

April 11, 1939.

A. A. LEVINE

2,153,577

PROCESS OF DEGREASING

Filed March 7, 1935

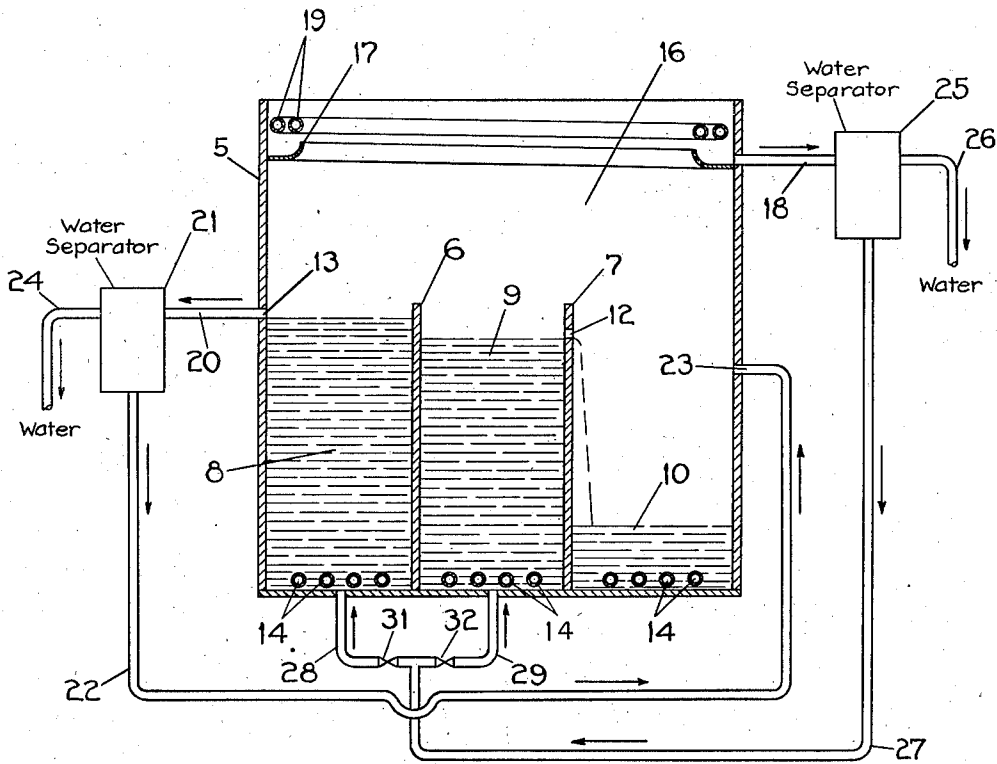


Fig. 1

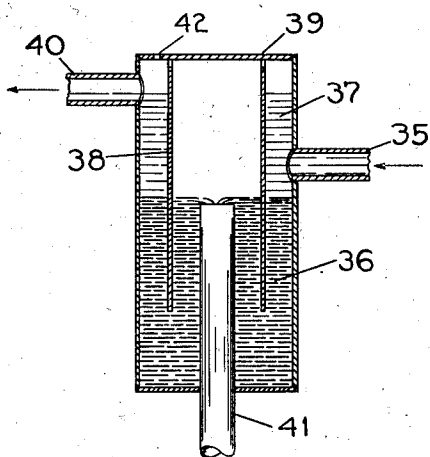


Fig. 2

INVENTOR.
Arthur A. Levine

BY

E. H. O'Brien
ATTORNEY

UNITED STATES PATENT OFFICE

2,153,577

PROCESS OF DEGREASING

Arthur A. Levine, Niagara Falls, N. Y., assignor
to E. I. du Pont de Nemours & Company, Wil-
mington, Del., a corporation of Delaware

Application March 7, 1935, Serial No. 9,911

3 Claims. (Cl. 87-6)

This invention relates to a novel degreasing process and apparatus. More particularly it is concerned with a method of degreasing metal articles with various solvents to remove grease and other impurities therefrom. Among the various solvents suitable for use in degreasing may be mentioned in particular the chlorinated hydrocarbon solvents such as trichlorethylene, perchlorethylene, ethylene dichloride, dichlorethylene, carbon tetrachloride, and various mixtures of these solvents. This invention also includes, as a novel composition, a liquid for use in degreasing and comprising one of these halogenated hydrocarbon solvents containing dissolved there-
in a small amount of an added agent.

In the degreasing of metal articles the removal of cutting oil residues which may remain on the articles has presented a serious and as yet unsolved problem. When machine parts and other objects are stamped, machined, or otherwise worked upon, a cutting oil is very frequently employed to assist in the mechanical operation. This oil ordinarily consists of a soap-water emulsion. After the machine operation is completed a soapy residue which may contain in addition to soap, a greater or less amount of water, oil and various other ingredients, is left on the metal. When the metal article is subsequently degreased, as for example by immersion in a bath consisting of a chlorinated hydrocarbon solvent in either liquid or vapor form, the soapy residue is not readily removed from the article because the soap is not soluble to any substantial degree in the chlorinated hydrocarbon solvent. This has been a serious disadvantage in the use of the halogenated hydrocarbons in degreasing operations on metal parts containing oil residues, and, in general, the methods now known do not yield entirely satisfactory results.

One of the objects of this invention is to devise a process which will successfully remove cutting oil residues from metallic parts being degreased during the degreasing operation. Another object of this invention is to provide means by which the soapy residue is brought into solution in the chlorinated hydrocarbon solvent which is used for degreasing. Another object of this invention is to provide means by which the chlorinated hydrocarbon solvent employed is continually purified and returned to take part in further degreasing operations. Still another object of the invention is to remove water from the solvent so that substantially water-free chlorinated hydrocarbon solvent is returned for subsequent use. These and still further objects of

my invention will be apparent from the ensuing disclosure.

In the description of the process which follows the degreasing solvent will be referred to as "trichlorethylene". This is the preferred solvent for use in my process, although, as indicated above, other liquids may also be suitable. Among other solvents may be mentioned halogenated hydrocarbons, particularly the chlorinated hydrocarbons, hydrocarbons, and petroleum fractions such as benzene, naphtha, etc. However, it may be mentioned at this time that in order for the water removal phase of my process to be carried out effectively it is necessary that a solvent be selected which has a specific gravity greater than that of water. For this reason the halogenated hydrocarbons are the solvents with which the invention is most directly concerned.

My novel process will be described with reference to the annexed drawing which is illustrative of a form of apparatus for carrying out my invention. By so describing the method I do not, of course, mean that it is restricted to use with this apparatus. The apparatus shown is merely a convenient and preferred way of utilizing my method in the removal of cutting oil residues from metallic parts being degreased.

In the drawing, Fig. 1 represents a schematic view of the entire equipment including various baths of liquid solvent in which the metal parts are to be immersed, and means for purifying the liquid solvent to remove therefrom the dissolved soapy residues and other impurities. Fig. 2 is a detail view, also schematic, of a water separator which may be employed in conjunction with the apparatus of Fig. 1.

In the drawing the numeral 5 represents a container in which the degreasing liquids and the other necessary elements are positioned. As shown, this container is divided into three compartments by means of the two interior baffles 6 and 7. These compartments are numbered respectively 8, 9 and 10 and contain various liquids to be presently described.

As shown, the baffle 7 has positioned near its upper end an overflow opening 12 which permits communication between chambers 9 and 10. Similarly, in the container wall 5 there is positioned an aperture 13 through which the liquid in compartment 8 may flow out. After emerging from compartment 8 this liquid flows through a pipe-line to be presently described.

Positioned at the bottom of each compartment is a series of steam pipes which are all indicated

in the drawing by the numeral 14. These pipes, through which steam or some other heating medium may be conducted, serve to volatilize the solvents in the various compartments and maintain the liquids at the boiling points. The vapors of the solvent, which in the installation being described is trichlorethylene, fill the space within the container below the condensing coils 19 to be presently described. This vapor space is indicated by the numeral 16.

At the upper portion of the apparatus and completely encircling the interior periphery thereof is positioned a trough 17. This trough is lower at the outlet where it is connected with pipe-line 18 than at any other portion of its extent. Above the trough and also extending along the entire interior periphery of the apparatus are the condensing coils 19 through which a cooling medium flows. This cooling medium, which may be water or some other liquid, serves to condense the vapor present in vapor space 16 and the condensate collects in the trough 17. Due to the fact that a portion of the trough 17 adjacent to pipe-line 18 constitutes what is in effect a sump, the condensate flows in the trough around to this point where it is removed from the apparatus by pipe-line 18.

In the compartment 8 trichlorethylene containing dissolved therein a small amount of oleic acid is initially placed. Details of this solvent composition and the possibility of substituting other materials for the oleic acid in the solvent mixture will be described subsequently. In compartment 9 pure trichlorethylene containing no dissolved oleic acid is placed. In compartment 10 a small amount of pure trichlorethylene may also be placed. Because of the steam pipes the three baths are brought to the boiling point and the vapor space 16 is filled with vapor. Vigorous boiling is necessary in order to effect the solvent purification phase of my invention, presently to be described.

As previously mentioned, a portion of the solvent in compartment 8 will overflow through the outlet 13 whence it is then conducted away through the pipe-line 20 to water separator 21. The liquid in compartment 8 should consist of pure trichlorethylene containing dissolved therein oleic acid for efficient operation, but in use water may be introduced therein either by the articles being degreased or in various other ways. This water being lighter than the trichlorethylene will tend to rise to the top and consequently the liquid flowing out through outlet 13 to pipe-line 20 may include water as one constituent. The water separator 21 removes any water from the mixture and the purified trichlorethylene flows outwardly through pipe-line 22 into compartment 10 through inlet 23. The water removed by the separator flows out through exit line 24. It is thus evident that trichlorethylene free from water is transferred from compartment 8 to compartment 10 where it is volatilized filling the vapor space 16 and then, upon condensation, falls into the trough 17.

The overflow outlet 12 providing communication between chambers 9 and 10 has previously been referred to. This permits the pure trichlorethylene to flow from compartment 9 to compartment 10. Thus, compartment 10 receives the trichlorethylene free from water from both of the other compartments.

As is well known from considerations of physical chemistry any high boiling material dissolved in the trichlorethylene or other solvent will not

be carried over into the vapor phase when the liquid is volatilized but will remain behind unvolatilized, as a liquid. Accordingly the vapor space 16, supplied by the ebullition of solvent in chambers 8, 9 and 10, will not contain any oleic acid but will consist of substantially pure trichlorethylene vapor together with any water vapor which may be volatilized. It is obvious, of course, that after use some water may find its way into the apparatus and might be volatilized. Thus the vaporization of trichlorethylene and its condensation by means of cooling coils 19 serves to purify the solvent, any high boiling impurity such as the oleic acid being left behind. Soap removed in the degreasing process is not carried over into the vapor phase but is also left behind. The condensate collecting in trough 17, pure trichlorethylene and water, flows out through the pipe-line 18 into water separator 25 which may be of the type illustrated in Fig. 2. Here the water is removed and flows out through pipe-line 26 whereupon substantially pure trichlorethylene is returned by pipe-line 27 to the apparatus. As indicated, means are provided comprising conduits 28 and 29 to supply this purified liquid trichlorethylene respectively to compartments 8 and 9. Valve means 31 and 32 are positioned in these conduits so that these chambers may be supplied with relative amounts of the solvent at will. In practice I have found it desirable to supply just enough solvent to the chamber 8 to maintain a sufficient head of liquid to cause the liquid to flow out through outlet pipe 13, whereas the quantity supplied to compartment 9 should be sufficient to keep this bath in a substantially pure state.

Vaporization, condensation, water removal, and return of the purified solvent to the chambers 8 and 9 are carried out at a rate rapid enough to maintain in these two chambers solvent free from dissolved soap and water. The liquid in compartment 8 contains dissolved oleic acid of course while that in compartment 9 should be substantially pure trichlorethylene freed from dissolved materials. By keeping the liquids in all three compartments at the boiling point and by condensing the vapor and returning purified condensate, it is possible to purify the solvent continuously during the process.

The operation of my improved process as applied to the degreasing of metal parts containing cutting oil residues may be as follows. As previously stated, these cutting oils all contain soap and some water; and/or an oily ingredient in greater or less amount may also be present. I have found that although soap will not dissolve readily in chlorinated hydrocarbon solvents such as trichlorethylene alone, all soaps are relatively soluble in such a solvent if oleic acid in amount from 1 to 5% is present therein.

Accordingly the first step in my process is to immerse the article containing the cutting oil residue in the liquid of compartment 8 which consists of trichlorethylene with oleic acid dissolved therein. Due to the presence of the oleic acid the soap will dissolve in the trichlorethylene and when the metal is removed it should be substantially free from grease and oil, as well as from the soapy residue. It may, however, contain on its surface small traces of oleic acid.

Accordingly the next step in my process is to immerse the metal in the solvent of compartment 9. This removes any small traces of oil or grease which may still be present thereon and also removes the oleic acid remaining on the

metal. When removed from this bath the metallic article should be substantially completely degreased.

However, in rare instances it may be found advisable to subject the article to a vapor rinse in a bath of solvent vapors at the conclusion of the step of immersing it in the liquid solvent of compartment 9. However, for this to be effective it is necessary that the metal be first cooled so that its temperature is below the boiling point of the vapors. It is only in very exceptional circumstances that the employment of such a step will be of value but I wish to mention this so that the process as described will be construed to include this step if the vapor rinse treatment is found to be necessary.

After completing the degreasing operations described, it is obvious that the solvent in compartment 8 will contain dissolved oleic acid and soap. When it is removed through overflow outlet 13 and allowed to flow into compartment 10, the dissolved soap will be carried over into this compartment with the solvent overflowing. Owing to the fact that this is primarily a distillation compartment the soap will tend to accumulate therein since it is not carried over into the vapor space 16 when the solvent is volatilized.

Similarly the solvent in compartment 9 is purified by overflowing continually into compartment 10 where it is volatilized. After condensation and removal of the water the pure solvent is returned to chamber 9 (as well as to chamber 8) by the conduits previously described, and this serves to keep the liquid in compartment 9 in a pure state. The relative amounts of purified solvent returned to compartments 8 and 9 are, as previously indicated, sufficient to provide a substantial overflow head through the overflow outlets permitting egress of a portion of the total volume of solvent from each chamber.

The apparatus in Fig. 2 illustrates only one type of the various water separators which might be used in practicing my invention. As shown, the solvent-water mixture flows in through entrance pipe 35 and the trichlorethylene tends to drop to the bottom by reason of its higher gravity. The halogenated hydrocarbon is illustrated on the drawing by the number 36. The water tends to form a supernatant layer 37. The baffle 38 is positioned in the housing 39 so as to aid separation of the liquids into two layers. The supernatant layer of water then flows out through outlet 40 whereas the trichlorethylene overflows into outlet pipe 41 and thus flows out from the separator. The numeral 42 indicates a vent opening which permits any vapor present to escape to the external atmosphere.

The novel composition suitable for degreasing metal parts containing soapy residues and consisting of a solvent in which is dissolved a fatty acid such as oleic acid in amounts ranging from 1 to 5% also forms a part of the invention. Larger amounts of the acid may be employed with equal success although I have found the amounts indicated to yield most satisfactory results. Amounts less than 1% may yield efficient

results if the quantity of soap present on the articles being degreased is not too great. Oleic acid is my preferred addition agent, principally by reason of its relatively low cost, but other higher fatty acids, such as stearic, palmitic, linoleic, ricinoleic, may also be utilized.

Various changes may be made in the invention as disclosed without departing from the essential principles thereof. It is to be understood that the disclosure in so far as it relates to specific amounts and procedure is to be considered as merely illustrative and the scope of my invention is to be construed solely in accordance with the appended claims.

I claim:

1. A method of degreasing metallic parts containing cutting oil residues which comprises immersing said metallic parts in a solvent which consists of liquid trichlorethylene containing oleic acid dissolved therein, withdrawing said articles from said bath and then immersing them in a bath of clean trichlorethylene in order to remove traces of oleic acid and grease remaining on said articles.

2. In an apparatus for degreasing metal articles, three contiguous compartments, the first compartment being adapted to contain a bath of trichlorethylene containing oleic acid dissolved therein, the second compartment being adapted to contain substantially pure trichlorethylene, and the third compartment being adapted to contain trichlorethylene in which is dissolved the greater part of those impurities removed from the metal articles which have been degreased in said first two compartments, means for withdrawing trichlorethylene and water floating thereupon from said first compartment, means for separating the trichlorethylene from the water, and means for returning the separated trichlorethylene to said third compartment.

3. In an apparatus for degreasing metal articles, three contiguous compartments, the first compartment being adapted to contain a bath of trichlorethylene in which oleic acid is dissolved, the second compartment being adapted to contain a bath of substantially pure trichlorethylene and the third compartment being adapted to contain trichlorethylene in which is dissolved the greater part of impurities which have been removed from said metal articles in said first two compartments, means for conveying a portion of the liquid in said first and second compartments to said third compartment in order that said impurities removed from said metal articles may collect in said third compartment, means, including a heater and a condenser, for purifying and replenishing the solvent thus removed from the baths contained in said first and second compartments, means for withdrawing trichlorethylene from the water floating thereupon from said first compartment, means for separating the trichlorethylene from the water and means for returning the separated trichlorethylene to said third compartment.

ARTHUR A. LEVINE.