July 3, 1962 T. J. KEARNEY ET AL 3,042,553

METHOD OF AND APPARATUS FOR CLEANING TANKS OF VEHICLES

Filed Oct. 20, 1959 4 Sheets-Sheet 1

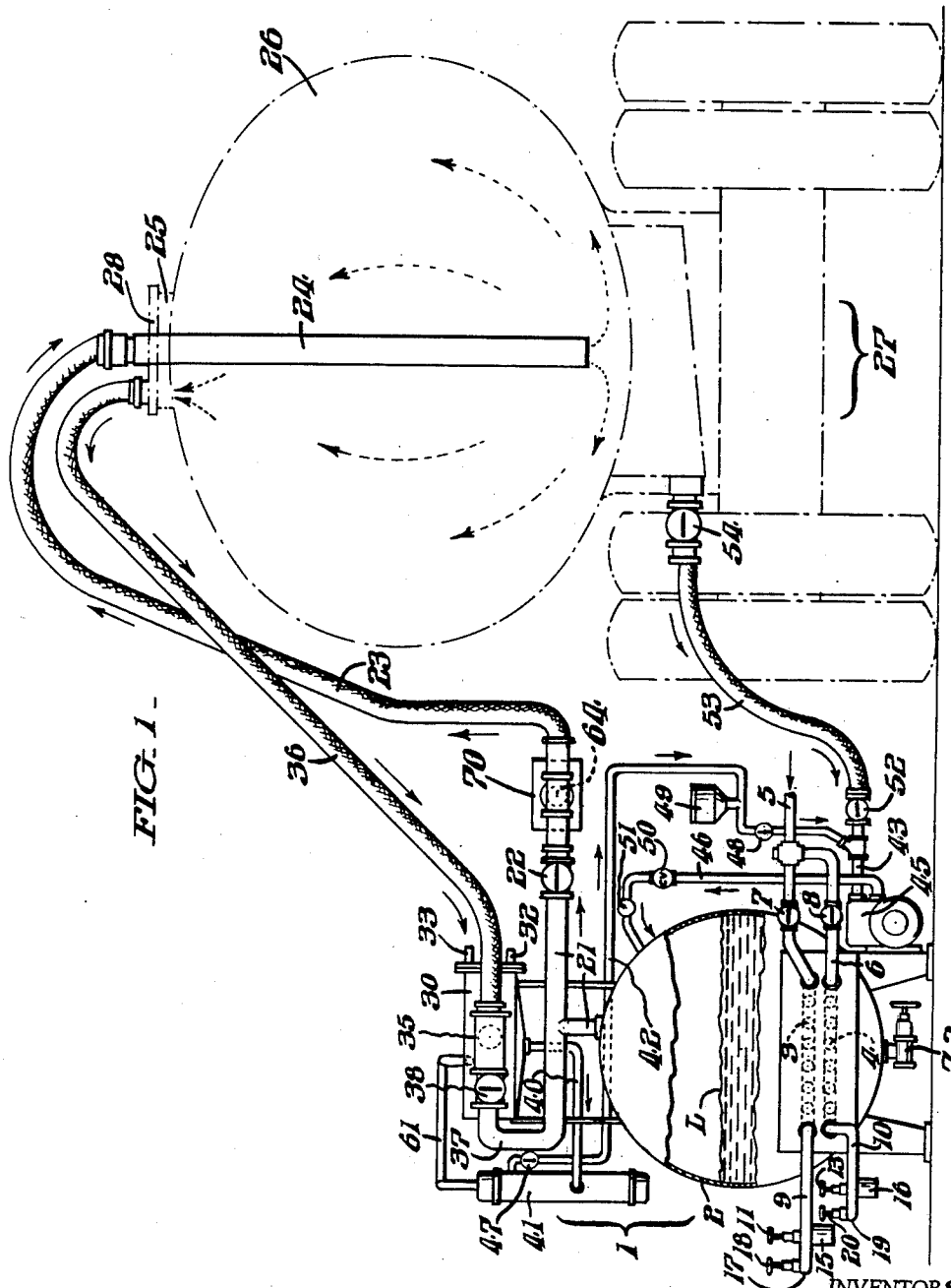


FIG. 1.

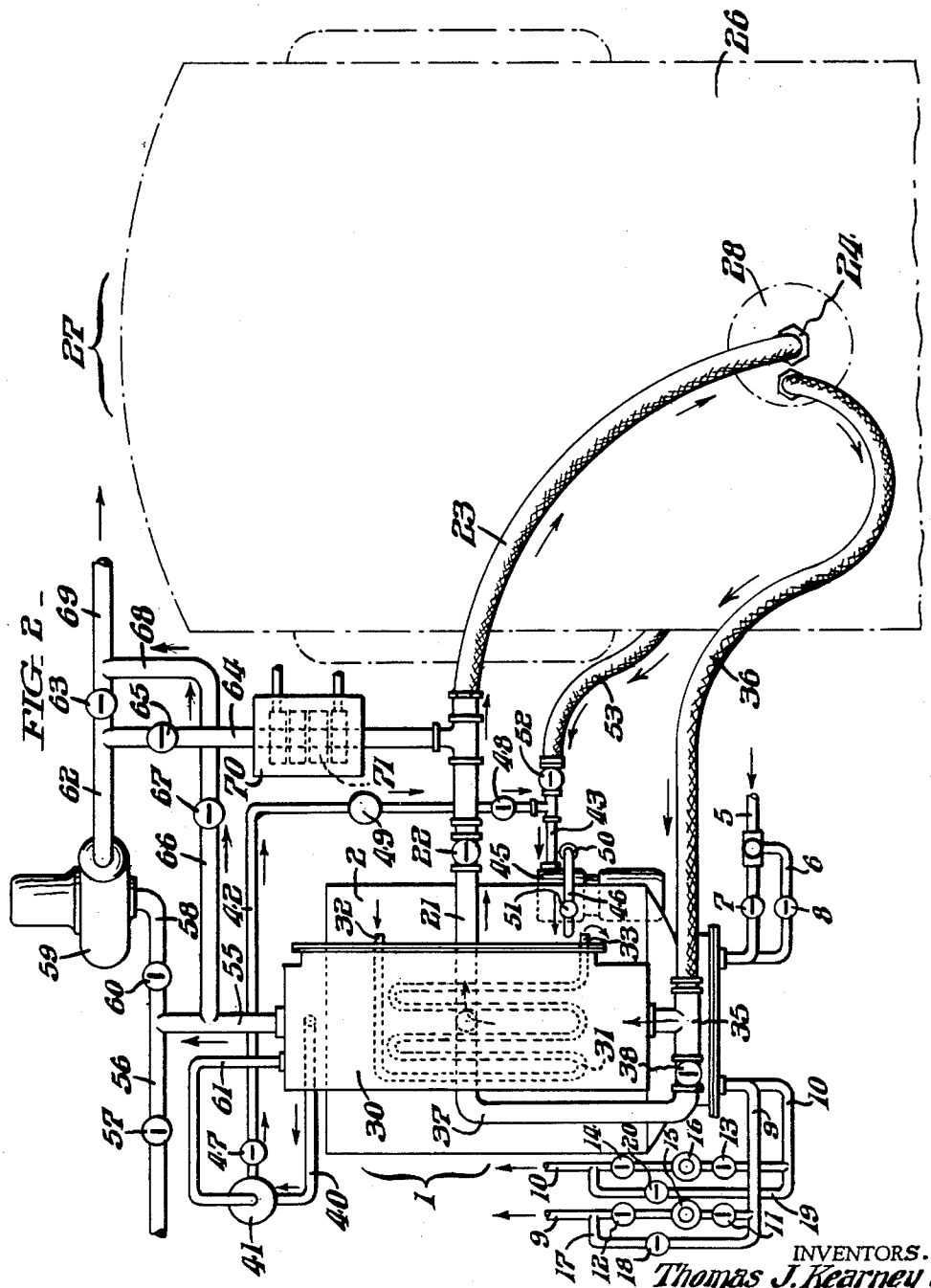
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METHOD OF AND APPARATUS FOR CLEANING TANKS OF VEHICLES

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FIG. 2.



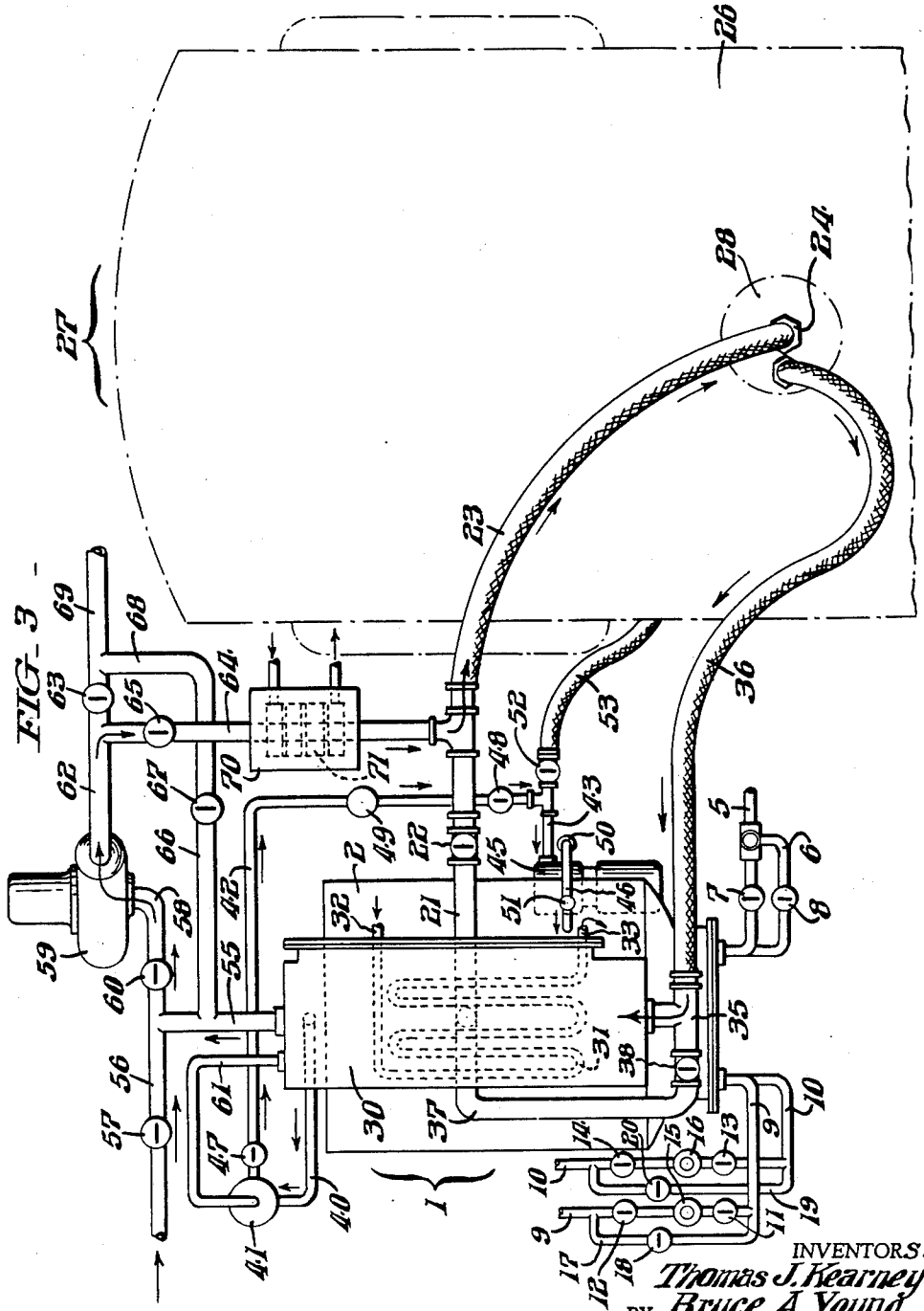
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METHOD OF AND APPARATUS FOR CLEANING TANKS OF VEHICLES

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FIG. 3



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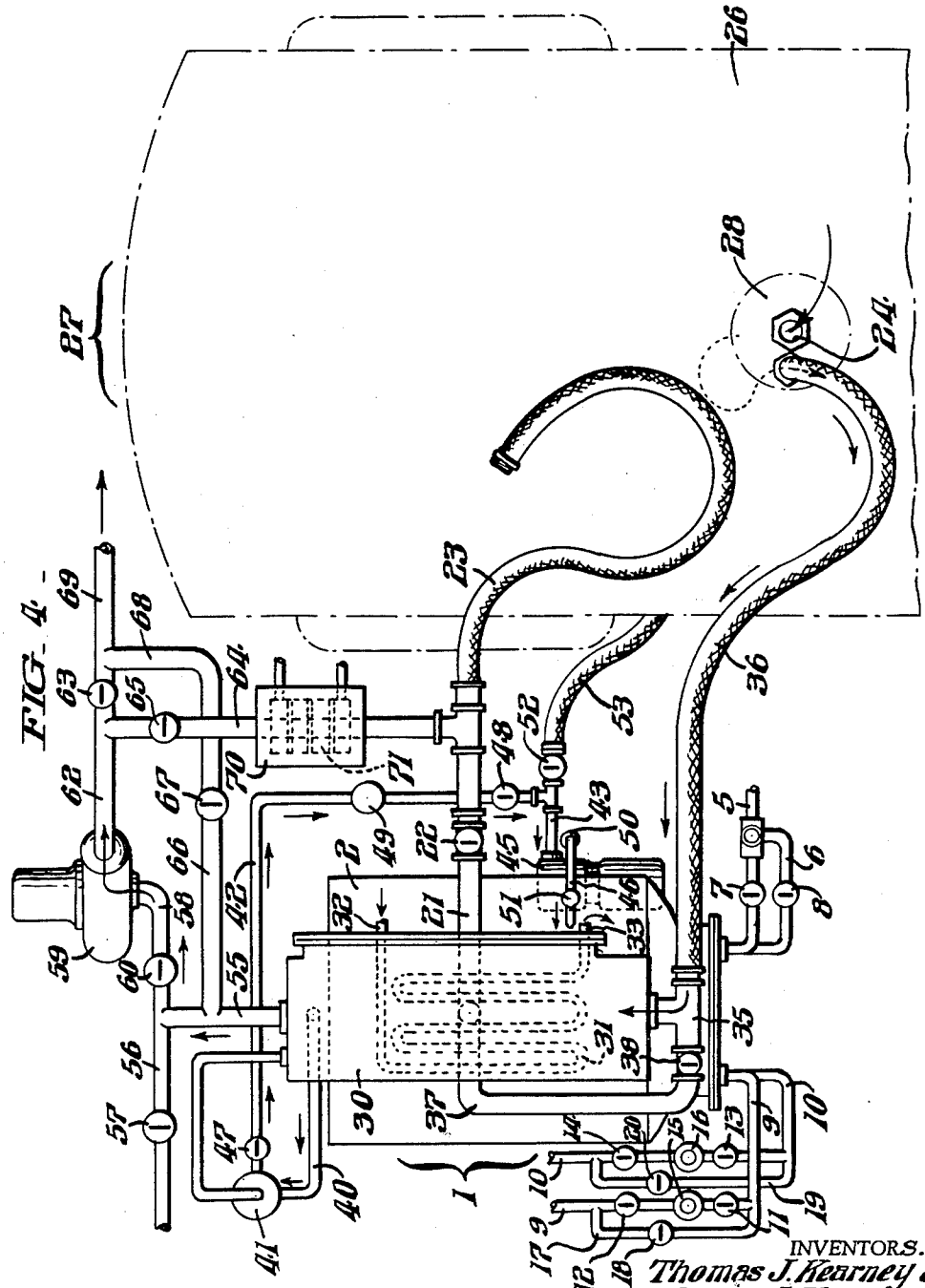


FIG. 4.

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METHOD OF AND APPARATUS FOR CLEANING TANKS OF VEHICLES

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Filed Oct. 20, 1959, Ser. No. 847,534
6 Claims. (Cl. 134—11)

This invention relates to a method of and an apparatus for cleaning tanks or containers, such as are used in storing, transporting or processing of fluid commodities such as oils, grease, crude petroleum products, petroleum asphalt, some coal tar products, resinous products, paints, and plasticizers and the like, with the aid of a suitable chlorinated solvent, for example: trichlorethylene, perchlorethylene or methylene chloride.

The effect of vapors of chlorinated solvents condensed on the interiors of metal tanks to remove adhering oil, grease and the like, has been long known. However, the use of chlorinated solvents for this purpose has not been generally adopted because of its high cost and total loss of the solvent in the processing.

Our invention has for its chief aim to obviate the above mentioned drawbacks. This objective is realized as hereinafter more fully disclosed through provision of a simple method and a correspondingly simple apparatus suitable for practice of such method by which tanks of vehicle or the like can be effectively cleaned interiorly of dissolvable clinging matter with the aid of a chlorinated solvent in a minimum of time and with negligible loss of the solvent.

As hereinafter more fully set forth, our improved tank cleaning method is accomplished in three distinct successive steps or cycles, to wit:

(1) A cleaning cycle in which hot vapors of the solvent are continuously circuited through the tank for a predetermined time interval to dissolve and remove contaminated matter from the inner surface of the tank wall, in which the contaminated liquid incidentally formed is drained from the tank, and in which the solvent is extracted therefrom for re-use; (2) a recovery cycle in which air is circulated for a predetermined time interval through the tank to remove solvent vapors remaining after completion of the scavenging cycle, and incident to which the solvent vapors are condensed and this condensate is recovered; and (3) a final or purging cycle in which outside air is drawn through the tank for a predetermined time interval.

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

FIG. 1 is a view in side elevation of a tank cleaning apparatus conveniently embodying our invention, and arranged for performing the scavenging cycle of the new method.

FIG. 2 shows the apparatus in top plan.

FIGS. 3 and 4 are views similar to FIG. 2, respectively showing the apparatus arranged for performing the recovery and purging cycles of the method.

As herein exemplified, the apparatus comprises a solvent vapor generating unit **1** having a horizontally arranged cylindrical vessel **2** which is kept filled with solvent approximately to the level indicated at L in FIG. 1. The solvent in the vessel **2** is continuously vaporized by heating means in the form of submerged steam coils **3** and **4**, the steam being conducted to said coils from a suitable supply source (not illustrated) by way of pipes **5** and **6** which are provided with flow controlling hand valves **7** and **8**. After traversing the coils **3** and **4** the spent steam is carried off through pipes **9**

and **10** provided with hand valves **11**, **12** and **13**, **14** as well as with steam traps **15** and **16** respectively. A bypass **17** with a valve **18** therein is shunted across the portion of the pipe **9** containing the valves **11**, **12** and the steam trap **15**, and similarly, a bypass **19** with a valve **20** therein is shunted across the portion of the pipe **10** containing the valves **13**, **14** and the trap **16**. Connecting into the top of the vessel **1** is a pipe **21** having a valve **22** therein and whereto is connected a flexible hose **23** that terminates in a spout tube **24** which is inserted downwardly through the filling opening **25** of the tank **26** herein exemplified as being that of a highway truck **27**. At its upper end, the spout tube **24** is fixed in a cover plate **28** temporarily substituted for the usual dome cover of the filling opening of the tank.

Also embodied in the generating unit **1** and arranged above the vessel **2** is a condenser **30** having a coil **31** therein through which liquid coolant (which may be water) is passed, the inlet and outlet ends of said coil being indicated at **32** and **33** respectively. Connected into one end of the housing of the condenser **30** is a T-fitting **35** to one end of which is attached a flexible hose **36**, the distal end of said hose being connected into the cover plate **28** previously referred to. The other end of the T-fitting **35** is connected to the pipe **21** by a branch pipe **37** provided with a hand valve **38**. The condensate collecting in the bottom of the condenser **30** is conducted, via a pipe **40**, to a water separator indicated at **41**. Leading from the water separator **41** is a pipe **42** which meets with a pipe **43** connecting into the intake of a motor driven pump **45**; and leading from the output of said pump is a riser pipe **46** which connects into the vessel **1** above the level L of the solvent as best seen in FIG. 1. Interposed in the pipe **42** respectively adjacent the separator **41** and the pipe **43**, are hand valves **47** and **48**, and at a point between said valves is connected a solvent fill pipe **49**. The riser pipe **46**, on the other hand, is fitted with a check valve **50** and a flow indicating sight glass **51**. Connected to the pipe **43**, beyond a hand valve **52**, is a flexible hose **53** whereof the distal end is removably coupled to a drain valve **54** at the bottom of the vehicle tank **26**. Leading from the end of the condenser **30** opposite that occupied by the T-fitting **35** is a pipe **55** which joins an air intake pipe **56** provided with hand valve **57**. Also joined to the pipe **55** is a branch pipe **58** which extends to the inlet of a rotary motor driven blower **59** and which is fitted with a hand valve **60**. It is also to be noted that a pipe **61** extends from the last mentioned end of the condenser **30** and connects into the top of the water separator **41** for the venting of said separator. Leading from the outlet of the blower **59** is a pipe line **62**, **69** having a valve **63** therein, and extending from the section **62** of said pipe line, and connecting into the pipe **21** beyond the valve **22** is a cross pipe **64** with a valve **65** therein. Also provided is a branch pipe **66** which extends from the pipe **55** and connects into the pipe section **69** to the right of the valve **63**, said pipe **66** being likewise fitted with a valve **67**. Surrounding the cross pipe **64** is a jacket **70** containing a heating coil **71** through which steam may be circulated for a purpose later on explained.

OPERATION

Cleaning Cycle

Assume that the hoses **23**, **36** and **53** are connected to the vehicle tank **26**, that the blower is quiescent, that the temperature of the solvent in the vessel **2** has been raised to the boiling point and that the various valves are set as shown in FIGS. 1 and 2. With the apparatus so prepared, a cleaning cycle is initiated by starting the pump **45**. In this cycle the solvent vapors generated in the vessel **1** by the heating action of the steam coils **3**

and 4, pass out through the pipe 21 and hose 23 and are discharged downwardly from the lower end of the tube 24 into the bottom of the vehicle tank 26 as shown by the arrows in FIG. 1. Due to the high density of the solvent vapors as compared to that of the air, the vapors gather in the bottom of the tank. As the solvent vapors are continuously introduced, however, the air in the tank is displaced upwardly and forced out through the hose 36 into the housing of the condenser 30. By reason of having been in contact with the solvent vapor some of the vapors are mixed with the air. As this gaseous mixture passes over the cold coils in the condenser 30, its temperature is reduced with the result that practically all of the solvent vapors are condensed, and the now solvent-free air is exhausted from the housing of the condenser by way of the piping 55, 66, 68 and 69, and discharged into the outside atmosphere. As the operation continues, the solvent vapors rise in the tank and some of them are condensed by the cold shell of the tank by radiation of the shell to the atmosphere, and thus wash off the oil, grease, crude petroleum, petroleum asphalt or other adhering material (as the case may be) and the contaminated condensate drains to the bottom of the tank, the excess vapors being all the while conducted through the conduit 36 to the housing of the condenser 30. As the contaminated condensate accumulates in the bottom of the tank 26, it is conducted through the flexible hose 53 to the pump 45 and by the latter forced through the riser pipe 46 into the top of the vessel 1, the cleaning cycle of the process being thus established.

Recovery Cycle

After a lapse of a comparatively short time, approximately 25 minutes for a 5,000 gallon tank, for completion of the cleaning cycle, the supply of steam to the heating coils in the vessel 1 is cut off by closing the valves 7 and 8, the valve 57 (air intake) valve 60 and valve 65 are opened, the valves 22, 63 and 67 are closed as in FIG. 3 and the blower 59 is started for the initiation of the recovery cycle. As a consequence, the solvent vapors and the solvent laden air are withdrawn from the tank 26, and are conducted through the hose 36 into the housing of the condenser 30. In traversing the condenser 30, the solvent content of the air is reduced to the quantity which saturates the air at the low temperature to which the air solvent mixture is cooled by the condenser coil 31. This denuded air is then recirculated through the tank by way of a piping 55, 58, blower 59, piping 62 and 64, valve 65 and flexible hose 23. As the solvent air mixture is cooled by the condenser coil 31, the solvent is condensed and this recovered solvent condensate drains from the bottom of the condenser housing through pipe 40 into the water separator 41. From the separator 41 the solvent flows through valve 47 and pipe 42 into pipe 43 and is reintroduced into the vessel 2 of the vapor generator 1 by the pump 45. During the recovery cycle, the valve 57 is left open so that air may enter to replace the volume of condensed solvent vapors. The recovery cycle described above, that is the act of reducing the solvent content in the tank, results in reducing solvent losses to a very minimum. The heater jacket 70 is intended to be used only when extremely low temperatures exist out-of-doors at the time the tank is being cleaned to heat the air prior to its introduction into the tank during the recovery cycle in order to more readily remove solvent from the cleaned tank by avoiding or minimizing possible excessive condensation of water vapor.

After a recirculating phase of ten to twenty minutes' duration, depending upon tank volume, all the solvent possible has been reclaimed and the purging cycle is started to completely aerate the tank 26.

Purging Cycle

In preparation for the purging cycle, valves 22, 38, 57, 65 and 67 are closed and valves 60 and 63 are opened and the hose 23 is uncoupled, as shown in FIG. 4. As a consequence, outside air can enter the downspout 24 to replace the air discharged by the blower 59 through pipes 62 to 69, and valve 63 to the atmosphere. The duration of this purging cycle will vary of course depending upon the ability to set the tank so that it will drain perfectly.

Distillation of Used Solvent

After a number of tanks have been cleaned in the above manner, by closing the valve 22 in the pipe 21 and opening the valve 38, the vapors generated in the vessel 2 will pass through the pipe 37 into the condenser 30. The saturated solvent vapors then condensed and collected in the bottom of the condenser flow through the pipe 40 into the water separator 41, from which the recovered solvent can be piped to a suitable container (not illustrated) for collection and re-use in the unit 1. The vapor generating unit is thus a self-contained solvent still. From time to time, the sludge collecting in the bottom of the vessel 2 may be removed by opening the drain valve indicated at 72 provided for that purpose.

While in accordance with the provisions of the statutes, we have illustrated and described the best 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 form 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. Obviously, instead of being stationary, the apparatus of our invention may be mounted on wheels for mobility to different parts of a plant to clean tanks or receptacles, heat exchangers, fractionating columns, and other equipment such as is used in processing commodities of the kind hereinbefore referred to.

Having thus described our invention, we claim:

1. In a method of internally cleaning receptacles used in storing, transporting or processing commodities such as oils, grease, crude petroleum products, petroleum asphalt and the like, the steps which comprise continuously boiling in a vapor generator a chlorinated hydrocarbon solvent selected from the group consisting of trichlorethylene, perchlorethylene and methylene chloride, continuously introducing the hot vapors so generated into a receptacle to be cleaned and allowing said vapors to dissolve adhering matter from the inner surface of said receptacle, continuously conducting uncondensed vapors and any air incidentally mixed therewith from the top of said receptacle, continuously cooling the gaseous mixture removed from the receptacle to condense the solvent vapors therefrom and then exhausting the air to the atmosphere, removing entrained water from the solvent so condensed, then continuously returning the solvent so recovered to said vapor generator for re-use in cleaning 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 to the atmosphere.

2. The method of claim 1 wherein the solvent contaminated with dissolved material removed from the walls of said receptacle and collecting in the bottom thereof is continuously conducted to said vapor generator.

3. Apparatus for interiorly cleaning receptacles used in storing, transporting or processing commodities such as oils, grease, crude petroleum products, petroleum asphalt and the like, comprising a vapor generator in the form of a vessel adapted to contain a chlorinated hydrocarbon solvent selected from the group consisting of trichlorethylene, perchlorethylene and methylene chloride, submerged heating means disposed in said vessel for boiling said solvent to vaporize it, a condenser with cooling means therein, an auxiliary cover adapted for application to the filling opening of said receptacle, said

cover having a spout tube extending downwardly therefrom to the bottom of said receptacle, conduit means leading from said vessel above the solvent level therein and connected by a flexible extension to said spout tube for conducting solvent vapor generated in said vessel to the bottom of said receptacle, further conduit means connected to said condenser and to said auxiliary cover for conducting uncondensed solvent vapors from the top of said receptacle to said condenser, further conduit means connected to said condenser and to said vessel for conducting solvent back into said vessel, a water separator connected with said conduit means between said condenser and said vessel for separating water from said solvent prior to the re-introduction thereof into said vessel, blower means connected to said first mentioned conduit means and operable after expiration of a predetermined period of time, for circulating air through said receptacle and said condenser by way of said first and second mentioned conduit means to recover solvent from the vapors remaining in the tank and means for finally passing unheated outside air through said receptacle for a time to purge said receptacle 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.

4. The apparatus defined in claim 3 wherein is included further conduit means for conducting condensed solvent contaminated with matter dislodged from the walls of said receptacle and collected in the bottom thereof, from the receptacle to the generator.

5. The apparatus defined in claim 4 wherein a pump is interposed in said third-mentioned conduit means between said receptacle and said vessel.

6. The method of claim 1 with the additional step of admitting atmospheric air at a temperature below the boiling point of said solvent into said tank to circulate the solvent vapor in said tank to said condenser to condense said solvent vapors and substantially replace the solvent vapor contents of said tank with atmospheric air.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,042,553

July 3, 1962

Thomas J. Kearney et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 30, for "vehicle" read -- vehicles --; line 38, for "circuited" read -- circulated --.

Signed and sealed this 16th day of October 1962.

SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents