Feb. 22, 1938. H. F. FISHER 2,109,131

PROCESS AND APPARATUS FOR DEWAXING OIL

Filed May 25, 1935 2 Sheets-Sheet 1

Fig. 1.

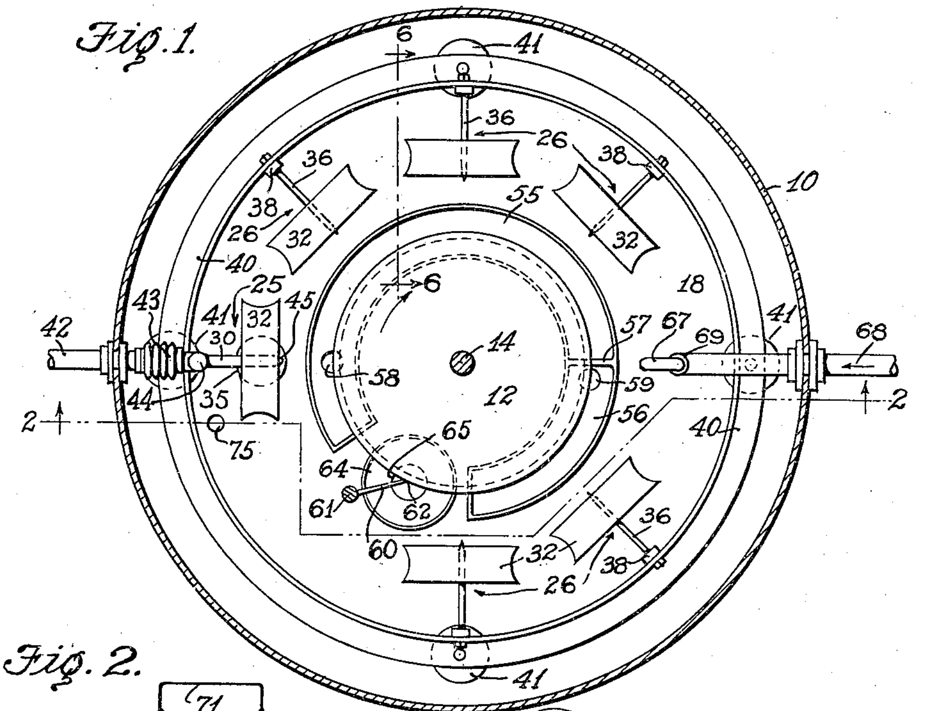
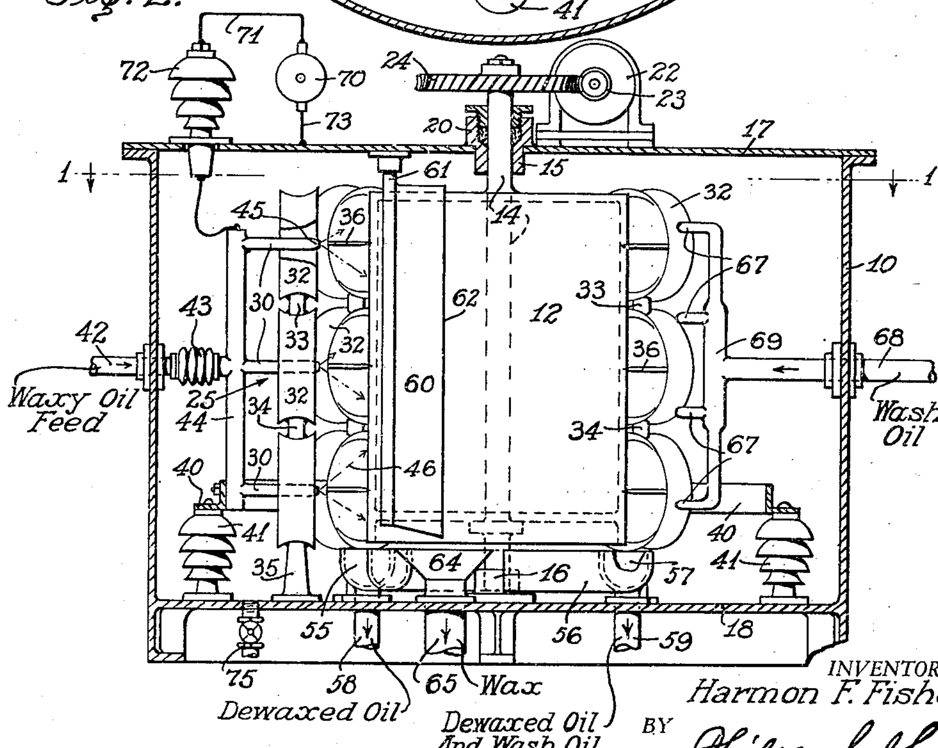


Fig. 2.



INVENTOR
Harmon F. Fisher

BY Philip Subkow
ATTORNEY.

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Fig. 3.

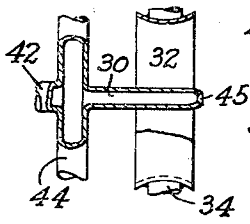


Fig. 4.

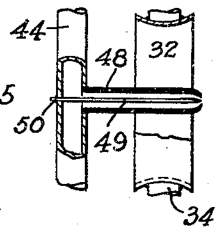


Fig. 5.

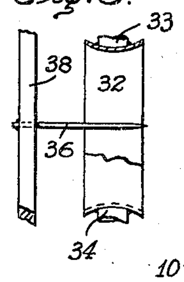


Fig. 6.

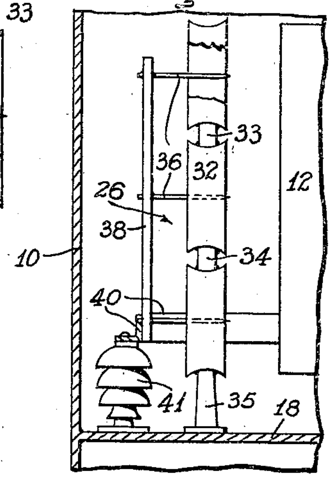


Fig. 7.

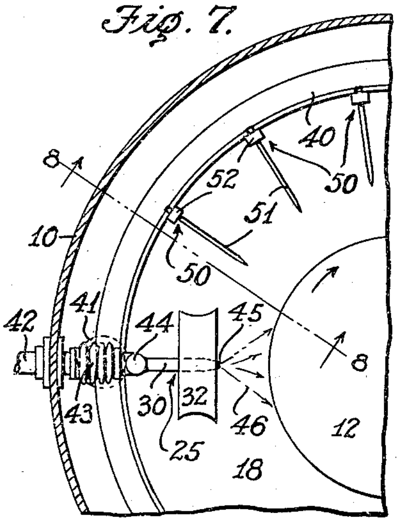


Fig. 8.

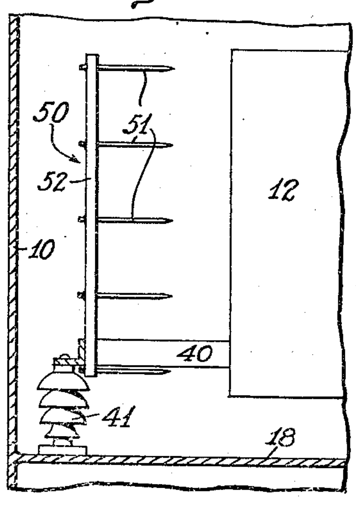
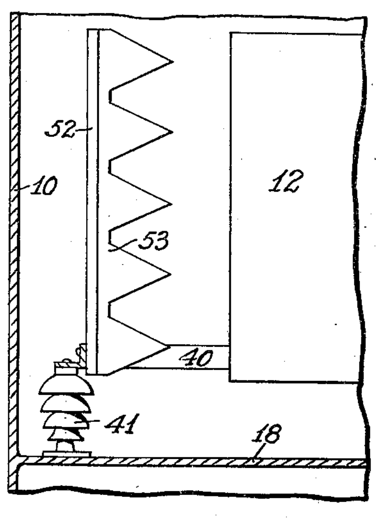


Fig. 9.



INVENTOR
Harmon F. Fisher

BY Philip Subkow
ATTORNEY.

Patented Feb. 22, 1938 2,109,131

UNITED STATES PATENT OFFICE

2,109,131

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. 23,469

10 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 oils or oil solutions such as chilled lubricating oil or other waxy petroleum oils, for example 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 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 low 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 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 electric 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 a high electric potential gradient is manifested in 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 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 the 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 being preferably elongated and directed toward a co-operating electrode.

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 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 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 an enlarged section through one of the combination ring-and-nozzle type units of the ionizing electrodes shown in Figs. 1 and 2 through which the diluted waxy oil is applied;

Fig. 4 is an enlarged section through an optional form of nozzle type unit of the ionizing electrodes;

Fig. 5 is a section through one of the combination rod-and-ring type units of the ionizing electrodes shown in Figs. 1, 2, and 6;

Fig. 6 is a partial sectional elevation of the treater taken at section line **6—6** in Fig. 1 showing the arrangement of the rod-and-ring type of ionizing electrode systems;

Fig. 7 is a partial plan view of a treater employing optional rod-type ionizing electrodes;

Fig. 8 is a partial sectional elevation of the treater of Fig. 7 taken from line **8—8** showing the arrangement of the said optional form of rod-type ionizing electrode systems;

Fig. 9 is another optional form of a notched or serrated type of an ionizing electrode system.

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**.

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 **25** and **26** as shown in Figs. 1 and 2, or systems **25** and **50** as shown in Figs. 7 and 8. Electrode system **25** is of the ring-and-nozzle type and is provided with nozzles **30** directed toward drum surface **12** for discharge of the oil therethrough, while a plurality of the other systems **26** or **50** is disposed around the drum **12** to provide the required additional ionizing fields. For convenience in illustration, these electrode systems are shown comprising groups of three or five units supported one above the other as illustrated in elevation in Figs. 2 and 6. Greater numbers of units may be so supported in each system for treaters of greater height and capacity.

The electrode units shown in Figs. 1 and 2 comprise two main classes, namely, the ring and co-axial nozzle combination **25** illustrated also in enlarged section in Fig. 3 and the ring and co-axial rod combination **26** illustrated also in Fig. 6 and in enlarged section in Fig. 5.

The ring electrodes **32** in all of the ring and rod type ionizing electrode units are practically identical, and are constructed with cross-sectional shapes which are convex with respect to the central co-axial rod or nozzle electrodes. These ring electrodes, as hereinbefore stated, are supported, as shown in Figs. 2 and 6, from the bottom **18** of the enclosure in groups of three, one above the other, by means of suitable metallic interconnections **33** and **34** and column **35**. The rings are thus electrically grounded to the surrounding structure including the container **10** and the drum **12**.

The central rod electrodes **36** in all of the ionizing electrode units of the combination ring and rod type, are likewise practically identical and comprise slender, sharp pointed wire-like rods. They are supported horizontally in groups, one above the other, and each co-axial with one of the ring electrodes **32**. The sharp pointed ends of the rods are directed toward the surface of drum **12** and extend just beyond the plane of the edges of the rings nearest to the drum **12**, the rod electrodes **36** in each group and the axis of the drum electrode **12** lying in common vertical planes. These rod electrodes are supported by means of upright bars **38** which 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 insulated from all of the other surrounding structures by means of several equally spaced insulators **41**.

The central nozzle electrodes **30** in all of the ionizing electrode units of the combination ring and nozzle type comprising the single nozzle electrode system **25** are supported in the same positions relative to their surrounding ring electrodes **32** and to the drum **12** as are the hereinbefore described rod electrodes **36**. These nozzle electrodes **30** which are hollow rods or suitable length of metallic tubing, are supported and connected together by means of a hollow pipe upright **44** which is closed at its ends and which is fastened and supported at its lower end to the angle iron ring **40**. To supply oil to the nozzles **30**, a supply pipe **42** enters the enclosure **10** and makes connection with said nozzle type of central electrodes **30** through the insulating pipe section **43** and said hollow upright pipe support **44**. Nozzle openings **45** (Fig. 3) are provided at the ends of each nozzle type electrode **30** to form suitable sprays which will impinge upon the cylindrical surface of the drum electrode 12 as illustrated at 46.

An optional form of nozzle type electrode is illustrated in enlarged cross-section in Fig. 4 which may be in some cases substituted for that illustrated in Figs. 2 and 3. This optional form of electrode comprises a hollow insulating tubing 48 with a co-axial metallic rod electrode 49 supported therein and electrically connected to the upright pipe 44 at 50.

The combination ring and rod types of ionizing electrode units as illustrated in the electrode systems 26 in Fig. 1 may be replaced under certain conditions as hereinafter described by plain horizontal pointed rod electrodes 51 without ring electrodes as illustrated in partial elevation in Fig. 8 and in partial plan in Fig. 7, or by notched or serrated and pointed sheet metal electrodes 53, as illustrated in Fig. 9. The rod electrodes 51 are supported in groups, one above the other, by means of upright bars 52 which are attached at their lower ends to the supporting ring 40 in a manner similar to that for the hereinbefore described rod electrodes of the ring and rod types. These electrodes without the rings can be placed with smaller spacing between them and for this reason a greater number of them are attached to a single upright as illustrated in Fig. 8, all being directed toward drum 12.

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 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 45 and 47 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 diametrically opposite the nozzle type system of ionizing electrode 25 is provided a plurality of 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 supporting them.

When in operation, the central electrode elements of the ionizing electrode units, comprising the nozzle type and the rod type electrodes, are 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 central electrodes by means of conductor 71 which enters the top of the treater enclosure 17 through a high potential lead-in insulator 72. Electrical connection common to all of the central electrodes is made from conductor 71 through the metallic supporting ring 40 and uprights 38 and 44. The electrical return circuit is completed to the potential source 70 from the grounded drum 12 and ring electrodes 32 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 or collected oil and diluent 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 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 through pipe 42 and is introduced into the hollow nozzle type electrodes 30 through insulating pipe 43 and upright distributing and supporting pipe 44 under pressure and issues from the nozzle end 45 thereof in the form of a finely divided conical spray as illustrated at 46. The thus formed conical spray impinges upon the outer cylindrical surface of the drum 12 forming as the drum rotates a thin waxy oil film thereon from top to bottom and extending continuously from the point of impingement in the direction of rotation. The thus formed waxy oil spray and film is simultaneously with its formation initially subjected to the intense ionizing field between the nozzle electrodes 30 and the drum surface. The effect of this ionizing field results in the 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 which in a short time coalesce and under the influence of gravity run down and drop from the lower edge of the drum into the trough 55. As the drum continues to rotate in the direction, as indicated by the arrow, the deposited wax layer from which the oil has thus been partially freed is further treated by the intense ionizing fields from the first group of three electrode systems 26. 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. The oil thus received in trough 55 is withdrawn 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 treated under the influence of the first group of electrode systems 26 for the removal of residual included and adhering oil is subjected to a spray of a wash oil such as cold liquid propane or other suitable light hydrocarbons 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 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 adjacent spouts or troughs, 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 impingement upon the deposited wax surface on the drum, effect a coalescence and removal of the dewaxed oil droplets and adhering oil film from the said surface. 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 26 which cause the removal from the wax of a large portion of the 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 de-oiled deposited wax layer is removed from the rotating drum surface by the scraper 60. The wax, removed by scraper 60, falls into 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 nozzle electrode system 25 and the cycle just described is repeated.

In some cases with certain oils it is desirable to employ the combined central rod electrode and insulating waxy oil supply nozzle which is illustrated in Fig. 4. When this type of central electrode is utilized the supplied wax-bearing oil containing the precipitated wax flows between the metal rod electrode 49 and the insulating tube 48 in an annular stream where it is subjected to the most intense portion of the electrostatic field between the said electrode 49 and the ring electrode 32. Pre-treatment of the waxy oil stream in this manner has a beneficial agglomerating effect upon the wax and apparently causes the spray issuing therefrom, as illustrated at 46, to take a much more finely divided and diverging form.

Electrode units of the types employing rings 32 as illustrated in cross-section in Figs. 3–6 are particularly desirable where the available applied electric potentials are limited and/or when the central electrodes must be of a relatively large diameter, such as for a nozzle. It has been found that for potentials ranging up to 30,000 volts that the most effective ionizing field is obtained with these electrode combinations employing the said ring electrodes 32.

It has also 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 type of electrodes employing surrounding rings are no longer needed to obtain the desired intensity of the ionizing field and that pointed rod electrodes 51 of the type illustrated in Figs. 7 and 8 or notched sheet metal electrodes 53 as illustrated in Fig. 9 without surrounding ring electrodes become equally effective. It is to be noted that where a surrounding ring electrode 32 is employed there are two ionizing fields, one between the central electrode 30 or 36 and the surrounding ring 32 and the other between the pointed end of the central electrode and the drum surface 12. With the rod types of electrodes illustrated in Figs. 7, 8, and 9, 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 Figs. 8 or 9 may be placed surrounding the drum electrode as shown in Fig. 7 in the same positions occupied by electrode systems 26 in Fig. 1 and with this arrangement satisfactory dewaxing is accomplished.

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 scraper 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 together around the drum electrode than the vertical distance between the individual points thereof. For example, when employing a potential difference between the electrodes and drum of 60,000 volts and when employing the plain pointed rod type of electrodes as illustrated in Fig. 8, an optimum spacing between the points of the electrodes has been found to be approximately four 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 vertically. 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 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 condition the pointed electrode unit is just spaced sufficiently far from the cylindrical electrode to prevent sparkover, 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 four 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 stream. 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 adjacent electric fields or ion streams.

From the foregoing, it will be observed that the ionizing electrode units may be of two general types, the 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 metal rod (or tube) 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 cylindrical surface of extensive area which in the present case is embodied in the rotatable drum. In operation of this arrangement, a uni-directional electric potential difference is impressed between these electrodes sufficiently intense to produce a non-disruptive electric discharge or a 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 of 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 co-axial ring. In operation of this second type of ionizing electrode, a uni-directional 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 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 sprayed 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 electrodes, 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 electrode should be changed to the same polarity as that which is found to be the preferential charge for the particular wax which is being removed.

In general, it has been found advantageous to employ a uni-directional 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 uni-directional 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 is 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, iso-butane, 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, therefore, 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 precipitated matter from oil, comprising applying the mixture in a layer to a depositing electrode surface, maintaining an ionizing electric field between a pair of electrodes adjacent to said depositing electrode surface sufficient to ionize the intervening gases, impressing another electric potential between one of said pair of ionizing electrodes and said depositing electrode sufficient to move the said ionized gas in the form of an electrical windage impinging upon said oil layer on said depositing electrode surface whereby precipitated matter in said oil is deposited on said depositing electrode.

2. A process according to claim 1 in which the precipitated matter is wax.

3. A process according to claim 1 in which the said precipitated matter is of the group consisting of asphalt and resin.

4. Apparatus for removing precipitated matter from oils comprising an ionizing electrode, a ring-shaped electrode surrounding said ionizing electrode, a depositing electrode surface of relatively large area adjacent to said ionizing electrode, means to apply oil containing precipitated matter in a layer to said depositing electrode surface, and means to maintain an electric potential difference between said ionizing electrode and said depositing electrode and between said ionizing electrode and said ring-shaped electrode.

5. Apparatus for removing precipitated matter from oils comprising a rod-shaped ionizing electrode, a ring-shaped electrode surrounding a portion of said ionizing electrode, a depositing electrode surface of relatively large area adjacent to said ionizing electrode, means to apply oil containing precipitated matter in a layer to said depositing electrode surface, and means to maintain an electric potential difference between said ionizing electrode and said depositing electrode and between said ionizing electrode and said ring-shaped electrode.

6. Apparatus for dewaxing oil comprising an insulating tubing, a coaxial rod electrode in said insulating tubing, a depositing electrode surface of relatively large area adjacent and substantially perpendicular to the axis of said rod electrode, means to supply wax-bearing oil under pressure to said insulating tubing, whereby said wax-bearing oil flows through and out of the end of the annular passage formed between the said rod electrode and said insulating tubing and impinges upon said adjacent depositing electrode surface, and means to maintain an electric potential difference between said rod electrode and said depositing electrode.

7. Apparatus for dewaxing oil comprising an ionizing electrode, a ring shaped electrode surrounding said ionizing electrode, a depositing electrode surface of relatively large area adjacent to said ionizing electrode, means to pass wax-bearing oil in a stream first in contact with said ionizing electrode and then onto said depositing electrode surface, and means to maintain an electric potential difference between said ionizing electrode and said ring-shaped electrode.

8. Apparatus for dewaxing oil comprising an ionizing electrode, a ring shaped electrode surrounding said ionizing electrode, a depositing electrode surface of relatively large area adjacent to said ionizing electrode, means to pass wax-bearing oil in a stream first in contact with said ionizing electrode and then onto said depositing electrode surface, means to maintain a potential difference between said ionizing electrode and said depositing electrode and between said ionizing electrode and said ring-shaped electrode.

9. Apparatus for dewaxing oil comprising a tubular electrode, a ring-shaped electrode coaxially surrounding said tubular electrode, a depositing electrode surface of relatively large area adjacent and substantially perpendicular to the axis of said tubular electrode, means to supply wax-bearing oil under pressure to said tubular electrode whereby said wax-bearing oil flows through and out of the end of said tubular electrode and impinges upon said adjacent depositing electrode, and means to maintain an electric potential difference between said tubular electrode and said depositing electrode and between said tubular electrode and said ring-shaped electrode.

10. Apparatus for dewaxing oil comprising an insulating tubing, a coaxial rod electrode in said insulating tubing, a ring-shaped electrode co-axially surrounding said tubing and said rod electrode, a depositing electrode surface of relatively large area adjacent and substantially perpendicular to the axis of said rod electrode, means to supply wax-bearing oil under pressure to said insulating tubing, whereby said wax-bearing oil flows through and out of the end of the annular passage formed between said rod electrode and said insulating tubing and impinges upon said adjacent depositing electrode surface, and means to maintain an electric potential difference between said rod electrode and said depositing electrode and between said rod electrode and said ring-shaped electrode.

HARMON F. FISHER.