Feb. 22, 1938.　　H. F. FISHER　　2,109,130

PROCESS AND APPARATUS FOR DEWAXING OIL

Filed May 25, 1935　　2 Sheets-Sheet 1

Fig. 1.

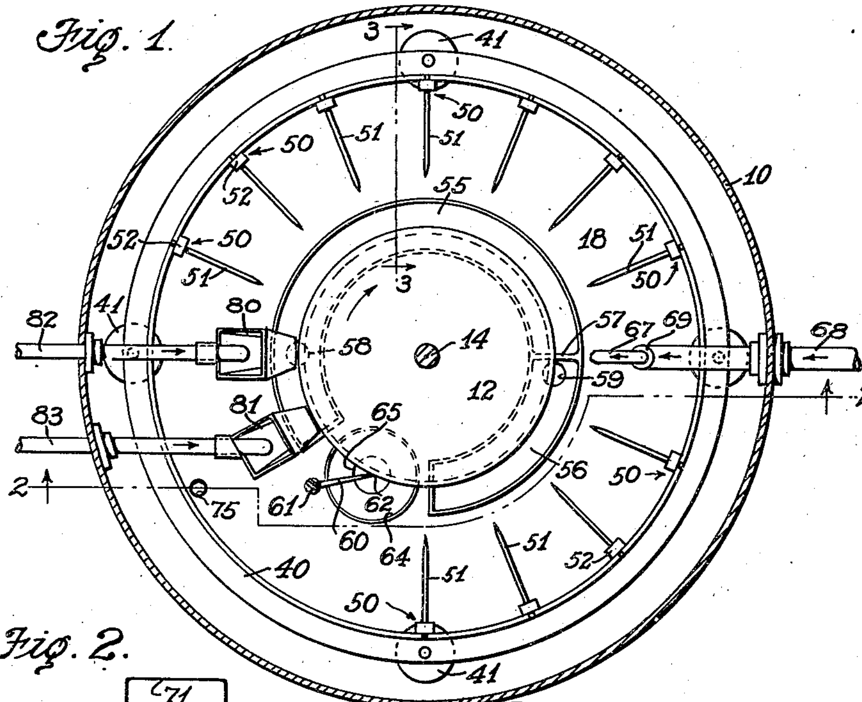
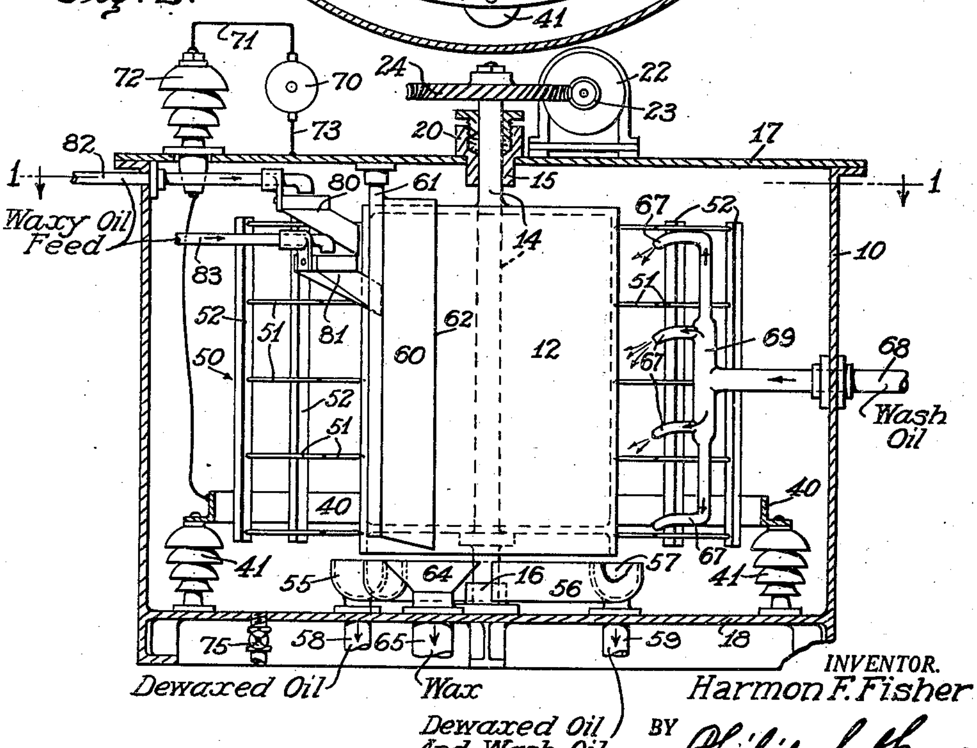


Fig. 2.



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Filed May 25, 1935 2 Sheets-Sheet 2

Fig. 3.

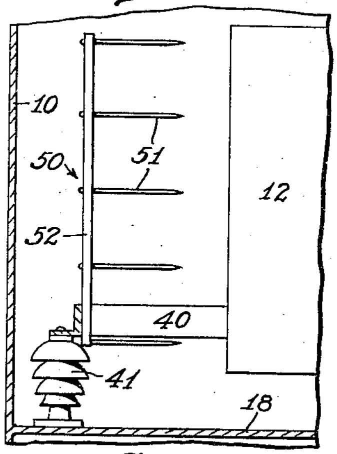


Fig. 4.

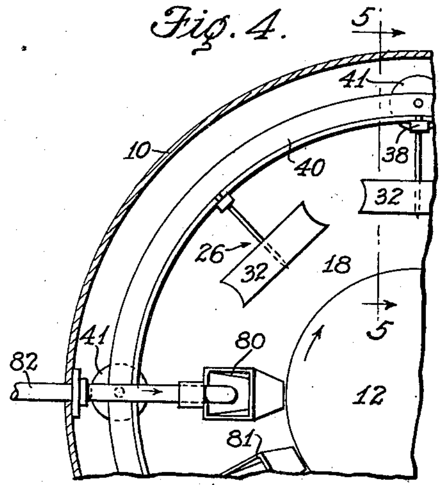


Fig. 6.

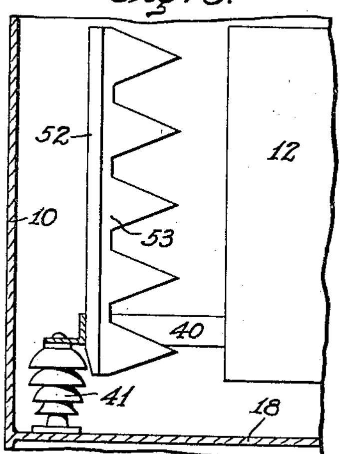


Fig. 5.

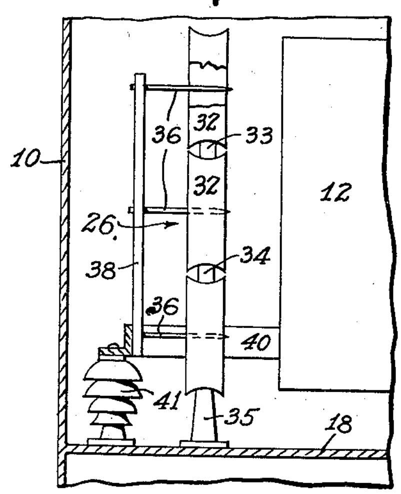
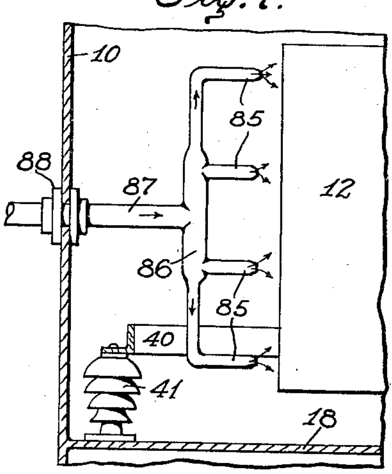


Fig. 7.



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Patented Feb. 22, 1938 2,109,130

UNITED STATES PATENT OFFICE

2,109,130

PROCESS AND APPARATUS FOR DEWAXING OIL

Harmon F. Fisher, Los Angeles, Calif., assignor to Union Oil Company of California, Los Angeles, Calif., a corporation of California

Application May 25, 1935, Serial No. 23,468

17 Claims. (Cl. 204—24)

This invention relates to the separation of wax from wax-bearing oil and relates more particularly to the electrical separation of suspensions of precipitated wax or similar materials from oil or oil solutions such as chilled lubricating oil or other waxy petroleum oils such as Diesel fuel oil.

When the temperature of lubricating oil containing wax or paraffin is sufficiently lowered, the wax or paraffin is found to begin to solidify and to be precipitated from solution in the form of a suspension of solids and as the temperature is further lowered more wax is precipitated until the oil and wax mixture finally congeals to a semi-plastic or even a solid mass. Oils containing a large quantity of wax will have relatively high congealing temperatures and oils containing a small quantity of wax will have correspondingly lower congealing temperatures. In the production of lubricating oils it is necessary to remove a large proportion of the wax or paraffin present therein in order to extend the lower range of temperature at which they will retain their lubricating qualities.

In general, present commercial methods of separating precipitated wax from wax-bearing oil such as cold settling, centrifuging, and filter-pressing are time consuming, are involved with mechanical difficulties, are intermittent in operation and produce separated wax which contains such a large percentage of included oil that it must be subsequently specially processed to avoid a prohibitive loss of oil.

It is an object of this invention, therefore, to provide a method and apparatus capable of quickly and thoroughly removing precipitated wax from suspension in wax-bearing oil to obtain an oil relatively free from wax. It is another object of this invention to provide a method and apparatus capable of efficiently removing the oil from the separated wax to produce a dry wax relatively free from included oil. It is also an object of this invention to provide a process and apparatus capable of continuous operation.

These objects are attained in brief by causing the wax to be solidified or precipitated in the oil by chilling preferably in the presence of a diluent, and electrically treating the oil mixture containing the suspension of precipitated wax by applying it in the form of a relatively thin film by any suitable means such as spouts, sprays or brushes, which are not necessarily associated with any electrical field or charge, to an electrode surface of extended area and then subjecting said oil film on said electrode surface to the ionizing effect of an intense ionizing electric field and/or an intense gaseous ion stream induced by an adjacent electrode of relatively small area maintained at an opposite electrical potential. This ionizing field partakes of the nature of a non-disruptive electrical discharge or a corona discharge from the adjacent electrode of small area through the intervening gas space to the electrode of extended area upon which the waxy-oil film is applied. Such electrical discharge phenomena appear to comprise an intense streaming of gaseous ions from the electrode of smallest area to that of largest area, and it is to the effect of this gaseous ion stream upon the intervening waxy-oil film that the operation of this method is attributed. The flow of the gaseous ions from one electrode to the other under the influence of the high potential gradient is manifested by a phenomenon known as "electrical windage" and is herein referred to as an electrical windage. Hereinafter the term "ionizing electric field" shall mean a field of the character above described, and an ionizing electrode shall mean an electrode capable of producing such a field.

The effect of the ionizing field upon the wax-bearing oil film is to cause the suspended solid wax therein to deposit itself instantly upon the electrode surface in a solid compact and relatively tenacious thin layer and to adhere there while oil is forcibly separated and exuded therefrom in the form of beads or droplets of apparently greatly altered surface tension characteristics with respect to the wax. The droplets are caused to be removed from the thus deposited wax layer and the electrode surface carrying it, in part by coalescence and gravity run off, in part by being ejected into the space between the electrodes by electrical repulsion and in part by means of subsequently applied fluid washes.

The continued electrical treatment by the ionizing field of the deposited wax layer from which the oil has been initially electrically separated and/or from which it has been washed as stated hereinabove, results in further removal of residual included oil and in producing a drier, more oil-free wax. It is an important feature of this invention, therefore, that the deposited wax can be so electrically treated by an ionizing electric field to produce a dry relatively oil-free wax.

Accordingly, therefore, one aspect of this invention, broadly stated, comprises subjecting a body of wax-bearing oil or similar oils containing suspended solid wax or the like to the effect of an ionizing electric field whereby the suspended wax is caused to be deposited upon an electrode under the influence of said electric field and whereby the wax is separated from the oil. Another broad aspect of the invention resides in the formation of the wax-bearing oil body or film upon the electrode on which the wax is to be deposited by means not necessarily associated with the electrical system, and without initial contact with an electrode of opposite polarity. Another aspect of the invention, broadly stated, comprises subjecting the deposited layer of wax to the continued effect of an ionizing electric field whereby it is compacted and included oil is expelled from the wax.

The invention also comprises jetting or washing the electrically deposited wax layer, either prior to, during, or preceding electrical treatment by the ionizing electric field, with a suitable liquid or gas to remove included and adhering oil.

The invention also comprises apparatus for carrying out the process of the invention and includes forms of electrodes adapted to produce intense ionizing fields. These electrodes preferably are elongated and directed toward a cooperating electrode such as a depositing electrode surface.

The apparatus of the invention in its more specific aspects comprises an electrode surface or depositing electrode, means to apply a film of wax-bearing oil to said surface, and adjacent ionizing electrode means for subjecting the wax-bearing oil film and deposited wax layer to an ionizing electric field. This phase of the invention also includes a liquid wash or gas jet to remove adhering and included oil from the deposited wax, and may further include a scraper or other means to remove the treated wax from the electrode.

Other objects, advantages and features of the invention will be evident hereinafter, and the invention further includes such other novel features and combinations of steps or parts and such other applications of the invention as may appear.

In the accompanying drawings, which illustrate various embodiments of the invention:

Fig. 1 is a sectional plan view of the treater, taken from line 1—1 of Fig. 2;

Fig. 2 is a sectional elevation view of the treater taken at section line 2—2 of Fig. 1;

Fig. 3 is a partial sectional elevation of the treater taken at line 3—3 of Fig. 1, showing the arrangement of the rod types of ionizing electrode systems;

Fig. 4 is a partial sectional plan view of a treater employing optional rod-and-ring types of ionizing electrode systems;

Fig. 5 is a partial sectional elevation of the treater of Fig. 4 taken from line 5—5 showing the arrangement of the said optional form of rod-and-ring type of ionizing electrode systems;

Fig. 6 is another optional form of a notched type of ionizing electrode system; and

Fig. 7 is an optional spray or jetting system for the application of liquid to be treated.

The treater as illustrated in Figs. 1 and 2 is provided with a gas tight enclosure 10 containing a drum shaped electrode 12 having a cylindrical surface constituting a depositing electrode rotatably supported vertically upon shaft 14 between bearings 15 and 16 at the top 17 and bottom 18 respectively of the enclosure 10. The upper end of shaft 14 extends above the top of the treater through stuffing box 20. Rotation of the drum 12 is accomplished by a motor 22 acting through worm pinion 23 and gear 24 upon the extension of shaft 14.

A pair of funnels or spouts 80 and 81 are provided within the enclosure 10 by means of which the liquid to be treated such as wax-bearing oil supplied through pipes 82 and 83 can be applied by flowing on in the form of a film or layer to the cylindrical surface of the drum electrode 12. The lower contracted ends of the funnels or spouts 80 and 81 conform closely to the contour of the cylindrical drum surface but with slight clearance. The spouts are placed at different elevations and spaced about the periphery of the drum surface in order to more uniformly and rapidly distribute the applied wax-bearing oil. While only two spouts 80 and 81 are illustrated a greater number of spouts similarly positioned at successively lower elevations may be employed under certain conditions.

An optional means for applying liquid to be treated to the drum electrode 12 which may be substituted for the funnels 80 and 81 is illustrated in elevation in Fig. 7 and comprises a series of jetting or spray nozzles 85 spaced one above the other at a suitable distance from the cylindrical surface. The spray nozzles are supported and connected to the liquid supply by means of manifolding 86 and supply pipe 87 which enters the treater enclosure 10 at 88.

Any other convenient method of application of the wax-bearing oil to the depositing electrode surface that will result in the formation of a uniform and satisfactory film or body thereon may be employed, for example dipping, brushing or flowing in a body.

Also contained within the treater enclosure 10 diametrically adjacent to and concentrically surrounding the cylindrical surface of the drum electrode are a plurality of ionizing electrode systems 50 as illustrated in Figs. 1, 2 and 3, or ionizing electrode systems 26 as illustrated in Figs. 4 and 5.

The ionizing electrode systems 50 as illustrated in Figs. 1, 2 and 3 are of the rod type and each comprises a plurality of slender, wire-like sharp pointed rod units 51 supported horizontally one above the other all in a plane common to the axis of the drum 12, by means of a bar upright 52. The pointed ends of the said rod electrode units are directed toward and are disposed adjacent to and spaced from the cylindrical drum surface 12 a suitable distance according to the applied voltages as specified hereinafter. The bar uprights 52 are attached at their lower ends to an angle iron ring 40 which encircles the drum 12. The angle iron ring 40 is supported from the bottom 18 of the enclosure 10 and is electrically insulated from all of the other surrounding structures by means of several equally spaced insulators 41.

The ionizing electrode systems 26 as illustrated in Figs. 4 and 5 are of the combination rod and ring type and each includes a plurality of units, each unit comprising a ring 32 and a coaxial rod electrode 36 directed toward drum surface 12. The ring electrodes 32 in all of the ring and rod types of electrodes are practically identical and are constructed with cross-sectional shapes which are convex with respect to the central coaxial rod electrodes. These ring electrodes are electrically connected to and supported from the bottom 18 of the enclosure 10 in groups one above the other by means of suitable metallic interconnections 33 and 34 and columns 35 as shown in Fig. 5. The central rod electrodes 36, in all of the ring and rod types of electrode systems 26 are supported in groups, one above the other and positioned with respect to the surface of the drum 12 in a manner similar to the hereinbefore described pointed rod type of electrodes 51 by means of bar uprights 38 which are likewise attached at their lower ends to the supporting angle iron ring 40. The rings 32 are positioned such that the pointed ends of the coaxial rods 36 extend just to or slightly beyond the plane of the edges of the rings nearest to the surface of the drum 12. Considerable variation on either side of this electrode position is allowable.

The electrode systems 26 and 50 are for convenience illustrated as comprising groups of three and five electrode units respectively, supported one above the other as shown in elevation in Figs. 3 and 5, but greater numbers of electrode units may be so supported in each system for treaters of greater height and capacity.

An optional form of ionizing electrode system is illustrated in elevation in Fig. 6 and comprises a serrated or notched thin metal sheet 53 supported by means of bar upright 52 in the same position and space relationship with respect to the drum 12 as hereinbefore specified for the rod type of electrode system 50, illustrated in elevation in Fig. 5. The notched ionizing electrode systems 53 may be substituted under some conditions for the rod type electrode systems 50 in the locations shown in Figs. 1 and 2.

Directly below the lower edge of the drum electrode 12 is positioned a trough or launder of semicircular outline in plan which is divided into two sections 55 and 56 by means of a division plate 57. These launders are adapted to catch treated liquid which runs down the outer cylindrical surface and drops from the lower edge of the drum. Troughs or launders 55 and 56 are provided with drain pipes 58 and 59 respectively, leading through sealed joints in the bottom 18 to gas-tight receivers or to other suitable means to maintain the enclosure 10 gas-tight and under pressure if desired.

A flexible scraper 60 is supported along one edge by means of an upright 61 connected at its upper end to the top 17 of the enclosure. The scraper 60 is adapted to contact the length of the cylindrical surface of the rotating drum along its scraping edge 62. Between the ends of trough 65 and 67 and directly under the contacting edge of the scraper 60 is positioned a funnel 64 adapted to catch the treated solids such as wax removed from the cylindrical surface of the drum 12 by said scraper 60. A pipe 65 extends through a tight joint in the bottom 18 of the enclosure for withdrawing the solids caught by the funnel 64 to a gas-tight receiver.

Approximately on the diametrically opposite side of the drum 12 from the funnel system 80—81 is provided a plurality of downwardly directed spray nozzles 67 which are directed to apply a liquid wash spray or jet of gas to the adjacent drum surface. A supply pipe 68 and branch manifolding 69 are provided for supplying wash liquid or gas to the spray nozzles and at the same time to supporting them.

The bar type of ionizing electrodes and the central electrode elements of the combination ring-and-rod type of ionizing electrodes are, in operation, maintained at a common high electric potential with respect to the surrounding ring electrodes 32 and with respect to the drum electrode 12 from a suitable source 70 of high voltage direct current. Electrical connection is made between this source of electric potential and the said electrodes by means of conductor 71 which enters the top of the treater enclosure 17 through a high potential lead-in insulator 72. The electrical connection common to all of the said electrodes is maintained from conductor 71 through the metallic supporting ring 40 and uprights 52 or 38. The electrical return circuit is completed to the potential source 70 from the grounded drum 12 and from the ring electrodes 32 when they are optionally employed, through the body of the treater and the connecting conductor 73.

A valve 75 is provided leading from the bottom 18 of the treater through which condensate, collected oil and diluent and wash oil spray can be expelled and by which internal gas pressure can be controlled.

The operation of the invention is as follows:

Oil containing wax in solution is chilled to a temperature at which wax is solidified or precipitated from solution and appears in the oil in the form of a suspension of solid or plastic wax particles. The thus chilled wax-bearing oil containing precipitated wax enters the treater under suitable pressure through supply pipes 82 and 83 and is introduced into the tops of funnels 80 and 81. The wax-bearing oil flows down to the ends of the contracted spout portions of the funnels 80 and 81 which conform closely, but with slight clearance, to the shape of the cylindrical drum surface, comes into contact with the cylindrical drum surface, and flows out through said slight clearance therebetween. Under the combined influence of gravity and rotation of the drum the thus applied wax-bearing oil forms a suitable film over the cylindrical surface extending continuously in the direction of rotation. The thus formed wax-bearing oil film is initially subjected to the intense ionizing field between the first of the ionizing electrode systems 50 and the drum surface, which effects an immediate deposition of the precipitated wax in a thin dense layer upon the cylindrical surface of the drum electrode with the simultaneous freeing of oil therefrom in the form of a multitude of small beads or droplets, a large portion of which, in a short time, coalesce and under the influence of gravity run down the wax surface and drop from the lower edge of the drum into the trough 55. As the drum continues through the initial rotation of 180° from the point of application of the wax-bearing oil in the direction as indicated by the arrow, the deposited wax layer from which the oil has been partially freed is further treated by the intense ionizing fields from the following ionizing electrode systems 50 which comprise the initial treating group of electrodes. These fields act to complete the deposition of wax and to remove a large portion of the residual oil included in the deposited wax layer. This residual oil removed from the deposited wax layer also drains into the trough 55 and oil thus received in trough 55 is withdrawn from the treater through pipe 58. This oil which is completely dewaxed constitutes a major portion of that which is separable from the deposited wax.

The deposited wax layer on the drum surface which has thus been initially treated under the influence of the first group of seven ionizing electrode systems 50 in the first 180° of rotation of the drum electrode 12 for the removal of residual included and adhering oil is subjected to a spray of wash oil such as cold liquid propane or other suitable light hydrocarbon from nozzles 67. The thus applied wash oil flows down the cylindrical surface of the rotating drum under the influence of gravity, carrying with it a large portion of the adhering dewaxed oil film and at the same time at this point where the deposited wax layer is not subjected to an intense electric field, a portion of the thus applied wash oil penetrates or soaks into the deposited wax layer. This penetration allows the wash oil to reach and dilute the included oil.

Other convenient means for applying a liquid wash at this point, such as spouts similar to those for the application of the wax-bearing oil to the drum surface, may be optionally employed.

Instead of employing a liquid wash, gas, such as propane or ethane may be supplied to the nozzles **67** under pressure to form gas jets which by reason of their downwardly directed impingement upon the deposited wax surface on the drum, effect a coalescence and downward sweeping of the dewaxed oil droplets and adhering oil film from the said surface and into the trough **56**.

The thus washed deposited wax upon further continuation of rotation of the drum electrode, is again subjected to intense ionizing fields from the remaining electrode systems **50** in the following approximately 90° of rotation subsequent to the washing process, which effects the removal from the wax of a large portion of remaining included and adhering dewaxed oil together in solution with the applied wash oil, which then coalesces and runs from the lower edge of the drum into the trough or launder **56** from which it is withdrawn through pipe **59**. Finally the thus washed and electrically deoiled deposited wax layer is removed from the rotating drum surface by the scraper **60**. The wax removed by scraper **60** falls into the funnel **64** from which it is removed through outlet **65**. The drum surface from which the wax has been removed by the scraper upon further rotation receives another application of wax-bearing oil from the funnels **80** and **81** and the cycle just described is repeated.

It has been discovered that the efficiency and thoroughness of electrical dewaxing according to this invention increases with increased applied potential. At applied potentials approaching 60,000 volts or more, it is found that the pointed rod types of electrode systems **50** as illustrated in elevation in Fig. 3, or the notched sheet metal electrodes as illustrated in Fig. 6, are effective for efficient and thorough electrical dewaxing.

Electrode units of the ring and rod type employing rings **32** as illustrated in elevation in Fig. 5, are particularly desirable where the available applied electric potentials are limited. It has been found that for potentials of approximately 30,000 volts or less that the most effective ionizing field is obtained with these electrode combinations employing the said ring electrodes **32**. It is to be noted that where a surrounding ring electrode **32** is employed there are two ionizing fields, one between the central electrode **36** and the surrounding ring **32** and the other between the pointed end of the central electrode and the drum surface **12**. With the plain rod types of electrodes illustrated in elevation in Fig. 3 employing no surrounding ring electrode, the ionizing electric field is maintained between the pointed end thereof and the cylindrical surface of the drum electrode only.

Thus with applied potentials of 60,000 volts or more, electrode systems of the type illustrated in Fig. 3 may be placed surrounding the drum electrode as shown in Figs. 1 and 2. With applied potentials ranging around 30,000 volts or less, the electrode systems of the type illustrated in Figs. 4 and 5 are most effective and may be placed surrounding the drum electrode as shown in Fig. 4, displacing the electrode systems **50** of Fig. 1 and with this arrangement satisfactory dewaxing accomplished. This particular arrangement illustrated in Figs. 4 and 5 has been made the subject matter of a co-pending application, Serial Number 23,469, filed May 25, 1935.

At the higher voltage ranges of operation, that is, at approximately 60,000 volts or more, the serrated or notched sheet metal electrode systems as illustrated in elevation in Fig. 6 may be substituted for the pointed rod type of electrodes illustrated in elevation in Fig. 3 with approximately equal effectiveness of dewaxing.

For the purpose of illustration, a limited number of electrodes have been shown. However, in practical operation it has been found advantageous to completely surround the drum electrode **12** except at the intervals where space is necessarily occupied by the washing spray nozzles **67** and the scraper apparatus **60**, with electrodes set as closely together as the available space will permit, but with the limitation, however, that in general the greatest efficiency of treatment has been obtained where the electrodes have not been placed closer circumferentially about the drum electrode than the vertical or longitudinal distance between the individual points thereof. For example when employing a potential difference between the electrodes and the drum of 60,000 volts and when employing the plain pointed rod type of electrodes as illustrated in Fig. 3, an optimum circumferential spacing between the points of the electrodes has been found to be approximately 4 inches. The optimum arrangement of pointed electrodes therefore, for this voltage, is one in which they completely surround the available cylindrical surface of the drum electrode on four inch centers, both circumferentially and longitudinally with respect to the drum surface. It has been observed that the ion stream flows from the end of the pointed electrode in a spray-like diverging stream to the cylindrical surface of the drum electrode, forming by impingement thereon a circular pattern which has a given effective diameter for each given combination of electrode separation and spacing suited to a given impressed potential difference. Under the conditions above mentioned, at a potential difference of 66,000 volts under which conditions the pointed electrode unit is just spaced sufficiently far from the cylindrical electrode to prevent spark-over, the diverging ion stream from the end of the said pointed electrode forms a circular pattern upon the cylindrical electrode surface having a diameter of approximately 4 inches. Most efficient spacing of these electrodes, therefore, is one where these patterns formed by the impingement of the ion streams approach tangency to one another, thus under the conditions just stated, the best electrode spacing is four inches on centers and under these conditions all parts of the cylindrical surface of the drum electrode when it is rotated are contacted by the ion streams. Under the above conditions an electrode spacing of less than four inches results in decreased treating effectiveness which is apparently due to mutual interference of the adjacent electric fields or ion streams.

From the foregoing, it will be observed that the ionizing electrode units may be of two general types, one in the form of a pointed or notched sheet of thin metal or a pointed metal rod only, and the other in the form of a pointed rod surrounded by a coaxial ring. In the case of the plain rod type the ionizing electrode comprising a pointed rod is positioned with its pointed end at a convenient distance from and with its axis perpendicular to the adjacent element of the cylindrical surface of extensive area which, in the present case is embodied in the rotatable drum. In operation of this arrangement, a unidirectional electric potential difference is impressed between these electrodes sufficiently intense to produce a non-disruptive electric discharge or corona discharge therebetween. This manifests itself as a brilliant glow around the end of the pointed electrode as viewed in the dark and results in copious ionization of the gases in the intervening space. The gaseous ions thus formed flow at high velocity under the influence of the potential gradient from the pointed electrode to the opposite electrode of extensive area.

In the case of the second or ring type electrode arrangement the rod electrode is similarly positioned and charged with respect to the opposite electrode of extensive area, but it is also surrounded near its end with a coaxial ring. In operation of this second ring type of ionizing electrode, a unidirectional electric potential difference is also maintained between the central rod electrode and the ring electrode as well as between the pointed rod and the opposite electrode of extensive area, sufficient to produce a corona and the copious ionization of the gas immediately along and surrounding the said rod. These gaseous ions as in the first case flow along the rod and stream from the point of the rod to the opposite electrode of extensive area which constitutes the depositing electrode on which the wax-bearing oil to be dewaxed is applied in the form of a film as described hereinbefore.

The above-mentioned rings 32 are constructed of sheet metal with convex cross-sectional shapes with respect to the said central electrodes as illustrated in order to make it possible to maintain a maximum electrostatic potential between said ring electrode and said central electrode for any given size and spacing thereof without occurrence of spark-over. The ring electrode however, can be of straight cylindrical shapes.

When the dewaxing process is applied to a highly paraffinic wax-containing oil, most efficient dewaxing is accomplished when the sharp pointed electrode elements of the ionizing electrode units are of a positive polarity with respect to the drum electrode. When the dewaxing process is applied to certain oils of asphaltic or mixed paraffinic and asphaltic types, the most efficient electrical dewaxing is accomplished when the pointed electrodes are charged negatively with respect to the drum electrode. In general it is found that the sharp pointed electrodes should be charged to the same polarity as that which is found to be the preferential charge of the particular wax which is being removed.

It has been found advantageous to employ a unidirectional electric potential to the electrodes which is as free from rapid variations or ripples as possible in order to maintain the highest effective electric potential possible for a given electrode spacing without break-down or flash-over. A pure direct current for this reason is desirable. While, as stated, a pure D. C. potential supply to the electrodes is desirable, pulsating unidirectional or even an alternating potential will operate, but at diminished efficiency. Potentials ranging from 66,000 up to 110,000 volts have been impressed between the ionizing electrodes and the drum surface with effective results. The spacing of these electrodes is always maintained as hereinbefore stated, such that copious ionization of the intervening gas is accomplished without spark-over.

The wax-bearing oil, before treatment according to this invention and prior to chilling to precipitate the wax in solid form, may be diluted with a suitable diluent in order to maintain the necessary fluidity. Diluents which can be employed are naphtha, kerosene, liquid propane, butane or any other light liquid hydrocarbon fraction either normally liquid or normally gaseous. Diluents other than hydrocarbons, particularly lighter diluents, also may be employed. Wash oils applied to the deposited wax layer as described hereinabove, may be of the same character as those employed for diluents.

Another application of this invention and process and apparatus as in the separation of asphaltic or tarry substances from asphalts or tarry oils or from cracked residues. The process of separation of the precipitated asphalts or tarry bodies in this application is carried on substantially as described hereinabove in connection with dewaxing operations. The asphaltic or tarry bodies may be solidified and precipitated in the oils containing them prior to their electric separation by the addition thereto of solvents or anti-solvents such as liquid propane, butane, isobutane, butylene, propylene, ethylene, ethane and numerous diluents or solvents of similar character, either with or without chilling. These precipitates may be so obtained with anti-solvents for the tarry or asphaltic bodies without chilling, or with solvents therefor when chilling is employed to solidify said tarry and asphaltic bodies.

These functions vary with the nature of the diluent and the materials to be separated and with temperature, as is well understood. In the case of oils containing both wax and asphalts, a mixture of these bodies will be precipitated together upon cooling, and such mixture may be removed by this invention.

Likewise, resins may be precipitated in various solutions such as gasoline or Diesel fuel oil, through the action of anti-solvents or chilling, and may be agglomerated and separated according to this invention. Finely divided sludge suspensions precipitated in acid or alkali treated oils may be also separated in the manner of this invention.

Polarities for electrical deasphalting, detarring and deresinating are in general the same as those employed for dewaxing mixed asphaltic and paraffinic oils, that is, a negative polarity is usually carried on the ionizing electrode with positive polarity on the depositing electrode.

This invention includes not only the treatment of wax-bearing asphaltic, tarry or resinous mineral oils for the purpose of the removal of wax, asphalt and the like, but also includes the treatment by the same for the removal of fatty, waxy, resinous and similar constituents precipitatable from oleaginous liquids in general. Certain fats such as spermacite, stearin, olein, palmitin, arachidin, elaidin and other high melting temperature fats and/or their acids may be separated or precipitated in the vegetable or animal oils containing them, by chilling and/or by means of anti-solvents, and separation thereof accomplished by the electrical processes and apparatus of this invention. Fatty oil to be freed from stearin, for example such oil as cottonseed oil, is diluted with a light volatile hydrocarbon fraction and chilled either directly by evaporation of a portion of the diluent or indirectly by heat exchange to precipitate the stearin, and the subsequent separation of the stearin and the thus treated cottonseed oil accomplished electrically according to the process described herein for the separation of wax from oil. A low cold test cottonseed oil is thus produced.

Other oils which may be so treated for the separation of the herein enumerated fats and fatty acids are sperm oil, oleo oil, lard oil, soy bean oil, etc.

The foregoing is merely illustrative of an operative apparatus and process, and the invention is not limited thereby but may include any process and apparatus which accomplishes the same result within the scope of the invention.

I claim:

1. A process for removing suspended matter from oleaginous liquids which comprises applying a film of said liquid to the surface of a depositing electrode of extended area and establishing an electric field between said depositing electrode and a second electrode of relatively small area as compared with said depositing electrode, said second electrode being substantially surrounded by a gaseous medium and spaced from said film of liquid and directed toward the surface of said depositing electrode and said electric field being of sufficient intensity to deposit suspended matter in said film of liquid on said depositing electrode, and depositing said matter in a layer on said depositing electrode surface under the influence of said field.

2. A process according to claim 1 in which said electrode of relatively small area is substantially rod shaped and with its longitudinal axis directed toward the depositing electrode and in which said electric field is of sufficient intensity to produce an electric windage impinging upon said film of liquid on said depositing electrode.

3. A process for removing suspended wax from wax-oil mixtures which comprises applying a film of said wax-oil mixture to the surface of a depositing electrode of extended area and establishing an electric field between said depositing electrode and a second electrode of relatively small area as compared with said depositing electrode, said second electrode being substantially surrounded by a gaseous medium and spaced from said film of oil and directed toward the surface of said depositing electrode and said electric field being of sufficient intensity to deposit suspended wax in said wax-oil mixture on said depositing electrode and depositing said suspended wax in a layer on said depositing electrode surface under the influence of said electric field.

4. A process for removing suspended asphaltic bodies from oil which comprises applying a film of said oil to the surface of a depositing electrode of extended area and establishing an electric field between said depositing electrode and a second electrode of relatively small area as compared with said depositing electrode, said second electrode being substantially surrounded by a gaseous medium and spaced from said film of oil and directed toward the surface of said depositing electrode and said electric field being of sufficient intensity to deposit the suspended asphaltic bodies in said film of oil on said depositing electrode and depositing said asphaltic bodies in a layer on said depositing electrode surface under the influence of said electric field.

5. A process according to claim 4 in which said suspended matter is asphalt.

6. A process according to claim 1 in which said suspended matter comprises organic fatty substances of the group consisting of stearin, olein, palmitin, arachidin and eladin, and depositing said matter in layers on said depositing electrode surface under the influence of said electric field.

7. A process of removing suspended matter from oleaginous liquids which comprises applying a film of said liquid to the surface of a depositing electrode prior to its entrance into the effective electric field, establishing an electric field between said depositing electrode and a second electrode of relatively small area as compared with said depositing electrode, said second electrode being substantially surrounded by a gaseous medium and spaced from said film of liquid and directed toward the surface of said depositing electrode, moving said applied film of liquid into the effective electric field, said electric field being of sufficient intensity to deposit the suspended matter in said film of liquid on said depositing electrode, and depositing said suspended matter in a layer upon said depositing electrode surface.

8. A process for removing suspended wax from oil which comprises establishing an electric field between a depositing electrode of extended area and a second electrode of relatively small area as compared with said depositing electrode, applying a film of said wax bearing oil to the surface of said depositing electrode out of the effective electric field, said second electrode being substantially surrounded by a gaseous medium and spaced from said film of wax bearing oil, said electric field being of sufficient intensity to deposit suspended wax in said film of oil on said depositing electrode, moving said applied film into said electric field, and thereby depositing said suspended wax in a layer upon said depositing electrode surface.

9. A process for removing suspended matter from oleaginous liquids which comprises establishing an electric field between a depositing electrode of extended area and a second electrode of relatively small area as compared with said depositing electrode, applying a film of said liquid to the surface of said depositing electrode out of the effective electric field, said second electrode being substantially surrounded by a gaseous medium and spaced from said film of liquid and said electric field being of sufficient intensity to deposit suspended matter in said film of liquid on said depositing electrode, subjecting said applied film to said electric field, and thereby depositing said suspended matter in a layer upon said depositing electrode surface.

10. A process for removing suspended wax from oils which comprises applying a film of said oil to the surface of a depositing electrode of extended area, and establishing an electric field between said depositing electrode and a second electrode of relatively small area as compared with said depositing electrode, said second electrode being substantially surrounded by a gaseous medium and spaced from said film of liquid and directed toward the surface of said depositing electrode, said electric field being of sufficient intensity to deposit wax from said film of oil on said depositing electrode surface in a layer, removing from the thus deposited wax layer a major portion of the oil from which the wax was deposited and washing said deposited wax layer on said depositing electrode surface with a stream of wash solvent for said oil and subjecting said washed wax while on said electrode

to the influence of an electric field to remove residual oil from said wax.

11. A process for removing suspended wax from wax-bearing oils which comprises applying a film of said wax-bearing oil to the surface of a depositing electrode of extended area, establishing a plurality of electric fields of sufficient intensity to deposit suspended wax in said film between said depositing electrode and a plurality of electrodes of relatively small area as compared with said depositing electrode, said electrodes of relatively small area being substantially surrounded by a gaseous medium and spaced from said film of liquid and directed toward the surface of said depositing electrode and moving said depositing electrode surface carrying said oil film through said electric fields whereby suspended wax in said film of oil is deposited on said depositing electrode surface.

12. A process for removing suspended wax from wax-bearing oils which comprises applying a film of said wax-bearing oil to the surface of a depositing electrode of extended area and establishing an alternating electric field between said depositing electrode and a second electrode of relatively small area as compared with said depositing electrode, said second electrode being substantially surrounded by a gaseous medium and spaced from said film of liquid and directed toward the surface of said depositing electrode and said alternating electric field being of sufficient intensity to deposit suspended wax in said wax-bearing oil on said depositing electrode and depositing said wax in a layer on said depositing electrode surface under the influence of said alternating electric field.

13. A process for removing suspended wax from wax-bearing oils which comprises applying a film of said wax-bearing oil to the surface of a depositing electrode of extended area and establishing a unidirectional electric field between said depositing electrode and a second electrode of relatively small area as compared with said depositing electrode, said second electrode being substantially surrounded by a gaseous medium and spaced from said film of liquid and directed toward the surface of said depositing electrode and said unidirectional electric field being of sufficient intensity to deposit suspended wax in said wax-bearing oil on said depositing electrode and depositing said wax in a layer on said depositing electrode surface under the influence of said unidirectional electric field.

14. A process for removing suspended wax from oil which comprises subjecting the oil containing suspended wax to the influence of an electric field and depositing the suspended wax in a layer upon an electrode surface and removing said deposited layer from the major portion of the oil from which it is deposited, subjecting said removed deposited wax layer on said electrode surface to a washing with a quantity of wash solvent while said layer is substantially free from the effective influence of an electric field, subsequently subjecting the washed wax layer to the influence of an effective electric field from a second electrode of relatively small area as compared with said depositing electrode, said second electrode being substantially surrounded by a gaseous medium and spaced from said film of wax and directed toward the surface of said depositing electrode, separating oil from said washed wax under the influence of the last named field and removing the thus treated wax layer from said electrode surface.

15. Apparatus for removing precipitated matter from liquids comprising a container, a plurality of pointed electrodes spaced from the container and substantially surrounded by a gaseous atmosphere, a depositing electrode surface of extended area spaced axially from the pointed electrodes and disposed substantially perpendicular thereto, means for applying a film of liquid containing precipitated matter to said depositing electrode surface, means for establishing an electric field of sufficient intensity to deposit precipitated matter in said film of liquid on said depositing electrode and means for removing deposited matter from said depositing electrode surface.

16. Apparatus according to claim 15 with means to apply a fluid wash to said depositing electrode surface, and means to remove liquid from which precipitated matter has been removed and the fluid wash in separate streams.

17. Apparatus for removing precipitated matter from liquids comprising a container, a drum-shaped depositing electrode surface inside of said container, a plurality of pointed electrodes in said container substantially surrounded by a gaseous atmosphere, and spaced from and substantially radially directed toward said drum-shaped depositing electrode surface, means to apply a film of liquid containing precipitated matter to said depositing electrode surface, means for establishing an electric field of sufficient intensity to deposit precipitated matter in said film of liquid on said depositing electrode and means for removing deposited matter from said depositing electrode surface.

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