July 31, 1934. C. E. ADAMS 1,968,239

ART OF DEWAXING HYDROCARBON OILS

Filed May 2, 1931 2 Sheets-Sheet 1

Fig. 1.

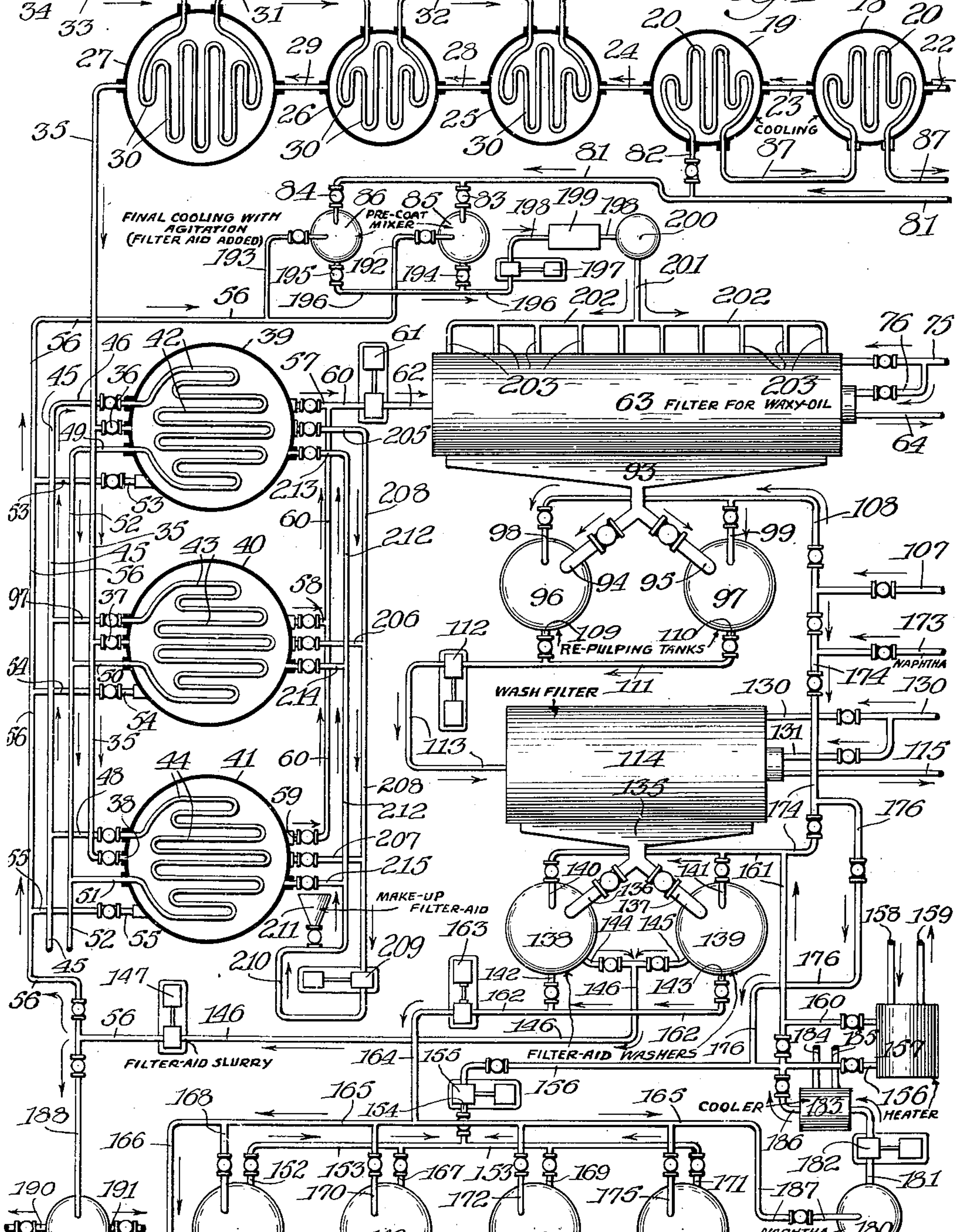

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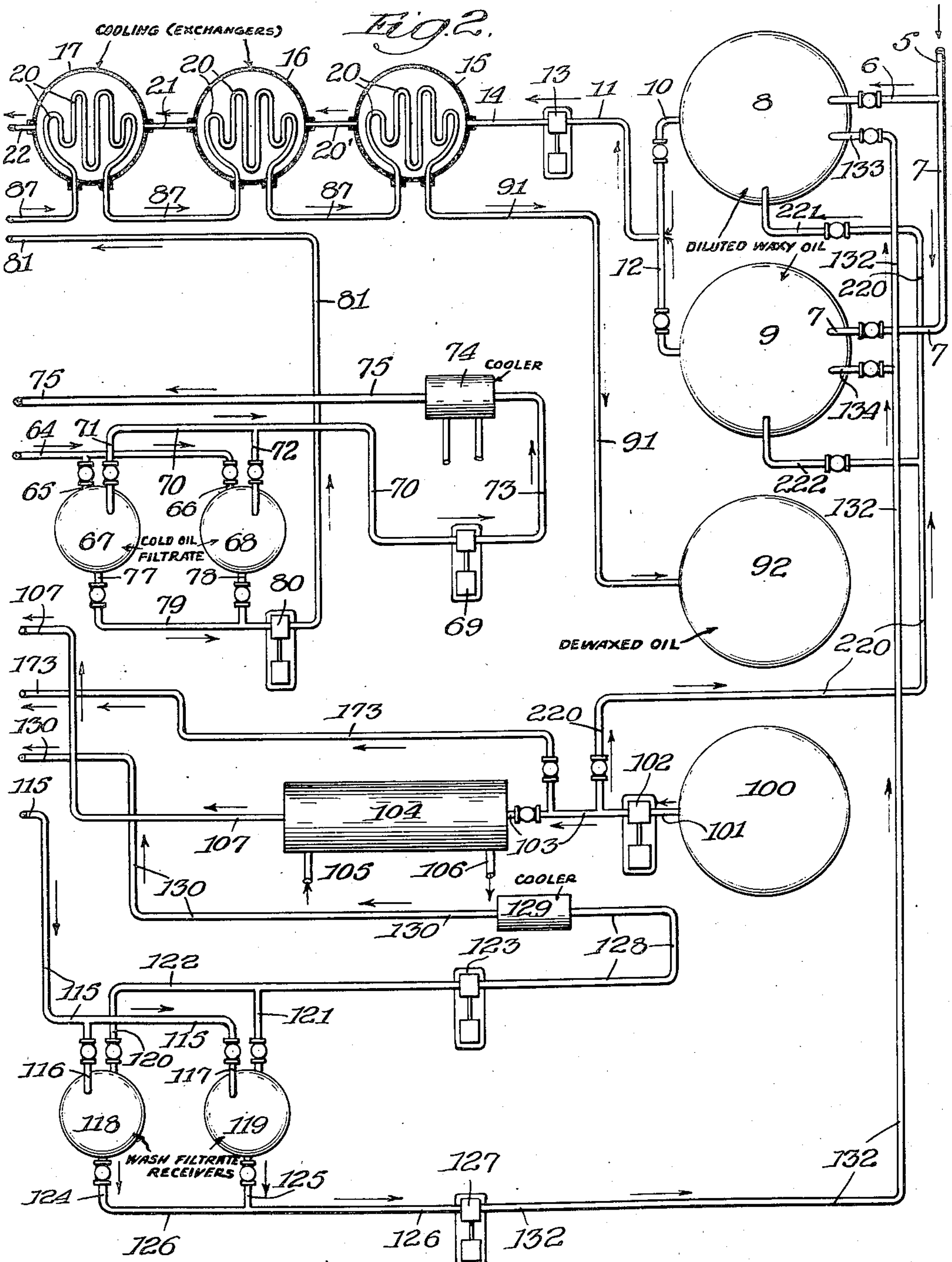
Fig. 2.



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ART OF DEWAXING HYDROCARBON OILS

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Application May 2, 1931, Serial No. 534,614

13 Claims. (Cl. 196—19)

The present invention relates to the art of dewaxing hydrocarbon oils and refers more particularly to a process, and apparatus therefor, adapted to be operated substantially continuously for effecting the removal of wax-material from such oils, for example, the heavy hydrocarbon oils suitable for use as lubricants, particularly oils produced by non-cracking distillation.

The invention will be fully understood from the following description in conjunction with the accompanying drawings in which is illustrated, more or less diagrammatically, in Figs. 1 and 2 a plan view of apparatus suitable for carrying out the process of the present invention.

Referring more in detail to the drawings, a lubricant stock containing wax is passed through line 5 and through either of lines 6 and 7 to either of storage tanks 8 and 9. This stock is preferably a distillate lubricant stock which has been acid treated and subjected to a decolorizing treatment, for example, percolation through clay. The oil is preferably washed with an alkali solution to render it non-acid before it is subjected to the dewaxing treatment of the present invention. The wax-containing oil in the tanks 8 and 9 is admixed with a substantial amount of a more volatile solvent of low viscosity to increase its fluidity; for example, a light petroleum distillate, such as naphtha, may be so used. It is preferred to maintain a batch of oil admixed with naphtha in one of the tanks 8 and 9 while such a mixture is being prepared in the other of the tanks 8 and 9. It will be understood that the proportion of light solvent which should be admixed with the oil will depend on several factors, for example, the physical properties of the wax-containing oil to be treated and of the operating conditions in the wax-removing process of the present invention.

The diluted wax-containing oil is withdrawn from tank 8 through lines 10 and 11, or from tank 9 through lines 12 and 11, as the case may be, by pump 13, by which it is forced through line 14 into and through a plurality of series-connected tanks 15, 16, 17, 18 and 19, the tanks 15 to 19 being serially connected by means of lines 20′, 21, 22 and 23. Each of the tanks 15 to 19 is provided with a coil 20 adapted to receive a suitable cooling fluid for reducing the temperature of the diluted oil passed through the said tanks 15 to 19. Any cooling fluid may be employed in coils 20; however, it is preferred to employ certain relatively cool products formed in the system, the source of which will be hereinafter described. The cooling fluid is preferably passed countercurrent to the flow of oil through the tanks 15—19. Each of the tanks 15—19 is provided with suitable means for mildly agitating the contents thereof.

The partially cooled oil is passed out of the last of the series of tanks 15—19, that is, the tank 19, through line 24 into and through a plurality of series-connected tanks 25, 26 and 27. The tanks 25, 26 and 27 are series-connected by means of lines 28 and 29 and the last tank of the series, that is, the tank 27, is preferably of greater size than the remainder. Each of the tanks 25, 26 and 27 is provided with a coil 30 adapted to receive suitable cooling or refrigerating fluid at temperatures considerably lower than the temperatures of the fluid supplied to the coils 20 in tanks 15—19, for example, a brine solution at about 0° F., or lower may be supplied to the coils 30. The coils 30 are preferably series-connected by means of lines 31 and 32, the flow of the brine through the coils 30 in the respective tanks being countercurrent to the flow of oil therethrough. Thus, the coil in tank 27 preferably is the first of the series to receive cold brine from a line 33 leading from a suitable source of supply, the coil in tank 26 receiving its supply of brine from the coil in tank 27, and the coil in tank 25 receiving its supply from the coil in tank 26. The spent brine is passed from the last of the series of coils 30 through a line 34. Each of the tanks 25, 26 and 27 is provided with suitable means for mildly agitating the diluted oil therein undergoing cooling.

The cooled, diluted oil is passed from the last tank 27 to a manifold 35 provided with valved branch-lines 36, 37 and 38 leading to tanks 39, 40 and 41, respectively, whereby the cooled oil from tank 27 may be selectively supplied to any one of the tanks 39, 40 and 41. Tanks 39, 40 and 41 are provided with cooling or refrigerating coils 42, 43 and 44, respectively. The coils 42, 43 and 44 are connected to a manifold 45, leading from a source of cooling fluid, by means of valved lines 46, 47 and 48, respectively, and each coil is provided with separate lines 49, 50 and 51 for discharging the spent cooling fluid into a manifold 52. It is preferred to operate the coils 42, 43 and 44 as direct expansion coils for compressed refrigerant, such as ammonia, the valves in lines 46, 47 and 48 being employed as expansion valves.

Valved lines 53, 54 and 55 lead to tanks 39, 40 and 41, respectively, and are connected to a line 56 leading from any suitable source of filter aid material which may be diatomaceous earth, clay, or the like, such as the product commercially known by the trade-mark "Filter-cel". This filter aid is preferably introduced into the tanks 39, 40 and 41 in the form of slurry, of the filter aid material in a volatile diluent of low viscosity, such as naphtha, preferably formed as hereinafter described. The tanks 39, 40 and 41 are each equipped with means for mildly agitating the oil undergoing chilling therein, to aid dispersion of the filter aid in the oil and effect uniform chilling of the oil. This agitation is preferably accomplished by slow moving agitators so that the physical structure of the filter aid material is not substantially altered, thereby maintaining the efficiency of the filter aid material. The oil is chilled in the tanks to the final temperature at which it is desired to subject it to filtration to effect removal of the wax and secure the desired cold test; for example, the oil may be chilled to a sub-zero temperature, say about −18° F. The chilled filter aid containing oil is selectively passed from any of the tanks 39, 40 and 41 through the corresponding valved branch lines 57, 58 and 59 and manifold 60 connected to a pump 61, by which it is forced through a line 62 leading to a filter shown diagrammatically at 63. The filter 63 is preferably continuous in operation and may be of the rotary disc vacuum type, described in the co-pending application of F. W. Sullivan, filed July 1, 1929, Serial No. 375,147.

It is preferred to pre-chill the oil to a temperature of from about 10 to 40° F. above the temperature at which it is filtered before adding the filter aid material thereto and effecting the final chilling.

The filtered diluted oil is withdrawn from the filter 63 through a suction line 64 connected to a pair of valved branches 65 and 66 leading to vacuum receivers 67 and 68, respectively, wherein any vapors and air admixed therewith are separated. The receivers 67 and 68, lines 64, 65 and 66, and the interior of the filter discs are maintained under vacuum pressure conditions by means of a suction pump 69 connected to the upper portions of the receivers 67 and 68 by a line 70 and valved branch-lines 71 and 72. The pump withdraws the vapors and air from the receivers 67 and 68 and forces them through line 73, cooler 74 and valved lines 75 and 76, into the filter 63, thereby aiding in maintaining it at a low temperature. The cold filtered diluted oil is withdrawn from receivers 67 and 68 through valved branch lines 77 and 78, respectively, and line 79, by a suction pump 80 by which it is forced through a line 81 connected to a valved branch-line 82 leading to the cooling coil 20 in the tank 19. The line 81 is also connected by valved branch lines 83 and 84 to tanks 85 and 86, respectively. The cold oil filtrate is passed through branch-line 82 to coil 20 in the tank 19 and then flows by means of connecting lines 87 through the coils 20 in tanks 18, 17, 16 and 15 countercurrent to the flow of the wax-containing diluted stock therethrough, as hereinbefore disclosed. The substantially wax-free dilute oil filtrate is passed from the coil 20 in tank 15 through a line 91 to a storage tank 92, from which it may be withdrawn to be subjected to a suitable distilling operation for the purpose of separating the light diluent, or naphtha therefrom.

The cold cake-like filtered material separated in the filter 63 is collected in a suitable hopper 93 disposed therebelow. The filter cake is preferably removed in the manner described in the aforementioned application of F. W. Sullivan, and comprises filter aid, wax, and some oil. The cold filter cake is withdrawn from the hopper 93 through either of a pair of valved conduits 94 and 95, leading to repulping tanks 96 and 97, respectively. The tanks 96 and 97 may be supplied with a chilled light oil, such as chilled naphtha, through valved lines 98 and 99, respectively. The tanks 96 and 97 are provided with suitable agitating means for repulping the cold filter cake in the puresence of the light oil to form a chilled oil-slurry of repulped filter cake. The repulping of the filter-cake is preferably effected by slow moving agitating means which do not substantially break down the physical structure of the filter-aid material, thereby avoiding any substantial impairment of its efficiency. The filter cake being repulped and the naphtha, in repulpers 96 and 97, are maintained at a temperature sufficiently low to prevent the wax material constituents of the cake from becoming dissolved in the naphtha.

The chilled naphtha may be supplied to tanks 96 and 97, as follows: The naphtha is drawn from a storage tank 100 through a line 101 by pump 102 and is forced through a line 103 to a cooler 104, wherein it is cooled to the desired temperature by a suitable cooling fluid which enters the cooler 104 through line 105, and is discharged through line 106. The chilled naphtha flows from the cooler 104 through a valved line 107 and to line 108 connected to the branch lines 98 and 99 leading to tanks 96 and 97.

The chilled naphtha-filter cake slurry may be drawn from tank 96 or tank 97 through either valved line 109 or 110 and through manifold line 111 by pump 112 and is formed through line 113 to a filter shown diagrammatically at 114. The filter 114 may be of a type similar to that of the filter 63 and is likewise adapted to be operated continuously. The cold filter cake slurry is subjected to a filtration in the filter 114, the filtrate being a naphtha-solution of any oil remaining in the cake, and the filtered material or filter cake being substantially oil-free filter-aid and wax material. The filtrate is withdrawn from the filter 114 through a suction line 115 and either valved branch line 116 or 117, leading to receivers 118 and 119, respectively, wherein any vapors and air admixed with the filtrate, are separated. The vapors, air and other gases are withdrawn from the upper portion of the receivers through valved branch lines 120 and 121 and are drawn through a line 122 by a suction pump 123. The liquid filtrate, i. e., the mixture of naphtha and oil from the repulped filter cake, is withdrawn from the lower portion of the receivers through valved branch lines 124 and 125 and is passed through a line 126 leading to a pump 127. The cold vapors and gas are forced by pump 123 through a line 128, a cooler 129, a line 130 and a branch line 131 to the interior of the filter 114, to aid in maintaining the latter at a low temperature. The cold liquid filtrate, i. e., naphtha-oil mixture, is forced by pump 127 through a line 132 and either of the valved branch lines 133 and 134 into either of the tanks 8 and 9, wherein it is employed as a diluent for the oil to be treated as hereinbefore described, thereby avoiding waste of the oil remaining in the filter cake from filter 63.

The cold filter cake produced in filter 114 is collected in a suitable hopper 135 disposed therebelow. The filter cake is discharged from the hopper 135 through either of a pair of valved conduits 136 and 137 into either of a pair of washing-tanks 138 and 139, one of which is filled with a desired quantity or charge of filter cake, which is washed as hereinafter described, while the other is being filled. In the charged tank the cake is washed with heated liquid wax-solvent, such as naphtha, whereby the wax contained in the cake is melted and dissolved, substantially wax and oil-free filter-aid being left in the washers 138 and 139. The hot washing naphtha is introduced into the washers 138 and 139 through valved lines 140 and 141, respectively, and the wax-naphtha solution is withdrawn therefrom through valved lines 142 and 143, respectively. The washers 138 and 139 preferably are of the percolating type, being provided with a foraminous false-bottom on which is carried the filter cake to be washed. The cake is maintained in the washers as a body in a substantially fixed position. The hot naphtha is supplied to the upper portion of the washers and percolates through the fixed body of cake and through the false bottom, below which it is withdrawn. The washed, restored wax and oil-free aid is then admixed with fresh light oil, or naphtha, and is formed into a slurry with such oil by means of slow moving agitators in the washers 138 and 139, the slurry being withdrawn from washers 138 and 139 from a point just above the false bottoms through valved lines 144 and 145, respectively, drawn through a line 146 by a pump 147 by which it is forced through the line 56 and into the final chilling tanks 39, 40 and 41, wherein it is admixed with the oil-stock to be dewaxed, in the manner already described. The formation of the oil-filter aid slurry in washers 138 and 139 is so carried out that substantially no breaking down of the physical structure of the filter-aid results, thereby maintaining the efficiency of the filter-aid material.

The filter cake may be subjected to a plurality of washes within the washers 138 and 139 with a plurality of separate batches of naphtha. It is preferred to employ as the first wash for each charge of cake, naphtha which has been used in washing a previous charge of cake, so that a naphtha of substantially high wax content is secured which may be passed from the system and subjected to suitable treatment, such as distillation, for separation of the wax. In effecting this method of operation it is preferred to retain in separate batches the naphtha employed for washing the last previous charge of cake washed in either of the washers 138 and 139. The various batches of naphtha employed in washing the last previous charge, with the exception of the batch employed in the first wash of the last previous charge of cake, are then successively re-used for washing the next charge of cake, the naphtha used in the first wash, for each charge, being withdrawn from the system, and the naphtha for the last wash being fresh naphtha introduced into the system. Thus, in the apparatus shown in the drawing, the various batches of naphtha employed in washing the last previous charge of cake with the exception of that used in the first wash, are stored in tanks 148, 149, 150 and 151. For example, the naphtha in tank 148 may be the batch of naphtha employed as the second wash in the washing of the last previous charge of cake subjected to washing, that in tank 149 may comprise the batch of naphtha employed in the third wash in the washing of the last previous charge of cake; that in tank 150 may be the batch of naphtha employed in the fourth wash of the previous charge of cake, and that in tank 151 may be the batch of naphtha employed in the fifth wash of the previous charge of cake. The naphtha in tank 148 will, of course, contain a larger portion of wax and oil and is therefore employed as the first wash in the next batch of cake to be washed.

In accordance with the above, the filter-cake may be washed as follows: Naphtha used in the second wash of the last previous charge of cake is withdrawn from the lower end of tank 148 through a valved line 152, header 153 and line 154 by a pump 155 and is forced through a valved line 156 to a suitable heater 157, wherein it is heated to the desired temperature, for example 160° F., by heat exchange with a heating fluid supplied thereto through line 158 and discharged through line 159. The heated naphtha passes from the heater 157 through valved lines 160, 161, and either of the valved lines 140 and 141 into the selected washer 138 or 139, wherein it percolates through the body of cake. The hot wax and oil-containing naphtha, thus used in the first wash of the fresh charge of cake, is passed from the washers through lines 142 or 143, as the case may be, through header 162 to a pump 163, by which it is forced through a line 164, header 165, and from the system through a valved line 166. The wax-containing naphtha thus passed from the system is subjected to suitable treatment, such as distillation, for effecting the separation of wax and oil therefrom.

After the cake-body has been washed with the naphtha in tank 148, the naphtha in tank 149, which is the batch employed in the third wash of the last previous charge of cake, is passed through valved line 167 into manifold 153, through heater 157 and into the selected washer 138 or 139, wherein it percolates through the fixed body of cake to effect the second washing thereof. This naphtha is withdrawn from either washer 138 or 139, as the case may be, and passes through header 165, a valved branch line 168, and into the tank 148. The naphtha in tank 150, which is the batch employed in the fourth wash of the last previous charge of cake, is then withdrawn through valved line 169 and passes in the same manner through the system and into the selected washer to effect the third wash therein. This batch of naphtha, used in the third wash, is passed through header 165, valved branch-line 170, and into tank 149. The naphtha in tank 151, which is the batch employed in the fifth wash of the last previous charge of cake, is withdrawn through a valved line 171 and passes through the system in a similar manner and into the selected washer to effect the fourth wash therein. This batch of naphtha is passed from the washer through header 165, valved branch-line 172, and into tank 150. The fifth wash of the cake is preferably effected by fresh naphtha which may be supplied to the system from storage tank 100 as follows: Naphtha is drawn through line 101 by pump 102 and forced through line 103, valved line 173, line 174, line 161 and through either of the branch lines 140 and 141 into the selected washer 138 or 139, wherein it percolates through the body of material therein to effect the fifth wash thereof. This naphtha is then withdrawn from the washer and is passed through manifold 165, valved branch-line 175 and into the tank 151. It is ordinarily preferred not to pre-heat this fresh naphtha from tank 100 employed in the fifth wash, however, in event it is desired to heat it, it may be passed from line 174 through a valved line 176 into the line 156 leading to heater 157, from which it passes through line 160, line 161, and into the washers 138 and 139.

Since the wax and oil-free washed aid is to be passed directly from the washers 138 and 139 to the untreated oil stock undergoing final chilling in tanks 39, 40 and 41, it is preferred to cool it following the several hot washes described above. To this end, naphtha or other suitable light distillate oil, is drawn from tank 180 through line 181 by pump 182 and is forced through a cooler 183 wherein it is chilled to a comparatively low temperature by cooling fluid supplied by a line 184. The chilled naphtha is passed from cooler 183 through a valved line 186 to line 161 and into the washer 138 and 139, wherein it percolates through the dewaxed filter-aid and substantially cools it. The naphtha so supplied to washers 138 and 139 is withdrawn therefrom through the connections already described and passes to manifold 165, from which it is withdrawn through a valved line 187 and returned to the tank 180. The chilled substantially wax and oil-free aid may be formed into a naphtha slurry and then withdrawn from washers 138 and 139 through line 144 or 145, as the case may be, and passed to the chilling tanks 39, 40 and 41 in the manner already described. This slurry may be formed with fresh naphtha drawn from tank 100, chilled in cooler 104 and passed through lines 107, 174 and 161 to the selected washer 138 or 139. The naphtha and aid are formed into a slurry by means of slow moving agitators which do not substantially impair the physical structure of the filter-aid material, thus maintaining the efficiency of the latter.

It will be seen that the aid is employed over and over again in the system. To guard against the eventual deterioration of the aid, it is preferred to withdraw a portion of it from the system following its removal in the form of a slurry from the washers 138 and 139. A portion of the aid may be withdrawn from the header 56 through a valved line 188 and passed to a settling tank 189 wherein the aid is permitted to settle out of the naphtha, the aid being withdrawn from the settling tank through a line 190 and the naphtha through a line 191. Ordinarily about 10% of the aid slurry is diverted to tank 189.

In order to aid the filtration operation in filter 63, the filter elements therein may be pre-coated with a slurry of filter aid in oil. The aid slurry necessary for such pre-coating may be formed in tanks 85 and 86 and may comprise aid withdrawn from line 56, through lines 192 and 193 leading to tanks 85 and 86 and a portion of the filtrate from filter 63 passed to tanks 85 and 86 through lines 83 and 84, already described. The aid and filtrate are thoroughly admixed in tanks 85 and 86 by suitable agitating means to form the desired slurry, which is withdrawn from the tanks 85 and 86 through respective lines 194 and 195, through line 196 by pump 197, by which it is passed through a header-pipe 198 provided with a strainer 199, and into a storage tank 200. The precoating slurry, thus formed, is withdrawn from tank 200 through line 201 and passed to a header 202 from which a plurality of branch-lines 203 lead to a suitable coating means within the filter 63.

In order to supplant the filter aid passed from the system to tank 189, an equivalent amount of fresh aid may be admixed with the fresh stock undergoing the final chilling in tanks 39, 40 and 41. This additional aid may be supplied to the oil in any of these tanks as follows: The tanks 39, 40 and 41 are, respectively, provided with valved branch lines 205, 206 and 207 leading to a header 208 connected to a pump 209. A portion of the oil may thus be passed from any of the tanks 39, 40 and 41 to the pump 209 by which it is forced through a line 210, provided with an injector-type dry feed hopper 211 and leading to a header-pipe 212 to which is connected valved branch-lines 213, 214 and 215 leading to tanks 39, 40 and 41, respectively. Thus, a portion of the oil from any of the tanks 39, 40 or 41 may be circulated past the hopper 211, and back to the same tank from which it was withdrawn, or to any other of the tanks 39, 40 or 41. The filter aid in the hopper 211 flows into the stream of oil flowing past the hopper and thus becomes admixed with the oil. This operation is continued for each of the final chilling tanks until the oil therein contains the desired amount of aid.

In a specific operation, an overhead distillate lubricating stock containing about 7 to 8% wax, and having a viscosity of 85 sec. Saybolt at 210° F., a gravity of 24° Bé., and a pour point of 110° F., is first subjected to treatment with sulfuric acid, washed with a caustic solution, diluted with 30% naphtha, and percolated through decolorizing material, such as filter clay or diatomaceous earth. This stock is passed to the mixing tanks 8 and 9 to which additional naphtha is supplied through lines 132 and 133 or 134 to bring the naphtha content of the mixture to about 43%. The naphtha added to the stock in tanks 8 and 9 may be at least in part that produced as filtrate in the cake filter 114 and is passed to the tanks 8 and 9 by lines 132, 133 and 134, as already described. If more naphtha is required, the amount necessary may be supplied from storage tank 100 through a valved line 220, leading from line 103, into tanks 8 and 9 through branch-lines 221 and 222, respectively. It is preferred to mix a complete batch of stock in one of the tanks 8 or 9 and supply such stock to the system while another batch is being formed in the other tank.

The naphtha-diluted lubricant oil stock is then passed through the pre-coolers 15 to 19 and 25 to 27 wherein it is substantially cooled, say to 10° F., first by the countercurrent flow of filtrate from filter 63 and subsequently by brine in countercurrent flow. The pre-chilled stock is then passed to the final chilling tanks 39, 40 and 41, wherein it is chilled to the temperature at which it is desired to subject it to filtration and also has admixed with it, the filter aid. The aid, as previously described, is supplied in a naphtha slurry withdrawn from washers 138 and 139. This slurry contains from about 1.8 to 2 lb. per gallon of naphtha and is introduced into chillers 39, 40 and 31 in an amount necessary to form a final stock of about 55% naphtha and about 45% of the lubricant oil, the amount of aid being about 1 lb. per gallon of the lubricant oil. It is preferred to operate the chillers 39, 40 and 31 alternately, so that one of them will contain completely chilled, diluted aid-containing stock which may be supplied to the filter 63 while the pre-chilled stock is undergoing the final chilling, dilution, and admixing with aid in the others. The above mixed stock is fed to the filter 63, say at a temperature of −18° F.

The re-pulpers 96 and 97 for the filter cake from filter 63 are preferably alternately operated; that is, a batch of filter cake is subjected to the re-pulping operation with cold naphtha maintained in one re-pulper while the other receives filter cake, from the hopper 93, to be repulped therein. The washers 138 and 139 are also operated alternately. That is, a batch of cake is subjected to all of the washings in one washer while the washed aid in the other is being passed to the chillers 39, 40 and 41 in the form of a cold naphtha slurry and the emptied washer receives additional filter cake.

The filtrate stock withdrawn from the filter 63 when separated from the naphtha, has a pour point of 10° F., a viscosity of 90 sec. Saybolt at 210° F., and a gravity of 23.5 Bé., and represents about 85% of the original lubricant stock.

It will be seen that the lubricant stock retained in the filter cake formed in filter 63 is substantially removed in naphtha solution in the filtrate from the filter 114 and is admixed with fresh stock to be treated. Accordingly, the loss of lubricant is very low. The entire operation in all its various stages is particularly adapted to avoid effecting any substantial change, or breaking down, of the physical structure of the particles of filter aid, as far as possible. I have found that the efficiency of such filter-aid material is materially reduced if the agglomerate of filter aid particles is maintained. In the present invention the filter-aid is subjected to a minimum of agitation. When it is necessary to effect its agitation, slow moving agitators are employed. The repulpers 96 and 97 are so operated that the aid is subjected to a minimum of abrasion, and is formed into a slurry with a minimum of agitation. By employing the percolating type of washers for removing the wax and oil from the filter aid, the aid is subjected to a minimum of handling and abrasion, and its efficiency is not materially impaired. Also, by introducing the aid into the stock to be filtered toward the end of the chilling operation, the aid is not subjected to prolonged agitation and very little agitation is necessary, if at all, to maintain the aid in suspension to the finally chilled stock. The aid is formed into a slurry whenever possible and is passed in such form to subsequent operations, so that it will be subjected to a minimum of abrasion.

It will also be seen that the various materials, products, etc., are, at all times, maintained within a closed system. Thus, evaporation losses and fire hazard are minimized.

While in the aforedescribed embodiment of the invention naphtha has been employed as a diluent for the oil, and a solvent for effecting removal of the separated wax, it will be understood that any other known oil soluble diluents and wax-solvents may be employed instead; naphtha, being ordinarily preferred because of its availability and its low cost. It will be understood, therefore, that the term "naphtha" embraces, in a broader sense, any suitable oil diluents and wax anti-solvents, for example, ethylene dichloride, a mixture of butanol and benzol (with or without naphtha), a mixture of alcohol and xylol, etc.

Although the present invention has been described in connection with the details of a specific embodiment thereof, it is not intended that such details should be regarded as limitations on the scope of the invention, except in so far as included in the accompanying claims.

I claim:

1. The process of dewaxing oils by the use of cellular filter aids which comprises diluting an oil-wax mixture with a diluent to lower its viscosity at dewaxing temperatures, cooling the diluted mixture to a temperature of about 10 to 40° F. to effect partial solidification of wax, adding a slurry of cellular filter aid to the partially cooled mixture, cooling the resulting mixture in a body with mild agitation to a temperature at which substantially all of the wax is solidified, filtering the solidified wax and cellular filter aid material from substantially waxfree diluted oil, washing wax from said cellular filter aid with naphtha at a temperature of about 160° F., forming a cold oil slurry of said filter aid while it is still wet with oil and re-introducing said cold oil slurry of recovered filter aid back to the body of oil which is undergoing cooling.

2. The process of dewaxing mineral oils by the use of cellular filter aids which comprises diluting an oil-wax mixture with a diluent to reduce the viscosity of the mixture at dewaxing temperatures, cooling the mixture to effect partial solidification of wax, adding a slurry of cellular filter aid to the cooled mixture containing solidified wax, cooling the resulting mixture in a large body with mild agitation to a temperature at which substantially all of the wax is solidified, filtering the solidified wax and cellular filter aid material from substantially waxfree diluted oil, removing wax from the filter aid by means of a warm solvent which is maintained below the boiling point of water, maintaining the filter aid continuously wet with oil and forming a slurry of said filter aid in cold oil as soon as it is free from wax, introducing said slurry of used filter aid into said large body of the cooled mixture containing solidified wax, continuously removing about 10% of the filter aid from the system and continuously adding an equivalent amount of fresh filter aid to compensate for that which is removed.

3. In a process for dewaxing oil, the method which comprises solidfying wax and filtering it from oil in the presence of a filter aid to give dewaxed oil and a filter cake material, maintaining a body of said cake material in fixed position, percolating through said cake body, in separate operative steps, a plurality of separate batches of a liquid wax-solvent, withdrawing each of said batches of solvent after percolation through said cake-body and maintaining each of said batches separate from the other, withdrawing from the system the batch of solvent employed in the initial of the percolation steps, percolating in the manner aforesaid the remaining batches of solvent through another fresh fixed body of said cake material, and withdrawing from the system the batch of solvent employed in the initial of the percolation steps relative to said second body of cake-material.

4. In a process for dewaxing oil, the method which comprises solidifying wax and filtering it from oil in the presence of a filter aid to give dewaxed oil and a filter cake material, maintaining a body of said cake material in fixed position, percolating through said cake body, in separate operative steps, a plurality of separate batches of a liquid wax-solvent, withdrawing each of said batches of solvent after percolation through said cake-body and maintaining each of said batches separate from the other, withdrawing from the system the batch of solvent employed in the initial of the percolation steps, percolating in the manner aforesaid the remaining batches of solvent through another fresh fixed body of said cake material, said remaining batches of solvent being employed in the treatment of the said second body of cake-material in the same order as they were employed in the treatment of the first body of cake-material, and withdrawing from the system

the batch of solvent employed in the initial of the percolation steps relative to said second body of cake-material.

5. In a process for dewaxing oil, the method which comprises solidifying wax and filtering it from oil in the presence of a filter aid to give dewaxed oil and a filter cake material, maintaining a body of said cake material in fixed position, percolating through said cake body, in separate operative steps, a plurality of separate batches of a liquid wax-solvent, withdrawing each of said batches of solvent after percolation through said cake-body and maintaining each of said batches separate from the other, withdrawing from the system the batch of solvent employed in the initial of the percolation steps, percolating in the manner aforesaid the remaining batches of solvent through another fresh fixed body of said cake material, said remaining batches of solvent being employed in the treatment of the said second body of cake-material in the same order as they were employed in the treatment of the first body of cake-material, withdrawing from the system the batch of solvent employed in the initial of the percolation steps relative to said second body of cake-material, percolating through said second body of cake material, as a step subsequent to percolation of said remaining batches of solvent therethrough, a batch of fresh wax-solvent, and repeating said operation relative to a third body of cake-material.

6. In a process for dewaxing oil, the method which comprises solidifying wax and filtering it from oil in the presence of a filter aid to give dewaxed oil and a filter cake material, maintaining a body of said filter material in a fixed position in a closed chamber, percolating a liquid wax-solvent through said cake body, and separately withdrawing from said chamber the solvent containing dissolved wax, and the substantially wax-free filter aid.

7. In a process for dewaxing oil, the method which comprises solidifying wax and filtering it from oil in the presence of a filter aid to give dewaxed oil and a filter cake material, maintaining a body of said cake material in fixed position in a closed chamber, percolating a liquid wax-solvent through said cake body, said solvent being at a temperature not below the melting point of said wax-material, and separately withdrawing from said chamber the solvent containing dissolved wax, and the substantially wax-free filter aid.

8. In a process for dewaxing oil, the method which comprises solidifying wax and filtering it from oil in the presence of a filter aid to give dewaxed oil and a filter cake material, admixing said filter cake material with a liquid oil-solvent and mildly agitating the mixture to form a slurry of said cake-material and said solvent, subjecting the slurry to a filtration operation wherein the solvent and dissolved oil constituents thereof are separated as filtrate, and wax and filter-aid are separated in the form of filter cake, subjecting said last-named filter-cake to a wash with a liquid-wax solvent, and separating the solvent containing dissolved wax-material from the filter-aid.

9. In a process for dewaxing oil, the method which comprises solidifying wax and filtering it from oil in the presence of a filter aid to give dewaxed oil and a filter cake, material, admixing said filter cake material with a liquid oil-solvent and mildly agitating the mixture to form a slurry of said cake material and said solvent, subjecting the said slurry, while maintaining it at a temperature sufficiently low to avoid solution of wax-material in said solvent, to a filtration operation wherein the solvent and dissolved oil constituents thereof are separated as filtrate, and wax and filter-aid material are separated in the form of filtercake, subjecting said last-named filter-cake to a wash with a liquid-wax solvent, and separating the solvent containing dissolved wax-material from the filter-aid material.

10. In a process for dewaxing oil, the method which comprises solidifying wax and filtering it from oil in the presence of a filter aid to give dewaxed oil and a filter cake material, admixing said filter cake material with a liquid oil-solvent and mildly agitating said mixture to form a slurry of said cake material and said solvent, subjecting the said slurry, while maintaining it at a temperature sufficiently low to avoid solution of the wax-material in said solvent, to a filtration operation wherein the solvent and dissolved oil constituents thereof are separated as filtrate, and wax and filter-aid are separated in the form of filter cake, passing said last-named filter cake to a closed chamber, maintaining the body of said last-named filter cake in fixed position in said chamber, percolating a liquid-wax solvent through said fixed cake body, and separately withdrawing from said chamber the solvent containing dissolved wax, and the substantially wax and oil-free filter-aid material.

11. In a process for dewaxing oil, the method which comprises solidifying wax and filtering it from oil in the presence of a filter aid to give dewaxed oil and a filter cake material, admixing said filter cake material with a liquid oil-solvent and mildly agitating the mixture to form a slurry of said cake material and said solvent, subjecting the said slurry, while maintaining it at a temperature sufficiently low to avoid solution of the wax-material in said solvent, to a filtration operation wherein the solvent and dissolved oil constituents thereof are separated as filtrate, and wax and filter-aid are separated in the form of filter cake, passing said last-named filter cake to a closed chamber, maintaining a body of said last-named filter cake in fixed position in said chamber, percolating a liquid-wax solvent through said fixed cake body, said solvent being at a temperature not less than the melting point of said wax-material, and separately withdrawing from said chamber the solvent containing dissolved wax, and the substantially wax and oil-free filter-aid material.

12. The method of claim 1 wherein the diluent is a wax antisolvent.

13. The method of claim 2 wherein the diluent is a wax antisolvent.

CHESTER E. ADAMS.