

Aug. 26, 1941.

W. D. PHILLIPS ET AL

2,253,579

PORTABLE DEGREASING UNIT

Filed June 3, 1940

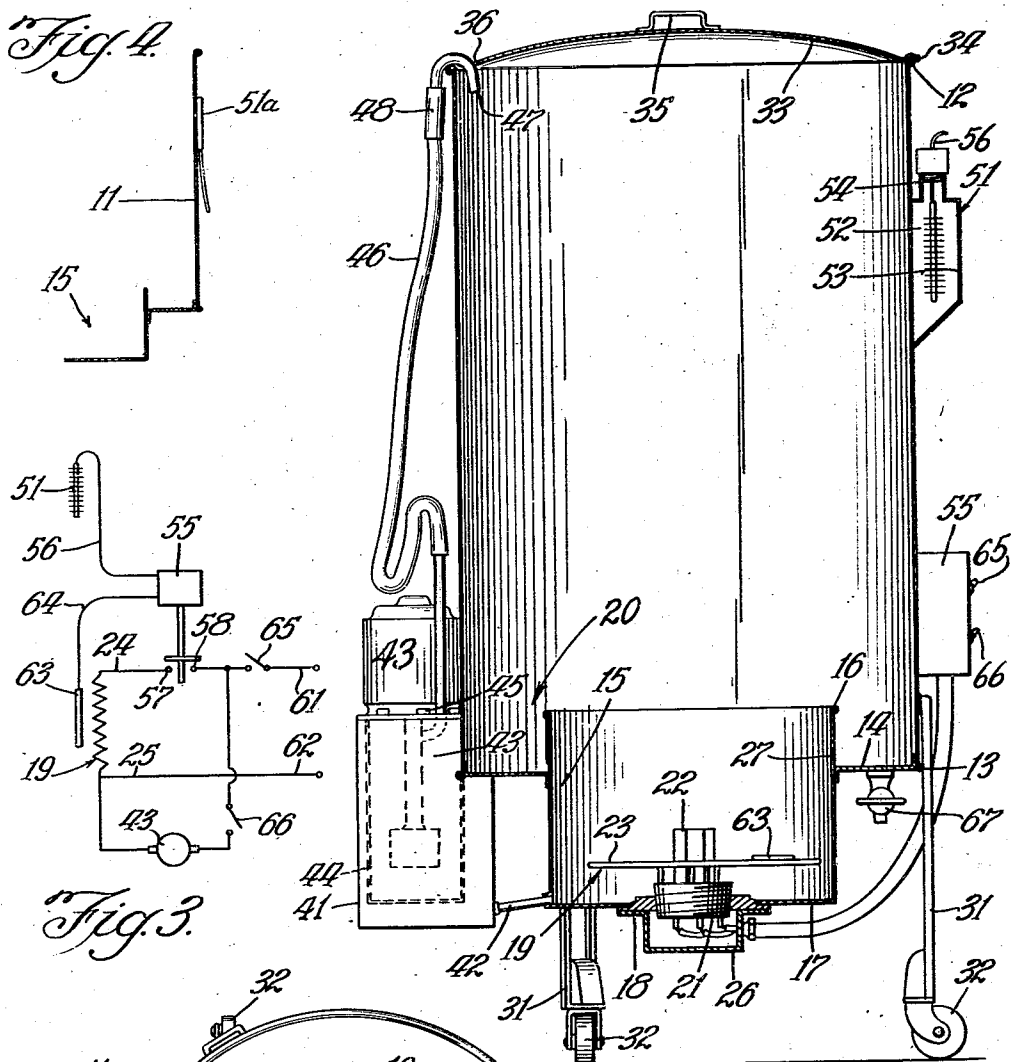


Fig. 1.

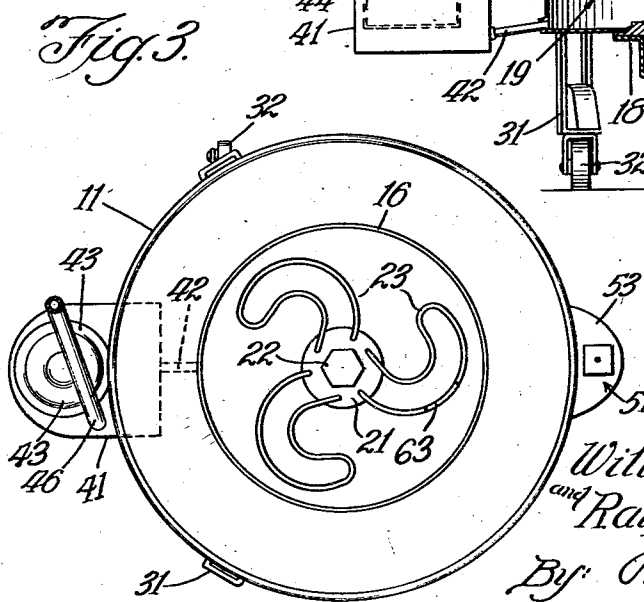


Fig. 2.

Inventors:
Willard D. Phillips
and Ralph A. Van Fossen
By Jeff & Jeff Attys.

UNITED STATES PATENT OFFICE

2,253,579

PORTABLE DEGREASING UNIT

Willard D. Phillips and Ralph A. Van Fossen,
Chicago, Ill., assignors, by direct and mesne
assignments, to The Dow Chemical Company,
Midland, Mich., a corporation of Michigan

Application June 3, 1940, Serial No. 338,478

2 Claims. (Cl. 202—170)

This invention relates to degreasing apparatus and more particularly to a small, portable, vapor-type degreasing unit adapted to be used in machine shops or in other industrial uses.

The recent improvements and developments in automatic production machinery and in tool-and-die lubricants, coolants and drawing compounds have greatly reduced the unit costs of manufacturing small metal units. However, the economies accomplished in the actual manufacture of the items have heretofore not been matched by comparable economies in cleaning the finished product, with the result that the degreasing costs on small screw machine items or similar parts are often greatly disproportionate to the manufacturing costs and, therefore, assume exaggerated economic importance.

One of the factors contributing to this disproportionate cleaning cost has been the fact that the degreasing apparatus commonly used in the prior art has been large and bulky equipment, inconveniently located with respect to the manufacturing machinery, and has been considered as not adapted to use in close proximity to factory rooms or other crowded localities because of the fumes developed by the degreasing apparatus.

It will be recognized that there are obvious advantages in the provision of a small portable unit, since such a unit may be positioned immediately adjacent an automatic machine, so that the manufactured parts will drop directly from the cut-off of the machine through a chute into the degreasing chamber, thus eliminating the necessity of providing conveyor equipment or employing labor to handle the parts and convey them from the manufacturing machines to the degreasing equipment. It is also greatly advantageous to have a small, light-weight degreasing unit, which may be easily moved from place to place according to the requirements of the moment, and which may be readily lifted and inverted to discharge metal chips or other insoluble and foreign matter without the necessity of dismantling the apparatus for cleaning. It is also obvious that a small, low-cost degreasing apparatus adapted to be quickly brought to operating temperature and provided with automatic control devices to properly control the vapor level and shut off the mechanism in case of an improper functioning is highly advantageous.

Portable units have heretofore been regarded as entirely impractical by virtue of the fact that the degreasing apparatus known in the prior art has not been adapted to small-sized units and

has been unsatisfactory for portable installations, since it has required extensive piping in the nature of gas or steam pipes for heating, cold water pipes for the condenser systems, or exhaust ducts or fans to carry off excess vapors.

A cursory survey of the prior art indicates that the deficiencies of the structures have arisen from a number of reasons:

First: In the apparatus heretofore known, the complete units have usually been quite large and elaborate, even though the actual cubic area of the degreasing chamber itself has been comparatively small. This condition often arises from the provision of dual chambers for redistillation of a hydrocarbon solvent, and while some provision for redistillation of the solvent must be incorporated in a successful apparatus, yet the disproportionate size of the entire apparatus with respect to the size of the actual treating chamber is a distinct disadvantage. It is also a distinct disadvantage to require a large quantity of liquid solvent to maintain a vapor in a comparatively small vapor chamber, since the solvents are relatively expensive.

Second: It has heretofore been regarded as essential to provide condensers, and to this end most prior art devices have been necessarily supplied with elaborate water jackets, condenser pipes and pipe lines to supply cold water to the devices and carry water from the apparatus to a suitable drain. This is disadvantageous on a portable unit for the reason that it requires extensive piping, and also for the reason that any water jackets, condensers or steam structures greatly add to the weight of the unit, and since these structures are customarily positioned near the top of the degreasing chamber, they tend to cause a unit to be top heavy, and thus unsafe or undesirable for use in a crowded factory room.

Third: The degreasing apparatus customarily used has been ordinarily provided with a solvent having a boiling point somewhat lower than the boiling point of water, wherein the water vapors present in the solvent chamber are not necessarily expelled, but may under certain conditions combine with the chlorinated hydrocarbon solvent to produce hydrochloric acid. The corrosive action of this acid is well recognized, and it has heretofore been combatted only by the provision of unusually heavy wall surfaces in the degreasing cabinet, which are obviously undesirable in a portable unit by reason of the increased weight of the unit.

Fourth: Probably the most fundamental limitations, however, of the prior art structure has

been the imperfect devices utilized to control the vapor level within the degreasing chamber. In this connection it is pointed out that in order to be satisfactory for use in a crowded factory building, it is essential that the hydrocarbon vapors 5 utilized as the active element in degreasing equipment be properly and effectively confined within the degreasing apparatus, since the presence of undue vapors in the air introduces an unpleasant atmosphere, and if the concentration of vapors rises above a minimum, it may be 10 actually harmful for persons working in the vicinity for long periods of time. This situation has been recognized by the public health authorities in practically every locality, and almost every 15 community has in effect public health regulations defining the maximum concentration of hydrocarbon vapors legally allowable in industrial locations. In fact, in industrial centers inspections of manufacturing premises are regularly conducted, and the degree of concentration 20 of hydrocarbon vapors in the atmosphere regularly tested by instruments designed for the purpose; for example, the halide lamp.

It is, therefore, a principal object of this invention to provide a simplified degreasing apparatus particularly adapted to use as a portable unit and arranged to be of a low height, so that it may be positioned below the discharge chutes of automatic screw machines and similar machinery. 30

Another important object of the invention is to provide an improved mechanical design or a degreasing apparatus, such that the actual area within the walls of the vapor chamber is substantially as large as the entire area occupied by the apparatus.

Another essential object of the invention is the provision of a novel and improved mechanism to control the vapor level within the vapor chamber, this mechanism being characterized by the fact 40 that its operation interrupts the vaporization of the liquid solvent, as contrasted with the prior art devices, which attempted to control the vapor level by means to condense vapors as rapidly as they were produced by the heated section of the apparatus.

A further object of the invention is to provide control devices to indicate the presence of undue quantities of oils in the liquid solvent and to interrupt the operation of the apparatus whenever a point of dangerous concentration of oils in the solvent is reached.

Another object of the invention is to provide an improved mechanical design for a degreasing apparatus, whereby a small quantity of solvent may be satisfactorily utilized to provide vapor throughout a relatively large vapor chamber.

Another important object of the invention is to provide a degreasing apparatus of improved mechanical design arranged so that the entire wall area of the vapor chamber may act as a condenser surface during the redistillation of the solvent, to the end that a solvent within the unit may be redistilled and purified quickly and conveniently. 60

A further object of the invention is to provide a simple portable degreasing unit having a distribution of mass of the elements of the apparatus so arranged as to provide a compact and efficient unit having a relatively low center of gravity to impart stability to the structure and resist tipping, thus providing a safer and more desirable apparatus for portable installations.

These and other important objects of the in- 75

vention are accomplished by practicing the principles of this invention and by the use of a typical structure, such as illustrated in the drawing forming a part of this specification, in which:

Fig. 1 is a vertical sectional view through a typical portable degreasing unit;

Fig. 2 is a plan view of the unit illustrated in Fig. 1, showing the cover removed;

Fig. 3 is a schematic electrical circuit diagram of the essential elements of the unit; and

Fig. 4 is a fragmental sectional view of the degreasing unit illustrating a slightly modified control arrangement.

The degreasing cabinet, or vapor chamber, illustrated in Figs. 1 and 2, comprises a thin sheet metal cylindrical body portion 11 terminating at its upper extremity in a beaded reinforcing rim 12, and terminating at its lower extremity in a beaded rim 13 interconnecting with the annular bottom portion 14. The bottom portion 14 extends inwardly and is joined to the walls of a cylindrical chamber or vaporizing sump 15 at a point somewhat below the upper extremity of the cylindrical walls to provide an upstanding partition 16 to define a distillate receiver or sump 20 between the cylinder 15 and the outer cylinder 11. The cylinder 15 is closed at the bottom by a bottom portion 17 to which a reinforcing flange 18 is secured, and an electrical heating element 19 is threaded into the flange 18 in close proximity to the bottom of the cylinder 15. 30

The heating element 19 is preferably arranged to provide a large screw threaded shank 21 having a hexagonal nut portion 22 at its upper end to facilitate threading into the flange 18, and the active element of the heater preferably consists of a tubular metal-covered resistor 23 of the so-called "calrod" type. The element 23 is fitted into drilled openings in the shank 21, and the electrical connections are carried through these openings and connected to feed wires 24 and 25 housed within the connection box 26. 35

The entire unit is supported on three legs 31 preferably welded to the cylindrical vapor chamber 11 and provided with casters 32 or other friction-reduction devices to facilitate easy and convenient movement of the entire unit.

A cover 33 is provided with a beaded edge 34 adapted to fit the upper beaded edge 12 of the vapor chamber and this cover 33 is preferably also provided with a lifting handle (not shown) and an orifice 36 near one edge. It is not essential that the cover 33 be used in the operation of the machine since the vapor level is actually controlled by mechanisms to be hereinafter described, but when the use of the cover is not otherwise objectionable, it may be desirable in order to prevent violent currents of air from disturbing the proper level of the vapor. For example, if the unit is positioned adjacent an automatic screw machine, it is convenient to place the cover in position and to introduce the screw machine parts into the vapor chamber by a small chute, which may extend through the orifice 36. 45 It will be understood that when machine parts are chuted into the chamber, as thus described, a suitable basket (not shown) is provided in the degreasing chamber so that they may be quickly and easily removed whenever a sufficient number have accumulated. 60

The principal cleaning action of the unit is accomplished by a hydrocarbon vapor within the vapor chamber 11, but it has also been found desirable to provide flushing means adapted to spray liquid solvents over the parts to remove 75

insoluble substances, such as metal chips, rust or road dirt. To this end it is desirable to provide a chamber or sediment sump 41 secured to the lower extremity of the vapor chamber 11 and connected to the vaporizing sump 15 by a tube 42. A motor-driven pump 43 is removably mounted in the top of the chamber 41 and is provided with a removable mesh screen 44 so that the entire pump and screen may be removed at will by loosening the machine screws 45 to provide convenient access to the inside of the chamber 41 in order to remove any accumulation of sediment within the bottom of the chamber. The pump 43 is arranged to draw solvent from the chamber 41 and discharge the solvent upwardly through the flexible tube 46, and the hook-shaped metal discharge tube 47, which may be provided with a handle portion 48. The hook-shaped tube 47 may be suspended over the upper beaded rim 12 of the chamber 11 to extend downwardly through the orifice 36 into the inside of the chamber and spray liquid solvent into the chamber at all times, but preferably it is used only when particularly obstinate accumulations of insoluble matter have formed on the work, and it is then directed towards the surface of the work by the operator.

The importance of a proper vapor control mechanism has been pointed out hereinbefore, but it will be appreciated that although the hydrocarbon vapors used are approximately five times more dense than air, yet they are not sufficiently dense to satisfactorily operate float valves, syphons or other such devices commonly utilized to control fluid levels. In the prior art attempts have been made to control the level of the vapor by providing a low-temperature condenser adjacent the top of the vapor chamber, either in the form of an annular water jacket around the chamber or by grill work of condenser pipes within the chamber itself in order to condense and liquefy any excess vapors which might tend to rise above the rim of the chamber and overflow into the atmosphere. So far as is known to the applicants, these devices have been highly unsuccessful with the result that it has been regarded as a foregone conclusion in the art that a considerable quantity of vapors will escape from any degreasing apparatus and that the apparatus is, therefore, unsuitable and dangerous for use in any location in close proximity to other workers. This has been particularly true of apparatus utilizing exposed flame heaters or in any apparatus in close proximity to fires or highly heated objects, since the chlorinated hydrocarbon solvents may, if exposed to high temperatures, break down into chlorine or phosgene gases which are extremely dangerous in any appreciable degree of concentration.

The characteristics of the individual solvents vary considerably, but may be illustrated by the characteristics of tetrachlorethylene, which is contemplated as the most satisfactory solvent for use in this type of apparatus.

The boiling point of tetrachlorethylene is approximately 249.5° F., but in the event that the vapors are raised to a temperature in the neighborhood of 275° F., they may break down into gases which are extremely unpleasant and harmful, and actually dangerous if encountered in sufficient concentration. Normally, these gases, if not under pressure, will not reach this temperature, but it has been found that if they escape, they may be drawn into an open flame by convection and a certain amount of gas will

be produced. This has been a distinct disadvantage by apparatus heated by an open flame, but it will be seen that this disadvantage has been overcome in the present construction by the provision of a heating unit entirely submerged in liquid solvent. Under these circumstances no portion of the apparatus can ever reach a temperature higher than the boiling point of the liquid in which the unit is submerged, with the result that even though a small amount of vapor should escape, there are no highly heated "flash" surfaces on the machine that might tend to convert the vapors into dangerous gases.

The improved vapor control mechanisms disclosed by this invention depend for their principle of operation on the fact that the body of vapor within the chamber will always be at an exactly uniform temperature, since the vapor chamber is unsealed, or open, and operates under atmospheric pressure only, and since any cooling of the vapor will re-convert it into liquid, whereupon it will drop to the lower portion of the chamber.

This invention takes advantage of this characteristic and provides a thermostat 51 positioned on the side wall of the vapor chamber 11 at a point substantially above the bottom of the chamber, but somewhat below the upper rim 12. As hereinbefore pointed out, the hydrocarbon vapors are approximately five times heavier than air, thus as the liquid solvent is heated and vapor begins to form, it will slowly rise to a uniform level throughout the chamber until the upper level of the vapor reaches the thermostat 51. It is understood, of course, that the critical temperature of the thermostat 51 is adjusted to be below the boiling point of the solvent, so that whenever the high temperature vapor contacts the thermostat, the thermostat may act through the temperature sensitive element 52 to open the electrical circuit through the heating element 21 and prevent the further production of vapor. Similarly, as the vapor condenses by contact with the work or the side walls, the vapor level will gradually fall until it is below the level of the thermostat 51. As this occurs, the air from the atmosphere of the room will be drawn in through the open cover and will contact the thermostat 51, and since this air is at a temperature far below the boiling point of the solvent, it will actuate the thermostat to again close the circuit through the heating element 19. It is to be noted, however, that although the vapor level may rise and fall within certain limits, that the temperature of the vapor is absolutely constant at all times.

The thermostat 51 may be of any desirable form, as for example, a conventional, tubular, temperature-sensitive thermostat bulb 51a, illustrated in Fig. 4. It has been found, however, that a more accurate control of the vapor level may be accomplished by providing a thermostat having a temperature-sensitive element 52 including a multiplicity of thin fins to effect a more instantaneous heat transfer. With this type of thermostat, it is desirable to provide a small thermostat pocket or chamber 53 outside of the vapor chamber 11 and connected therewith and to mount the thermostat 52 on a vertical sleeve 54 welded or otherwise secured in the top of the chamber 53. By providing this thermostat chamber, the thermostat bulb is removed to a position outside of the regular dimensional limits of the vapor chamber, so that the entire

area within the chamber will be clear and may be utilized to contain objects undergoing degreasing treatment. Thus, the thermostat will not interfere with the introduction of large objects into the degreasing chamber and will not be in danger of becoming damaged as the articles are placed in or taken from the chamber.

The vertical sleeve 54 is not necessarily an essential element of the invention, but it has been found that in practice this sleeve is quite important, since when such a sleeve is used, the temperature control of the thermostat functions more satisfactorily and controls the vapor level with a greater degree of accuracy.

The temperature-sensitive element of the thermostat 51 is connected with a pressure switch 55 by an operating tube 56. The pressure switch 55 includes contactor members 57 and 58 arranged in circuit with the power supply lines 61 and 62 to open or close the electrical circuit to the heating unit 19 in the vaporizing sump 15 in the bottom of the degreasing cabinet.

The electrical resistance unit of the heating element 19 is also provided with a tubular temperature-sensitive thermostat bulb 63 connected to the pressure switch 55 by an operating tube 64. The bulb 63 may be soldered or clamped in intimate engagement with the heating element 19 to establish an intimate heat transfer relationship between the heating element and the thermostat bulb. The thermostat bulb 63 is arranged with a critical temperature appreciably above the boiling point of the solvent and considerably below the point of temperature at which the solvent will break down into gas. Thus, as a usual thing, the temperature of the solvent can never rise above its boiling point and the thermostat bulb 63 will never act to interrupt the circuit through the heating unit. However, it has been discovered that after a long period of operation of the degreasing unit without the desirable redistillation of the solvent considerable quantities of oil may mingle with the solvent in the vaporizing sump and under certain conditions this mixture may have a boiling point considerably higher than the boiling point of the pure solvent. In fact, it has been found that unless the degree of saturation of oil in the solvent is controlled, it is possible for this boiling point of the mixture to rise sufficiently to cause a chemical breakdown of the solvent and generate dangerous gases directly from the liquid.

It is not believed that this characteristic has been fully appreciated in the prior art and it is one of the objects of this invention to provide means to control the degree of saturation of the solvent, or rather, to interrupt the operation of the machine in the event that the solvent and oil mixture approaches a dangerous point of saturation. This is well accomplished by the provision of the thermostat bulb 63, since whenever the mixture of oil and solvent becomes of sufficient concentration to raise the boiling point appreciably, the pressure switch 55 will operate to break the contacts 57 and 58 and interrupt the electrical circuit to the heating element 19. The thermostat 63 also provides another incidental, desirable function, since it will interrupt the circuit to the heating element 19 in the event that the solvent level falls below the upper level of the resistance unit and thus prevents any possibility of burning out these units.

The operation of the mechanism is as follows: The solvent is placed in the bottom of the vapor

chamber 11, where it will pass from the outer annular sump 20, through the port 27 in the inner annular partition and come to rest in the vaporizing sump and submerge the heating element 19. The operator will then close the manually operated switch 65 to bring the heating element to full heat and begin vaporizing of the solvent. It is understood, of course, that at this time both of the thermostat bulbs 51 and 63 are relatively cool and the pressure switch contacts 57 and 58 will be closed.

As the solvent boils, the vapors will rise in the vapor chamber 11 and since they are considerably more dense than the air, they will maintain a constantly level upper surface and will rise until this upper surface envelops the thermostat bulb 51. The vapors, of course, are at a temperature of 249.5° F. and when they strike the thermostat bulb 51 will operate the pressure switch to break the contacts 57 and 58 and interrupt the electrical circuit of the heating element 19. The vapor level will then gradually fall, due to the fact that the vapors are constantly condensing on the thin outer walls of the vapor chamber 11, and when the vapor level moves below the thermostat bulb 51 and allows the air drawn into the chamber to contact the bulb, the pressure switch will again close the contacts 57 and 58 and again complete the electrical circuit to the heating unit 19 to repeat the operation.

It will be understood, of course, that the wall surfaces of the vapor chamber 11 are constantly acting as condenser surfaces and are at all times being cooled by contact with the air on the outside of the chamber. By virtue of the high-temperature solvent employed, it has been found unnecessary to provide water jackets or other auxiliary cooling mechanisms, since the thin metal of the chamber 11 provides a good heat-conducting medium and particularly since there can be no danger of an overflow of the solvent vapor due to the limited capacity of the condenser surfaces, because the thermostat 51 absolutely controls the vapor level and maintains the level at a point substantially below the upper surface of the chamber, so that the vapors can not escape even though they be agitated by introduction or removal of large materials being treated, or by swirling currents of air in the vicinity. It will be seen that the normal vapor level is several inches below the top of the vapor chamber and thus the vapors may be permitted to swirl or eddy considerably without danger of overflow.

Articles to be treated by the degreasing process are suspended within the chamber 11 in any convenient manner, as, for example, by hooks, wires or baskets, so that the vapors may condense on the cold metal and flush any grease or foreign matter from the metal surfaces. Since the temperature of the vapor is well above the boiling point of water, all water vapors within the chamber will have been expelled and any troubles due to steam smudge, such as encountered in prior art apparatuses will be eliminated.

If the operator desires he may close the manual electrical switch 66 to complete the circuit through the pump motor 43 and may direct the stream of liquid solvent from the hook-shaped nozzle of the flexible solvent hose against the surface to assist in flushing heavy or insoluble dirt from the work. After a great volume of work has been treated, it will be appreciated that the

oils removed from the work will have to a certain extent adulterated the liquid solvent, although the vapor is at all times absolutely pure. As heretofore pointed out, however, it is desirable to avoid unduly concentrated solution of oil in the solvent, and for that reason it is necessary to provide means to distill and purify the solvent. Elaborate apparatus has been provided in the prior art, but in the present structure, it is accomplished by the simple arrangement of the center vaporizing sump and the annular distillate reservoir or sump at the lower extremity of the side walls of the vapor chamber 11.

To redistill it is only necessary to plug the port 27 in the annular upstanding partition between the vaporizing sump and the distillate sump and then close the switch 65 to the heating element. The vapors in the chamber will form in the usual way and rise to the regular control level. Since no work is in the machine at the time, however, the only condensation will be on the side walls of the vapor chamber 11 and all of the solvent thus condensed will flow into the annular distillate sump. It is to be particularly noted that this arrangement utilizes the entire area of the chamber walls and thus accomplishes the distillation with extreme rapidity, so that it is entirely unnecessary to interrupt the operation of the device for more than a very few minutes at any time. When the distillation process has continued until the solution in the vaporizing sump reaches a point of concentration where further distillation would be undesirable because of the danger of gas formation, the operator may open the switch 65, or if this is not done, the circuit will be automatically interrupted by the operation of the thermostat bulb 63 and the pressure switch 65. In fact, this is preferred, since by allowing this thermostat to operate all of the solvent may be reclaimed within the margin of safety carefully calculated and determined by the critical temperature of the thermostat 63.

The pure solvent in the distillate sump may then be removed from the unit by a syphon or through a drain petcock 67, and the oils and foreign matter removed from the vaporizing sump either by operating the flushing pump, or in any other manner.

It is to be particularly noted, however, that any heavy chips, metal, sand, gravel, etc., that may have collected in the bottom surface of the sumps may be easily and quickly discharged from the machine by simply inverting the machine to allow the heavy materials to fall out and that the light and durable construction of the unit makes this procedure entirely feasible and eliminates the necessity of dismantling the degreasing unit to remove these heavy materials.

The pure solvent is then placed in the sumps, the plug in the partition is removed, and the device is again ready to operate.

From the foregoing description, it should be apparent that the portable unit disclosed herein accomplishes certain notable advances in the art not heretofore accomplished, nor apparent, as follows:

First: The present invention discloses a mechanical design of extreme simplicity unequalled in the prior art.

Second: The present design provides a degreasing unit having a very large capacity as compared with the space occupied by the unit. In this connection it is pointed out that the en-

tire diameter of the vapor chamber 11 is available to treat the work and this diameter is substantially equivalent to the entire outside diameter of the machine, since the walls are of a single thickness of metal and extremely thin, and since the thermostat chamber or flushing pump do not occupy any considerable portion of space on either side of the unit.

Third: This invention discloses an entirely new and highly desirable type of vapor level control, having inherent advantages not contemplated in the art.

Fourth: By practicing the principles of this invention, it is possible to eliminate the danger of production of dangerous gases, since this invention discloses means to indicate the degree of concentration of oils in the liquid solvent and, further, since the device is arranged so that no exposed flame or highly heated surface can possibly be contacted by the hydrocarbon vapors, even in the event that a certain overflow should take place.

Fifth: The design of the present disclosure permits a small volume of solvent to be satisfactorily used to produce a vapor throughout a comparatively large vapor chamber.

Sixth: The present invention discloses a novel mechanical design for a degreasing unit, such that redistillation of the solvent may be accomplished in the same chamber in which work is treated and provides means whereby the entire area of the chamber may be utilized as a condenser surface during this redistillation to effect rapid operation.

Seventh: All of the above features have been incorporated in a single small unit having a comparatively low height adapted to be placed under the discharge chute of modern, automatic production machinery and arranged in a convenient, portable assembly having a low center of gravity and an equalized distribution of mass, thus providing a unit of great stability.

While we have shown and described the present preferred embodiment of this invention in compliance with the patent statutes, it is subject to numerous changes and modifications without departing from the invention spirit, and we, therefore, do not wish to be limited except as by the scope of the appended claims.

We claim:

1. In a portable degreasing apparatus, the combination of a vapor chamber having side walls of thin heat conducting material, a distillate sump in the bottom of said chamber, a vaporizing sump below the distillate sump, said sumps being arranged to include means to direct all of the condensate on the side walls of said chamber into the distillate sump, means to direct the condensate from the distillate sump, either to the vaporizing sump or to a separate container at the will of the operator, an electric heating element mounted in the vaporizing sump adjacent its bottom, a temperature-sensitive element in operative relationship with said heating element, a temperature control chamber adjacent the top of the vaporizing chamber and outside of the dimensionable limits of said chamber, a temperature-sensitive vapor actuated element housed in said control chamber, means responsive to the operation of said temperature-sensitive elements to control the aforesaid heating-elements, the proportion and structure of the vapor chamber, the sumps and the heating element providing means to degrease materials and return the dis-

tillate to the vaporizing sump for continuous degreasing operation, and to separate the clear liquid solvent from contaminated solvent, including only the thin heat conducting side walls of the vapor chamber as the sole condensing means.

2. In a portable degreasing apparatus, the combination of a vapor chamber having side walls of thin heat conducting material, a distillate sump in the bottom of said chamber, a vaporizing sump below the distillate sump, said sumps being arranged to include means to direct all of the condensate on the side walls of said chamber into the distillate sump, means to direct the condensate from the distillate sump, either to the vaporizing sump or to a separate container at the will of the operator, an electric heating element mounted in the vaporizing sump adjacent its bottom, a temperature-sensitive ele-

ment in operative relationship with said heating element, a temperature-sensitive element mounted in the vaporizing chamber adjacent the top of said chamber, means responsive to the operation of said temperature-sensitive elements to control the aforesaid heating elements, and proportions, weight and structure of the chamber, sumps, the heating element providing means to operate the device practically continuously as a degreasing unit and to distill clear liquid solvent from contaminated solvent with the thin heat-conducting side walls of the vapor chamber as the sole condensing means, the device as a unit permitting manual dumping of the refuse without disturbing any part or connections.

WILLARD D. PHILLIPS.
RALPH A. VAN FOSSEN.