

June 28, 1955

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2,711,978

MEANS FOR CLEANING SURFACES OF OIL AND OILY DEPOSITS
AND FOR RECLAIMING THE LIQUID USED IN CLEANING

Filed Aug. 8, 1951

6 Sheets-Sheet 1

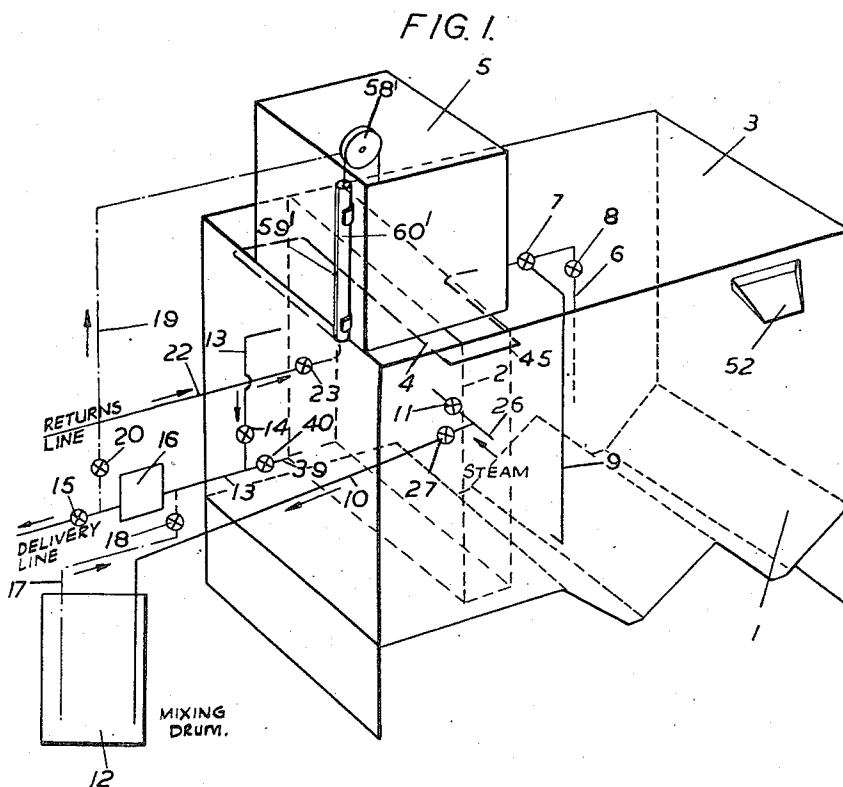
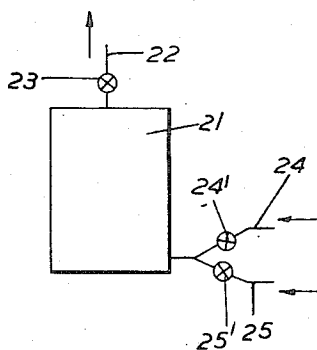


FIG. 2.



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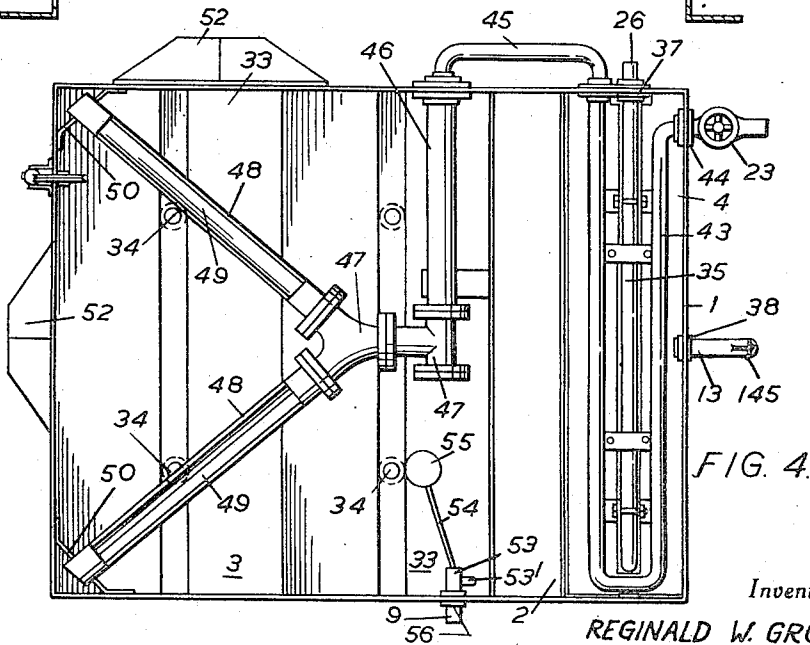
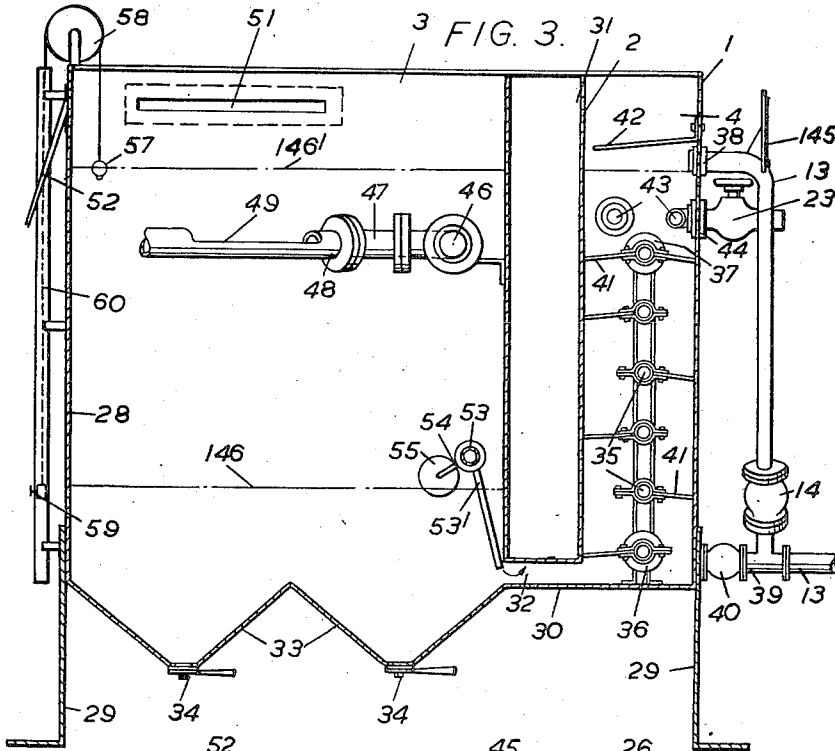
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6 Sheets-Sheet 2



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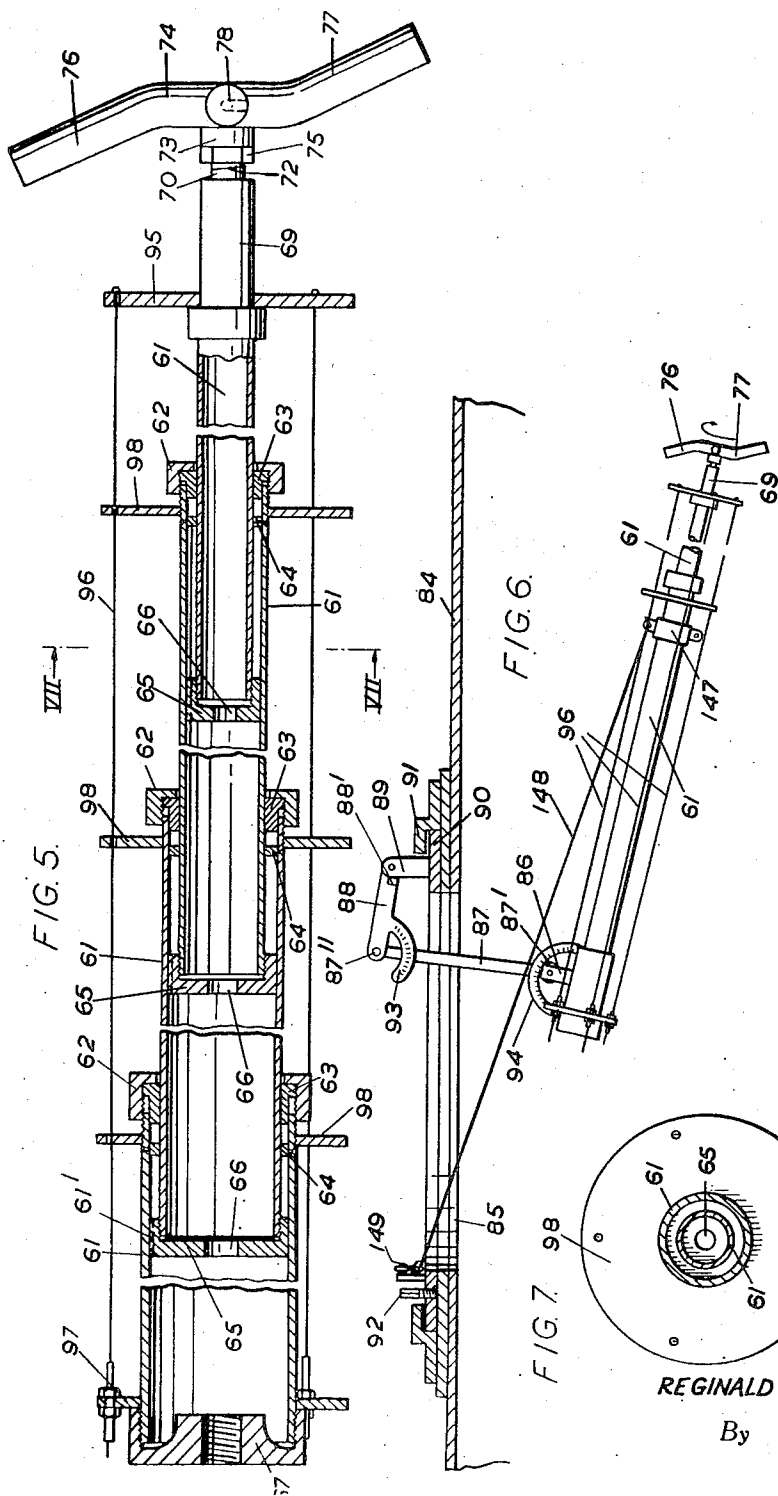
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6 Sheets-Sheet 3



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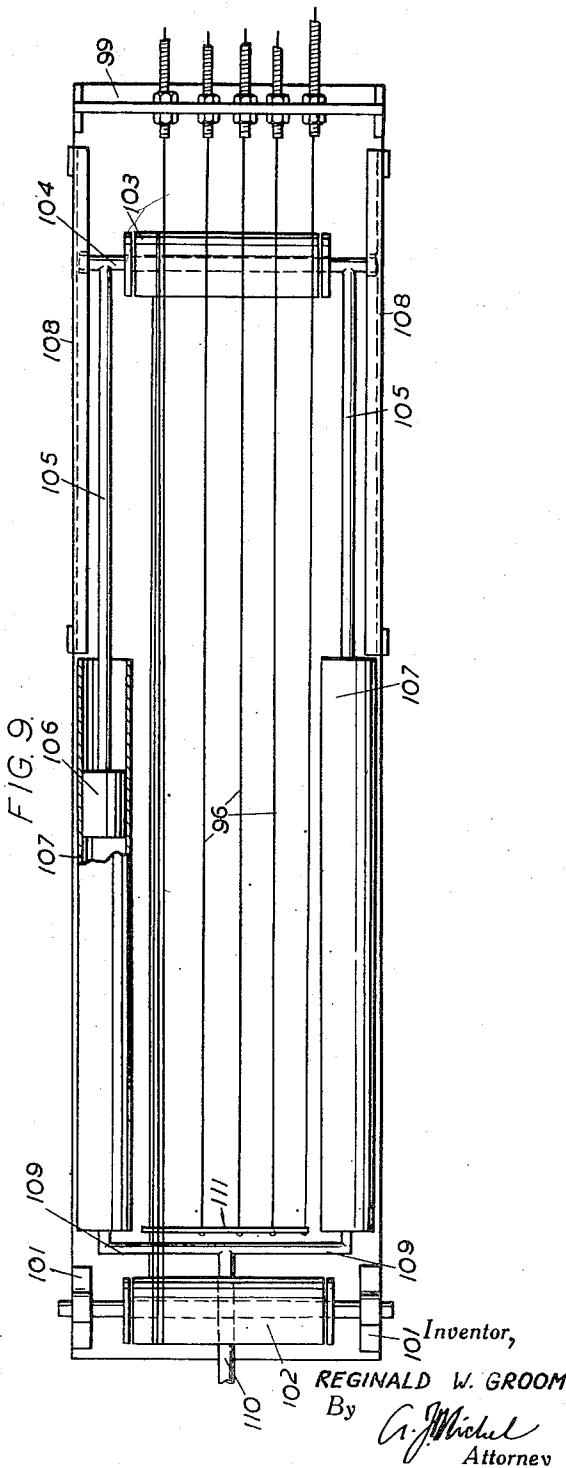
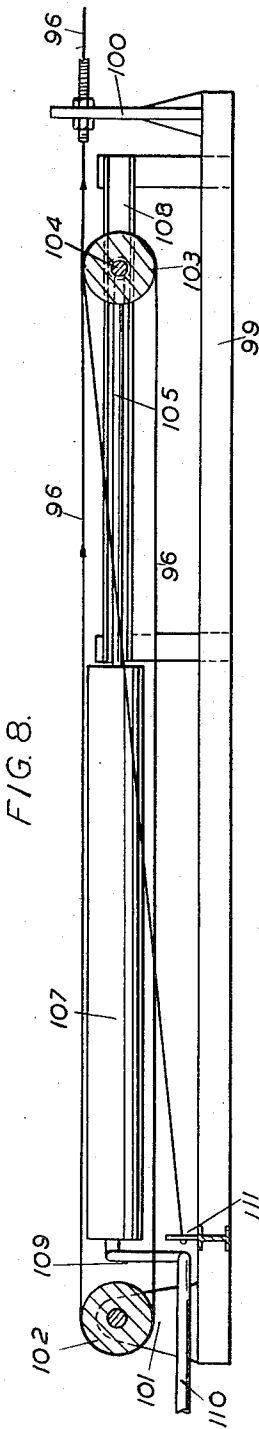
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6 Sheets-Sheet 4



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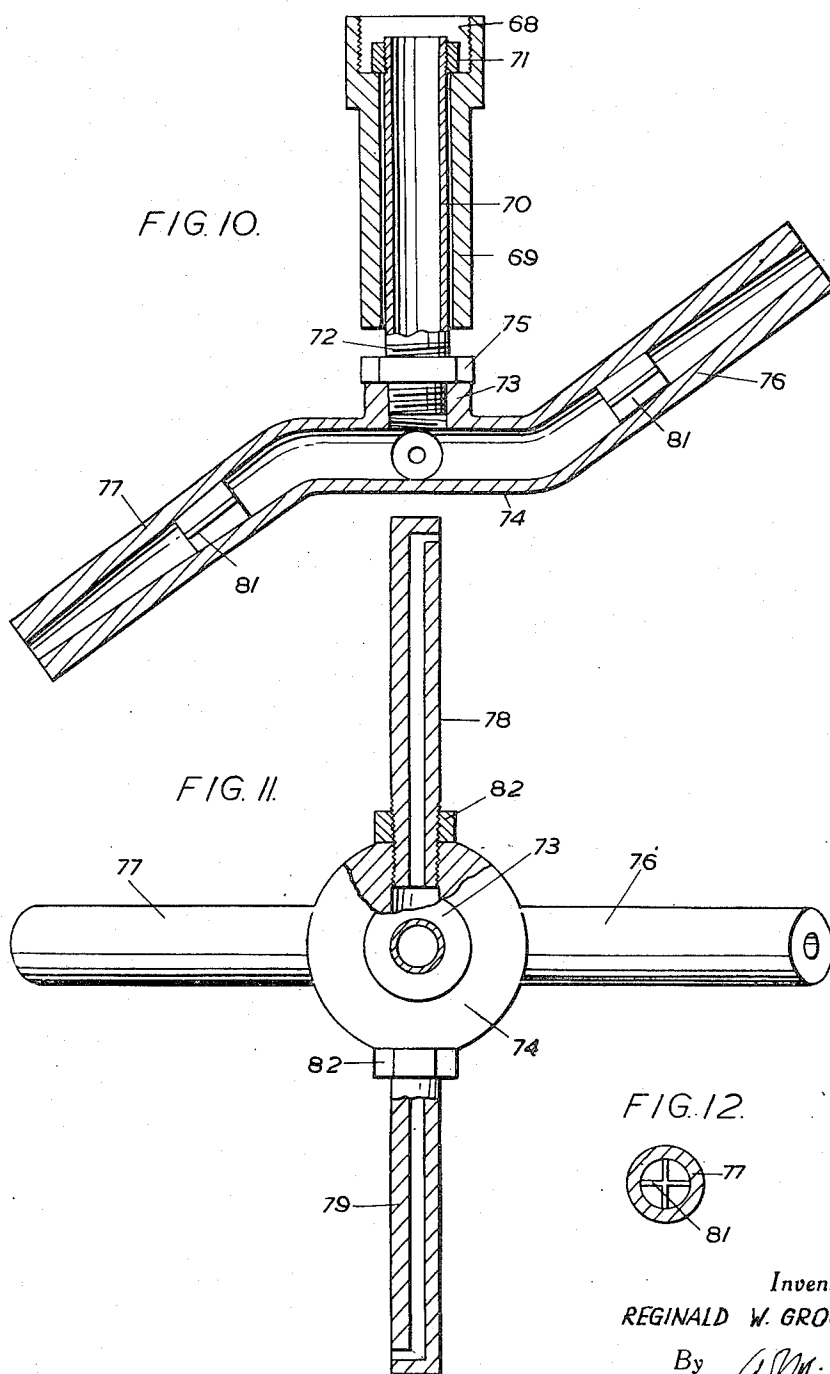
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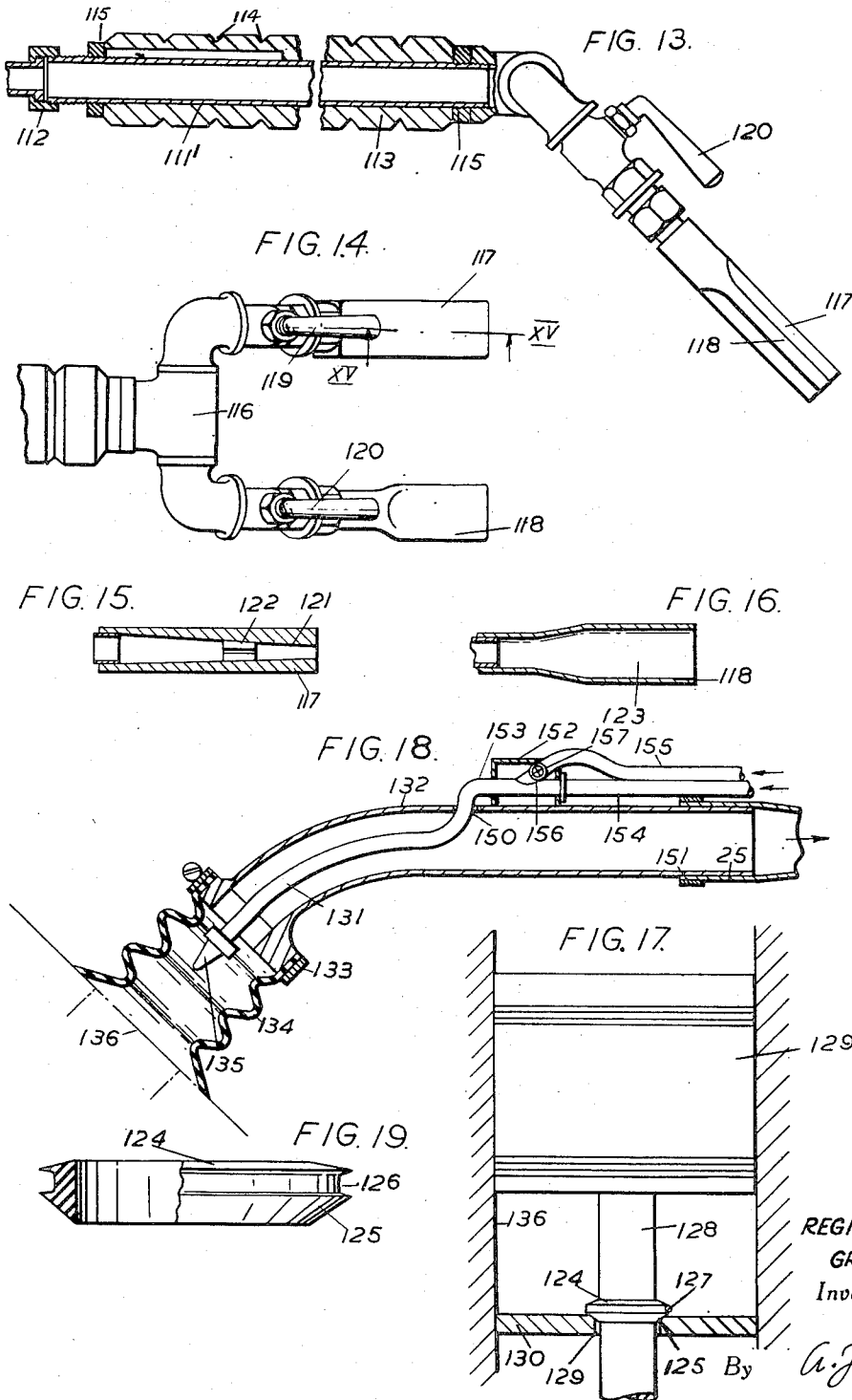
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6 Sheets-Sheet 6



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MEANS FOR CLEANING SURFACES OF OIL AND OILY DEPOSITS AND FOR RECLAIMING THE LIQUID USED IN CLEANING

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Application August 8, 1951, Serial No. 240,944

4 Claims. (Cl. 134—10)

This invention relates to the removal of deposited matter, e. g. oil and oily deposits from the surfaces on which such matter is deposited.

Hitherto the removal of oil and oily deposits from oil tanks, ships' double bottom tanks, and chambers such as under piston superchargers has mainly had to be done by hand, and in view of the unpleasant and unhealthy nature of the work it has been difficult to get workmen to undertake it. For example, in the cleaning of ships' double bottom tanks, the workmen have had to bucket out the dirty oil in confined and remote spaces—work which was arduous, exhausting and dangerous to health.

Prior proposals have been made for effecting this work by mechanical means, involving the projection of liquids against the surfaces to be cleaned, but in such cases large volumes of liquid (e. g. of the order of 400 gallons per minute) at high temperatures (for example over 200° F.) have been required, thus demanding large and costly heat exchangers. Furthermore, such systems have relied upon high pressure impact of the liquid to erode or knock off the oil or other sediments from the surfaces to be cleaned. Furthermore, the apparatus provided in such systems has not allowed for the cleaning of remote places or places difficult of access, such as are formed by tank corners, reinforcing beams and the like.

It is thus an object of the present invention to deal with these various difficulties and to provide for a more efficient cleaning.

A further object of the invention is to enable the liquid used for the cleaning operation to be automatically reclaimed after use and subsequently re-employed so that only a relatively small quantity of liquid is used.

Another object is to recover oil from the deposited matter.

To this end the present invention provides a method of removing deposited oil and foreign matter from the walls of ships' and other oil tanks and like surfaces, such method comprising the steps of projecting an aqueous detergent liquid on to the surface to be cleaned so as partially to emulsify and thereby remove the deposited oil; collecting and withdrawing the detergent liquid (contaminated with the removed oil and foreign matter), and separating the oil and foreign matter from the detergent liquid; and recycling the latter for re-use in the cleaning operation; and withdrawing the reclaimed oil and foreign matter separately from the separated detergent liquid.

The arrangement is such that the detergent liquid is forwarded in heated condition from the detergent container to a projector which directs the liquid against the surfaces to be cleaned, whereafter the liquid with entrained matter is automatically returned to the scumming container, the entrained matter there separated out and the clean liquid passed back into the detergent container for re-cycling. Hence a comparatively small quantity of detergent can be used over and over again. Moreover, the invention provides for the recovery of the matter removed from the tank wall or other surface. In the case

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of oil tanks, the recovery of the oil in this way can represent a substantial economy.

The recirculation of the detergent liquid is effected by pump means which can, if necessary, be provided as part of the cleaning equipment, or use may be made of existing pumping installations for this purpose.

The detergent used in the case of the removal of oil from the walls of tanks and the like is destined to effect a partial emulsification of the oil and thus destroy the interfacial tension between this oil and the metal of the wall, and the detergent used will be suitably selected according to the material to be dealt with.

By the term "detergent liquid" is meant an aqueous solution of a water-soluble detergent compound or mixture consisting of or comprising a wetting agent, preferably with one or more of the following additional compounds:

- Sodium silicates.
- Sodium carbonate, anhydrous or crystallized.
- Sodium sesquicarbonate.
- Sodium phosphates.
- Sodium hydroxide.
- Sodium borates.
- Sodium salts of certain organic acids such as acetic acid.
- Sodium sulphate.
- Sodium nitrate.
- Sodium chloride.

The above additional compounds, or the equivalent potassium salts, can be used with the wetting agent either alone or in various admixtures with one another in proportions varying from 0–100%, according to the specific purpose.

In a very suitable example, the detergent is composed of 50 parts by weight of sodium metasilicate, 50 parts by weight of anhydrous sodium carbonate and 5–15 parts of a wetting agent of the sodium alkyl-sulphate type.

Furthermore, in certain applications the wetting agent, dissolved in water, can be used without addition of the sodium or potassium compounds mentioned or, alternatively, only a small proportion of such additional compounds used, e. g. up to 25% of the wetting agent.

The wetting agents referred to are those known as water soluble surface active agents and belonging to either the cationic, anionic, or non-ionogenic class.

In a similar way, the temperature to which the detergent liquid is raised in the detergent container will depend first on the appropriate temperature at which it should meet the oil or the like and secondly on the heat losses likely to be encountered in its passage from the detergent container to the point of use. It has been found that a temperature of about 160° F. in the detergent container, producing a temperature at the point of use of about 150° F. is very suitable.

Again, the pressure of the detergent liquid at the point of discharge can also vary, but 80 to 100 lbs. per square inch has been found suitable. Moreover a forwarding rate for the liquid of about 4 to 8 gallons per minute has also proven satisfactory.

Various features of the invention, relating to the formation and parts of the detergent and scumming containers, and various forms of projector, both mechanically and manually operable in nature, are hereinafter disclosed in the specification and claims.

The accompanying drawings illustrate forms of various parts of the invention, and reference will now be made to these drawings.

Figure 1 is a diagrammatic illustration of a combined detergent and scumming container, in accordance with the invention, indicating the various connections thereof which may be used in accordance with the invention;

Figure 2 is a diagrammatic indication of connections to the return pump used in association with the equipment;

Figure 3 is a vertical cross section of one form of tank according to the invention in which the detergent and scumming containers are combined;

Figure 4 is a plan view corresponding to Figure 3;

Figure 5 is a view, partly in vertical cross-section, of one form of mechanical projector according to the invention;

Figure 6 is a view, on a smaller scale, of the projector showing it mounted for use inside a tank to be cleaned;

Figure 7 is a cross section on the lines VII—VII of Figure 5;

Figure 8 is a side elevation of a means for controlling the speed of projection, and for controlling the retraction, of the projector illustrated in Figures 5 to 7;

Figure 9 is a plan view of the device illustrated in Figure 8;

Figure 10 is a section, on an enlarged scale, through the projector nozzle used with the device illustrated in Figures 5 to 7;

Figure 11 is a view, partly in section, of the nozzle unit, as seen at right angles to the aspect illustrated in Figure 10;

Figure 12 is an end view of an element seen in Figure 10;

Figure 13 is a view, partly in section, of a manually operated form of projector which can be used in accordance with the invention;

Figure 14 is a plan view of the nozzle and nozzle control parts of the projector illustrated in Figure 13;

Figure 15 is a section on XV—XV, of Figure 14;

Figure 16 is a horizontal section through one of the nozzles of Figure 14;

Figure 17 is a diagrammatic indication of a collar which is used with the equipment according to the invention in the particular case of the cleaning of under piston superchargers;

Figure 18 is a sectional illustration of a projector adapted for use in this particular application; and

Figure 19 is an elevation, partly in section, of the collar indicated in Figure 17.

A general diagrammatic indication of the layout of the equipment according to the invention is illustrated in Figure 1 of the drawings. This indicates a main tank 1 which is divided by a partition, indicated at 2, into two containers 3 and 4, the first of which is intended to receive the detergent liquid returning from the cleaning operation, with the oil and foreign matter suspended therein, and which container will hereinafter be referred to as the scumming container. The second container 4, hereinafter called the detergent container, is that which contains the fresh or cleaned detergent liquid and from which the latter passes to the projector or projectors for effecting the cleaning operation.

In this arrangement an auxiliary tank 5 for containing the detergent liquid and intended for making up the detergent liquid in the scumming container is indicated as being mounted on the top of the main tank 1 straddling the partition 2.

A make-up pipe 6 controlled by valves 7 and 8 leads from the make-up tank 5 into the scumming container 3. A further make-up pipe 9, this time controlled only by the valve 7, passes from the make-up tank 5 externally of the tank 1 and is inserted at its lower end into the scumming container 3 at the position of a ball float valve therein, as will be referred to hereinafter.

The detergent liquid in the detergent container 4 is heated by steam which passes through a coil (to be hereinafter referred to) supplied through a steam line 26, controlled by a valve 11, from a steam producer (not shown).

The heated detergent liquid passes along a line 13 from the detergent container 4, being pumped in the direction of the arrow by means of a suction pump 16 to the place of use, and after use it is returned, containing entrained

substances, largely deposited oil and foreign matter in the form of solids such as oxidised oil and asphaltic residuals from the walls of the cleaned receptacle, by means of a further pump 21 (see Figure 2) through a return line 22 controlled by a gate valve 23 to the scumming container 3, the pipe line 22 itself passing through the detergent heating container 4 before discharging into the scumming container 3 and completing the cycle.

A branch 10 from the steam line 26, with a valve 27 therein leads to a drum or container 12 used for mixing the detergent solution. In practice a highly concentrated detergent liquid is made up in the drum 12 by filling the latter with water, opening valve 27 to deliver steam into the drum to raise the temperature of the water, and then adding the detergent in solid form into the heated water in the drum 12.

Before commencement of the cleaning operation the concentrated liquid mixed in 12 is pumped into the make-up tank 5 where it is diluted to the strength required for the cleaning operation and then discharged into the scumming container 3 via the line 6, this procedure being repeated until the level of the detergent liquid has risen to the permissible limit in containers 3 and 4, a reserve supply being kept in tank 5 by shutting down valve 8.

Use is made of pump 16 in effecting the transfer of detergent liquid from drum 12 to make-up tank 5, a connection 17, with a valve 18 therein, being made to the suction side of pump 16, and a further connection 19, incorporating a valve 20, leading from the delivery side of pump 16 to the make-up tank.

Inserted in the line 13 are, as indicated, stop valves 14 and 15. These valves are fully opened during the cycle of forwarding detergent liquid through line 13 but are closed when the pump 16 is used to forward the concentrated liquid to the make-up tank 5, the valves 18 and 20 then being opened.

When the stage is set for the cleaning operation, the valve 7 is open.

The return pump 21 is preferably arranged at a point in the circuit which requires a minimum amount of lift from the bottom of the oil tank or equivalent which is to be cleaned, and has its suction side connected to lines 24 and 25. The first of these is connected to the sump (or lowest point of the oil tank being cleaned), thereby to ensure drainage of all the materials accumulated in the tank, and the second line 25 represents a wandering suction line which is operated at any required point enabling certain of the contaminated detergent solution to be picked up and returned to the scumming tank before reaching this lowest point, thus increasing the efficiency of the equipment in use. Preferably the line 25 is of a flexible character, e. g. is a flexible hose, so that it can quickly be located at any point in the interior of the tank or the like.

The lines 24 and 25 have stop cocks 24' and 25' therein which provide for their alternative use.

In some instances, such as modern cargo vessel tanks, there is a sump in the bottom of the tank with a suction pipe passing laterally out of the sump. In such cases the return pump 21 is preferably arranged as near as possible to the lowest level of the suction pipe from the sump, the line 24 then being connected up to this suction pipe. In other cases the oil tank design or location may require that the lines 24 and/or 25 are passed through the top of the tank to be cleaned.

In the case of double bottom tanks, with a central longitudinal bay and longitudinal side bays, it is preferred to arrange the line 25 so that it passes into the bottom of the side bay, the fixed line 24 being connected to the lowest fall of the tank bottom, such as the inboard longitudinal.

Referring now to Figures 3 and 4 which show one form of the tank 1, it is to be noted that this comprises an outer casing 28 which is mounted on feet 29 whereby it can be arranged in any appropriate position, e. g. on the

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deck of a ship. The partition 2 constituting a heat insulating division between the containers 3 and 4 is arranged so as to extend transversely across the whole width of the tank but is spaced slightly from the floor or bottom 30 of the latter or is provided with an aperture(s) at its lower end so as to provide a communication or connecting passage 32 between the two containers 3 and 4. This partition comprises a hollow casing forming an air space 31.

Alternatively, instead of a single tank 1 sub-divided into two containers, these containers may be separately formed and connected by a pipe or pipes at their lower portions.

The scumming container 3 is initially filled with detergent liquid and, during the operation, serves the purpose of receiving heated contaminated detergent liquid, resulting from the cleaning of the oil tank or its equivalent, and permitting demulsification and gravity separation of the detergent liquid from the oil carried thereby. The detergent liquid will be of greater specific gravity than the entrained oil, so that the cleaned detergent liquid will separate out below the oil and pass through the passage-way 32 beneath the baffle 2 into the detergent container 4 for re-use. At the bottom part of the scumming container 3 the floor or bottom of tank 1 is formed to provide hoppers 33 adapted to receive solid matter separating from the liquid in container 3. Removal of this matter is effected, whenever required, through sludge valves 34.

Before passing to its place of use, the detergent liquid is heated and, in the example illustrated, the heating means, which is located in the detergent container 4, consists of a coil 35, in which the arms are horizontal and located one above the other, and which is supplied by steam from the steam line 26 referred to in connection with Figure 1. The steam enters at 37 and passes out at 36 to a steam trap (not shown). Alternatively an electric immersion heater may, for example, be used for the same purpose.

The heated detergent liquid, for example at a temperature of 160° F., passes out through an opening towards the upper end of the detergent container 4 into the line 13 which is connected by a union 38 to the tank 1 at this point and includes a checking thermometer 145 in the vicinity of this union.

To make provision for reducing the temperature of the outgoing detergent liquid if desired, cooler liquid, which has not passed over the coil 35, can be admitted to line 13 via a branch 39 connecting with the bottom of the detergent container 4, by opening a valve 40 provided in this branch.

To ensure sinuous flow of the detergent liquid upwards through the detergent container 4, and thus efficient heating thereof by the coil 35, baffle plates 41 are connected between each run of the pipe and alternate side walls of the container.

Above the union 37, i. e. the point of discharge from the container 4, is a further baffle plate 42 which extends almost the complete distance from the outer wall of the container to the partition 2. The baffle plate is slightly downwardly inclined thereby to encourage the hottest portion of the detergent liquid to flow to the pipe 13. It is to be observed that the baffles 41 and 42 extend the complete width of the container.

Also extending within the container 4 and above the coil 35, is a return flow heating pipe 43, which is of U-shape in plan and is connected by means of the union 44, to the return line 22 indicated in Figure 1. This pipe 43 leads out again from the wall of the tank 1 and is connected by a short section 45 to a tubular section 46 of enlarged diameter in the scumming container 3. This section 46 terminates in a T junction 47 from which are branched two discharge pipes 48 which are horizontally disposed, and located more or less diagonally in relation

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to the complete tank 1, in the upper portion of the scumming container 3.

With a view to preventing turbulence the pipes 48 are open at their upper parts for the majority of their lengths so as to form troughs 49 from which the material returning from the cleaning operation outflows to merge with the liquid in the scumming container 3. The pipes 48 are supported at their free ends by brackets 50 arranged across the appropriate corners of the tank 1.

At the upper part of one or both of the two side walls of the scumming container 3 is arranged a slot 51 which communicates at the exterior of the container with a guide chute 52. This serves for discharge of the scum or oil, which separates out and rises to the upper region of the liquid in scumming container 3, to a sullage container or other means for the collection or conveyance away of the scum or oil. The container 3, it will be understood, is always full of liquid up to the lower edges of the slot or slots 51.

Arranged at a relatively short distance above the lower edge of the partition 2, e. g. about one-fifth the distance from the tank floor or bottom 30 to the lower edge of overflow slot 51, is a float control for the low level limit of the detergent liquid in the tank, this being in the form of a valve 53 whose arm 54 is connected to a ball float 55 which is so designed as to float on the detergent liquid but sink in the oil. The valve 53 is connected at 56 to the external make-up pipe 9 leading to the make-up container 5 (see Figure 1), and the ball float is set so that, should the oil/detergent liquid interface reach a predetermined low level limit, designated 146 in Figure 3 of the drawings, the ball 55 will fall and cause the valve 53 to be automatically opened to permit the passage of fresh detergent liquid from the make-up tank via the pipe 9, the valve 53, and a conduit 53' from the valve 53, into the tank 1 in the vicinity of connecting passage 32. The valve 53 automatically closes when the oil/detergent liquid interface rises again above the lower level limit.

Also arranged in the scumming container 3 is a further float 57, again adapted to float on the detergent liquid but to sink in oil, this float being adapted to operate any suitable indicator; for example it may be carried by a chain or cable which runs over a pulley 58 mounted on the top of the tank 1 and which has at its other end an indicator 59 co-operating with a scale 60 which is suitably calibrated and is secured to the outside of the tank. The scale 60 and pulley 58 are shown, for convenience of illustration, as attached to the left hand wall of the scumming container 3, but it will be understood that in practice these parts would be secured to the far wall (as seen in Figure 3 of the drawings) for convenience of inspection by the operator. The indicator 59 thus indicates the level of the oil/detergent liquid interface in the container 3 and, when this reaches a predetermined line below the slot 51, e. g. 2 inches below the slot, as indicated at 146', the operator will adjust the valve 23 according to the tendency of the indicator to rise above or fall below this "working level" line 146'. If this interface level falls it will mean that the returning mixture of detergent liquid and contaminating matter has not a sufficiently high proportion of detergent solution in it to replace the controlled column of detergent liquid being discharged, as will hereinafter be described. The operator will then increase the rate of liquid return by operating valve 23, until the interface level is kept reasonably constant. If the indicated interface level tends to rise above 146' it means that the proportion of detergent liquid returning in the mixture is greater than is required to balance the volume being discharged through line 13 so the operator will reduce the rate of return through valve 23.

Thus by keeping the interfacial level 146' reasonably constant, whatever oil is returned with the mixture separates out and forms a body of oil above the interface level 146'. When such body of oil builds up to a depth

of, say, 2" above the line 146' and its superficial surface therefore comes level with the slot 51, such superficial surface (oil of highest degree of reclamation) will start to overflow through slot 51. All succeeding returned oil in the mixture returned through valve 23 will similarly rise through the detergent liquid in the scumming container 3 to lie on the superficial surface of the reclaimed detergent liquid at the maintained interfacial level 146' and thus force an automatic proportional overflow of reclaimed oil through slot 51.

A further float-operated indicator 58', 59', 60' of similar form to that described above may be arranged on the auxiliary tank 5, as indicated in Figure 1. The scale 60' is calibrated in inches and provides a means for gauging the dilution of the detergent liquid in the make-up tank to a given percentage.

Operation of apparatus above described

In operation, the tank 1 is first filled with detergent liquid and the steam heating coil 35 is brought into operation. The pumps 16 and 21 are then actuated so that heated detergent liquid is drawn out through the line 13 and projected (as will be later described) against the surfaces to be cleaned. The detergent liquid, carrying the oil and solids, is then returned via the valve 23, pipe 43 (where it is preheated to promote subsequent demulsification and separation), and troughs 49 into the detergent liquid in the scumming container 3. The oil then separates out from the detergent liquid by demulsification and, owing to the greater density of the detergent liquid as compared with the oil, the oil forms in the upper region of the scumming container 3 on top of the detergent liquid. The separated detergent liquid is continually drawn through the passage 32 for re-use so that it is recycled through the system and wastage avoided. The oil duly overflows through the slots 51 for collection and the solids settle to the bottom of the scumming container 3 whence they are periodically removed through sludge valves 34.

Detergent liquid projecting means

Various means which may be employed for projecting the detergent liquid, passing through the line 13, against the surface to be cleaned are illustrated in Figures 5 to 19. These means may be either mechanically- or manually-operated.

Examples of the former are illustrated in Figures 5 to 12 in which the projector for the detergent liquid comprises a series of pipes 61 which may be of any number and which are of diminishing diameter in the outward direction of the projector and are arranged to telescope one within the other after the manner of a trombone. Each pipe has at its forward end a gland comprising a gland nut 62, a packing ring 63 and a gland neck bush 64, the next smaller trombone pipe in each case sliding within these parts with sufficient radial compression from the gland to prevent the escape of liquid.

Screw-threadedly attached to the rear end of each sliding trombone pipe is a piston head 65 having a central opening 66 therein which provides for the passage of liquid into the pipe, this liquid initially entering the projector through a bore in an end nut 67 which is connected up to the detergent liquid supply line 13. A longitudinal groove or channel 61' is formed in each head 61 to relieve pressure in the space between its skirt and the adjacent bush 64.

Connected by threading 68 (Figure 10) to the front end of the foremost trombone pipe 61, which is externally threaded for this purpose, is a sleeve 69 which carries therein a short length of hollow shaft 70 which is threaded at its rear end to a collar 71 adapted to bear against a shoulder formed in a socket provided at the inner end of this sleeve 69. At its front end the shaft 70 is screw-threaded, at 72, and engages with corresponding internal threading in a boss 73 provided on the hub 74 of a rotatable projector nozzle, being locked thereon by a nut 75.

In the example illustrated the projector nozzle has four radial arms, two of which, 76 and 77, represent nozzles for projecting the detergent liquid passing thereto from the trombone pipes, whilst the other two, 78 and 79, represent jet-reaction means for rotating these two nozzles. It will be observed from Figures 10 and 11 that the arms 78 and 79 are aligned with one another, but that the nozzles 76 and 77 have their axes parallel to each other but oblique to the axis of the shaft 70. This permits the projection of liquid to the desired places without undue strain on the suspended projector.

The bores in the arms 76 and 77 are of tapered form and each includes, in its length, a tapered element 81 of cruciform shape, as seen from Figure 12. This element serves to part the stream of liquid flowing through the bore of the respective arm into component streams which converge downstream from the element, this, coupled with the tapered form of the arm resulting in the liquid issuing from the nozzle as a compact stream.

Each of the arms 78 and 79 also has an internal passage, but of uniform cross section, which turns through a right angle short of the outer end of the respective arm so as to open from the latter at its rear. These two arms pass radially into the hub 74 and are secured in the latter by screw-threading and by lock nuts 82.

The detergent liquid flowing through the hollow shaft 70, when it reaches the boss 73, passes into the four arms. In the case of two of these, 78 and 79, it passes along the length of the arm and out through the orifice at the end thus, by jet reaction, causing the complete nozzle unit to rotate. At the same time the liquid passes out from the arms 76 and 77 thus to be projected against the walls of the tank or the like to be cleaned.

The apertures 66 in each of the piston heads 65 are greater in area than the combined exit areas of the nozzles 76 and 77, whereby free passage of liquid can take place through the projector and maintain a pressure at these nozzles.

In use the detergent liquid is pumped into the projector at a suitable pressure, e. g. 80 to 100 pounds per square inch, and this causes the projection of a stream of the detergent liquid from the nozzles 76 and 77 against the surface to be cleaned. The rotation of the hub 73 by the jet-reaction arms 78 and 79 causes the liquid to sweep circumferentially the faces of the sides, bottom and top of the tank to be cleaned with successive impingement on these parts of the detergent solution. To prevent feathering and premature break-up of the issuing streams of liquid, the speed of revolution of the nozzle head is reduced by appropriate rotational setting of one or both of the arms 78 and 79 relatively to the hub 74.

The projector may be operated from the outside of a tank 84 to be cleaned (see Figure 6), by inserting the nozzle end through a hose 85 in the wall or top of this tank, or alternatively the projector may be mounted inside the tank at any suitable point. Thus the projector can be mounted by a suitable hinging device such as is illustrated in Figure 6. In this case an arm 87 is connected by a lockable ball joint 87' to pincers 86 rigidly secured to the rear trombone pipe 61. The other end 87'' of arm 87 is pivotally connected to a link 88 which has an abutment stud 88' and is pivoted to a lug 89 mounted on a ring 90 which is rotatable within a flanged ring 91 secured around the opening 85. The position of the ring 90 can thus be varied rotationally, as desired and, having been adjusted, is secured in the selected position by screws 92, one of which is shown, having squared ends for operation by a wrench. The arm 87 co-operates with a scale 93 which forms part of the link 88, and the radial positioning of the projector from the horizontal status, through 90°, to the vertical position is indicated by this and a further scale 94 secured to the projector.

By the means described the projector can be set to project streams of liquid therefrom in any desired direction within the tank, thus providing means whereby

the streams of liquid from the nozzles 76 and 77 can be projected against any corners or out-of-the-way parts, e. g. between roof trusses, of the internal surface of the tank to be cleaned.

Attached to the leading end of the first trombone pipe 61 is an eye bolt 147 to which is attached a cable 148 by which, when the projector is suspended in the tank, this projector can be elevated to present the jets from the discharge nozzles at the appropriate striking angle relatively to the tank structure. The free end of cable 148 is tied to a cleat 149 on the plate 90.

It will furthermore be appreciated that the effective length of the projector is also automatically variable, by virtue of the telescopic pipes 61 thereof and the fact that the entering detergent liquid exerts pressure at the boss 73.

Thus, the nozzles are set to spray the tank walls starting with the projector retracted and continuing until the latter is extended to its full length. Upon completion of this operation the projector is retracted and its direction re-set for extension in the new direction. By this means all areas within the tank can be reached by the streams of detergent solution, which are projected at a combined rate of, for instance, 4 to 8 gallons per minute, so that the oil, asphaltic residues, and so on are broken down and detached from the metal walls by the surface and interfacial tension reducing action of the detergent liquid and washed down to or towards the lowest point in the tank, being picked up and forwarded to the container 3 via the line 24 or 25 by the pump 21.

Restraining control for telescopic projecting means

Figures 5 to 9 illustrate one form of means for mechanically controlling the speed of the extension of the trombone pipes 61. To this end there is provided around the sleeve 69 a collar 95 of slightly greater diameter than the nut 67. Secured to this collar are the ends of a number of, for example five, rust-proof Bowden wires or nylon cables 96 which are spaced uniformly and radially around the collar 95. Each of these wires or cables 96 passes rearwards through corresponding guide orifices in a collar 97 adjacent the end nut 67, being guided in their passage between collars 95 and 97 by a series of appropriately perforated collars 98 which are secured to the various trombone pipes 61 adjacent the respective gland nuts 62.

The wires or cables 96 pass rearwards from the projector through the wall of the tank being cleaned to a control mechanism which may, for example, be mounted on the deck of the ship. This control mechanism comprises a base 99 having an upstanding bracket 100 through which the wires or cables 96 pass at suitably spaced positions. Also mounted on the base 99 are brackets 101 on which is rotatably mounted the shaft of a drum 102. The wires or cables 96 pass round the outside of this drum and in turn around that of a further drum 103 spaced along the base 99 from the drum 102. The drum 103 is loosely mounted on a transverse member 104 which has piston rods 105 projecting rearwards from each side of the drum and carrying at their outer ends pistons 106 each arranged in a related cylinder 107. The ends of the member 104 are slidable in guideways 108 of channel section supported on the base 99.

The heads of the cylinders 107 above the heads of pistons 106 are respectively connected by pipes 109 to a common conduit 110 which communicates through a $\frac{1}{32}$ " orifice plate (not shown) with the delivery side of the pump 16 of the equipment. This conduit may have a manually controlled needle valve (not shown) bleeding to atmosphere inserted therein between the orifice plate and pipes 109 to permit manual control of the operation. Hence, it will be observed that, when the detergent liquid passes through the projector, it bears against the boss 73 to extend the trombone pipes against the action of the wires or cables 96, these being anchored at their ends to a stationary bracket 111 provided on the base 99.

The amount of resistance to this extension is controlled by the amount of pressure fluid allowed to escape from the heads of the cylinders 107 through the pipes 109 and from the orifice plate controlled delivery pipe 110, this being determined by manipulation of the bleed valve. When the automatic projector is to be shortened by telescoping the trombone pipes 61 one within the other, then the bleed valve is shut down to allow pressure to be exerted through the pipe 110, which causes the movement of the pistons 106 along their cylinders 107, and, by virtue of the winding of the wires 96 around the drums 102 and 103, a much magnified hauling in of these lines 96 and thus quicker contraction of the length of the projector. During retraction a three-way cock (not shown) connected to the line 13 adjacent the nut 67 (Figure 6) is opened to relieve pressure on the trombone pipes 61 by shutting off the supply of detergent liquid and opening the interior of these trombone pipes to atmosphere.

Manually operated projection means

Preferably the equipment of the invention also includes one or more manually operated projectors which can be used as an adjunct to or instead of the automatic projector previously described, for example for dealing with small double-bottom tanks. A convenient form of such manually-operated projector is illustrated in Figures 13 to 16. This projector comprises a cylindrical tube 111' which is arranged for connection, e. g. by a union nut 112, with a hose line from the pump 16. Surrounding this tube is a handle grip 113 which has hexagonal sides and which may conveniently be made of a moulded plastic or of a material such as hard wood and which has a series of circumferential grooves 114 to facilitate handling. The grip 113 is secured on the tube 111' by washers 115 threaded on secured ends of the tube 111', and the latter carries at its outer end a T-junction 116 providing a connection to a pair of branch nozzles 117 and 118.

These two nozzles are designed respectively to provide a long carrying jet with which the material to be cleaned off the surface of the tank or the like, is dealt with, and a wash down nozzle for washing the floor of the tank or the like. The two nozzles are independently controlled by manually-operable cocks 119 and 120 respectively so that they can be used alternatively, as is the case in practice to avoid exaggerated withdrawal of detergent liquid from the scumming container 3, such as would give insufficient time for the desired separation therein. Alternatively the two nozzles may be controlled from a single multi-way cock.

The bore 121 through the nozzle 117 is, as shown by Figure 15, of frusto-conical section, tapering towards the outer end so as to project a high velocity, and thus long-carrying, stream of detergent liquid to the surface to be cleaned. There may, furthermore, be inserted in this bore 121 an element 122 of cruciform shape in cross section and similar in form and function to the element 81 described in connection with Figures 10 to 12.

As shown by a comparison of Figures 13, 14 and 16 of the drawings, the nozzle 118 is of flattened fish tail form so that the jet of liquid from the bore 123 of this nozzle is of flat section. The sectional area of the jet emerging from the nozzle 118 is moreover larger than that of the jet from the nozzle 117, for example, twice the area.

The oil or the like detached from the walls of the apparatus being cleaned by the action of the detergent liquid from the nozzle 117, and then washed from the floor by the nozzle 118, is withdrawn by the return pump 21 to the scumming container 3 for separation.

Modified projecting equipment for use, for example, with piston supercharger casings

The apparatus illustrated in connection with Figures 17 to 19 is related to a form of projector, which may be included with the equipment according to the invention, for the removal of certain kinds of oily deposits, such as

the highly oxidised oil in under piston supercharger casings, channels, etc., where discharge of a large body of water may not be practicable and where a very large concentration of the detergent, which term in this case may include an appropriate solvent, needs to be applied to remove the surface skin or "varnish," and also where leakage of foreign liquid out of the casing is undesirable, such as down the sides of a piston rod into the crank case beneath, in the case of piston supercharger casings.

With this in view, the apparatus illustrated in Figures 17 to 19 includes a collar 124 of resilient material, such as rubber, having a bevelled lower surface 125 and, above this, a peripheral groove 126 for receiving a tightening ring or spring 127. This collar is arranged around the piston rod 128 at a suitable distance beneath the piston 129 and secured in position by tightening up the ring 127. To facilitate positioning of the collar and this tightening operation, the collar 124 is divided by a slot (not shown) which may be in the form of a diagonal scarf of such a width and formation that when the ring 127 is tightening up the inner edges of the collar first contact one another before the side of the slot abut completely together.

When the collar 124 has been secured on the piston rod 128, the engine is turned to cause the rod to travel downwards until the collar has been tightly wedged in the opening 129 in the lower wall 130 of the under piston chamber with its chamfered portion 125 sealing the opening 129. In this position the collar provides a complete water seal between the under piston chamber and the crank case.

The projector used for supplying the detergent liquid and/or steam to the cylinder walls in this case comprises a lance or nozzle 131 arranged within a suction tube 132 which is connected by a coupling ring 151 to the end of a lead from the return pump 21, e. g. the line 25. Secured to the other end of the tube 132, by means of a band 133, is a suction hood 134 of concertina-like form, and made of a flexible material, for example rubber, which is impervious to the action of the steam (hereinafter referred to) and detergent used. As will be observed from Figure 17, the tapered end 135 of the lance or nozzle 131 projects only slightly beyond the suction tube 132 so that this end 135 will, in use, be spaced from the cylinder wall 136, from which the deposit is to be cleaned.

The lance or nozzle 131, at its rear end passes through the wall of the suction tube 132, and is provided, outside tube 132, with an injection unit comprising a casing 152 having an exit conduit 153 of which the lance 131 is a continuation. Opening into this conduit 153 is a branch conduit 157 connected to a lead 155 which is coupled to the supply line 13 and, to the rear of the inlet into the conduit 153 of the conduit 157, a further lead 154 from a pressure steam source. The steam thus acts in injector fashion and forwards the detergent liquid from the lead 155 at high velocity into the lance 131. A valve 156 is provided in conduit 157 to control the inflow of detergent liquid or to enable it to be shut off completely. The place 150 where the lance or nozzle 131 passes through the wall of tube 132 is suitably sealed.

The tube 132 will be inserted into the under piston chamber through the opening therein provided by removal of the outer casing and the end of the hood 134 pressed against the portion of the wall 136 or of the piston or piston rod from which the deposit is to be dislodged.

The steam and detergent liquid are then projected against the selected wall portion. As the deposit accumulated in the supercharger under piston chamber is practically insoluble when in the mass, the initial dislodgment of the deposit is effected by controlling the ratio of the volume of detergent liquid to steam discharged, by operation of the valve 156, thus causing projection of a concentrated jet of liquid at high velocity on the mass, so causing the latter to break up and be loosened from the cylinder wall. Alternatively the ratio of liquid may be

smaller in comparison with the steam, merely wetting the skin or varnish under low pressure.

A percentage of a solvent for the particular deposit may be added to the detergent solution to encourage surface dissolution and break up of the mass, and to remove the residual or inherent skin or varnish of oxidised oil.

The initial break-down of the mass deposit may alternatively be achieved by cutting off the steam and projecting the detergent liquid only under pump pressure.

The deposit so dislodged is removed by suction through tube 132 to the scumming tank 3.

I claim:

1. A method of cleansing the interior surfaces of tanks by the substantial removal of oily deposits from such surfaces, such method comprising introducing at least one nozzle into the tank; heating and supplying to the said nozzle an aqueous detergent liquid of suitable concentration under such pressure that said liquid is projected against and cleans the said surfaces; collecting the mixture of aqueous detergent liquid and removed oily deposits; withdrawing said mixture from said tank; separating, by gravity separation, from such mixture the aqueous detergent liquid, the oil (which floats on the surface of the aqueous detergent liquid) and the sludge (which sinks in such liquid); withdrawing the said oil for reclamation; withdrawing the said sludge separately of said oil; re-heating said separated aqueous detergent liquid and re-circulating it to said nozzle for further use.

2. A method of cleansing the interior surfaces of tanks by the substantial removal of water-insoluble deposits therefrom, such method comprising continuously (during the cleansing operation) heating and projecting an aqueous detergent liquid against said surfaces whilst moving the projected stream of liquid over such surfaces; continuously collecting and withdrawing from said tank the mixture of aqueous detergent liquid and removed insoluble deposits produced by the cleansing operation; passing such withdrawn mixture in heat exchange relationship with the said heated aqueous detergent liquid; continuously effecting the gravity separation of such mixture into aqueous detergent liquid, a water-insoluble constituent which floats on the surface of the aqueous detergent liquid and water-insoluble sludge which sinks in the aqueous detergent liquid; withdrawing the said floating insoluble constituent; withdrawing the said sludge; introducing into the liquid cycle fresh aqueous detergent liquid whenever the interface between the separated floating insoluble constituent and aqueous detergent liquid falls to a predetermined low level; re-heating said separated aqueous detergent liquid and re-projecting the same from said nozzle.

3. A method of cleansing the interior surfaces of tanks by the substantial removal of oily deposits therefrom, such method comprising introducing at least one nozzle into the tank; heating to about 160° F. and supplying to the said nozzle an aqueous detergent liquid comprising an aqueous solution of a water-soluble alkaline compound or mixture in which the said compound or mixture incorporates up to 50% by weight of a synthetic wetting agent, said aqueous detergent liquid being supplied to the said nozzle at a pressure of about 80 to 100 pounds per square inch at a return of about 4 to 8 gallons per minute; projecting the said heated aqueous detergent liquid against the surfaces to be cleansed; collecting the mixture of said aqueous detergent liquid and the removed oily deposits; withdrawing the said mixture from said tank; separating from such mixture the aqueous detergent liquid, the oil and the heavier than water deposits; withdrawing the said oil; withdrawing the said heavier than water deposits separately of the said oil; re-heating the said separated aqueous detergent liquid and re-circulating it to the said nozzle for further use in the cleansing operation.

4. A method according to claim 3, in which the detergent of the said detergent liquid comprises 50 parts by

weight of sodium metasilicate, 50 parts by weight of anhydrous sodium carbonate and 5 to 15 parts of a wetting agent of the sodium alkyl sulphate type.

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