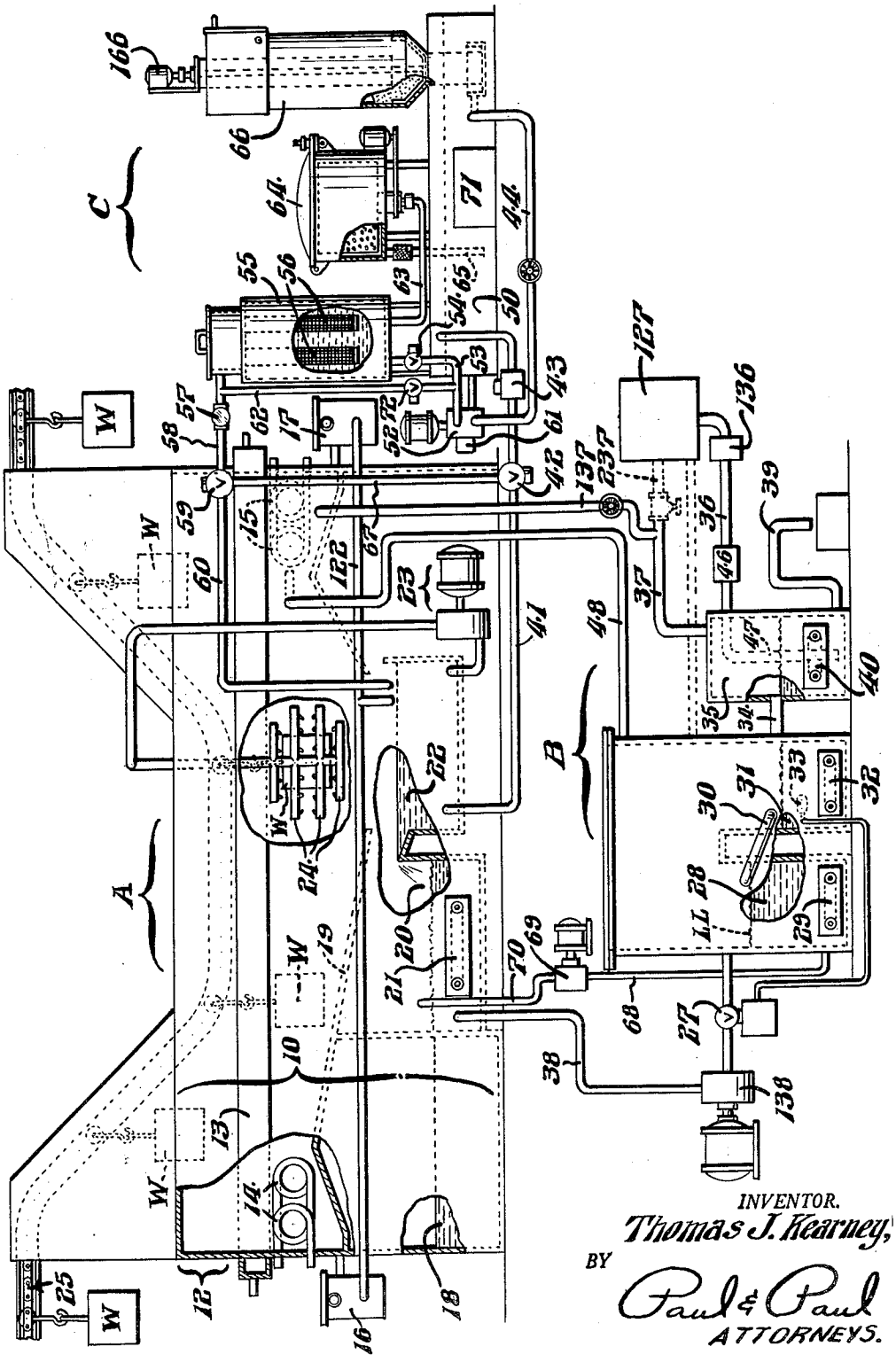
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CONTINUOUS DEGREASER

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CONTINUOUS DEGREASER

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This invention relates to a degreasing system employing a volatile solvent and adapted to be used for removing soluble and insoluble liquid and solid soils from a work piece and to transfer said soils to the solvent.

The object of the invention is to provide a degreasing system which is adapted to be operated substantially continuously without having to shut the degreaser down at frequent intervals for cleaning.

An important feature of the degreasing system of the present invention is the provision of a heating source for the solvent vapor which is external of the degreaser. By keeping the heating elements out of the degreaser itself, the heating elements do not become fouled with insoluble soils and therefore do not require frequent cleaning. The relatively simple provision of alternative or stand-by heating elements will then also insure that even infrequent cleaning need not interfere with or interrupt degreaser operation. This feature, in combination with the other features of the continuous degreaser system as hereinafter described, makes possible a substantially continuously operative degreaser.

While the work piece to be cleaned may be other than metal, a typical example of a degreaser is one used in metal degreasing. The vapor degreasing of metals is a process which requires the use of a solvent which is volatile. The solvent used may be one of the common halogenated hydrocarbons, such as perchlorethylene, trichlorethylene, methyl chloroform, or methylene chloride, or may be a suitable fluorinated hydrocarbon, or a more flammable solvent, such as naphtha, mineral spirits, a paint thinner, or the like. In all cases, however, in vapor degreasers, the solvent used is volatile.

The soils to be cleaned from the metal or other work piece include chips, turnings, lubricants, dusts, films, and other soils. The degreasing process may include heating or cooling of the work piece.

Degreasing machines, commonly referred to simply as degreasers, have developed from simple tubs containing a solvent to fairly complex machines fitted with mechanical equipment to carry out a carefully predetermined cleaning cycle. Many modern degreasers are fitted with conveyors to carry the work through the degreaser, thereby to obtain continuous degreasing production at relatively high rates.

While the desire for higher degreasing productive capacities has led to the introduction of increasingly complex degreasers of automatic types, there has at the same time been a parallel tendency to operate more simple degreasers at higher rates more closely approaching their full capacities. In this manner, the total number of degreasers required can be reduced, thereby reducing the invested capital.

It follows that if the degreasers are to be operated at high rates approaching their full capacity, little or no time is available for cleaning the degreasers, or for carrying out other routine maintenance operations.

The conventional prior art degreaser contains one or more heating units for heating the solvent to vaporize it, and a principal item of maintenance has been the cleaning of the surfaces of the heating units and the entire boil sump, which tend to become fouled by the soils. Recently developed changes in chlorinated solvent stabilizer compositions have had as an object the reduction of the fouling of the surfaces of the heating units in degreasers

for the purpose of reducing the maintenance requirements, but these developments attack only a small part of the problem since the larger part of the problem is caused by the concentration of oleaginous substances and solid soils in the boil sump of the degreaser, the presence of which is unavoidable since their source is inherent in the cleaning function of the degreaser.

Degreasers of the type of the prior art ordinarily include a vaporizing chamber or boil sump for the solvent and a vapor zone above the vaporizing chamber. They may also include a rinse or spray chamber in which liquid solvent rinses or sprays may be installed in a desired arrangement. Vapor rinses may also be employed.

In accordance with the present invention, the heating units ordinarily found within the vapor degreaser itself are installed in a separate still connected by piping to but physically separate from the vaporizing chamber of the degreaser itself.

The size of the heating element or unit in the still used to replace the heating element or unit in the boil sump of the degreasers of the prior art is determined by the heat losses in the degreaser itself and in the still. A degreaser is normally in heat balance. Heat is added by the heating element and removed by the condensers in the degreaser, by the work and by losses to surrounding. The net heat input to the degreaser from the solvent vapors furnished by the still must be sufficient to maintain the heat balance of the degreaser.

By having two of the new stills available for successive or alternate use, continuous operation of the degreaser is substantially assured, with a constant supply of clean solvent vapor or liquid delivered by at least one still to the degreaser. One of the stills can then be shut down for any necessary maintenance without disturbing the operation of the degreaser.

The use of a plurality of stills has the further advantage that any still which will generate sufficient solvent vapors to operate the degreaser can be employed. The only requirement then is that the still or the number of stills in operation at any one time be capable of separating the solvent from the soils at a sufficient rate to supply the required quantity of solvent vapor. This is especially true because filtration capacities are normally much greater than distillation capacities.

It will be readily seen that a result of the provision of a proper distillation rate will make it possible to further simplify the degreaser by reducing the number of sumps to one only. This sump may be used to supply the still or stills by overflow to a drain. This has the advantage of separating insoluble soils by decantation if they are denser than the solvent used. The filtration system may then feed from the bottom of the single sump of the degreaser to provide for removal of the insolubles. If insoluble soils are present which float on the solvent, the contents of the sump may be fed to the still through the filter, thus avoiding fouling of the still and dispensing with the necessity for an overflow arrangement. The single sump need not contain any large quantity of solvent at any time, since the still can vaporize solvent at the average rate of condensation in the degreaser. It is thus possible to use a spray to keep the entire degreaser essentially free of soils at all times.

The invention of the present application will be best understood from a consideration of a detailed description of a preferred embodiment selected for illustration in the single figure of drawing which shows in diagram form a continuous degreaser in accordance with the present invention.

In describing the preferred embodiment of the invention illustrated in the drawing, specific terminology has been resorted to for the sake of clarity. However, it is not the intention to be limited to the specific terms so

selected, and it is to be understood that each specific term includes all technical equivalents which operate in a similar manner to accomplish a similar purpose.

The apparatus and its operation will first be described briefly. Referring to the drawing, A is the degreaser, B is the still, and C is the filter. The degreaser A is provided with a shed plate **19** for directing solvent which condensed on the work W, and the soils, soluble and insoluble, carried therein, to the spray or rinse sump **22**.

Solvent from the rinse sump **22** is supplied to the spray bank **24** by way of the pump **23**, solvent from the rinse sump **22** is also conveyed to the filter C where it is cleaned and made free of insoluble soils, and then returned to the sump **22**. Filter C is preferably a type adapted for automatic and continuous operation, as will be described.

The work W is conveyed through the degreaser A, as by a conveyor **25**. By means of the shed plate **19**, the soluble oleaginous materials and insoluble soils removed from the work W by the solvent are collected in the spray sump **22** as a solution in the solvent. The spray sump **22** overflows into the sump **20**. Sump **20** is the conventional vaporizing sump and is conventionally provided with a heating means **21** for vaporizing the solvent. However, by the use of the external still B, provided in accordance with the present application, the heating means **21** may be used only at start-up, or during very heavy loads, or may, if desired, be eliminated entirely, as later discussed.

From the sump **20**, the oil-solvent mixture is conveyed by the piping **38** to the still B. In the still B, the oleaginous materials are separated from the solvent at a high distillation rate. From the still B, the oil-free solvent vapor is returned by the piping **48** to the degreaser A, while the residue or comparatively non-volatile residues are continuously discharged from the still B through the piping **39**.

The still B may be adapted for automatic and continuous operation. It may be adapted to continuously discharge non-volatile soluble soils, solid and liquid, and to return clean solvent vapor to the degreaser. Filter C, which may be adapted for automatic backwashing and automatic filter powder dispensing, is adapted to filter out the insoluble soils, solid and liquid, and to return a continuous supply of filtered or clear solvent to the degreaser.

The apparatus and its operation will now be described in greater detail. The vapor degreaser A includes a lower tank **10**, a water jacket condenser **13**, a freeboard **12** above the water jacket, condenser coils **14** and **15**, water separators **16** and **17**, a storage tank **18**, the shed plate **19**, the sump **20**, the heating means **21** (optional), the rinse or spray sump **22**, the motor-driven spray pump **23**, and the bank of spray nozzles **24**. As the work to be cleaned W is carried into the degreaser unit A on the monorail conveyor **25**, the work W enters the solvent vapors at the vapor level established by the water jacket **13**. Solvent vapors condense on the surface of the cold work W and in dripping therefrom remove soils from the surface. The off-fall collects on the inclined shed plate **19** and is carried thereby into the rinse or spray sump **22**. Any soils which remain on the work W after vapor cleaning are removed by the forceful spray of the solvent from the nozzles of the rinse or spray bank **24**, the off-fall of which also flows into the spray sump **22**.

The contents of the spray or rinse sump **22** are pumped through the filter C for the purpose of removing the insoluble soils. I have found that if the solvent contents of the spray or rinse sump **22** are pumped through the filter C at a rate of ¼ to ½ of the capacity of the spray sump each minute, the solvent will be maintained adequately clean of insoluble soils even when the soils being removed from the work W include chips, dust, fines, buffing compounds, rouge, lapping compound and the like. The return from the filter gives sufficient turbulence in sump **22** to insure that all insolubles are carried through the filter.

The oil-solvent mixture which overflows from sump **22** into sump **20** is pumped, as by pump **138**, through the piping **38** to the external still B. On its way to the still B, the mixture passes through the temperature controlled valve **27**, controlled by the temperature sensitive bulb **33** in the second well **31** of the still B. Preceding well **31** is a first well **28** into which the mixture from piping **38** first flows. Well **28** is provided with a heating means **29**, and in well **28** the major portion of the solvent is vaporized, preferably to a resultant concentration of 70% solvent and 30% comparatively non-volatile soluble soils.

When the volume of solvent-oil mixture having the above approximate concentration exceeds the liquid level LL in the well **28**, the mixture overflows through the piping **30** into the second well **31**. Well **31** is also heated, as by the heating means **32**, usually a steam coil, and in well **31** the solvent-oil mixture is further reduced in solvent content by additional vaporization of the solvent.

As an example of the operation of the still B up to this point, assuming trichlorethylene is the solvent, if 15 p.s.i.g. steam is employed (approximately 250° F.) it is usually possible to attain a temperature in the range of 235°–240° F. in well **31**. For the purpose of maintaining a flow of solvent-oil mixture from the degreaser A which will remain within and not exceed the vaporization range of the still B, the sensitive bulb **33** of the temperature control valve **27** is inserted in the well **31**. By these means, the flow of the solvent-oil mixture into the well **28** is restricted to the vaporization rate obtainable from heating means **29** in well **28** of concentrator B. If too much solvent, or too high a percentage of solvent, exists in the solvent-oil mixture which is delivered to the well **28**, and the heating means **29** cannot vaporize the solvent at a suitable rate, the mixture that overflows through pipe **30** into the well **31** will lower the boiling point in the well **31**. Such reduction in the boiling point in well **31** is sensed by the element **33** as a fall in temperature and the reverse-acting control valve **27** (which opens on a temperature rise) will in response to the drop in temperature restrict, or if necessary cut off, the supply of the solvent-oil mixture to the chamber **28** until sufficient solvent is vaporized from the wells **28** and **31** for the boiling point of the mixture in well **31** to return to the range 235°–240° F. Thus, with the control just described, all the mixture which overflows from well **31** through pipe **34** into chamber **35** is at a temperature in the 235°–240° F. range and contains approximately 80% oil–20% solvent. The solvent vapors from the still B are conducted by the piping **48** to the condenser coils **15** of the degreaser A. The condensate collects in the circumferential trough of the degreaser and flows down into the water separator **17** where the solvent is collected and returned to sump **22** by piping **122**.

Referring again to still B, under average operating conditions of the degreaser A, the overflow rate through piping **34** into the third still chamber **35** will not exceed about 1.25 times the rate of soluble non-volatile soil accumulation by the solvent in the degreaser A. In chamber **35**, the mixture is heated by the heating means **40**. Heated air is introduced into the liquid in chamber **35**, as from a blower **136**, through the piping **36**, the heater **46**, and the piping **47**, to a point near the floor of the chamber **35**. This heated air strips most of the remaining solvent from the mixture. The resulting warm solvent-air mixture may be carried as by piping **37** and **137** to the condenser coils **15** within the body of the degreaser A. Here the solvent-air mixture is cooled, the solvent is condensed, collected by the water separator **17**, and returned to the sump **22**, while the air is permitted to diffuse out of the body of the degreaser A. As an alternative, a separate condenser **127** may be employed outside of the body of the degreaser A and the solvent-air mixture from the chamber **35** may be conducted by the piping **37** and **237** to the separate condenser **127**. In

the condenser 127, the solvent-air mixture is cooled, and the condensed solvent may be collected and returned to the still B to be vaporized and returned to the degreaser by way of piping 48. The cooled air in condenser 127 will be saturated at the temperature obtained in the condenser. This cooled air can then be passed through the blower 136, reheated by the heater 46, and reintroduced into the chamber 35 to complete the stripping cycle. The use of the separate condenser 127 avoids having to introduce even the comparatively small amount of air into the body of degreaser A. This has the advantage of eliminating from the degreaser itself even small vapor-disturbing air curernts.

If an inflammable solvent is used in the degreaser it will obviously, for safety reasons, be improper to use an air stripping method. For such solvents an inert gas such as flue gas, nitrogen or the like can be used. For solvents not appreciably miscible with water steam injection can be used instead of air or an inert gas. The use of steam has the further advantage of not introducing a non-condensible gas into the vapor zone of the degreaser.

Filter C includes a storage tank 50 to which solvent and soils are carried from the spray sump 22 through the piping 41, magnet valve 42 and float-control valve 43. The soiled solvent is pumped, by pump 52 from the filter storage tank 50 by way of the piping 44, the pump 52, the piping 53 and the open magnet valve 54 into the lower end of the filter 55 Filter 55 is shown as having depending tubular filter elements 56 the mesh of which is coated with diatomaceous earth filter powder for removing the insoluble soils from the solvent flowing therethrough. The solvent flows through the filter-powder coating into the interior of the tubular filter elements 56, up through the interior of the elements, out past sight gage 57, through piping 58, magnet valve 59 and back to the spray sump 22 by way of piping 60.

Pump 52 is provided with a pressurestat 61 which senses the pressure of the fluid flowing through the pump. When the pressure rises to a preselected value, due to the accumulation of solid soils on the diatomaceous earth filter-powder coating on the filter elements 56, the pressurestat 61 (by control means 71) initiates the backwash operation. This is effected by the automatic opening and closing of the magnet valves in such arrangement that thereafter the flow of solvent from the filter supply tank 50 is through the now open magnet valve 72, the piping 62, into the top of the filter 55 (valve 59 being now closed), down through the interior of the tubular filter elements 56, and out through the mesh and filter-powder coating, thereby causing the filter-powder cake to drop from the mesh and to the carried by the piping 63 into the auxiliary filter 64, from which the solvent drips by gravity down through the piping 65 and is thus returned in clean condition to filter storage tank 50.

Following the backwash operation just described, the drive motor 166 of the filter powder dispenser 66 is automatically energized to add filter powder to the solvent in the supply tank 50 and the electro-magnetic valves are automatically changed so that the flow of solvent is now through the valve 54, in through the mesh and up through the interior of elements 56 of filter 55, out past sight gage 57, through piping 58, magnet valve 59, down through the piping 67, valve 42 and through the float-control valve 43 back into the filter supply tank 50. During this flow, which lasts but a short time, the tubular mesh elements 56 of filter 55 again become coated with diatomaceous earth filter powder. The control system then shuts off the filter powder dispenser motor 166 and effects a change in the condition of the magnet valves 59 and 42 so that the flow of solvent through the piping 67 is cut off and the solvent flows out through the piping 60 and in through the piping 41. Thus, the flow path first described above is re-established for effecting filtering out of the solid soils from the solvent in sump 22.

As described in the aforesaid co-pending patent application, the control system may, if desired, effect the intermittent actuation of the filter powder dispenser 66 to add filter powder intermittently to the solvent during the filtering cycle.

Also as described in the said co-pending application, the auxiliary filter 64, which is of the centrifuge type, may be driven rotationally from time to time to extract additional solvent from the contents of the filter bag. Such centrifuging, may, for example, be performed once for every 25 backwashings.

It will be seen that the degreasing apparatus illustrated in the drawing and described hereinabove may be adapted substantially to continuous operation by the provision of two stills B for single successive use with degreaser A and filter C, thereby permitting the cleaning of one still while the other is in use.

As mentioned previously hereinabove, if desired, vaporizing heater 21 in the body of degreaser A may be used only to start-up or when the work load is exceptionally heavy. When so used, there will be times when the degreaser A will have to be shut down while the heater 21 is cleaned. However, the frequency of such shut down will be substantially less than required of prior art degreasers, due to the substantially reduced use of heater 21 due to the provision of the separate still B.

When heater 21 is not in use, the solvent mixture in sump 20 is maintained at a vaporizing temperature by the return to sump 20 of hot solvent mixture from well 28, by way of piping 68, pump 69 and piping 70, at a rate sufficient to maintain the solvent mixture in sump 20 at a vaporizing temperature.

While the preferred embodiments of this invention have been described in some detail, it will be obvious to one skilled in the art that various modifications may be made without departing from the invention as hereinafter claimed.

I claim:

1. A degreasing apparatus adapted for substantially continuous operation, said apparatus including a degreaser and a multi-stage still; said degreaser including a storage tank for volatile liquid solvent having an upper chamber for the solvent vapors, means for receiving work to be cleaned into said upper chamber, and sump means for collecting liquid solvents and insoluble and soluble soils including soluble oleaginous materials; said multi-stage still having still means external of said degreaser having communication means to said sump means for receiving a mixture of liquid solvent and soluble soils, including oleaginous materials, having means for distilling off the solvent, and having communication means between said still means and said upper chamber of said degreaser for returning solvent vapors from said still means to said degreaser chamber, said still means including a final-stage stripping chamber having means for introducing heated gas thereinto at a point near the floor thereof for stripping solvent from the mixture contained therein, having means for returning the stripped-off solvent to said degreaser chamber, and having means for continuously discharging the residue of oleaginous material from said stripping chamber.

2. Apparatus as claimed in claim 1 characterized in that a separate condenser is coupled to said stripping chamber for recovering the solvent stripped from the mixture, and having means for returning the recovered solvent to said degreaser chamber.

3. Apparatus as claimed in claim 2 further characterized in that said means for returning said recovered solvent to said degreaser chamber includes means for returning said recovered solvent to a preceding stage of said still.

4. Apparatus as claimed in claim 2 further characterized in that heater means are provided for the gas returning from said separate condenser to said stripping chamber.

5. A degreasing apparatus adapted for substantially continuous operation, said apparatus comprising; a degreaser, a filter, and a multi-stage still; said degreaser including a storage tank for volatile liquid solvent having an upper chamber for the solvent vapors, means for receiving work to be cleaned into said upper chamber, and sump means for collecting liquid solvents and insoluble and soluble soils including soluble oleaginous materials; said filter comprising continuously operable filter means external of said degreaser having communication means to said sump means for receiving a mixture of liquid solvent, soluble soils and insoluble soils from said sump means for filtering out said insoluble soils and having return communication means to said sump means of said degreaser for returning a mixture of solvent and soluble soils to said sump means free of insoluble soils; said multi-stage still having still means external of said degreaser having communication means to said sump means for receiving a mixture of filtered liquid solvent and soluble soils, including oleaginous materials, having means for distilling off the solvent, and having communication means between said still means and said upper chamber of said degreaser for returning solvent vapors from said still means to said degreaser chamber, said still means including a final-stage stripping chamber having means for introducing heated gas thereinto at

a point near the floor thereof for stripping solvent from the mixture contained therein, having means for returning the stripped-off solvent to said degreaser chamber, and having means for continuously discharging the residue of oleaginous material from said stripping chamber.

6. Apparatus as claimed in claim 5 characterized in that a separate condenser is coupled to said stripping chamber for recovering the solvent stripped from the mixture, and having means for returning the recovered solvent to said degreaser chamber.

7. Apparatus as claimed in claim 6 further characterized in that said means for returning said recovered solvent to said degreaser chamber includes means for returning said recovered solvent to a preceding stage of said still.

8. Apparatus as claimed in claim 6 further characterized in that heater means are provided for the gas returning from said separate condenser to said stripping chamber.

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