O. C. SWAN.

PROCESS AND APPARATUS FOR TREATING OILS.

APPLICATION FILED JUNE 11, 1917.

1,250,526.

Patented Dec. 18, 1917.

2 SHEETS—SHEET 1.

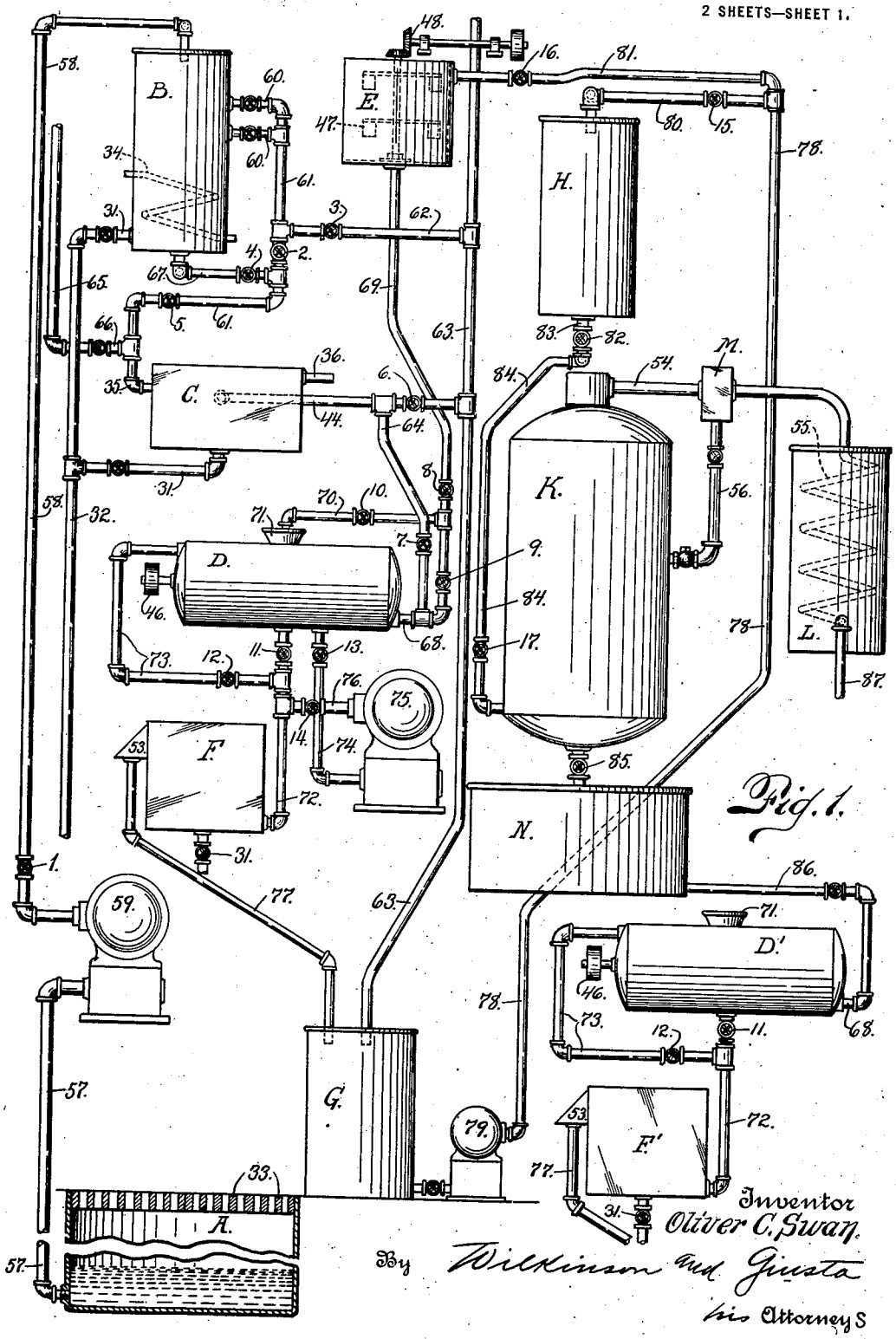


Fig. 1.

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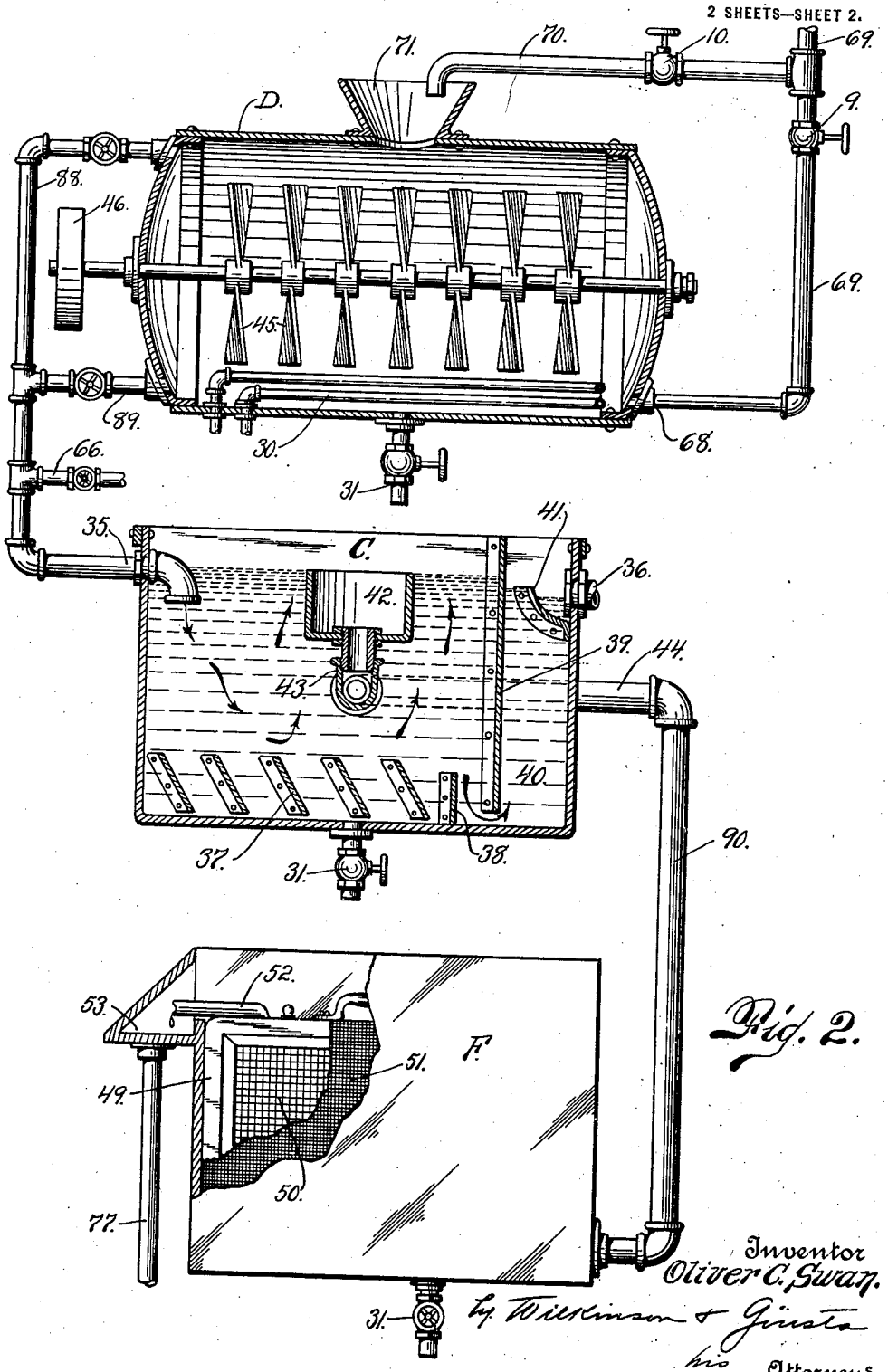


Fig. 2.

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UNITED STATES PATENT OFFICE.

OLIVER C. SWAN, OF DENVER, COLORADO, ASSIGNOR TO THE SWAN PROCESS OIL COMPANY, OF DENVER, COLORADO, A CORPORATION OF COLORADO.

PROCESS AND APPARATUS FOR TREATING OILS.

1,250,526. Specification of Letters Patent. Patented Dec. 18, 1917.

Application filed June 11, 1917. Serial No. 174,023.

To all whom it may concern:

Be it known that I, OLIVER C. SWAN, a citizen of the United States, and a resident of the city and county of Denver, State of Colorado, have invented a certain new and useful Improved Process and Apparatus for Treating Oils; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to an improved process and apparatus for treating oils, and more particularly lubricating oils that have been used and are generally allowed to go to waste.

While my present invention is not necessarily limited, in its application, to the treatment of any specific nature of lubricating oils, or their source of supply, still in the following specification I have deemed it desirable to refer to this particular field of usefulness by way of illustration.

Even during this era of intensive conservation of ordinary waste values, enormous losses, almost incredible, are annually sustained from the waste of the heavy viscous lubricating oils, the refuse from the cylinders of internal combustion engines and other lubricating sources.

For instance, the used oils drained from the crank cases of gasolene engines, besides being densely discolored and malodorous, are more or less gummy and heavily charged with unused gasolene, carbon in suspension and other foreign substances, manifestly deleterious, in that state, for use as a lubricant. The same is largely true with other used lubricating oils from other sources, wherein they are heavily laden with dross impurities, and even in unrefined crude oils these objectionable impurities have to be eliminated.

With systems as heretofore generally employed for purification purposes, it is believed to be impracticable to entirely eliminate these impurities by the ordinary methods of filtration.

The primary object of the present invention is to more satisfactorily treat these heavy viscous oils, and more particularly to reclaim the otherwise discarded refuse oils, heretofore referred to, by removing therefrom their organic and inorganic impurities and also their volatile constituents deleterious to the most effective uses of lubrication, thus restoring the impure oils to their normal or even improved conditions.

In the process and apparatus disclosed in a former application, Serial No. 79,680, filed February 21, 1916, the substantially successful reclamation of these used oils was accomplished in part by the introduction therein of a harmless treating agent, such as kieselguhr, for preparing the same *en masse* or as a conglomerate mixture, functioning for more effective filtration.

In the present application, I still employ my former method in substance, but in addition I have introduced other beneficial steps in the method of treatment, all of which will hereinafter appear in detail, the particular steps and features of novelty being succinctly specified and set forth in the appended claims.

In fully disclosing the invention, I will now first refer to the accompanying drawings, embodying my improved apparatus or system for carrying out the process, in which drawings like parts are designated by the same reference characters in the several views, of which—

Figure 1, is an elevational view, illustrating diagrammatically a systematic arrangement for carrying out the process, the receiving tank for the waste impure oils, being shown in vertical section, and partly broken away; and

Fig. 2, is an enlarged view of a slightly different arrangement of the treating tank, flotation separator and pressure filter, relatively to each other, the treating tank and flotation separator being shown in vertical longitudinal section, and the pressure filter in broken away elevation and partly in section.

To avoid a stretched out illustration on several sheets of drawings, the system is simply shown diagrammatically in comprehensive yet compact arrangement, with the several elements disposed in proper sequential order, but in actual practice it will be understood that an installed plant would preferably occupy the several floors of a building, and the piping lines varied accordingly. The flow of oil through the various steps of the process is accomplished either by gravitation or through the agency of suitable pumps, or by both methods conjointly, as desired.

Briefly stating first the several tank or container elements of the system, A designates a receiving tank for the impure oils to be treated, B one of a series of heated clarifying tanks or defecators, C a flotation separator, D a treating tank, E a mixing receptacle for the treating agent, and F a filter press or other suitable pressure filter, having the usual filter frames, the foregoing elements functioning to clarify and purify the oil prior to further treatment by distillation, which latter forms an important step in the present process.

G designates one or more clear oil container tanks, H one of a series of clear oil still supply tanks, K the oil still, L a condenser, M a "catch-all" or vapor trap, N one of a series of residual oil storage tanks, and D' and F', respectively, designate a treating tank and pressure filter, for further treating and refiltering the more or less purified oil after its volatile constituents have been distilled off.

The several elements mentioned are suitably coupled up by various pipe lines and branch pipes, pumps and controlling valves being supplied, where needed, but as these equipment fittings are so numerous, and as their general arrangement and functioning are fairly obvious from the drawings, it would only result in unnecessary repetition to specify them in detailed connection at this point, as they will be fully referred to by reference characters in the description of the operation of the system, in carrying out the steps of the process.

Where desirable, the various receptacles are provided with heating coils, primarily for increasing the fluidity of the heavy oils, illustrated only, at 30, in the sectional view of the treating tank D, Fig. 2. Similarly they may be equipped where needed with the usual appurtenances, not shown, such as thermometers, water and oil gages, relief valves, sight glasses, peep-holes, sampling cocks, etc. Also valve controlled outlets 31 may be employed for drawing off sediment and for washing out purposes, and may be coupled up with a waste drainage pipe 32.

The receiving tank or tanks A are preferably provided with a strainer or grating 33 to initially screen off any contained coarse impurities, in the impure oils, liable to injure the pumps or system. These tanks are in the nature of "sump" tanks, sunk to a level with the floor, so that barrels of oil may be readily rolled thereover and discharged.

The defecators B are open tanks, into which a defecating agent may be introduced, when needed, and are suitably heated in any way, shown conventionally by an internal steam coil 34.

The preferred construction of the water flotation separator C is illustrated in the sectional view, in which the tank is provided with an inlet pipe 35, which may serve both as a water and oil inlet, and with an outlet water pipe 36. The bottom of the tank may also have the inclining baffle plates 37, for deflecting the heavy precipitated impurities. 38 designates a shallow upwardly disposed vertical baffle plate and 39 a deeper downwardly disposed one, the latter providing, with the former and with the end wall of the tank, a channel 40 for directing the excess water to the waste overflow 41, thence through the outlet water pipe 36 to a sewer or otherwise. 42 is a collecting trough or cup, for the overflow of floated oil, the open top of which cup is disposed slightly above the level of the water overflow 41. The bottom of the cup may have an elbow fitting 43 coupled with the oil outlet pipe 44.

The tank D is adapted to receive the oil to be treated and also a certain harmless treating agent, in the nature of an inert absorbent medium as hereinafter referred to. The oil may be introduced into the tank D, after passing through the water flotation separator C, as shown in Fig. 1, or the relative positions of these tanks may be reversed as in Fig. 2.

Any suitable provision is made for agitating the contents of the tank D to cause a thorough commingling of the oil and treating agent as a conglomerate freely flowing mass. While not so limited this is conveniently shown by the stirrers or agitator blades 45, mounted on a rotary shaft driven by any suitable means, conventionally designated by the band pulley 46.

The treating agent might be directly introduced into the tank D, but as a convenient expedient it is desirable to employ the mixing receptacle E, in which the treating agent is first mixed with clean oil and caused to flow into the treating tank in proportionate amounts as desired.

The details of this mixing receptacle are immaterial, any suitable agitating means being provided, indicated conventionally as comprising rotatably mounted stirrers 47, shown in dotted lines, driven by gearing 48.

After washing and treating, or reversely treating and washing the oil, the conglomerate mass of the oil and treating agent is passed through the first filter element of the system. This filter element F may be either the usual filter press, or as shown in Fig. 2, in detail, a pressure filter of the well known type, employing replaceable bag covered frames. In Fig. 2, 49 designates the readily removable and replaceable hollow filter frames, having wire gauze facings 50, which frames are enveloped by the filter cloth bags 51. The tops of the frames provided a clear oil space, discharging through the drip spouts 52, into the elongated trough 53, having an outlet connection for the purified filtered oil.

The details of the clear oil containers G, the still supply tanks H, and the residual oil storage tanks N, are immaterial, they simply being open tanks, preferably provided with heating coils.

Also the specific type of still K, while of considerable importance itself in more efficiently carrying out the process, is for a separate invention requiring no detailed description or illustration in so far as the broad steps of the process are concerned. It may not be amiss to state briefly, however, that it is of a type to prevent what is known in the art as "cracking" distillation, having upper steam jacketed chambers to maintain the top of the still at the same or even a higher temperature than the heated oil chamber at the bottom. The details of this preferred form of still are fully disclosed in my co-pending application for oil stills, Serial No. 165,240, as is also the vapor trap M, which is simply located in the vapor line 54 leading to the coil or worm 55 of the condenser L, its aim being to trap any sprays of oil entrained with the vapors, and conduct the former back to the still through the connection 56.

The treating tank D′ and pressure filter F′ are similar to the same elements D and F employed in the initial steps of the system, the local pump connections and treating agent supply pipes being omitted to avoid overcrowding of the drawings.

In carrying out the broad principles of my invention, I do not necessarily limit myself to the use of kieselguhr as the treating agent, although I prefer to use the same, or its equivalent, as owing to its diatomaceous or natural peculiar cellular formation, and the further fact that it is light and highly buoyant as a permeated oil laden vehicle, it is particularly adapted for use in the steps of my process employing an inert pulverized absorptive and filtration medium.

Having thus generally outlined the characteristic elements of the system and certain details thereof, I will now trace out the lines of connections between these several elements, and later the functioning of the whole system in carrying out the steps of the process involved.

57—58 is a pump line from the receiving tanks A to the defecators B, a pump 59 being interposed in the line as shown.

60 are valved outlets at the top of the defecators, connected with a defecator pipe line 61, which communicates at its other end with the inlet 35 of the flotation separator C. 62 is a branch from the line 61 to a supply conduit pipe 63 leading to the clear oil container tanks G from a position above the level of the defecators, its upper end serving as a vent.

65 is a water feed pipe, with a valved connection 66 communicating with the defecator line pipe 61, and 67 is a branch from the bottom of the defecators to the line 61, as shown.

68 is an inlet connection near the bottom of the treating tank D, and 64 is a branch pipe leading thereto from the oil outlet pipe 44 of the flotation separator.

69 is a pipe leading from the mixing receptacle E, and the lower end of this pipe also connects with the inlet pipe 68 of the treating tank, while a branch 70, from the pipe 69, discharges into the top of the tank D, as through a funnel opening 71.

72 is a pipe connection between the bottom of the tank D and the bottom of the first pressure filter F, and 73 is a pipe leading from the top of the tank D, at the end opposite the inlet 68, and connecting with the pipe 72 as shown. An auxiliary pump line is also shown, consisting of the pipe 74 leading from the bottom of the tank D to the suction chamber of a pump 75, the outlet pipe 76 of which connects with the pipe 72.

77 is a pipe conduit from the trough 53 of the pressure filter F to the clear oil containers G, in the initial steps of process, and from the trough 53 of the filter F′, following the step of distillation, from which latter filter the pipe 77 may lead to other treating tanks or filters, as desired, or to storage, for commercially packing in barrels or other containers.

78 is a pipe line, connected at one end, through a pump 79, to the bottoms of the containers G, and at its other end communicating, through the branch 80, with the open tops of the still supply tanks H, and also with the mixing receptacle E, through the extension pipe 81.

Below the still supply tanks H extends a branch pipe 82, with which there is connected valved outlets 83 from the respective still supply tanks.

A single conduit pipe 84 leads from the branch supply 82 into the bottom of the still K.

85 is a valved connection providing for the discharge of the residual oil from the still to the oil storage tanks N, and 86 is a valved pipe leading from the residual oil storage tanks N to the inlet 68 of the treating tank D′, in the same substantial relation as the oil branch pipe 64, excepting that the supply of oil is now from the tanks N and not from the flotation separator C which is not employed after distillation.

Also the other connections with and from this treating tank D′ are the same and have, therefore, been numerically designated as previously described with reference to the treating tank D and pressure filter F, with the exception that the treating mixture pipe lines 69 and 70 have been omitted, as well as the pump connections 74—75—76, for the reasons before stated.

87 is an outlet from the worm coil of the condenser, and while not illustrated with reference to the refinement of lubricating oils, as a matter of actual practice, this outlet 87 leads to a similar treating and filtering process, as before described with reference to the lubricating oils, so that the condensed vapors or highly volatile petroleum distillates, in the nature of naphtha, are also conserved as a valuable refined commercial product.

In the arrangement shown in Fig. 2, the flotation separator C is disposed between the treating tank and pressure filter, the valved outlet pipe 88, leading from the top of the tank D, and the valved branch 89, leading from the bottom thereof, communicating with the combined oil and water inlet 35 of the flotation separator C, while the oil outlet pipe 44 from the latter is connected, through the pipe 90, with the bottom of the pressure filter. Otherwise the functioning of the system is substantially the same in both instances.

These various pipe lines and branches, as just described, are suitably provided with controlling valves, as shown, and certain of these valves, hereinafter more specifically referred to, have been designated by the reference numerals 1 to 17, inclusive.

In operation, the valve 1 being opened and the pump 59 started, the impure oil is pumped up from the tanks A, through the pipe line 57—58, to the defecators B, where it is first highly heated, as by steam coils 34, and allowed to settle.

If acidity appears in the oil, milk of lime, or its equivalent, may be introduced into the defecators as a neutralizing agent, or any other suitable defecating agent, as desired, may be employed generally for clarification purposes.

Before subjecting the partially defecated oil to further treatment, with the valve 3 open and the valves 2 and 4 closed, any supernatant clear oil may be decanted off from desired levels in the defecators (without passing through the entire system) by way of the valved branches 60, the upper portion of the pipe line 61, branch 62 and supply conduit 63, from which it is discharged into the clear oil containers G. Or if it is desired to wash the decanted clear oil first, to eliminate odors etc., with the valves 3 and 4 closed and the valves 2 and 5 open, the decanted oil will flow to the inlet 35, into and through the water of the flotation separator C, thence out through the oil outlet pipe 44, the valve 6 being also open, and into the conduit 63, leading to the containers G.

To pass the remaining contents of the defecators through the whole initial treating system, the valves 2 and 6 being closed and the valves 4, 5 and 7 opened, the flow from the defecators will be through the branch 67, the lower line 61, the inlet 35, and through the water of the flotation separator, the washed oil passing thence through the pipes 44 and 64 into the treating tank D at the inlet 68.

At the same time water, preferably heated, is supplied to the flotation separator C from the water pipe 65, the valved connection being open, through the combined oil and water inlet 35.

In passing through the flotation separator, the oil substantially follows the course indicated by the main arrows, the heavier impurities washed out being precipitated and baffled to the bottom of the tank, and the floated or supernatant washed oil itself, overflowing into the open cup 42, thence through the elbow 43 and oil outlet pipe 44 as mentioned, while the excess water is deflected around through the channel 40, and discharges above the overflow 41 into the waste water outlet pipe 36, the top of the overflow located slightly below the open top of the cup 42 preventing the water from reaching the level of the open top of the cup 42, and hence water will not flow out with the oil.

Also, with the valves 8 and 9 open and the valve 10 closed, the kieselguhr, or other substantially equivalent treating agent, mixed with clean oil, is caused to flow, through the pipe 69 and inlet 68, into the treating tank D at its bottom, while with the valve 9 closed and the valves 8 and 10 open, the discharge of the treating mixture is in through the top of the treating tank, which is oftentimes desirable.

In the treating tank D the partly defecated and washed oil and the treating mixture are thoroughly agitated to cause an intimate commingling of same, resulting in a conglomerate freely flowing mass.

When the treatment in the tank D is to be continuous, the valves 11, 13 and 14 are closed and the valve 12 opened, when the mixture passes through the outlet pipe 73 and the pipe 72 into the bottom of the pressure filter F. Where the treatment is not continuous, but in charges, the valves 12, 13 and 14 are closed and the valve 11 opened, whereupon the flow of the mixture is directly through the pipe 72 into the pressure filter. And finally, in cases where the pressure from the inside and the outside of the filter is so equalized that the flow therethrough is diminished or retarded, the valves 11 and 12 are closed and the valves 13 and 14 opened, so that upon operation of the pump 75, the mixture is sucked from the bottom of the tank D and forced positively into the pressure filter by way of the lower pipe line 72.

Up to the point of filtration through the pressure filter F, the kieselguhr has acted

upon the impregnating entrained oil to absorb in a large measure its colloidal and coloring substances, and it now becomes necessary to separate the oil from the kieselguhr and the remaining insoluble suspended impurities.

During the operation of filtration through the pressure filter F, whether the delivery thereto is by gravitation or forced feed, it is obvious that the flow of the treating agent will become obstructed and halted, but as the kieselguhr is very buoyant and does not settle, it gradually forms as a thickened surface exteriorly of the filter frames.

Instead, however, of clogging up and retarding filtration through the pores of the filter cloth bags, it acts reversely and itself becomes an extremely effective physical agency of separation, its innumerable walls of irregular microscopic cells providing an enormous area of filtering surfaces, as is understood, and the oil seeping through this sponge like porous mass is substantially freed from all carbonaceous and other insoluble matters, while the kieselguhr itself, with its absorbed gummy matters and other impurities, is halted in its flow, the filtered oil passing up and off through the drip spouts 52, of the filter frames, into the trough 53, from whence it is led, by the pipe 77, to the clear oil containers, as a substantially purified and clarified liquid.

While the oil is now substantially free of colloidal and general organic and inorganic impurities, it still contains a large percentage of naphtha and similar volatile constituents, very deleterious to the same for the highest lubricating efficiency.

The second phase, therefore, of the present improved process, and perhaps the most important step thereof, resides in the elimination of these harmful volatile constituents.

In the accomplishment of this, the now clear oil is led into a still, suitably heated to avoid "cracking" distillation so that vaporization of the lighter volatile constituents is effected as speedily as possible, without any of the vapors condensing in the still and falling back into the body of the oil.

The oil may first be pumped up through the pipe line 78 and branch 80 into the still supply tanks H, the valve 15 being opened and the valve 16, in the extension 81, closed.

It may also be conveniently stated here that, if it is desired to fill the mixing receptacle E with clean oil, this may readily be done by closing the valve 15 and opening the valve 16, as will be apparent.

From the still supply tanks H the bottom of the still is partially filled with the clear oil, and after distillation has progressed sufficiently to pass off as vapors the lighter distillates through the vapor line 54 and condenser coil 55, the valve 17, in the line 84, is set so that the feed of fresh oil to the still may be regulated as desired, the hot oil in the still serving to immediately vaporize off the lighter volatilizable constituents of the inflowing oil.

When the still finally becomes filled to the level desired, the valve 17 is shut off and the heavier distillates are gradually vaporized off also, until the residue oil has attained the flash and fire points desired, all as set forth fully in my oil still application before mentioned.

After the still is shut down, its contents may then be drawn off, into the residual oil storage tanks N, through the valved outlet 85.

The oil as a lubricant is now in excellent condition, being relieved substantially of most impurities as well as the naphtha distillates, but in order to still further improve the same, I find that extreme beneficial results are attained by further treatment after distillation, as extreme purifying action seems to be more effective after distillation. This may be in part accomplished by suitable filtration alone, although perfection is more nearly approached by conducting the residual oil through the steps initially applied, to the partially defecated oil, with reference to treatment with kieselguhr and subsequent filtration. This needs no further explanation, although the tank D′ and pressure filter F′ are illustrated as a means for carrying out these final steps.

Obviously the pipe 77 from the filter F′ may lead to storage or to further treating or filtering means, until such continued treatments result in the oil becoming practically pure white. This, however, would simply mean repetition of the first steps of treatment and filtration after distillation, and would therefore add no additional novelty to the process.

While I have thus disclosed my process and a practical system for carrying out the same, I do not limit myself to minor details, the process and apparatus not being restricted, excepting as limited by the scope of the ensuing claims, viewed from a fair standpoint of the doctrine of equivalents.

For this reason, the arrangement of the tank D, flotation separator C and pressure filter F, as shown in Fig. 2, is not deemed to be substantially different from that shown in Fig. 1.

What I claim as new and patentable, is:—

1. The process of reclaiming oils, which includes the step of treating the impure oil with an inert pulverized absorbent medium to initially relieve it of its foreign impurities; subsequently distilling from the clarified and purified oil its naphthas and finally subjecting the residue product, as relieved of its naphtha constituents, to further treatment by filtration, substantially as described.

2. The process of reclaiming oils, which includes the step of thoroughly combining a

proportionate amount of an inert pulverized absorbent medium with the impure oil to provide a conglomerate freely flowing mixture; then causing said mixture to flow into association with a retarding filtration agency, the flow of said treating substance and substantially colloidal and other foreign impurities being halted by said filtration agency as the oil percolates therethrough; and subsequently distilling from the clarified and purified oil its naphthas, substantially as described.

3. The process of reclaiming oils, which includes the step of thoroughly combining a proportionate amount of a suitable treating substance, substantially as set forth, with the impure oil to provide a conglomerate freely flowing mixture; then causing said mixture to flow into association with a retarding filtration agency, the flow of said treating substance and substantial colloidal and other foreign impurities being halted by said filtration agency as the oil percolates therethrough; subsequently distilling from the clarified and purified oil its naphthas; and finally subjecting the residue product, as relieved of its naphtha constituents, to further treatment by filtration, substantially as described.

4. The process of reclaiming oils, which includes the step of treating the impure oil to initially relieve it of its substantial foreign impurities; subsequently distilling from the clarified and purified oil its naphthas; then combining a proportionate amount of an inert pulverized absorbent medium with the residue oil, as relieved of its naphtha constituents, to provide a conglomerate freely flowing mixture; and finally causing said mixture to flow into association with a retarding filtration agency, the flow of said treating substance and substantial remaining impurities being halted as the oil percolates through said filtration agency in a refined state substantially as described.

5. The process of reclaiming oils, which includes the initial steps of washing and treating the impure oil with an inert pulverized absorbent medium, to provide a freely flowing conglomerate mixture of the oil and treating substance; then flowing said conglomerate mixture into association with a retarding filtration agency, the flow of said treating substance and substantially colloidal and other foreign impurities being halted by said filtration agency as the oil percolates therethrough in a substantially clarified and purified state; and finally distilling its naphthas from the clarified and purified oil, substantially as described.

6. The process of reclaiming oils, which includes the steps of initially heating the impure oil in a defecator, a suitable defecating agent being introduced as desired; then treating the partly defecated oil by passing the same through the water of a flotation separator and adding thereto a proportionate charge of an inert pulverized absorbent medium, to provide a freely flowing conglomerate mixture of the oil and treating substance, with the odors and heavier impurities washed out; then flowing said conglomerate mixture into association with a retarding filtration agency, the flow of said treating substance and substantial colloidal and other foreign impurities being halted by said filtration agency as the freed oil percolates therethrough in a highly defecated state; and finally distilling from said defecated residue oil its naphthas, substantially as described.

7. In a system for reclaiming oils, the combination of a treating tank for receiving the impure oils in conjunction with a proportionate amount of a suitable treating substance substantially as set forth; a filter tank suitably coupled up in communication with said treating tank and containing filtering means permitting of the percolation of oil therethrough while halting the flow of said treating substance and other impurities; a still suitably coupled up with the pure oil chamber of said filter tank; a vapor line leading off from said still; and means for further filtering the contents of said still after distillation, substantially as described.

In testimony whereof, I affix my signature.

OLIVER C. SWAN.