

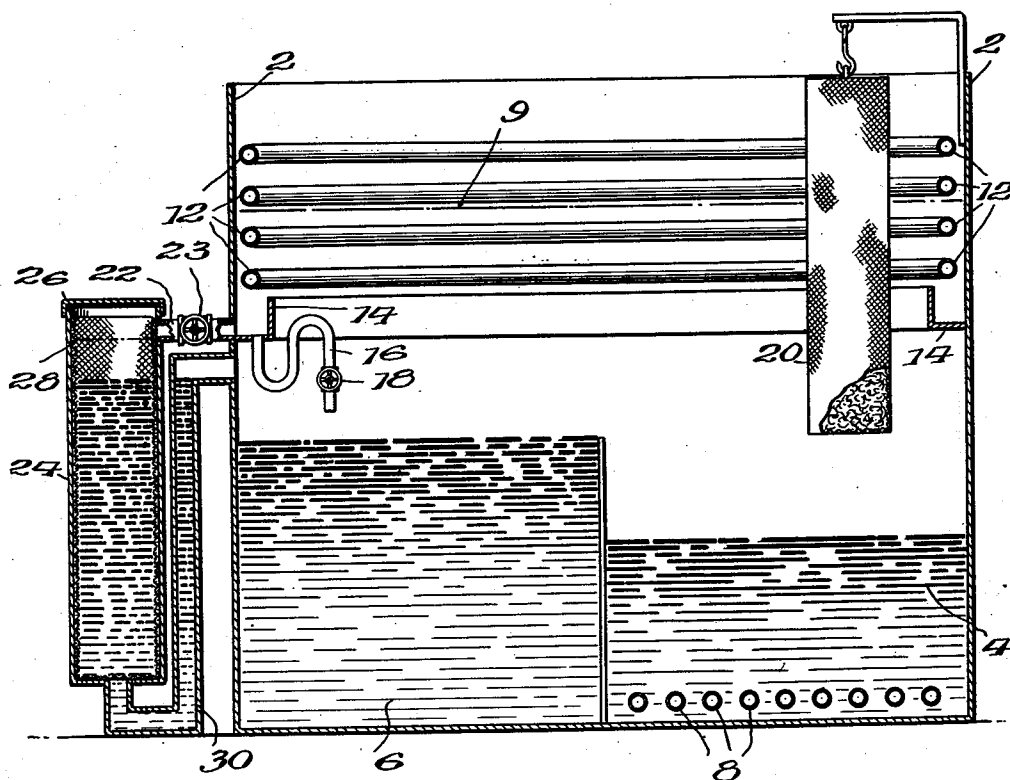
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DEGREASING

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DEGREASING

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This invention or discovery relates to degreasing; and it comprises a method of vapor-phase degreasing, wherein a lake or body of organic solvent vapor is established and maintained between a supply of boiling solvent and a supernatant atmospheric layer, and metal parts or other objects to be degreased are contacted with said solvent vapor body, and wherein parts of said solvent vapor taken from an intermediate high level layer are condensed, and wherein undesirable constituents are removed from the system by contacting the vapor in said lake or in the condensate formed therefrom with an inorganic adsorbent or combination of adsorbents adapted to take up one or more of the undesirable constituents present, including water, acids, and odoriferous substances; and it comprises apparatus adapted for application in the practice of this process; all as more fully hereinafter set forth and as claimed.

Vapor-phase degreasing systems are well known and widely employed for the removal of grease, dirt, etc., from metal objects. In some instances, sheet metal and other large objects are subjected to a degreasing treatment of this type, and in other instances nuts, bolts and other small machine elements are so treated, usually in baskets or racks adapted to hold a large number of these small pieces.

Any volatile grease solvent yielding heavy vapors, that is, of comparatively high molecular weight can be used, but in practice halogenated derivatives of the aliphatic hydrocarbons are in general favor, and particularly trichlorethylene. All these halogenated bodies have a tendency towards hydrolysis with development of acid in the presence of moisture and in a body of hot vapor maintained in service over a period of time, the tendency may lead to annoying results. Moisture is constantly entering with the articles to be degreased.

Generally speaking, a vapor-phase degreaser consists of a reservoir for solvent, means for heating and evaporating the solvent in the reservoir, a chamber for a body of evolved vapors above said reservoir, a cooling coil or other cooling means at an appropriate height in said chamber to prevent the vapors from rising too far or passing into the air and out of the system, and means for conducting the articles to be degreased to, through and from the vapor chamber. This may include a suitable trolley system with baskets or racks for small parts to be treated.

In operation, solvent in the reservoir is boiled, usually by passing steam at suitable pressure through heating coils in the reservoir. The solvent vapors evolved pass upwardly into the degreasing chamber, and being considerably heavier than the atmosphere in the chamber, they

tend to form a more or less uniform layer. At or near the desired upper surface of this vapor layer or lake, cooling coils are provided on the sides of the chamber, and these coils are maintained at such temperature that any solvent vapors reaching them are condensed. The condensed vapors of clean solvent are ordinarily collected in an annular trough or channel around the chamber below the cooling coils, and from this trough the condensate is returned to the system. It is generally returned to a clean solvent reservoir separate from, but communicating with, the evaporator reservoir; and in some methods of operation, the articles to be degreased are dipped in this clean solvent reservoir before passing into the body of solvent vapors.

As stated, because of their relatively high specific gravity, the solvent vapors tend to form a substantially uniform layer between the boiling solvent and the supernatant atmospheric layer. In operation, there is, of course, an intermediate layer between the solvent vapor and the normal atmosphere in which a certain amount of solvent vapor is mixed with air due to disturbances caused by introducing articles to be degreased into the vapor lake and removing them therefrom. Moisture entering the system tends to pass into this mixed layer as an azeotropic vapor mixture. This intermediate layer generally does not extend substantially above the cooling coils, however, because the solvent content of such a layer, when proper solvents are employed, is readily condensed. When operating such a system, it is generally desirable to so regulate the steam supply to the evaporating section that a minimum amount of solvent is condensed by the cooling coils. Condensation of very large amounts of solvent vapor involves a waste of both steam and cooling water. In order to maintain a body of solvent vapor of the desired depth, however, it is necessary to supply a certain excess of heat units and to condense a certain amount of solvent.

When a vapor-phase degreasing system is operated, articles more or less coated with grease and other dirt are immersed in the lake of solvent vapor in any suitable manner. The vapor removes the grease from the surfaces, often by condensation of solvent thereon due to the low temperature of the treated material. It drips off. The grease and other removed impurities tend to accumulate in the solvent evaporating section, being generally less volatile than the solvent.

The solvent employed is generally anhydrous or commercially dry when it is introduced into the system, but under some climatic conditions, water is introduced into the system by condensation from the atmosphere, and also by the articles degreased. Water in the system is highly undesirable, however, both because it disturbs the

stratification heretofore described, and because it also tends to increase the corrosion of metal equipment in contact with the solvent and its vapors. Trichlorethylene is frequently employed as a solvent in vaporphase degreasing systems because water does not make it very corrosive to metal, even at the boiling temperature. Cheaper solvents, such as carbon tetrachloride, for example, could be employed to advantage, however, if the water could be excluded from the system or promptly removed therefrom before it has an opportunity to cause corrosion. The exclusion or removal of water is also advantageous in improving the effectiveness of the system and the uniformity of its operation with any solvent.

I have now found that the difficulties encountered because of the entrance of moisture into a vapor-phase degreasing system can be avoided by providing in the system means for contacting the solvent vapors, or part or all of the condensate formed therefrom, or both the vapors and the condensate, with suitable inorganic adsorbents; and I have also found that by properly selecting these adsorbents, the acids which tend to form in the system even when using stabilized solvents can be eliminated. Still further, odoriferous substances formed from the greases and other impurities collected in the system during operation can also be eliminated by suitable adsorbents. The elimination of any one of the undesired substances (water, acids and odoriferous bodies) from vapor-phase degreasing systems is an important advance in this art, and the simultaneous removal of two or more of these substances is of great benefit from the standpoint of economy of operation, quality of results obtained, and convenience of operation.

For the removal of water or water-vapor from the system, I employ any of several inorganic adsorbents of neutral or alkaline reaction. For example, I use such materials as silica gel, activated alumina and activated bauxite, having an action in such systems which is essentially physical; or I use calcined magnesias or activated magnesias or like materials having a combined physical and chemical action. When removal of water is the sole desideratum, it is immaterial which of these materials is employed. However, even when employing the best stabilizers for organic solvents which are now known, there is almost always some formation of acid during the operation of a degreasing system. It is therefore ordinarily desirable to employ an adsorbent having some chemical reactivity enabling it to remove the acids along with the water. I therefore find it advantageous, as one specific embodiment of my invention, to employ an alkaline material such as some form of calcined magnesias, for the adsorbent in my process; but this alkaline material may be used, if desired, in admixture with a strictly physical adsorbent such as silica gel.

As previously stated, during operation of a degreasing system there accumulate in the pool of boiling liquid varying quantities of oils, fats, gums, resins and miscellaneous organic substances removed from the articles cleaned. Decomposition or oxidation of this organic matter often results in the development of undesirable odors which, as is well known, are generally noticeable around any degreaser in service, and constitute one of the unpleasant features of degreaser operation. This undesirable condition prevails even when the degreaser includes condensers so efficient as to keep solvent loss quite low. Certain activated adsorbents, such as the

"activated magnesias" made by careful dehydration of hydrated magnesias, as disclosed and claimed in my copending application Serial No. 26,006, filed June 11, 1935, have a selective adsorbing power for organic materials of the nature of these odoriferous substances; and when activated magnesias or other suitable activated adsorbents are employed for the adsorption of water and acids, in accordance with another specific embodiment of my invention, there also results a substantially complete elimination of the heretofore objectionable odors from degreasing systems. It is clear, of course that this deodorization can be effected without an accompanying complete removal of water and acids, but it is generally desirable to simultaneously effect removal of all of these undesirable elements from the system, and this constitutes an especially desirable embodiment of my invention.

After selection of an adsorbent or mixture of adsorbents adapted to accomplish the desired purpose or purposes of any specific embodiment of the present invention, I apply the adsorbent material or mixture in various ways. For example, a basket of perforated metal or wire screen containing magnesium oxide or other adsorbent is suspended in the lake or stratum of solvent vapor in the degreaser, and any vapor coming in contact with this adsorbent has undesired constituents removed therefrom. I find that it is generally even more effective, however, to provide a container of the selected adsorbent in the path of liquid condensed solvent returning from the cooling coils to the degreaser reservoir. As previously stated, the usual vapor-phase degreaser includes an annular channel or gutter which collects the condensed solvent dropping from the cooling coils, and with such degreasers it is a simple matter to introduce a percolating tower containing magnesium oxide or other selected adsorbent into the line returning the clean condensed solvent from this collecting channel to the clean solvent well or to any other desired part of the system. Part of the condensed solvent may flow through this tower while part of it is by-passed around the tower, directly back to the system, if desired.

In order that my invention may be more readily understood, it will now be described with reference to the accompanying drawing, in which the single figure is a more or less diagrammatic illustration of a cross sectional view of a vapor-phase degreasing apparatus adapted for operation in accordance with my invention, and constituting part of my invention.

In the drawing, 2 indicates the walls or shell of a degreaser containing a bottom portion which is divided into a vaporizing section or evaporator 4 and a clean solvent well 6. The vaporizing section 4 is provided with steam coils 8 which are supplied with steam from any suitable source (not shown) in quantity sufficient to vaporize the desired amount of solvent. The vaporized solvent rises into the chamber above the vaporizing section to a predetermined level such as that indicated by the line 9, and any substantial quantity of vapor rising above this level is condensed by the cooling coils 12. These coils are advantageously individually controlled, so that effective cooling can be accomplished at any desired level. Condensate formed by the operation of the cooling coils 12 collects in the annular channel 14, from which it may be returned to any desired part of the system, such as the clean solvent well 6, through a pipe 16, for example.

This pipe may be provided with an adjustable level regulator and a valve 18; or it may be omitted in which case condensed solvent overflows from the trough 14 into the well 6.

5 In one embodiment of my invention, a wire screen or perforated metal basket 20 containing granular calcined magnesium oxide or other suitable adsorbent is suspended in the vapor stratum, and the adsorbent effects the desired
10 purification of the solvent vapor by removal therefrom of water, acids and odoriferous substances, or some of these undesired constituents.

In another and generally more advantageous embodiment of my invention, the condensate
15 collected in the channel or gutter 14 passes through a suitable conduit 22, which may be equipped with a valve 23, into a percolating tower 24 or other suitable container. This container is advantageously provided with a removable cap or cover 26, and a removable basket of perforated metal or wire screen 28 fitting rather snugly in its interior. This basket is filled with a suitable absorbent through which condensate
20 delivered through the passage 22 must trickle or percolate on its way back to the system. This results in an effective purification of the condensed solvent, which then flows through a pipe 30 back to the clean solvent reservoir 6. Part of the condensed solvent may by-pass directly
30 from the channel 14 back to the clean solvent reservoir through the pipe 16, if desired, with the valve 18 and the pipe 16 adjusted to maintain the desired level in the channel 14. Alternatively, the valve 18 may be closed entirely. If
35 desired, I may, of course, employ both the external percolating tower 24 and the internal suspended basket 20, but it is seldom necessary or desirable to employ both of these expedients simultaneously. Clean solvent collected in the
40 well 6 overflows into the evaporating section 4, where it is again vaporized into the system; and I have found that in all the embodiments of my invention water, acids, and odoriferous substances are readily eliminated or minimized when employing suitable adsorbents.

45 My invention has been described hereinabove with special reference to certain types of construction, methods of operation and choices of adsorbents, which are now considered desirable, but it is to be understood that these references
50 are by way of illustration only and that the invention is not limited to them but may be variously embodied and practiced within the scope of the appended claims.

55 What I claim is:

1. In a process of vapor-phase degreasing wherein a body of organic solvent vapor of high molecular weight is established and maintained
60 between an underlying boiling body of the liquid solvent and a supernatant atmospheric layer, with cooling and condensation of solvent vapor passing upwardly above a predetermined level in said body of vapor and return of condensed solvent to the system, the improvement comprising
65 contacting solvent vaporized from said boiling body of solvent and before its return thereto with an inorganic adsorbent to remove water therefrom.

70 2. In a process of vapor-phase degreasing, wherein a body of organic solvent vapor of high molecular weight is established and maintained

between an underlying boiling body of liquid solvent and a supernatant atmospheric layer, and wherein solvent vapor passing upwardly above a predetermined level in said body of vapor is condensed and returned to the system, the improvement comprising contacting vaporized solvent in
5 said body of solvent vapor with an inorganic adsorbent to remove water therefrom.

3. In a process of vapor-phase degreasing, wherein a body of organic solvent vapor of high molecular weight is established and maintained
10 between an underlying boiling body of liquid solvent and a supernatant atmospheric layer, and wherein solvent vapor passing upwardly above a predetermined level in said body of vapor is condensed and returned to the system, the improvement comprising contacting liquid solvent condensed
15 from said body of solvent vapor with an inorganic adsorbent to remove water from the solvent before it is returned to said body of liquid solvent.

4. The method of claim 1, wherein at least a part of said inorganic adsorbent has an alkaline reaction and adsorbs acids from the vaporized
20 solvent.

5. The method of claim 1, wherein said inorganic adsorbent comprises a mixture of alkaline and non-alkaline adsorbent materials.

6. The method of claim 1, wherein at least a part of said inorganic adsorbent is sufficiently
30 activated to adsorb odoriferous organic impurities from the vaporized solvent.

7. The method of claim 1, wherein said inorganic adsorbent comprises activated magnesia.

8. Apparatus for vapor-phase degreasing, comprising a chamber for solvent vapors, means communicating with said chamber from below for enclosing and boiling a body of liquid solvent, means for condensing solvent vapor passing above a predetermined level in said chamber, means for returning solvent so condensed to the system, and means for contacting solvent vaporized from said
40 body of liquid solvent and before it is returned thereto with an enclosed mass of inorganic adsorbent adapted to remove water therefrom.

9. Apparatus for vapor-phase degreasing, comprising a chamber for solvent vapors, means communicating with said chamber from below for establishing and maintaining a boiling body of liquid solvent and furnishing vapors to said chamber, means for condensing solvent vapor passing above a predetermined level in said chamber, means for returning solvent so condensed to the system, and means positioned in said chamber for contacting the vapor in said chamber with an enclosed mass of inorganic adsorbent adapted to remove water from said vapor.
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10. Apparatus for vapor-phase degreasing, comprising a chamber for solvent vapors, means communicating with said chamber from below for establishing and maintaining a boiling body of liquid solvent and furnishing vapors to said chamber, means for condensing solvent vapor passing above a predetermined level in said chamber, means for returning solvent so condensed to the system, and means operatively connected with said means for returning condensed solvent to the system and adapted to contact the condensed liquid solvent with an enclosed mass of inorganic adsorbent to remove water from the solvent.
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