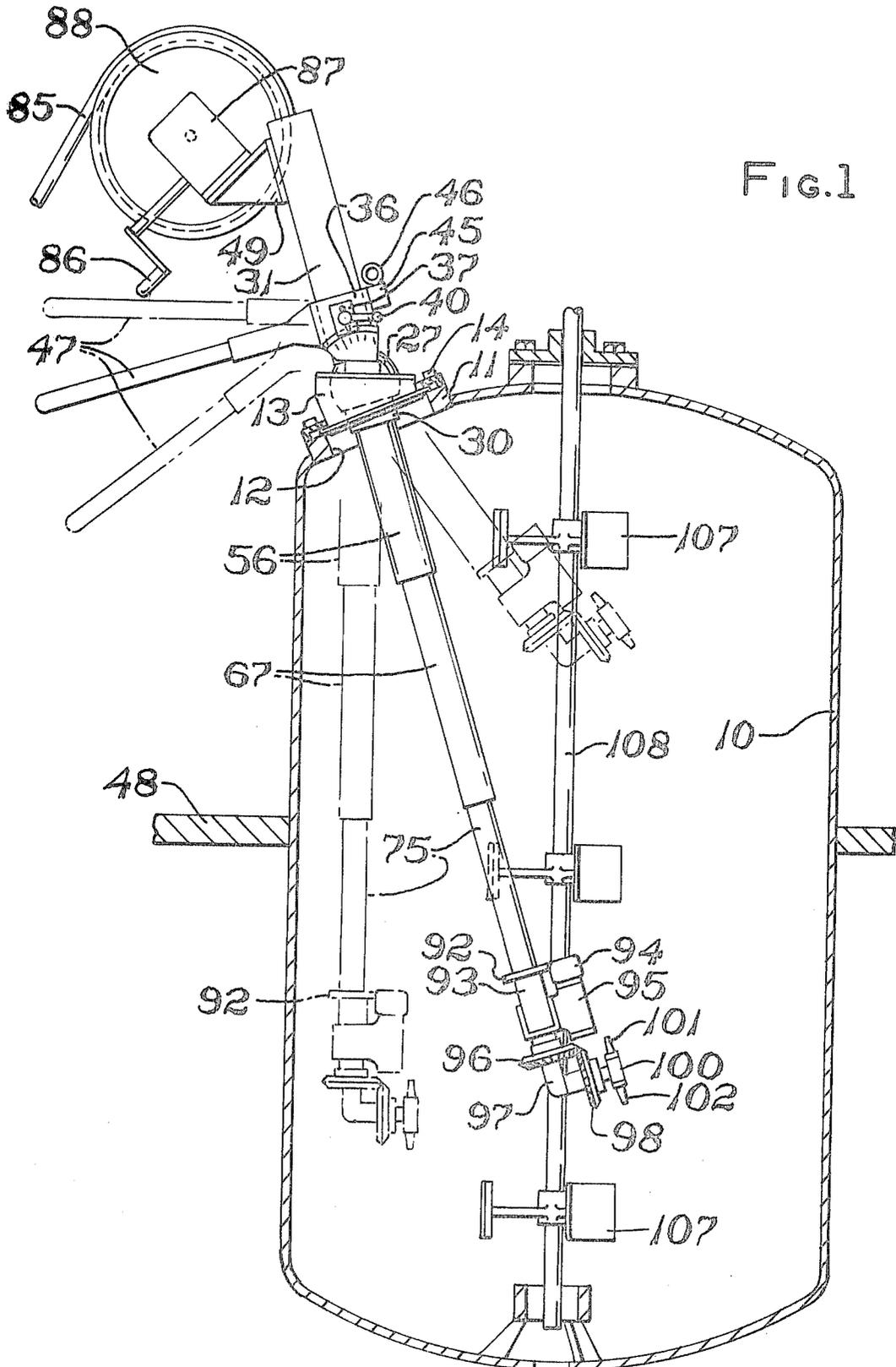


FIG. 2

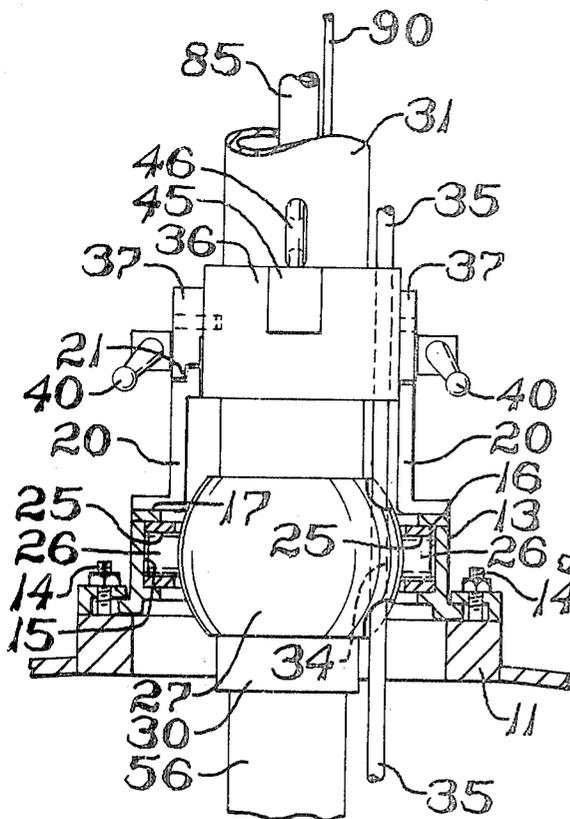
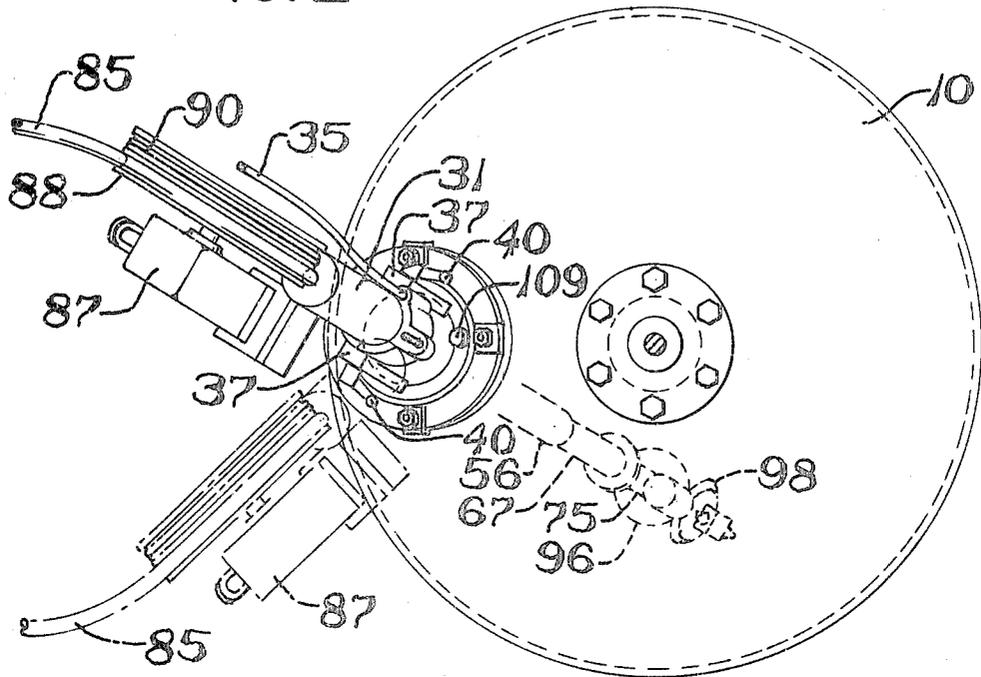


FIG. 3

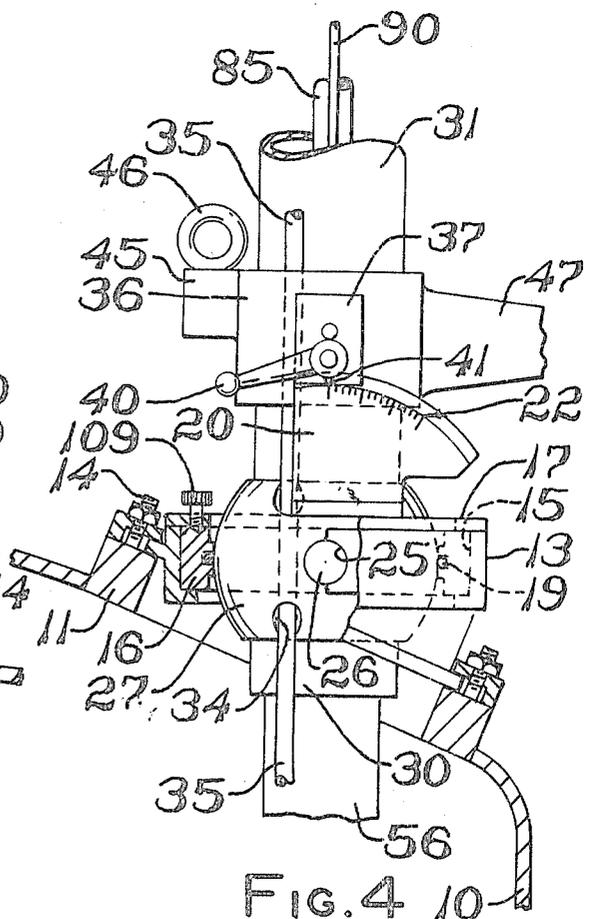


FIG. 4

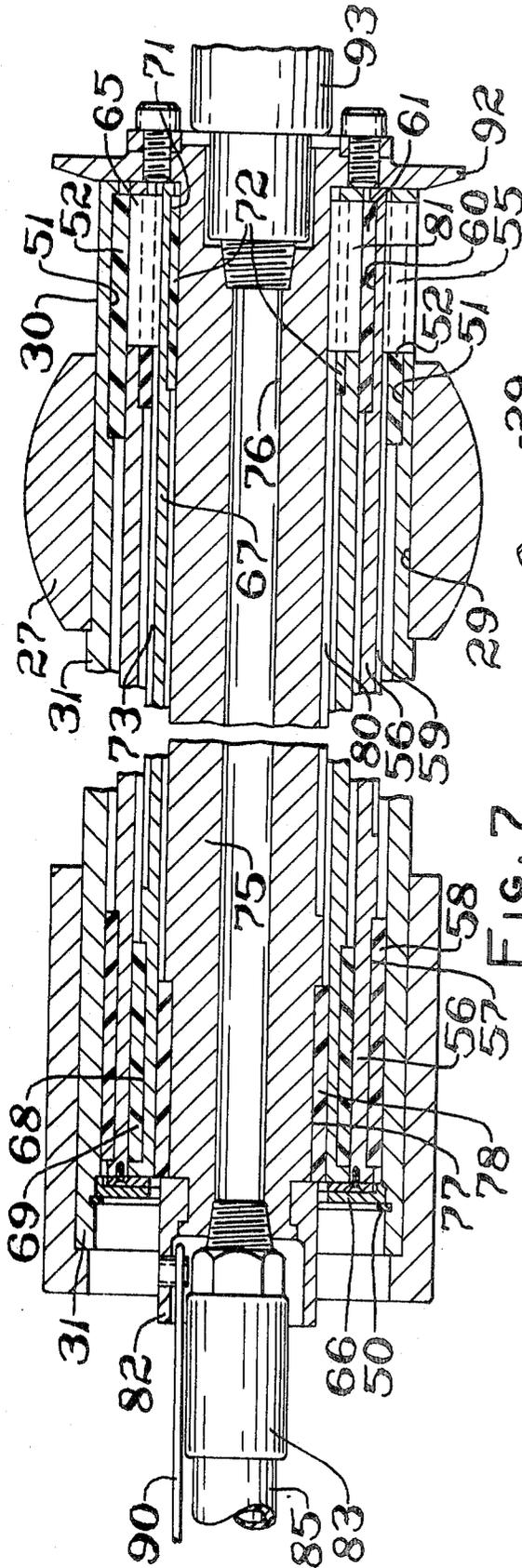


FIG. 7

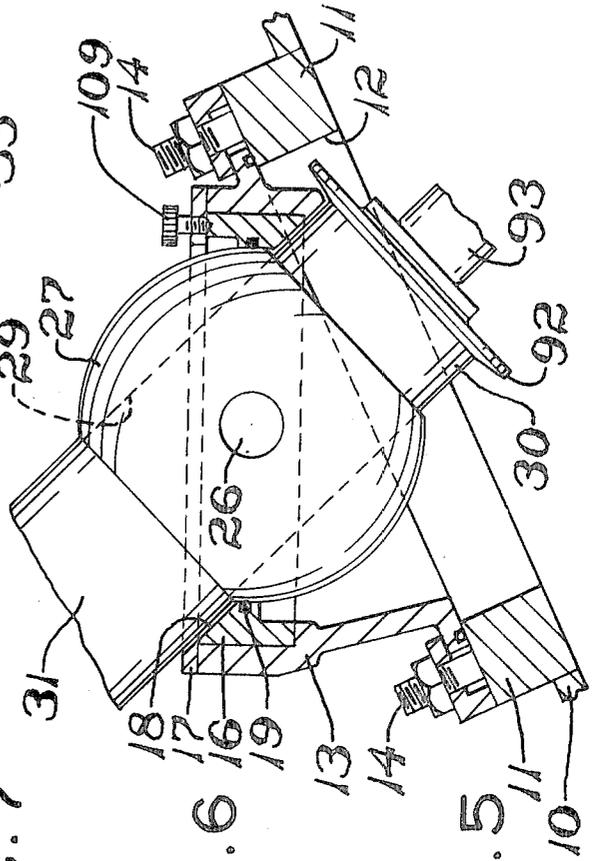


FIG. 5

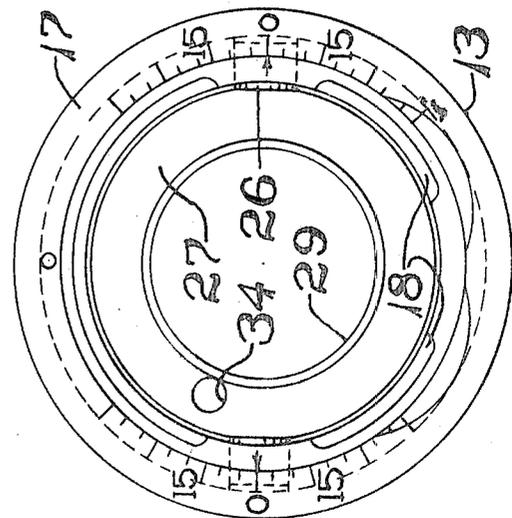


FIG. 6

1
TANK CLEANER

BACKGROUND OF THE INVENTION

This invention relates to a high-pressure cleaning apparatus and more particularly to a portable and adjustable tank-cleaning apparatus with telescopic sections to facilitate the positioning of the apparatus's cleaning head to different locations so that the head can direct a high-pressure stream of fluid against all interior surfaces of a chemical processing vessel.

In the chemical processing industry large storage and processing tanks or vessels are utilized which must be periodically cleaned. Interior surfaces of such tanks or vessels invariably become contaminated and fouled due to the chemicals processed therein. In polymerization of polyvinyl chloride, for example, cleaning of processing vessels, is necessary after the completion of each batch polymerization process. In addition to the interior surface walls of such tanks, the interior of such chemical processing tanks may contain baffles, crevices, agitators and agitator blades and the like, which also must be cleaned. Cleaning periodically is necessary so as to prevent contamination of succeeding polymerization batches and to assure a consistent quality product.

Cleaning of the interiors of such tanks is normally accomplished by manually scrapping the interior walls, baffles and agitator blades in such tanks. Manual methods are time consuming, ineffective for thorough cleaning due to the inherent deficiencies of a manual operation and additionally subjects wall surfaces to scratches and mars due to the use of scrapers. Hand lances utilizing high-pressure nozzles have been used to supplement the hand scrapping to clean the interiors of tanks; however, an operator using a hand lance is essentially still a manual operation wherein the operator maneuvers the hand lance, which maneuvering is rendered difficult by the length of such lances and the inaccessibility from the exterior thereof. Operating a hand lance outside the vessel makes it impossible to reach all interior surfaces within the vessel. A hand lance invariably creates a "fog" which further hampers the operator from observing the interior of the tank. Hand lances are further difficult to maneuver and, due to the high-pressure system, create an ever present danger to operating personnel. Numerous safety procedures are necessary with manual operations, such as locking out the agitator motor and panel switch to render the agitators inoperable, connecting an exhaust hose to the tanks prior to cleaning and exhausting the interior thereof for at least 20 minutes to assure that the toxic fumes therein are all exhausted, since such fumes are heavier than air, locking various valves and engaging safety alarms for the sole purpose of protecting operators working within and around the vessel. The operator has difficulty climbing into the tank requiring considerable effort and maneuvering. Accordingly, such manual cleaning methods employed are time-consuming, cumbersome, dangerous, a health hazard and are further inadequate for providing the necessary clean surfaces within the vessels. Efforts to mechanize the cleaning of tanks by cleaning apparatus has encountered difficulty in handling of the portable apparatus due to the limited availability of overhead space in the processing plants compared to the size of tanks being cleaned. These and other disadvantages are no longer encountered in practicing this invention.

The advantages realized with this invention are numerous. A manual cleaning operation is eliminated which avoids occupational hazards, health hazards and further eliminates inherent deficiencies of hand operations such as fatigue and carelessness. A portable cleaning apparatus with nozzle is inserted into the tank and adjusted for the desired position within the tank and then operates without operator manipulations, which apparatus effectively cleans all interior surfaces and is further easily manipulated into and out of the tank.

SUMMARY OF THE INVENTION

In accordance with this invention a portable, high-pressure jet spray apparatus with telescopic and adjustable features is provided for rapidly and effectively positioning the apparatus

2

within the vessel. The jet nozzles on this extreme end of the telescopic apparatus are driven by gear means such that the rotating jet nozzles revolve through a predetermined geometric pattern for directing high-pressure sprays to all surfaces within the tank effectively cleaning the interior of the tank.

To clearly illustrate this invention, reference will henceforth be made to the embodiment of this invention shown in the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation view of a cleaning apparatus within a tank, showing the tank in cross section.

FIG. 2 is a plan view of the invention shown in FIG. 1.

FIG. 3 is an enlarged fragmentary view of the upper portion of the cleaning apparatus showing the swivel joint with the support in cross section.

FIG. 4 is an enlarged fragmentary view of the upper portion of the cleaning apparatus similar to FIG. 3; however, showing the upper portion 90° from that shown in FIG. 3.

FIG. 5 is an enlarged fragmentary view of the swivel joint with the support in cross section.

FIG. 6 is a plan view of the upper portion of the support showing a portion of the upper cleaning apparatus which houses the telescopic sections.

FIG. 7 is an enlarged cross-sectional view of the telescopic sections of the cleaning apparatus with intermediate portion broken away to more clearly show the details of the sections.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown a tank or vessel 10 which receives the jet-cleaning apparatus to be described. The tank 10 is suitably secured to the floor 48 extending downwardly therethrough. The upper portion of vessel 10 has a circular flange 11 defining a manhole 12 for entry into the inside of vessel 10. The portable cleaning apparatus includes a support base or support means 13 which is suitably secured to the flange 11 as by suitable bolts 14.

Support means 13 has an inner annular guideway 15 which journals for rotation therein an annular support member 16. The upper surface 17 of support 13 has suitable indicia thereon, as shown in FIG. 6. Annular member 16 has a pair of spaced recesses as at 18 on its upper surface and an annular seal 19 on its inner periphery. Suitably secured to the annular support member 16 for rotation therewith are a pair of spaced upwardly extending brackets 20 (FIGS. 3 and 4). The upper end portions of each bracket 20 is arcuately shaped and recessed as at 21, with indicia 22 thereon. Annular support member 16 has a pair of diametrically spaced bores 25 therein operative to receive the respective trunnions 26—26 of a spherical shaped housing 27. The annular support member 16 is shown as a one-piece member for simplicity of illustration and it may be of a two-piece split construction to simplify the reception of the trunnions 26—26.

Spherical shaped housing 27 has a centrally located bore 29 extending therethrough to receive the reduced end portion 30 of an elongated tubular support 31, which support 31 is suitably secured to the housing 27 for movement therewith. Spherical housing 27 has a second bore 34 (FIG. 6) to provide for the passage of an air hose 35 (FIGS. 2 and 3) for a purpose to be described. Tubular support 31 has an annular ring 36 closely adjacent to the reduced end portion 30. Mounted on support 31 for movement toward and away from such support 31 are a pair of clamping blocks 37 that are operated by respective handles 40, which upon tightening thereof secures the tubular support 31 from rotation, whereas upon loosening of the clamping block 37, as best seen in FIG. 4, permits the pivotal movement of the tubular support 31 along with spherical housing 27 relative to the brackets 20 and the annular support member 16 about the trunnions 26—26. As an example of the movement of spherical housing 27 and the tubular sup-

port 31 relative to the annular support member 16, note FIGS. 4 and 5, wherein the tubular support 31 is shown in the vertical position and thence in inclined position. Clamping block 37 has an indicator 41 thereon which registers with the indicia 22 on bracket 20 to indicate the degree of tilt or incline.

Annular ring 36 of support 31 has an abutment 45 integral therewith with an eye hook 46 suitably connected thereto for connection to a hook of a hoist for manipulation of the cleaning apparatus into and out of the vessel or tank. Extending outwardly from ring 36 is a handle 47 by which the operator can pivot the apparatus about trunnions 26—26. The upper end portion of the tubular support 31 has secured to it a bracket 49 for a purpose to be described. An annular washer 50 is secured to the upper inner periphery of tubular support 31 to limit the outward movement of the telescopic sections to be described. The lower end portion of tubular support 31 has inner peripheral groove 51 which receives a nylon bushing 52. The nylon bushing 52 and tubular support 31 are recessed to house a key 55 that extends laterally therethrough.

Slidably mounted within tubular support 31 is an elongated tubular member or telescopic section 56, which section 56 has an annular recess 57 at its upper end portion which receives a nylon bushing 58. Tubular member or telescopic section 56 has a groove 59 extending substantially the full length thereof and operative to receive the one end of key 55 to prevent relative rotation between tubular member or telescopic section 56 and the tubular support 31. The lower inner periphery of section 56 has an annular recess 60 to receive an annular nylon bushing 61. The lower end portion of section 56 and bushing 61 are suitably recessed to receive a key 65. The upper end portion of tubular member or telescopic section 56 has an annular plate 66 secured thereto operative as a stop means. Slidably received within section 56 is an elongated tubular member or telescopic section 67, which member or section 67 has an annular recess 68 on its upper outer periphery to receive an annular nylon bushing 69. The lower end portion of tubular member or section 67 has an annular recess 71 on its inner periphery to receive a bushing 72. Tubular member or section 67 has an elongated keyway 73 extending substantially the full length thereof to slidably receive key 65. Key 65 thus extends through tubular member or section 56 into keyway 73 to prevent relative rotation between tubular members 56 and 67 but permits sliding movement therebetween.

Slidably received by tubular member or telescopic section 67 is an elongated tubular member or telescopic section 75 having a central bore 76 extending longitudinally therethrough. Tubular member or section 75 has an elongated keyway 80 that extends for substantially the entire length thereof, receiving a portion of a key 81, which key 81 is secured to the lower end portion of tubular member 67, thereby permitting relative sliding movement between tubular members 75 and 67, but preventing relative rotation therebetween. Tubular member or section 75 is recessed at one end as at 77 to receive a bushing 82. A coupling 83 is threadedly secured to the upper end portion of tubular member or telescopic section 75 such that a hose 85 connected to coupling 83 may supply pressurized fluid to the central bore 76.

Mounted on bracket 49 is a gear reduction unit 87 controlled by a handle or hand crank 86 which controls the rotation of a storage reel 88 upon which hose 85 may be wound. Reel 88 has provision for the simultaneous winding up and storage of a cable 90 (FIG. 7) which is connected to the bushing 82 and the tubular member or section 75 via which the telescopic sections or tubular members 75, 67 and 56 may be collapsed or extended relative to the stationary tubular member 31.

Suitably secured to the lowermost end portion of inner tubular member or section 75 is a flange 92 and housing 93. Housing 93 supports an air motor 94 and transmission means 95.

A bevel gear 96 is suitably secured to housing 93. The output of transmission means 95 is suitably connected to one end

of a right-angle swivel joint 97, such that rotation of joint 97 carries with it a lower bevel gear 98 which in turn meshes with bevel gear 96 such that as joint 97 rotates about the axis of tubular member 75 and about the axis of stationary housing 93, bevel gear 98 travels about bevel gear 96. Secured to rotating bevel gear 98 for rotation therewith is a T-fitting 100. High-pressure spray nozzles 101 and 102 are secured to the end portions of T-fitting 100 to receive pressurized fluids from hose 85 via tubular members 75, 67 and 56 for a purpose to be described. The pressurized fluid to hose 85 may be supplied from a centralized pressure source or via a separate pump, not shown. The air hose 35 which passes through the spherical housing 27 has one end connected to air motor 94 and the other end connected to a suitable pressure source.

Upon activation of air motors 94, rotation of spray nozzles 101 and 102 are effected through lower bevel gear 98, meshing with bevel gear 96. The number of teeth on stationary bevel gear 96 is different than the number of teeth on rotational bevel gear 98. As an example, stationary bevel gear 96 can have 105 teeth with a 16 diametrical pitch and a 20-degree pitch angle, while bevel gear 98 can have 104 teeth with a 16 diametrical pitch and a 20-degree pitch angle. In such example, the geometric spray pattern of lower nozzles 101—102 changes continuously upon one complete revolution of gear 98 such that the changing geometric pattern, in cooperation with the telescopic sections and the repositioning of the cleaning apparatus, is able to clean effectively the entire interior surface of the vessel and the parts therein. A clamping means 109 (FIG. 4) is threadedly mounted on the support means 13 to assure a means for preventing the rotation of the support member 16 once the rotated position is adjusted relative to the support means 13.

In the operation of the apparatus described, assuming that the cleaning apparatus is in a collapsed position, as shown in phantom lines in FIG. 1 and in FIG. 7. The apparatus with the hook 46 permits the manipulation of the cleaning apparatus, as by an overhead crane for positioning into the vessel, even where the overhead clearance space is limited, due to the compactness of the telescopic sections. Support base 13 is positioned on the flange 11 and secured thereto as by clamps 105 and bolts 14. Handle 86 is then rotated to unwind steel cable 90 which lowers the housing 93 and the tubular member 75, which is effected due to gravity because of its weight. Section 75 moves downwardly initially, carrying with it its upper bushing 78 until bushing 78 engages bushing 72 secured to section 67, thereby carrying section 67 downward therewith. Section 67 moves downward until its upper bushing 69 comes in contact with section 61, thereafter carrying section 56 downwardly therewith until its outer bushing 58 contacts bushing 52 secured to the lowermost end portion of stationary tubular member 31 which extends the cleaning apparatus to its fullest extension for cleaning as shown in FIG. 1. Cleaning fluid is then pumped under high pressure of about 3,000 to 6,000 p.s.i. via hose 85 which transmits the cleaning solution under high pressure to jet nozzles 101 and 102. Air motor 94 is activated to rotate gear 98 via transmission means 95 such that nozzles 101 and 102 rotate in a predetermined geometric pattern which covers as much of the entire interior surfaces of the tank as possible from one position, taking into consideration that certain areas are prevented from being reached as by the obstructions of the baffles and the agitator blades 107 and its central drive shaft 108. Upon completion of the rotation of gear 98 and the return of jet nozzles 101 and 102 to their original position, the operator may then loosen clamping block 37 and pivot the housing 27 about trunnions 26—26 as by manipulation of handle 47 such as to position the cleaning apparatus in the extended position shown in phantom lines in FIG. 1. The cleaning operation is then continued. It should be noted that the recesses 18—18 in the support 13 facilitate the pivotal movement of the cleaning apparatus in the tank. The operator may reach other portions of the tank, depending on the locations of the baffles, the type of agitators therein, the type of chemical used and the degree of buildup within the tank.

The operator may manipulate the cleaning device rotating the cleaning device via handle 47 by swinging spherical housing 27, together with annular support 16 relative to support base 13 in guideways 15, which permits a 360° rotation therebetween. Thereafter the operator may collapse the cleaning apparatus by rotating handle 86 which retracts the respective sections or tubular members 75, 67 and 56 to the position shown in FIG. 7 so that the collapsed unit may assume one of several positions for cleaning, one of which is shown in phantom lines in FIG. 1. This is achieved by rotating handle 47 which rotates the cleaning apparatus in annular support 13 or by unclamping block 37 and pivoting the cleaning apparatus on trunnions 26—26 and reclamping the blocks 37 to assure the operator that the cleaning apparatus will retain its adjusted position.

Although a specific embodiment and a preferred mode of operation of the invention has been hereinbefore described, it is understood that the subject invention is not limited thereto since variations and modifications thereof can be made without departing from the principles of the invention.

What is claimed is:

1. A portable tank-cleaning apparatus comprising: support means for attachment to a tank or vessel; a plurality of nested telescopic sections supported by said support means; means operatively connected to said sections to provide for extending and retracting said telescopic sections relative to said support means and to each other to provide a compact unit which facilitates removal and insertion of said portable cleaning apparatus into the tank or vessel; spray nozzle means mounted on one of said telescopic sections for rotation thereon; said telescopic sections having passageway means interconnected therein and therethrough; said passageway means connected to said spray nozzle for delivering high-pressure fluid to said spray nozzle means; and motive drive means mounted on the lower most section of said sections connected to said spray nozzle means; said motive drive means operative upon energization for rotating said spray nozzle means through a changing pattern of movement; and power means connected to said motive drive means for energizing said motive drive means.

2. A portable tank cleaning apparatus as set forth in claim 1 wherein said telescopic sections are rotatable and pivotally secured to said support means.

3. A portable tank cleaning apparatus as set forth in claim 1 wherein said support means has an annular race; an annular support is journaled in said race for rotational movement therein; a spherically shaped housing is journaled in said annular support for pivotal movement thereon and operative to support said telescopic sections; said nozzle means and said motive drive means include spray nozzles mounted on a first bevel gear rotatable about the axis of a second bevel gear rotatable and wherein said second bevel gear has a plurality of teeth differing in number than said first bevel gear.

4. A portable tank-cleaning apparatus comprising: support means for attachment to a tank or vessel; a support base mounted on said support means; a housing pivotally mounted

on said support base; clamp means interconnecting said support base and said housing to permit relative pivotal movement therebetween and simultaneous rotation therewith; a plurality of nested telescopic sections supported by said housing; a cleaning head mounted on one of said telescopic sections for directing pressurized fluid therefrom onto the interior walls of the vessel to be cleaned; first power-operated means mounted on said one telescopic section and connected to said cleaning head for changing the position of said head relative to said one telescopic section; and second power-operated means connected to said telescopic sections to extend and retract said sections relative to each other to extend and locate said cleaning head into position in a vessel for use and to facilitate the removal and insertion of said portable cleaning apparatus into the tank or vessel.

5. A portable tank-cleaning apparatus as set forth in claim 4 wherein said support means has an annular guideway, said support base has an annular guide received by said guideway, said housing having a pair of spaced trunnions journaled in said support base.

6. A portable tank-cleaning apparatus as set forth in claim 5 wherein said apparatus has storage means mounted thereon for receiving and dispensing fluid-conducting means to said telescopic sections for directing high-pressure fluids to said cleaning head.

7. A portable tank-cleaning apparatus comprising: support means for attachment to a tank or vessel; an annular support journaled in said support means for rotation therein; bracket means secured to said annular support; a spherical-shaped housing mounted in said annular support for movement therein; a tubular support member secured to said housing for movement therewith, clamping means interconnecting said bracket means and said tubular support for securing said tubular support member and annular support for simultaneous rotation or to permit relative movement therebetween; indicia on said support means and said brackets to provide visual indication of the relative position of said annular support and said tubular support member; a handle secured to said tubular support for manipulating said tubular support and said housing; telescopic sections supported by said tubular support for extension therefrom and retraction thereto; power-operated means connected to one of said sections for retracting and extending said sections; spray nozzle means mounted on said one section for rotation; motive drive means connected to said nozzles for rotating said nozzle through a changing pattern of movement.

8. A portable tank-cleaning apparatus as set forth in claim 7 wherein said spherical-shaped housing has a pair of trunnions journaled in said annular support for pivotal movement thereon; a storage reel secured to said tubular support member; a hose wound on said reel and connected to said one section for movement therewith, and a cable interconnected with said reel and said one section to retract and let out said sections relative to said housing.

* * * * *

60

65

70

75