

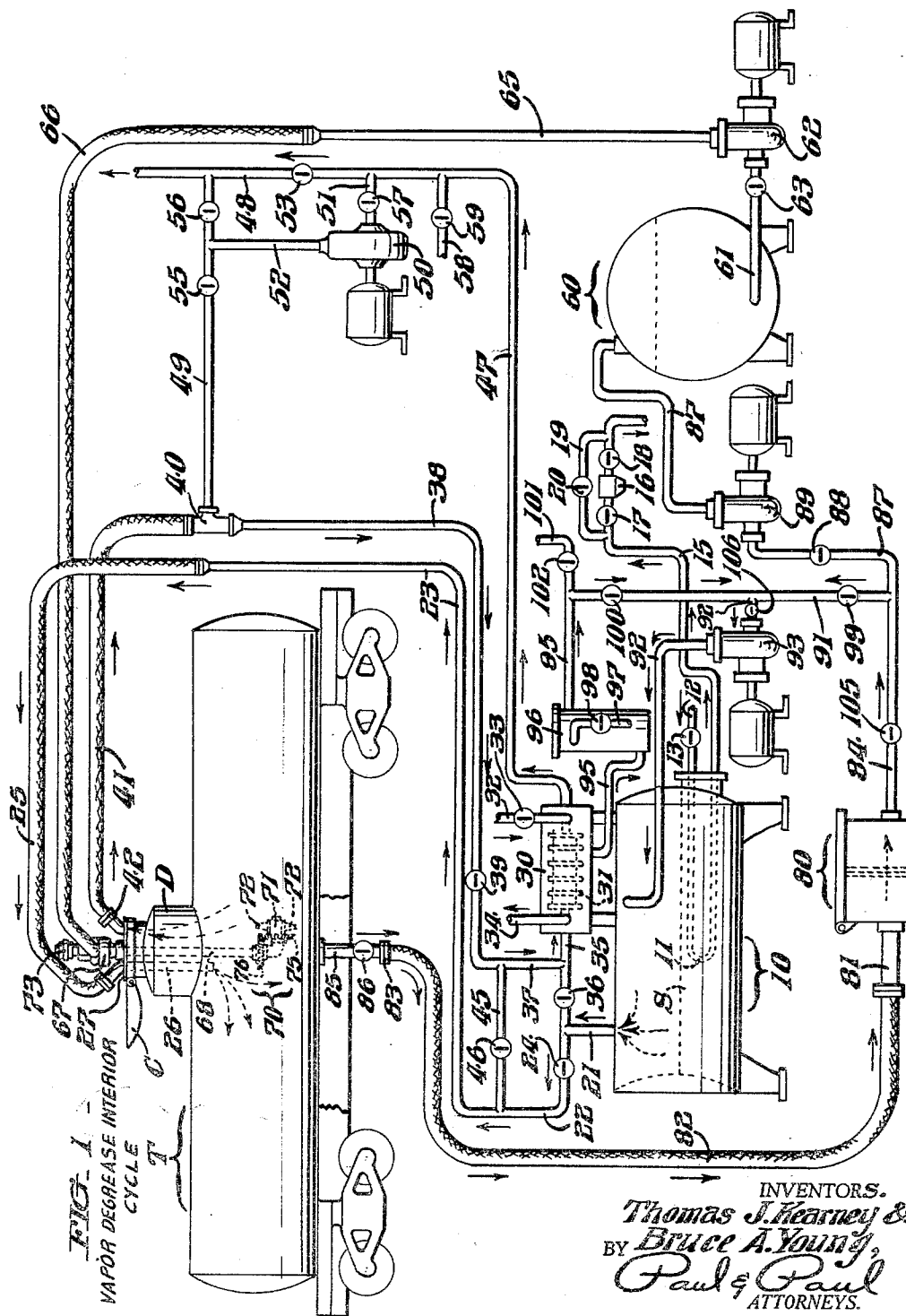
July 24, 1962

T. J. KEARNEY ET AL
METHOD AND APPARATUS FOR INTERIORLY
CLEANING TANKS AND THE LIKE

3,046,163

Filed April 6, 1960

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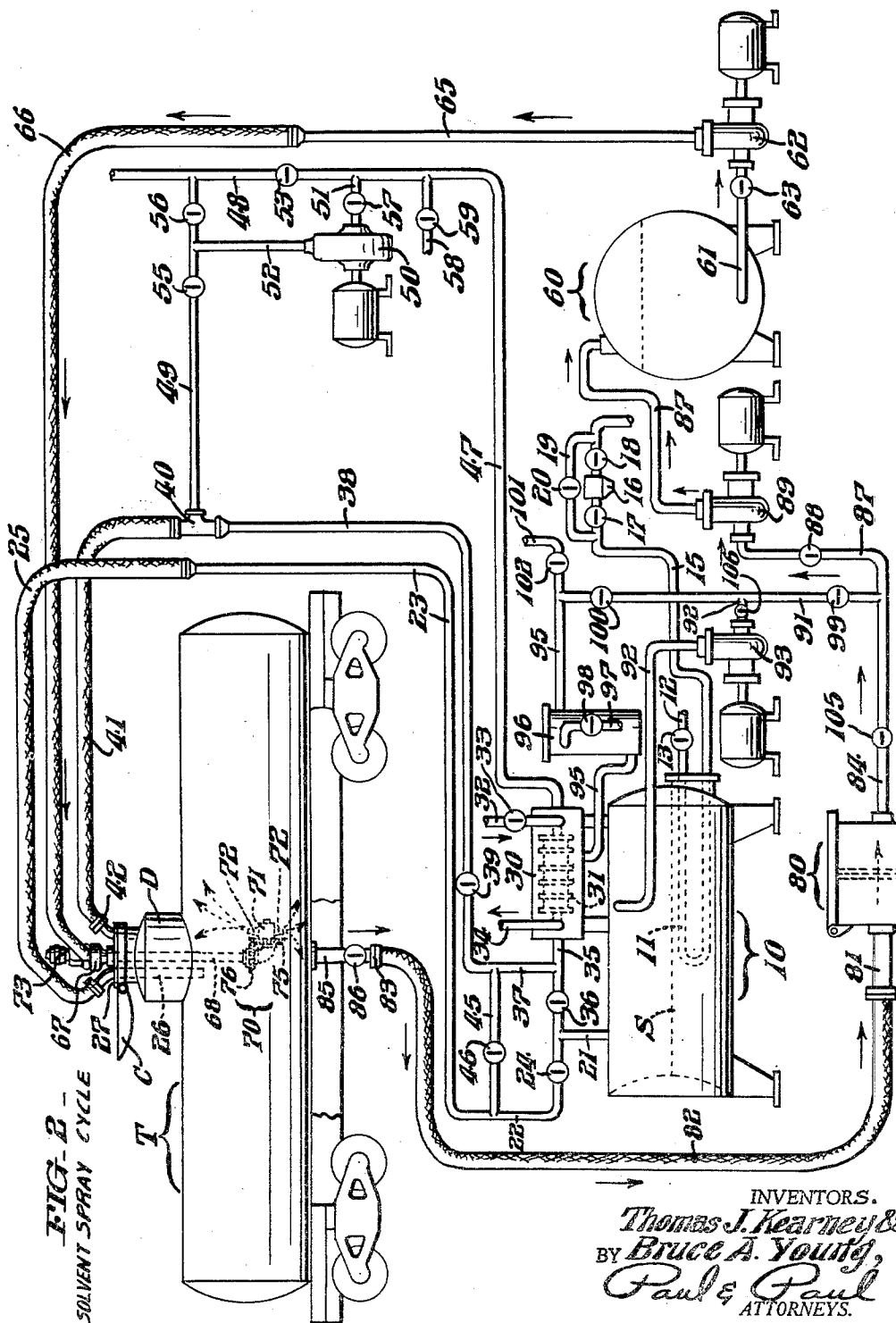
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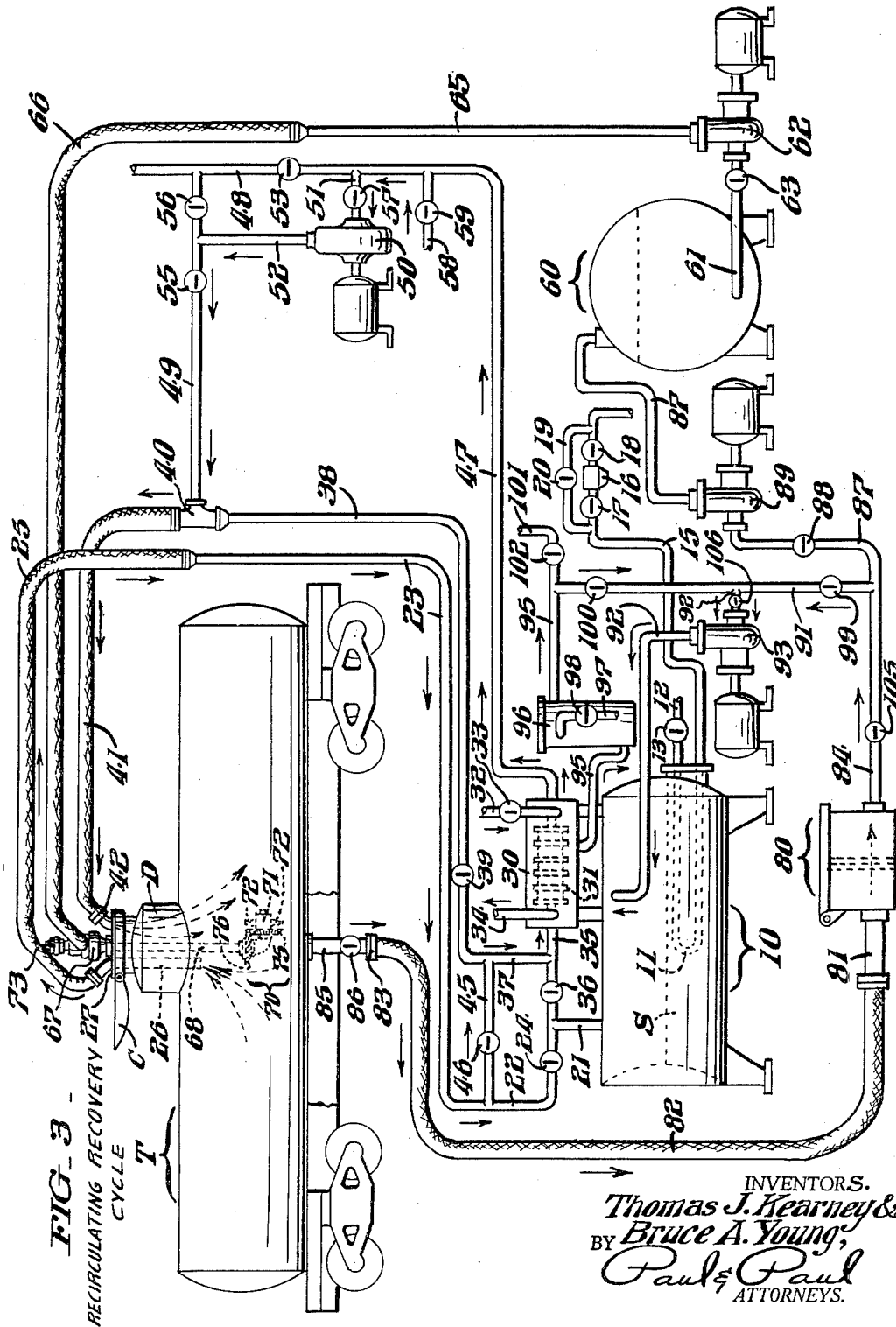
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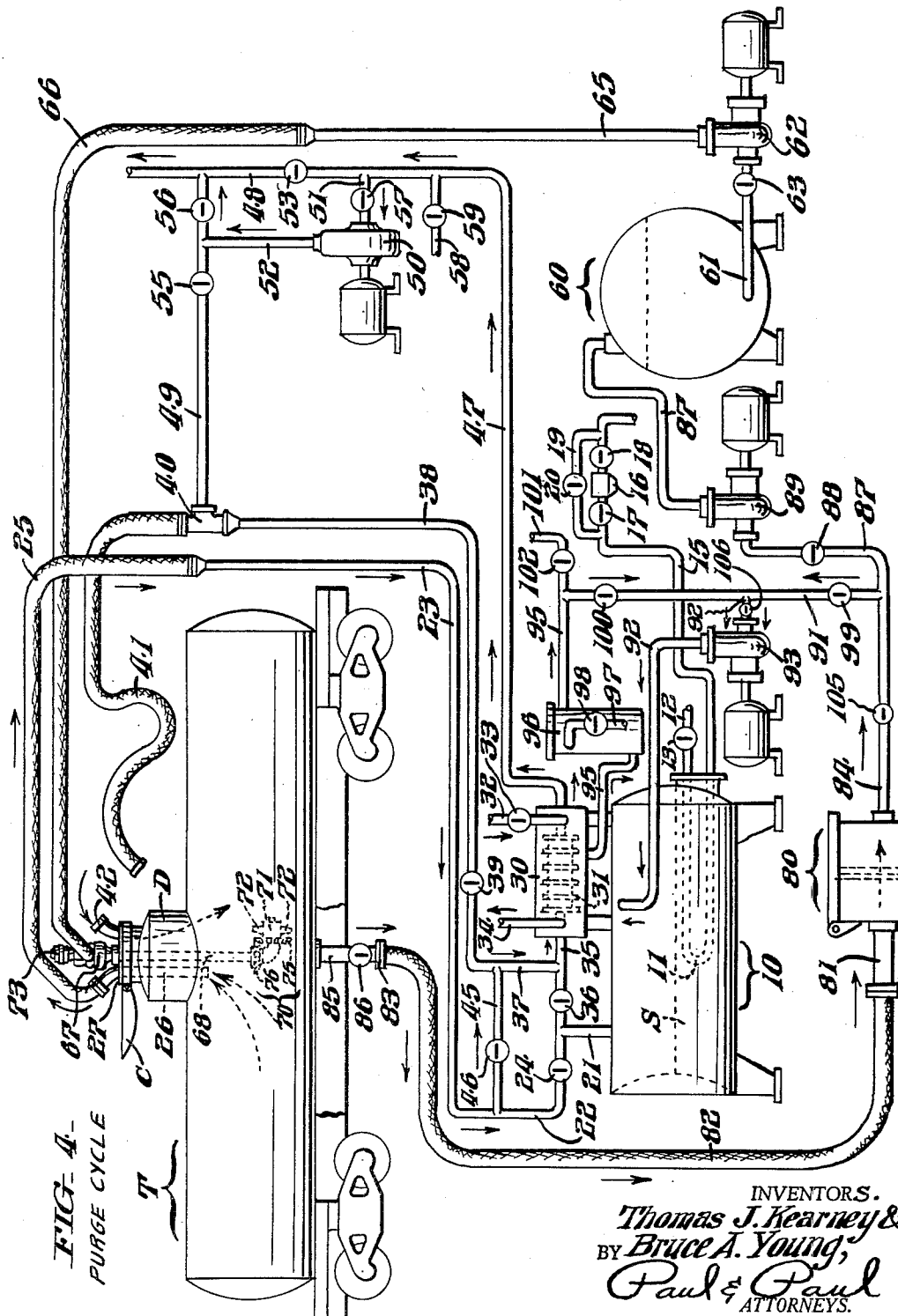


Filed April 6, 1960

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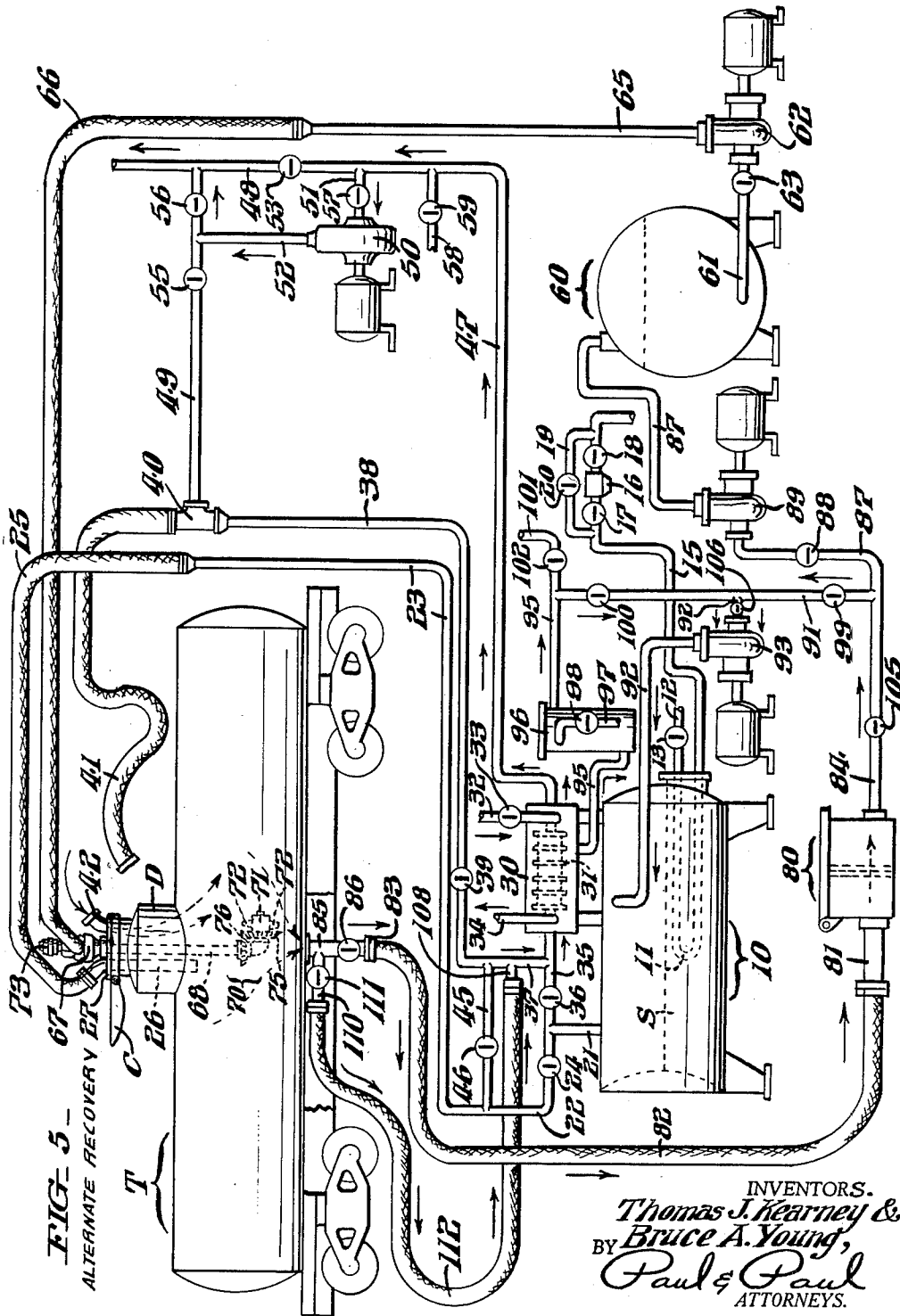
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METHOD AND APPARATUS FOR INTERIORLY
CLEANING TANKS AND THE LIKE

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Filed Apr. 6, 1960, Ser. No. 20,467

2 Claims. (Cl. 134—11)

This invention relates to a method and an apparatus for interiorly cleaning tanks, particularly tanks of railway cars or highway vehicles used in transporting liquid commodities of various kinds as well as tanks of comparative sizes or other equipment used in storing or processing such commodities.

One of the chief objects of our invention is to provide a simple method by which the interiors of tanks or equipment of the kind referred to can be thoroughly cleaned of adhering oil, grease, fats, tar, solvent soluble resin products, paints, plasticizers, clinging solid matter and other contaminants with the aid of a chlorinated hydrocarbon solvent such as trichloroethylene, perchlorethylene or methylene chloride.

Briefly described, the cleaning method of our invention involves the steps or cycles of first passing hot vapor of the solvent into a tank for example, to dissolve adhering grease, fats, oils and other dissolvable matter on the tank walls and to loosen clinging solid matter and recovering the solvent; then forcibly jet spraying the tank interior with a chlorinated hydrocarbon solvent in liquid form delivered under pressure to dislodge the clinging matter, eliminating the solid matter from the sludge thus formed and recovering the solvent therefrom; then again passing hot solvent vapors through the tank to heat the tank walls and vaporize the residual solvent left on said walls after the spraying; then drawing the hot solvent vapor from the tank, condensing it and recovering the condensate; and finally passing outside air through the tank for a time to purge it of the solvent odors, and recover the condensate of any remaining traces of solvent vapor before releasing the air into the atmosphere.

Another aim of our invention is to provide an equally simple apparatus in which the foregoing method can be carried out quickly and effectively with minimum loss of solvent.

Other objects and attendant advantages will appear from the following detailed description of the attached drawings, wherein:

FIG. 1 is a diagrammatic view of a cleaning apparatus conveniently embodying our invention.

FIGS. 2, 3 and 4 are views similar to FIG. 1, showing how the successive steps of our improved cleaning method are carried out in the apparatus; and

FIG. 5 is a view similar to FIG. 4 showing a modification.

With more detailed reference, first to FIGS. 1-4 of these illustrations, the numeral 10 comprehensively designates a vapor generator containing hydrocarbon solvent S which, during use of the apparatus, is maintained at the boiling point by a submerged heating coil 11 whereto steam is conducted from a suitable supply source (not shown) through a pipe 12 having a valve 13 therein, the spent steam being conducted from said coil through an exhaust pipe 15. Interposed in the pipe 15 is a steam trap 16 with valves 17 and 18 connected respectively to opposite sides of the trap. Shunted across said trap and said valves is a bypass 19 with an interposed valve 20. The hot solvent vapors pass out of the top of the generator 10 by way of a pipe 21, which joins a pipe line 22, 23, having a valve 24 therein. Connected to the distal end of the pipe section 23 is a flexible hose 25.

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As shown, the hose 25 terminates in a discharge tube 26 which is fixed in an auxiliary cover plate 27 adapted to be placed over the filling dome D of tank T, herein represented as the tank of a railway car, after retraction of the usual dome cover C of said tank. Mounted upon the vapor generator 10 is a condenser 30 having a coil 31 interiorly of its casing through which coil a coolant such as water is passed, the coolant being supplied through an inlet pipe 32 under control of a valve 33 and carried off through an outlet pipe 34. Leading from one end of the housing of the condenser 30 is a pipe 35 which joins the pipe section 22 and which is provided with a valve 36; and connected to said pipe 35 between the condenser and said valve is a pipe 37, 38 fitted with a valve 39. Connected in turn to a T fitting 40 at the end of the pipe section 38 is a flexible hose 41 which, at its terminal end, has a coupling 42 for removable connection over an outlet opening in the auxiliary tank dome cover 27. As further shown, a bypass pipe 45 with a valve 46 therein extends crosswise between the pipe sections 22 and 37. Leading from the opposite end of the housing of the condenser 30 is a pipe line 47, 48. Extending from the pipe section 48 and connected laterally into the T fitting 40 at the end of the pipe section 38 is a cross pipe 49. The motor driven blower indicated at 50 has its inlet connected by way of a pipe 51 to the pipe section 48 and its outlet by way of a pipe 52 to the cross pipe 49. As shown further, the pipe section 48 is provided in the interval between the pipes 49 and 51 with a valve 53, and the cross pipe 49 with valves 55 and 56 respectively to opposite sides of the connection of the pipe 52 with said cross pipe. It is to be further noted that the pipe 51 is also provided with a valve 57, and that another branch pipe 58 fitted with a valve 59 is connected to the pipe section 48.

Also included in the apparatus is a solvent storage reservoir 60 to which there is connected, adjacent the bottom, a pipe 61 which extends to the inlet of a motor driven rotary pump 62, and which is provided with a valve 63. Leading from the outlet of the pump 62 is a pipe 65 to which there is connected a flexible hose 66, the terminal end of which is connected to a fitting 67 at the top of a tube 68 which is fixed in the auxiliary dome cover 27 of the car tank T and extends down through the dome D into the interior of the tank.

Attached to the bottom end of the tube 68 is a spray device 70 having a head 71 with plural radial discharge nozzles 72. In the operation of the device 70 the head 71 is rotated about the axis of the tube 68, through interposed connections (not shown) by an air motor 73 at the top of said tube. At the same time head 71 is rotated in a horizontal plane through co-action of a bevel gear 75 with a stationarily held bevel gear 76. It is to be understood that the spray device 70 is of a well known commercially available type and, per se, is not of our invention.

The apparatus further includes a settling and straining tank 80 having connected to its inlet 81 a flexible hose 82 which, by means of a coupling 83 at its distal end, is connectable to a drain outlet 85 at the bottom of the car tank T having a valve 86 therein. Extending from the outlet 84 of the tank 80 is a pipe line 87 which connects into the top of the solvent storage reservoir 60 and in which are interposed a valve 88 and a motor driven rotary pump 89. Joined with the pipe 87 is a pipe 91 with a bypass pipe 92 extending therefrom and connecting into the top of the tank of the vapor generator 10 with interposition therein of a motor driven rotary pump 93. Another bypass pipe 95 leads from the bottom of the housing of the condenser 30 and connects with the pipe 91 beyond the pump 93 and has interposed therein a water separator 96 from the top of which water is carried off through a pipe

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97 provided with a valve 98. As further shown, the pipe 91 is fitted respectively to opposite sides of the connection of the bypass pipe 92 with valves 99 and 100, and the pipe 95 is extended as at 101 and the extension is provided with a valve 102.

For a purpose later on explained, the pipe 84 is provided immediately beyond the strainer 80 with a valve 105, and the bypass pipe 92 is fitted with a valve 106 ahead of the inlet of the pump 93.

It is to be understood that the apparatus may be permanently located alongside a railway track, or mounted on a truck for mobility from place to place as desired or found to be most convenient.

OPERATION

(I) Vapor Degreasing Cycle

To prepare the apparatus for the initial or vapor degreasing cycle of our improved tank cleaning method, the various valves are set as conventionally indicated in FIG. 1. The solvent in the generator 10 is brought to the boiling point by steam admitted into the coil 11, and the pump 93 is started. The generated hot solvent vapors, which are four and one-half times heavier than air, pass from the generator 10 by way of the piping 21, 22, 23, hose 25 and tube 26 into the car tank T. The hot vapor displaces the lighter air from the tank, most of it condenses on the tank walls, thereby dissolving adhering oil, grease, fats, asphalts and other dissolvable contaminants, and at the same time, loosening clinging solid matter. The contaminated solvent runs down the tank walls to the bottom of the tank from whence it passes off through the drain outlet 85 into the hose 82 by which it is conducted to the strainer 80 for removal of solid contaminants therefrom. After being strained, the screened solvent is drawn by the pump 93 from the strainer 80 by way of the piping 84, 91, 92 and returned to the generator 10. Also by action of the vapors entering the tank, the displaced air, with which some of the vapor becomes mixed, is drawn from the top of the tank by way of the hose 41 pipe 38, 37, 35 and delivered to the condenser 30. The solvent thus reclaimed in the condenser 30 is returned by way of the piping 95, 91, 92 to the generator 10, while the denuded air is exhausted to the atmosphere through the piping 47 and 48. Ordinarily a twenty minute time period for this step is sufficient for effective accomplishment of the stated purpose. Solid residues of crude oil, coke-like residues of overheated asphalt and the like which may remain in the lower part of the car tank (especially in a tank provided with heating coils where such solids often become lodged between the coils and the tank bottom) are removed in the solvent spray cycle of which a description immediately follows.

(II) Solvent Spray Cycle

In preparation for this cycle, the various valves are set as shown in FIG. 2, the pump 93 is stopped and the pumps 62 and 89 are started. Under these conditions liquid solvent is drawn from the storage reservoir 60 by the pump 62 through the open valve 63 and pipe 61 and conveyed through the pipe 65, hose 66 and tube 68 to the spinarete or spray device 70 for forceful discharge in all directions within the car tank T against the inner surfaces of the tank walls at a nozzle pressure between 100 and 1,000 p.s.i. In this way the clinging contaminants loosened by the vapor treatment in the first described cycle are forcibly removed and carried by the solvent to the bottom of the tank. The accumulated sludge passes out through the open drain valve 86 and is conducted by the hose 82 to the strainer 80. After removal of the solids by the strainer 80, the screened solvent is conducted by the action of the pump 89 through the piping 84, 87, open valves 105 and 88 and pipe 87 back to the storage reservoir 60. Thus, in the second step of the method, liquid solvent is continuously circulated between the storage reservoir 60 and the car tank, with the result that sub-

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stantially all of the contaminants are removed from the interior of the tank. Ordinarily, a period of between fifteen and forty-five minutes (depending upon the quantity of the soil and the tank interior condition) suffices for accomplishment of this second step. In the event that the solvent becomes excessively contaminated, it can be diverted to the generator 10 for distillation by opening the valve 99 in pipe 91 and using the pump 93 it will be readily understood from FIG. 2, after which the distillate can be returned to the reservoir 60 for continued use in the spraying. At the termination of the spray cycle and delivery of the waste from the car tank to the reservoir 60, there will remain a very considerable film of solvent on the tank wall interiors. To facilitate eventual recovery of this remaining solvent, the immediately following cycle is resorted to.

(III) Vapor Degreasing Cycle

This cycle is a repetition of cycle 1 and provides a vapor rinse to vaporize most of the heavy film of solvent condensed on the tank walls cooled during the spray cycle. At the conclusion of this third cycle, the tank will still contain a very considerable volume of solvent vapor (fifteen to twenty gallons of vaporized solvent if trichloroethylene is used, for example). This solvent is recovered in the next cycle of our cleaning method.

(IV) Recovery Cycle

In preparation for this cycle the pumps 89 and 62 are stopped, the various valves set as in FIG. 3, and the pump 93 and the blower 50 are started. Under these conditions air is circulated through the car tank T by action of the blower 50 via the piping 52, 49 and the hose 41, to carry off residual solvent from the tank, the solvent laden air passing out of the top of the tank into hose 25 and being conducted by the piping 23, 45, 37, 35 to the condenser for recovery of the solvent, the denuded air being drawn off from the condenser by the blower 50 via the piping 47, 48 and 51. This fourth step is satisfactorily accomplished during a period of from fifteen to twenty minutes.

(V) Purging Cycle

In preparation for this cycle, the various valves are set as in FIG. 4, with the pumps 62 and 89 and the motor 73 stopped but with the blower 50 in operation and the hose 41 disconnected at 42 from the auxiliary dome cover 27. By action of the blower 50, outside air is then drawn into the tank T and, after having circulated through the tank, passes out through the tube 26, hose 25, piping 23, 45, 37, 35 into the condenser 30. After being denuded there of all traces of solvent vapor which may have remained at the completion of the recovery cycle, it passes through pipes 47, 57 to the blower 50 from which it is exhausted to the atmosphere through the open valve 56 and the pipe 48. In this way, the tank is purged of all residual odors and left in a fresh, clean condition within a period of from fifteen to thirty minutes.

In the modification illustrated in FIG. 5, the tank drain 85 is in the form of an elbow of which the lateral arm 110 has an interposed valve 111 and to which is connected one end of a flexible hose 112, the other end of said hose being connected to the pipe 37 in the interval between the pipes 35 and 45. In all other respects the modification is identical with the first described apparatus. Accordingly, in order to dispense with the necessity for a separate detailed description of the modified embodiment all other components thereof having their counterparts in the first described embodiment, have been identified with the same reference characters previously employed. In preparation for the final or recovery cycle of our method with the modified apparatus, the various valves are set as shown in FIG. 4, the hose 41 is disconnected from the part 42, the pump 93 is operated, the motor 73 is stopped, and the blower 50 is operated. By action of the blower 50 outside air is continuously drawn through the fitting 42 into the top of the car tank T and,

after traversing the tank, passes out through the lateral leg 110 of the drain elbow 85 and is conducted by way of the hose 112 piping 108, 37 and 35 to the condenser 30. Here, the remaining traces of solvent vapor are condensed and the stripped air continues on by way of piping 47, 51 to the blower 50 and is exhausted to the atmosphere through the pipe 52. The condensate collecting in the condenser 30 is returned to the vapor generator by the action of the pump 93 in the same manner as described hereinbefore in connection with FIG. 4.

While in accordance with the provisions of the statutes, we have illustrated and described the best forms of embodiment of our invention now known to us, it will be apparent to those skilled in the art that changes may be made in the forms of the apparatus described without departing from the spirit and scope of the invention as set forth in the appended claims, and that in some cases certain features of our invention may be used to advantage without a corresponding use of other features.

Instead of being stationary the apparatus of our invention obviously may be mounted on wheels for mobility to different parts of a plant to clean out tanks or receptacles, heat exchangers, fractionating columns, conduiting, and other equipment used in processing commodities of the kinds hereinbefore referred to.

Having thus described our invention, we claim:

1. A method of interiorly cleaning a tank or the like, used in transporting, storing or processing commodities such as oil, grease, crude petroleum products, coal tar products, resinous products, paints, plasticizers or the like, said method comprising the steps of first passing hot vapor of a chlorinated hydrocarbon solvent into the tank and condensing said vapor on the tank walls thereby dissolving adhering dissolvable matter on the interior surfaces of the tank and loosening clinging solid deposits; draining off the contaminated condensate thus formed and recovering the solvent; then pressure spraying the interior of the tank with chlorinated hydrocarbon solvent in liquid form to remove the clinging matter loosened during the first step, draining the incidentally formed sludge from the tank and recovering the solvent from the

sludge; then again passing hot chlorinated hydrocarbon solvent vapor into said tank to vaporize the residual liquid solvent remaining on the tank walls after spraying; thereafter evacuating the solvent vapor from the tank, and finally passing unheated outside air through the tank to purge it of solvent odors and recovering the remaining traces of solvent vapor from the air before releasing the air into the atmosphere.

2. Apparatus for interiorly cleaning a tank or the like, used in transporting, storing or processing commodities such as oil, grease, crude petroleum products, coal tar products, resinous products, paints, plasticizers and the like, said apparatus comprising means for first passing hot vapor of a chlorinated hydrocarbon solvent into the tank for a time to dislodge adhering dissolvable matter and to loosen clinging solid deposits on the inner surfaces of the tank walls and means for concurrently draining the contaminated solvent condensate incidentally formed and concurrently drawing the excess solvent vapor from the tank condensing it and recovering the condensate for re-use in the apparatus; and means for thereafter forcibly spraying the inner surfaces of the tank walls with chlorinated hydrocarbon solvent in liquid form to dislodge the loosened solid matter, draining the contaminated solvent from the bottom of the tank and recovering it for re-use in the apparatus; means for thereafter drawing the solvent vapor from the tank, condensing it and recovering the condensate; and means for finally passing unheated outside air through the tank for a time to purge it of solvent odors, condensing any remaining traces of solvent vapor from the air before exhausting the air into the atmosphere, and incidentally recovering the condensate for re-use in the apparatus.

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