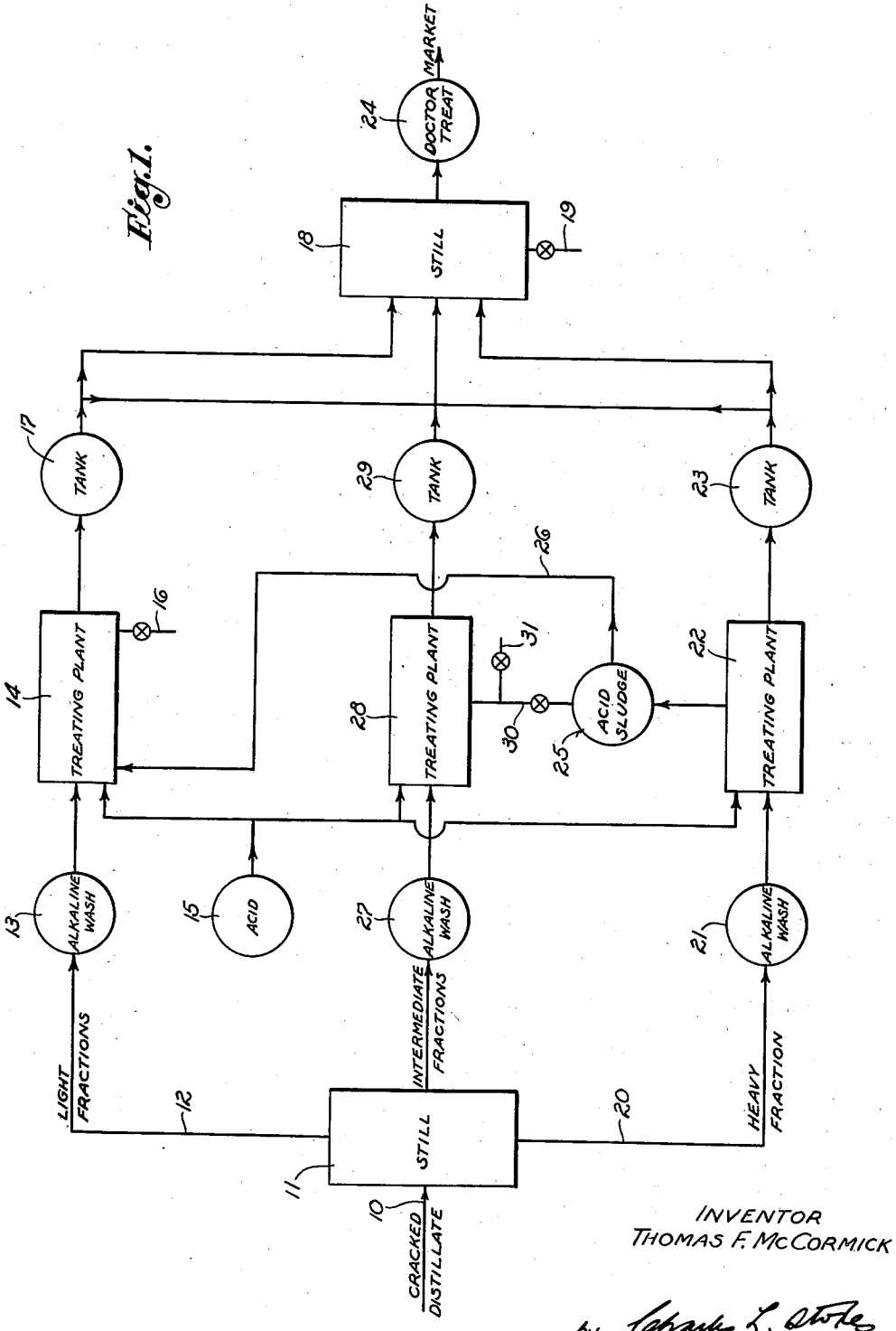
Oct. 22, 1940. T. F. McCORMICK 2,219,109

PROCESS OF DESULPHURIZING PETROLEUM OILS

Filed Nov. 16, 1935 7 Sheets-Sheet 1

Fig. 1.



INVENTOR
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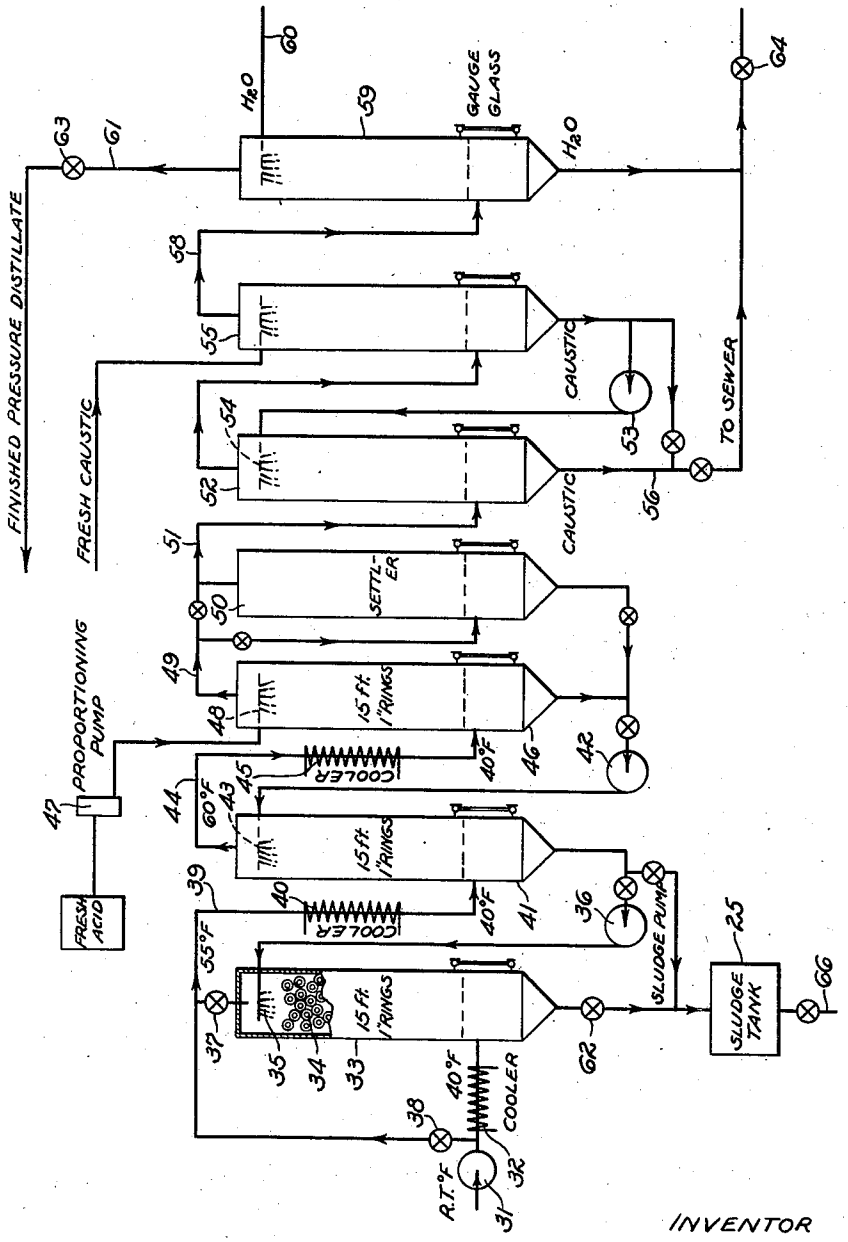
by Charles L. Stoddard
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PROCESS OF DESULPHURIZING PETROLEUM OILS

Filed Nov. 16, 1935 7 Sheets-Sheet 2

Fig. 2.



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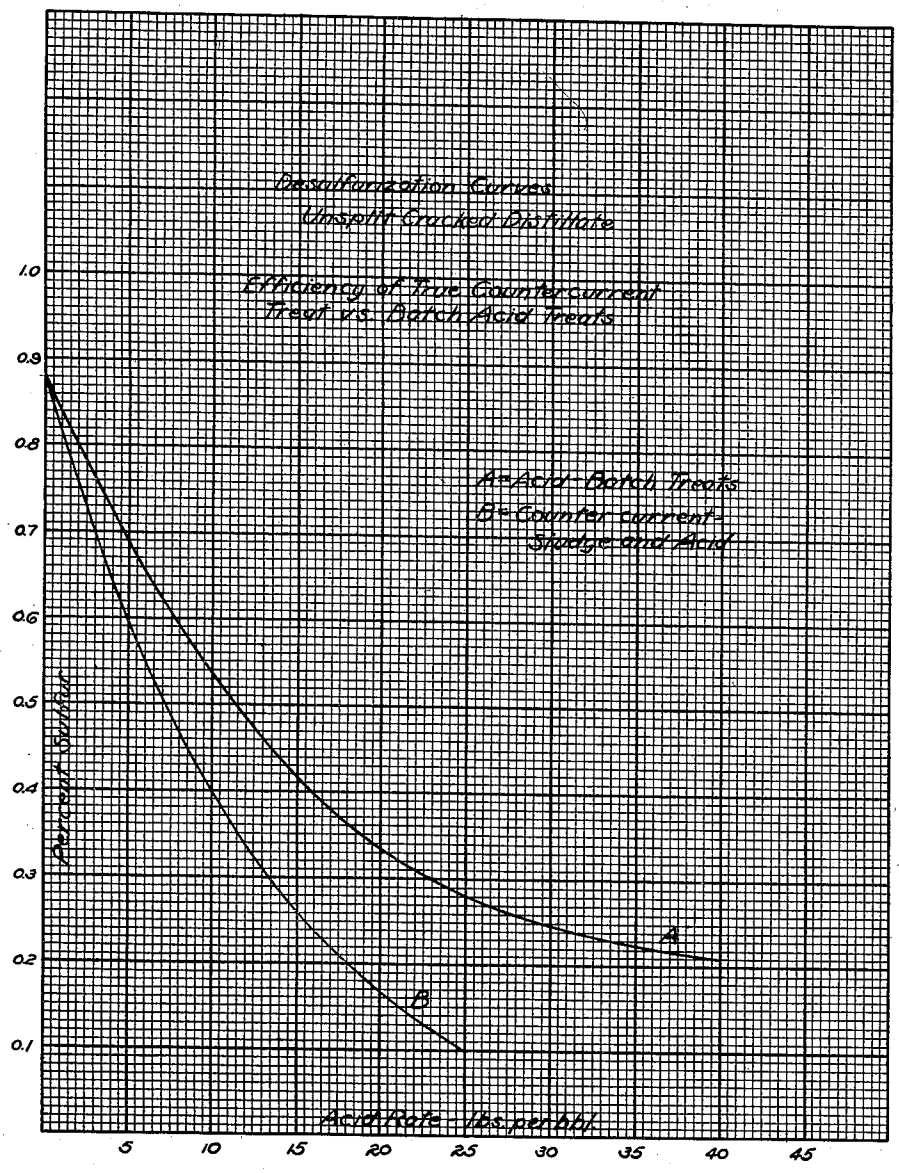
by Charles L. Stokes
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PROCESS OF DESULPHURIZING PETROLEUM OILS

Filed Nov. 16, 1935 7 Sheets-Sheet 3

Fig. 3.



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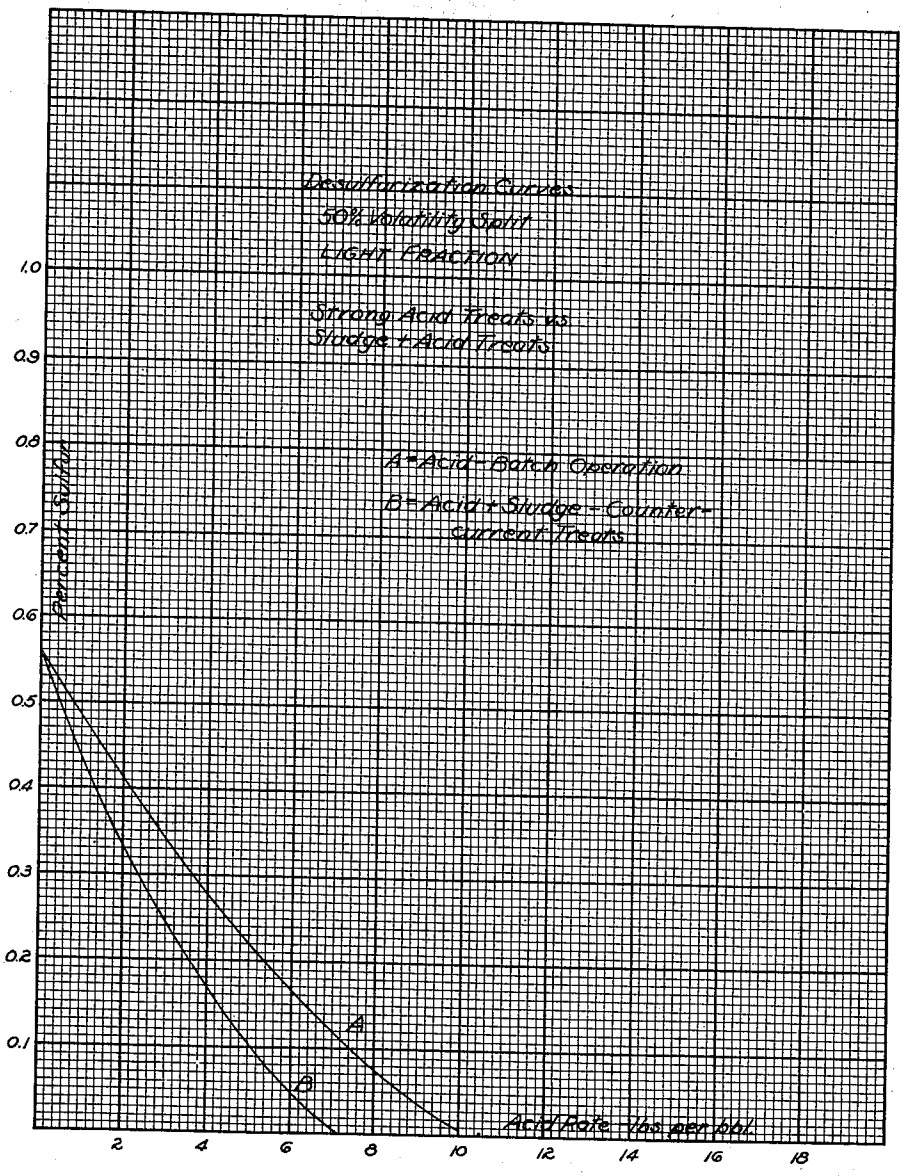
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PROCESS OF DESULPHURIZING PETROLEUM OILS

Filed Nov. 16, 1935 7 Sheets-Sheet 4

Fig. 4.



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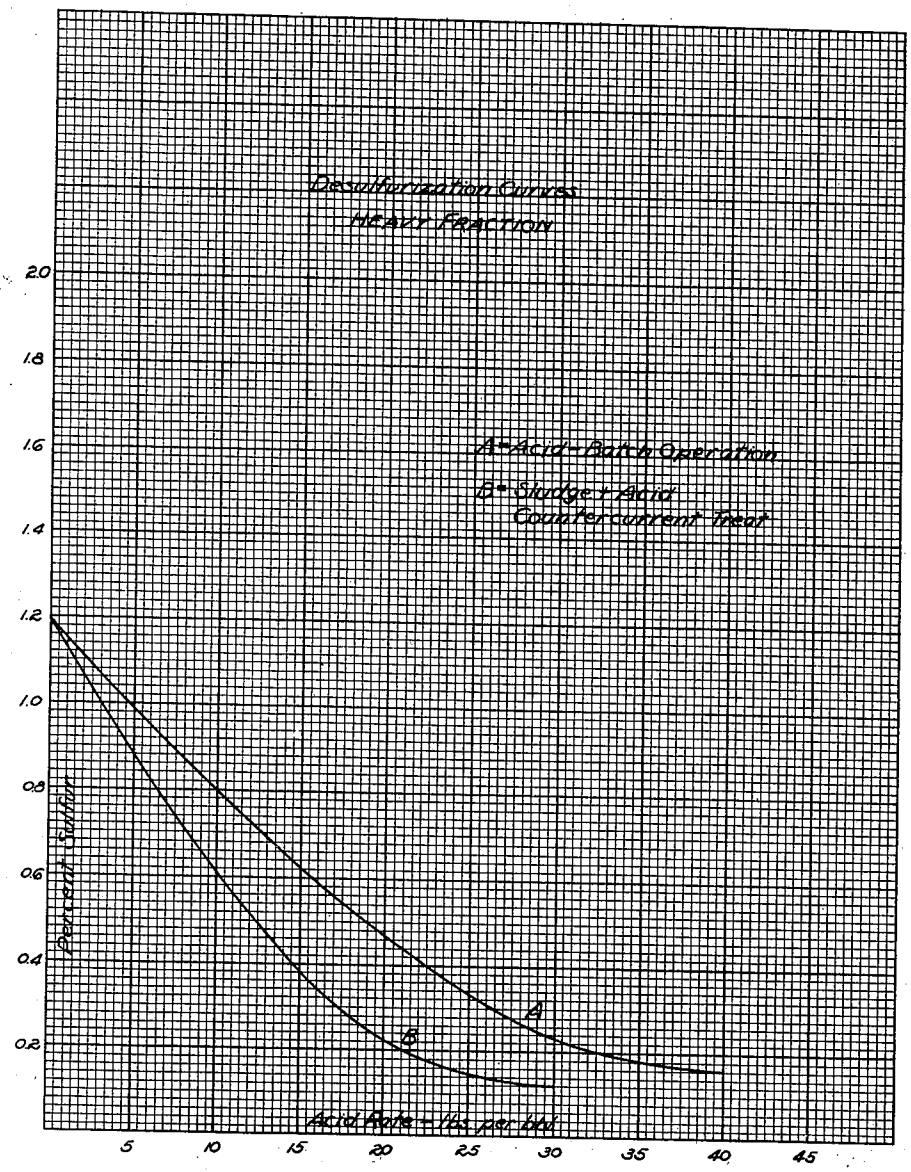
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PROCESS OF DESULPHURIZING PETROLEUM OILS

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Fig. 5.



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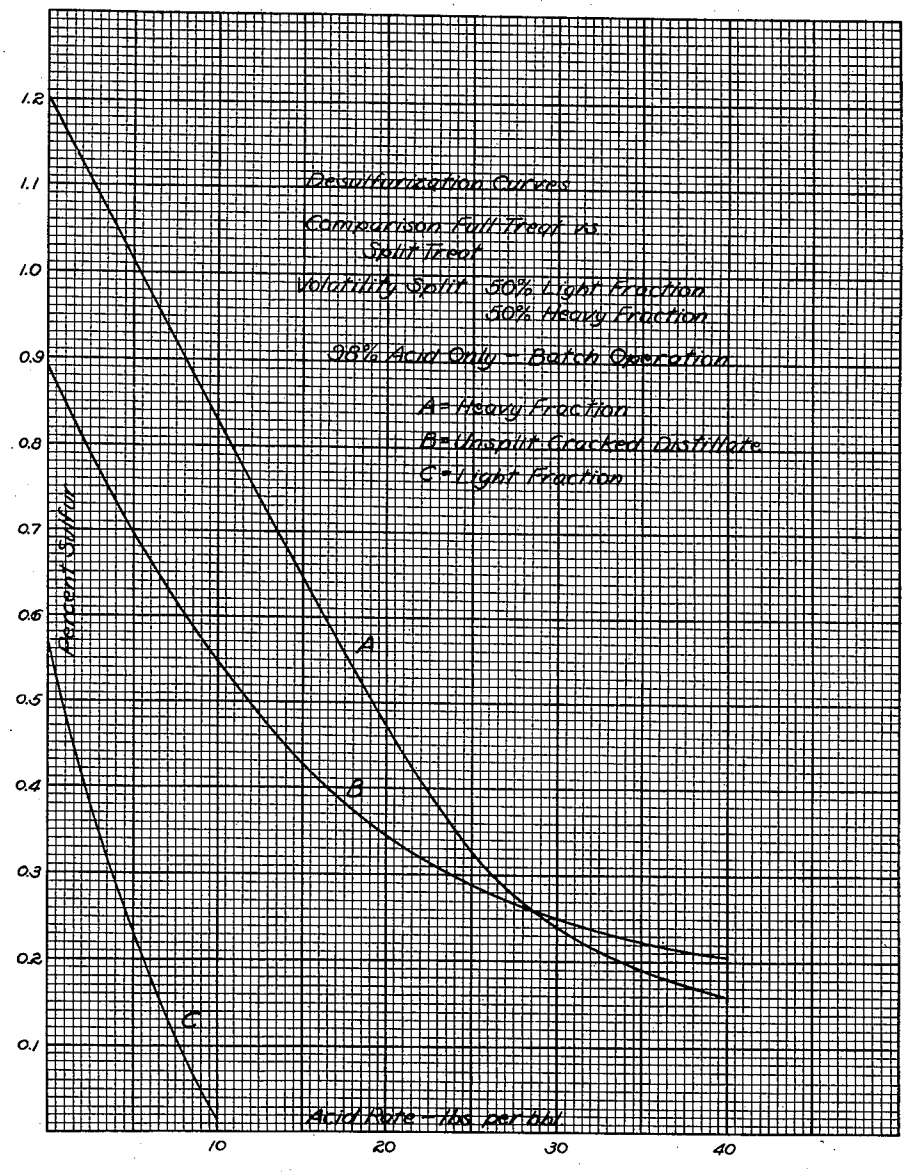
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PROCESS OF DESULPHURIZING PETROLEUM OILS

Filed Nov. 16, 1935 7 Sheets-Sheet 6

Fig. 6.



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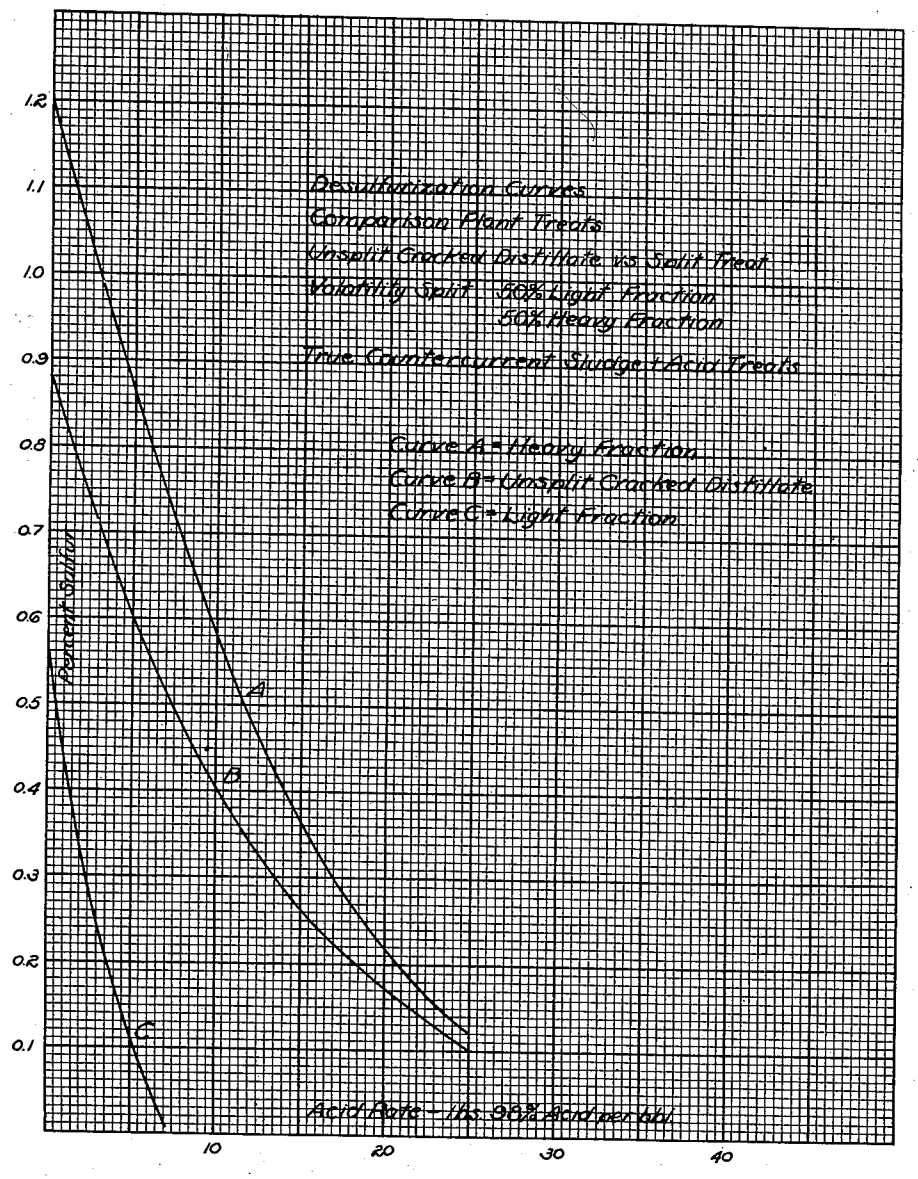
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PROCESS OF DESULPHURIZING PETROLEUM OILS

Filed Nov. 16, 1935 7 Sheets-Sheet 7

Fig. 7.



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Patented Oct. 22, 1940 2,219,109

UNITED STATES PATENT OFFICE

2,219,109

PROCESS OF DESULPHURIZING PETROLEUM OILS

Thomas F. McCormick, Martinez, Calif., assignor, by mesne assignments, to Tide Water Associated Oil Company, San Francisco, Calif., a corporation of Delaware

Application November 16, 1935, Serial No. 50,206

11 Claims. (Cl. 196—31)

This invention relates to the treatment of petroleum oil, or distillates thereof, and has for a particular object the reduction of the sulphur content of cracked distillates with concomitant improvement in color, odor and octane rating.

The invention is particularly applicable for the above purposes to a distillate derived from cracking petroleum, or its fractions, such as cracked gasoline which is selected for illustration herein, but the invention is not necessarily limited to processing such gasoline, being in a broad sense directed to the treatment of any petroleum or distillate thereof, having characteristics in conformity with this disclosure and responsive to the steps outlined herein.

Cracked gasoline is particularly useful for use as a fuel in internal combustion engines which, with modern high compression pressures, require a fuel with relatively high octane number to prevent detonation.

This octane number with ordinary cracked gasoline may be obtained by the addition thereto of well known anti-knock compounds such as tetra-ethyl lead, etc., but it is much more preferable and economical to utilize as far as possible the anti-knock values in the crude cracked gasoline itself.

This is accomplished by the herein described process in so treating a crude cracked gasoline with sulphuric acid that the selective solvent action of the acid is exercised in at least two directions, which may be termed a "split-treat," with great economy of acid and large reduction in sulphur.

Cracked gasolines vary in chemical structure, percentage of sulphur, etc., with the type of stock used for cracking as well as the type of cracking process employed. In general, cracked gasolines contain increased percentages of unsaturated hydrocarbons over the stock from which they were derived and usually contain a substantial quantity of sulphur compounds.

The unsaturated hydrocarbons, which include the olefines and aromatics, are highly desired in motor fuel as anti-knock compounds to reduce, or suppress, detonation and the problem of retaining the same during treatment with sulphuric acid for the removal of undesired sulphur is solved herein in a novel and highly useful manner.

It has been determined that when a total cracked distillate is carefully fractionated by taking a 10% cut comprising each fraction that the first few cuts up to about 40% are relatively low in sulphur while being the highest in octane number. Also, the same first few cuts are relatively high in percentage of unsaturated compounds which shows conformity with high octane number.

The remaining 60% of the cracked distillate shows increasing sulphur content up to about 70% and from there on to the end of the fractionation a slight drop in sulphur occurs, but in no way to a degree approaching the low sulphur content of the first 40%.

This may be better illustrated by the following table, which is typical of California cracked distillates of high sulphur content, and in which it will be seen that the sulphur content of each 10% fraction bears out the above statements, the sulphur being expressed as a percentage by weight of a particular cracked gasoline fraction.

Fraction No.	Percent of original	Sulphur, percent
1	10	0.19
2	10	0.34
3	10	0.90
4	10	1.24
5	10	1.44
6	10	1.48
7	10	1.74
8	10	1.69
9	10	1.40
10	10	1.37

The above fractions are, of course, taken in the usual manner in accordance with volatility of the fractions and the results show that a maximum sulphur content is reached when from about 70% to 80% of the distillate has been taken off.

If each of the above 10% fractions is then treated individually with the same amount of sulphuric acid, for instance 98% acid, for the purpose of reducing the sulphur content to a desired maximum, it may be seen there is a large jump in the sulphur content of the heavier fractions of the distillate from 40% on as shown in the following table:

Fraction No.	Per cent	Sulphur (raw stock), per cent	Sulphur (treated stock and distilled), per cent
1	10	0.19	0.01
2	10	0.34	0.02
3	10	0.90	0.04
4	10	1.24	0.06
5	10	1.44	0.16
6	10	1.48	0.23
7	10	1.74	0.74
8	10	1.69	0.80
9	10	1.40	0.74
10	10	1.37	0.70

This indicates that an amount of sulphuric acid which is sufficient to desulphurize more volatile fractions up to about 40% of the cracked distillate is insufficient to desulphurize the heavier fractions from 40% on.

The reason for this is believed to be that the

sulphur in the lighter and more easily desulphurized fractions is largely in the form of sulphides and mercaptans while in the heavier fractions the sulphur is in a different form, probably as thiophenes.

From this it may be seen that if a cracked total distillate is treated as a whole with sufficient concentrated sulphuric acid to remove the sulphur from the heavier fractions thereof, the lighter fractions must then be subject to a sulphuric acid treat far in excess of requirements to remove only sulphur and therefore the desired antiknock compounds of the lighter fractions will respond to the sulphonating and polymerizing action of the excess concentrated acid and are removed in the acid sludge and re-run distillation with large losses of the very constituents desired to be retained.

This defect in treatment is overcome in the present invention by utilizing methods of treating the total cracked distillate wherein the distillate is first separated by fractionation according to the sulphur content of the different fractions and each fraction thus separated is then treated separately with just sufficient sulphuric acid to remove the desired amount of sulphur and then the treated fractions may be blended to form the total finished gasoline containing a minimum percentage of sulphur and a high percentage of the unsaturates present in the stock before acid treatment.

The total cracked distillate may be separated into any desired number of fractions to be separately treated with sulphuric acid, but in commercial refinery operations, it is generally sufficient in obtaining the desired results to fractionate the crude cracked distillate, in accordance with boiling ranges, into two or possibly three fractions and then separately treating each fraction in accordance with its sulphur content.

The simplest way is, of course, to divide the total cracked distillate into two parts by fractionation, one part containing from about 20% to 60% of the lighter fractions relatively low in sulphur and relatively high in unsaturates, and the other part containing from about 80% to 40% of the heavier fractions relatively high in sulphur. Each fraction may then be separately treated with sulphuric acid of the same degree of concentration to assure the desired desulphurization but the rate of treatment, or pounds of sulphuric acid per barrel, for the lighter fraction will be far less than that required for the heavier fraction.

At times it may be desirable to similarly separate the crude total cracked distillate into three fractions:

(1) Light fractions relatively low in sulphur and relatively high in unsaturates comprising for instance about from 20% to 40% of the distillate.

(2) Intermediate fractions relatively high in sulphur which, however, is contained in compounds easily absorbed by, or reactive with, sulphuric acid, and comprising about from 30% to 50% of the distillate.

(3) Heavy fractions relatively high in sulphur which, however, is contained in compounds of the residual type requiring comparatively large amounts of concentrated sulphuric acid for their removal.

The distillation range of each fraction to be thus separately treated may be easily determined by simple laboratory control to fix the points at which the cuts should be made and at the same time to determine the rate of acid treatment for desired results. Hence, the invention is not limited to any particular fractional division of the total cracked distillate, but is applicable to the treatment of any number of fractions in which the described steps are used. Nor is the invention limited to the treatment of selected fractions for the removal of sulphur and retention of unsaturates, as it is applicable in its broadest sense to the selective application to selected fractions for removal of unsaturates of certain concentrations of sulphuric acid as, for instance, the removal of olefines from the lighter fractions relatively high in unsaturates to recover alcohols from the olefine containing acid sludge by hydrolysis.

The preferred application of the invention is, however, directed to the production of a motor fuel retaining the bulk of the unsaturates and one method of treating is shown in the accompanying drawings, in which:

Fig. 1 is a diagrammatic flow sheet showing a "split-treat" in which a two, or three fraction cut can be used.

Fig. 2 is a diagrammatic flow sheet taken from the co-pending application of Edwards and Stark, Ser. No. 532,000, filed April 22, 1931, for use with Fig. 1 and showing a preferred form of contacting the acid and distillate.

Fig. 3 is a chart illustrating the efficiency of a true countercurrent treatment of a cracked total distillate as shown in Fig. 2 over a batch treatment of the same distillate when treating in both cases with acid of the same concentration to effect the removal of the same percentage of sulphur.

Fig. 4 is a chart showing the efficiency of treating a selected light fraction from a cracked end point distillate by the countercurrent method of Fig. 2 over a batch treatment of the same fraction when treating in both cases with acid of the same concentration to effect the removal of the same percentage of sulphur.

Fig. 5 is a chart illustrating the efficiency of treating a selected heavy fraction from a cracked end point distillate by the countercurrent method of Fig. 2 over a batch treatment of the same fraction when treating in both cases with acid of the same concentration to effect the removal of the same percentages of sulphur.

Fig. 6 is a chart illustrating the efficiency in sulphur removal by batch treatment, comparing the results obtained in sulphur removal by splitting a cracked end point distillate into 50% of a light fraction and 50% of a heavy fraction and treating each fraction separately with acid to the results obtained by treating the cracked end point distillate as a whole; in both cases using sulphuric acid of the same concentration.

Fig. 7 is a chart showing the efficiency of treating the light and heavy fractions obtained from a cracked end point distillate separately in true countercurrent flows according to Fig. 2 over treating the unsplit distillate by the same method; sulphuric acid of the same concentration being used in both cases and the light and heavy fraction each consisting of 50% of the unsplit distillate according to volatility.

Referring to Figs. 1 and 2, it will be seen that the cracked distillate may be passed continuously through line 10 into a still, or fractionator, 11, wherein controls are established in well known manner to pass say 50% of the distillate according to volatility through suitable condensers (not

shown) in line 12 and through an alkaline wash 13 such as caustic soda, or sodium carbonate, or other suitable solution, to remove certain impurities such as hydrogen sulphide and organic acids, and the thus treated liquid fraction is then passed through a treating plant 14 (which is preferably of the type shown in Fig. 2) wherein the fraction is subject to true countercurrent contacting with the required rate of sulphuric acid supplied from tank 15, the acid sludge being continuously drawn off through line 16.

The light fraction thus treated with relatively low rates of sulphuric acid may flow to a run down tank 17 whence it is withdrawn to a re-run still 18, from which rerun bottoms comprising polymerized bodies are withdrawn through line 19.

In similar fashion and simultaneously with the light fraction, the heavy 50% fraction from still 11 passes through line 20, alkaline wash 21, treating plant 22, run down tank 23 to rerun still 18 where it blends with the light treated fraction and is distilled therewith to end point gasoline, which is then subjected to the usual sweetening process 24 by means of doctor solution, or other sweetening process, and is thus finished ready for use.

The heavy fraction is, of course, subject to countercurrent treatment with concentrated sulphuric acid in treating plant 22 at a much higher rate than that applied to the light fraction in treating plant 14 and the acid sludge from treating plant 22 is collected in tank 25.

It is found that such acid sludge obtained from treating the heavy fraction in plant 22 with high acid rates contains sufficient reactive sulphuric acid to function efficiently for the desulphurization of the light fraction in treating plant 14, hence a preferred form of the invention includes the supply of acid sludge derived from the treatment of the heavy fraction from sludge tank 25 through line 26 to treating plant 14 for the treatment of the light fraction therein and the rate of such supply is, of course, in conformity with requirements for efficient desulphurization of the light fraction to the desired degree.

Apparently, the acid sludge produced from the treatment of the heavy fraction at relatively high acid rates to remove a relatively high percentage of sulphur from the heavy fraction, although having accomplished maximum desulphurization of the heavy fraction still retains sufficient chemical reactivity to treat effectively the more unsaturated light fraction without substantial loss of unsaturates therefrom. In addition, the use of such sludge accomplished the removal of unstable unsaturates such as the gum forming constituents like di-olefines together with acid soluble sulphur compounds, all of which improves the odor and stabilizes the color of the light fraction.

It seems that the abstracted organic matter in the acid sludge acts as a diluent and its effect on the more stable and desired unsaturated compounds in the light fraction appears to be the same as that of a treatment with dilute sulphuric acid so that excessive sulphonation and polymerization of desired unsaturates is prevented.

Depending, of course, on the degree of desulphurization required, the light fraction may or may not be desulphurized to a point sufficient for commercial requirements by the use of the acid sludge from the heavy fraction treating, inasmuch as the sulphur thus removed from the light fraction may only vary from 20% to 50% of the removable sulphur which is often sufficient.

However, the use of other suitable sludges as, for instance, the acid sludge obtained from the sulphuric acid treatment of straight run gasoline or kerosene, or from other sources, is contemplated herein for the treatment of the light fraction in place of the straight acid treatment, it being understood, of course, that if any of the sludges utilized for this purpose are deficient in acid value for treatment of the light fraction, such sludge can be increased in acid concentration by the addition of a required amount of fresh acid from tank 15.

Alternatively, if the acid sludge derived from the heavy fraction is not sufficiently reactive to reduce the sulphur content of the light fraction to a very low figure, the light fraction may be further separately treated with fresh acid at a rate of say up to five pounds per barrel of 98% acid and in accordance with the true countercurrent flow shown in Fig. 2.

A similar procedure is used when the cracked distillate is split into three fractions, the intermediate fraction being passed from still 11 through alkaline wash 27, treating plant 28, run down tank 29 to re-run still 18, where it is blended and distilled with the light and heavy fraction as before described.

If the acid sludge from the intermediate fraction contains sufficient acid value it may be run through line 30 to sludge tank 25 for use in desulphurizing the light fraction, otherwise it may be withdrawn through line 31.

Treating plants 14, 22 and 28 are preferably constructed and operated in accordance with the process disclosed in said co-pending application Ser. No. 532,000, as illustrated in Fig. 2 hereof, in which any of the fractions, or the unsplit total distillate, is passed by pump 31 through a cooler 32 into the bottom of a contact tower 33 substantially filled with a suitable contact material 34, comprising Raschig rings, glass beads, crushed gravel or other well known material, and meets therein in true countercurrent flow acid sludge from a spray 35 derived from the succeeding treatment of the distillate and forced through spray 35 by pump 36.

The distillate thus treated with relatively spent acid sludge passes through a valve 37 into line 39 being alternatively by-passed if desired through valve 38) and is cooled to a desired degree by cooler 40 before passage into the bottom of a second similar contact tower 41, supplied with less spent acid sludge derived from a succeeding tower through pump 42 to spray 43.

The more treated distillate then passes through a line 44 and cooler 45 to the next similar contact tower 46 which is supplied with fresh acid through a pump 47 and spray 48.

In this manner, there is provided true countercurrent contacting of the distillate with the acid, or acid sludge, in each tower together with true countercurrent flow of distillate with acid sludge through the system so that maximum desulphurization combined with minimum losses of desired hydrocarbons is assured.

The temperature during the acid treats in each contact tower should be sufficiently low to permit selective solvent action of the sulphuric acid on undesired sulphur compounds and gum forming constituents while preventing excessive sulphonation and polymerization of unsaturates. Depending on the type of stock treated, concentration of acid used, etc., such treating temperatures may range during reaction from 0° F. to 40° F. or even lower or higher. Simple laboratory tests,

well known to those skilled in the art, will determine the optimum temperatures taking all things into consideration.

The countercurrent acid treatment of the distillate being finished in tower **46**, the distillate may be passed through line **49** into a settling chamber **50**, similarly filled with contact material to separate any entrained acid sludge, and thence through line **51** into a similarly filled contact tower **52**, receiving spent caustic sludge through pump **53** and spray **54** from the bottom of a second caustic contact tower **55** supplied with fresh caustic solution, the spent caustic from both towers **52** and **55** being discharged through line **56**.

The caustic treatment serves to neutralize any remaining acidity, such as dissolved SO_2 and the neutralized distillate is then passed through a line **58** and a wash tower **59**, supplied with a water spray through line **60**, to a run down line **61** controlled by valve **63**, which serves to apply a predetermined pressure of from 50 to 100 pounds per square inch on the system for the purpose of holding SO_2 gas in solution.

The discharge of acid sludge is controlled by a valve **62** and the discharge of caustic sludge is controlled by a valve **64** which, together with valve **63**, maintain the desired pressure on the system.

As before stated, the acid sludge derived from the treatment of a heavy fraction may be run into tank **25** to be supplied through line **26** for treating the light fraction.

Pumps **36** and **42** serve to withdraw acid sludge as rapidly as possible from the bottom of towers **41** and **46**, respectively, together with a portion of the distillate from each of said towers for the purpose of establishing first a circulatory system for the distillate between two of the towers and secondly to pass the sludge from a succeeding tower to the top of a preceding tower for contacting the cooled distillate therein, the sludge being separated from the accompanying distillate from each pump in the top of each tower due to a reduction in velocity therein where it is sprayed on the contact material evenly and descends countercurrent to the rising distillate.

The increased velocity of the distillate stream thus circulated between two towers adds largely to the efficiency of the interposed cooling sections **40** and **45**.

As an example of treating efficiency in utilizing the acid sludge from the heavy fraction for desulphurizing the light fraction, the following data, derived from operating the above described "split-treat" when the total cracked distillate is split according to volatility into 55% of a light fraction and 45% of a heavy fraction and treating the heavy fraction with 10 pounds of 98% sulphuric acid to the barrel to recover an acid sludge used on the light fraction, is illustrative:

	Sulphur	Octane No. C. F. R. motor method	Color	U. S. B. M. gum	Odor
	Percent				
Raw light fraction	0.57	76.0	Yellow	20 Mg/100 cc	Poor.
Treated light fraction	0.34	76.0	+30	None	Good.

The sulphur removal will depend in part on the chemical structure of the sulphur compounds present and also on the characteristics and quantity of the sludge obtained from the treatment of the heavy fraction. With acid rates higher than 10 pounds of 98% acid to the barrel there is naturally a higher desulphurization of the light fraction due to the greater reactivity of the sludge and also the desulphurization is greater, when using a true countercurrent contact of acid sludge and oil as before described.

The relative efficiencies of batch and true countercurrent contacts are well illustrated in Fig. 3 as well as the relative efficiencies of the batch and true countercurrent contacts of the light fraction and of the heavy fraction which are shown in Figs. 4 and 5. The relative efficiencies between batch treatment of the complete cracked distillate and the same distillate split into a light and a heavy fraction and treated as above described are shown in Fig. 6. The relative efficiencies between true countercurrent treatment of the complete distillate and true countercurrent treatment of the light and heavy fractions separately are shown in Fig. 7.

These charts shown in Figs. 3 to 7 inclusive are self-explanatory to those skilled in the art and show improved desulphurization in every case by use of the herein described process.

In all cases herein where sulphuric acid is used, the tests were made with 98% sulphuric acid and the same is used as illustration only and not as a limitation.

Other strengths of acid can be used depending on operating conditions such as a range of from 66° acid up to 20% fuming sulphuric acid, the concentration being determined for optimum results by laboratory control. Likewise, the temperature may vary with the concentration of acid and consequent degree of reaction heat between —0° F. up to 80° F.

The rerunning of the light and heavy fractions may be done at one time, or separately, or, when only a light sludge treatment is given the light fraction for stabilization, the rerun distillation thereon may be eliminated.

The "total cracked distillate" referred to herein is a distillate made from the pyrolytic cracking of various stocks and is usually a distillate cut to an end point by A. S. T. M. distillation similar to normal motor fuel marketed. However, the total cracked gasoline may have an end point from 250° F. to 500° F., or higher, depending entirely on the particular fractionating process and equipment used.

As a rule, the end point on total cracked gasoline is cut with modern methods and equipment to somewhere between 350° F. and 437° F., but variations from this range are permissible within the scope of the invention and may include distillates from other sources such, for instance, as those made by polymerization of hydrocarbon gases and sulphur bearing distillates from other sources.

A typical California cracked distillate respon-

sive to the herein described process may have the following Engler distillation figures:

I. B. P.	90
5%	120
10	139
20	173
30	211
40	242
50	266
60	288
70	312
80	340
90	368
95	395
E. P.	400
Recovery—per cent	96.5
Residue	1.0

The distillation characteristics of such unsplit distillate, or an unsplit distillate of closely similar boiling range will, of course, vary and when the same are split to be treated according to the described process there will be some variations in result.

The following table illustrates distillation characteristics of various percentage splits taken from the processing of different stocks.

Fraction	Light	Heavy	Light	Heavy	Light	Heavy
Approximate percentage of cut—percent	30	70	50	50	60	40
Engler:						
I. B. P.	65	202	82	294	82	323
5%	70	228	105	303	114	330
10	74	238	115	308	126	333
20	82	252	134	317	148	337
30	90	266	150	321	170	341
40	98	280	168	327	190	345
50	106	296	186	335	210	350
60	117	314	200	343	226	356
70	128	332	214	353	240	363
80	142	350	228	364	256	370
90	160	370	244	376	270	383
95		386		386		393
E. P.	182	400	276	402	313	407
Recovery	92.5	98.0	96.0	98.0	95.5	98.0
Residue	1.0	1.0	1.0	1.0	1.0	1.0
Loss	6.5	1.0	3.0	1.0	3.5	1.0

The above figures are merely used by way of illustration and it must be understood that the invention is not limited to any particular percentage of cut for treatment, or boiling range, or concentration of acid, but is only limited by the scope of the appended claims, in which

I claim as my invention:

1. A process of removing sulphur from hydrocarbon oils which comprises: fractionating a total cracked distillate into two fractions, one fraction consisting of about 20% to 60% of the lower boiling constituents of the total distillate and the other fraction consisting of about 80% to 40% of the total distillate and in which the light fraction is relatively low in sulphur and relatively high in unsaturated hydrocarbons when compared with the heavy fraction, treating the heavy fraction with sulphuric acid at such a rate as to reduce the sulphur content thereof a desired amount, recovering the acid sludge from treatment of the heavy fraction, and treating the light fraction with said acid sludge.

2. A process of removing sulphur from hydrocarbon oils which comprises: fractionating a total cracked distillate into two fractions, one fraction consisting of about 20% to 60% of the lower boiling constituents of the total distillate and the other fraction consisting of about 80% to 40% of the total distillate and in which the light fraction is relatively low in sulphur and relatively high in unsaturated hydrocarbons when compared with the heavy fraction, treating the heavy fraction with sulphuric acid at such a rate as to reduce the sulphur content thereof a desired amount while at a temperature below 60° F. sufficient to minimize the effect of the acid upon unsaturated compounds, recovering the acid sludge from treatment of the heavy fraction, and treating the light fraction with said sludge.

3. A process of removing sulphur from hydrocarbon oils which comprises: fractionating a total cracked distillate into a plurality of fractions, one of which consists of not more than 50% of the total distillate and contains lower boiling constituents and another of which consists of heavier boiling constituents, treating the heavier boiling fraction with sulphuric acid at such a rate as to reduce the sulphur content thereof while leaving the resulting acid sludge in reactive condition, removing the said reactive sludge from the heavy fraction, and treating the light fraction with said sludge.

4. A process of removing sulphur from hydrocarbon oils which comprises: fractionating a total cracked distillate into a plurality of fractions, one of which consists of not more than 50% of the total distillate and contains lower boiling constituents and another of which consists of heavier boiling constituents, treating the heavier boiling fraction with sulphuric acid at such a rate as to reduce the sulphur content thereof while leaving the resulting acid sludge in reactive condition, removing the said reactive sludge from the heavy fraction, treating the light fraction with said sludge, then further treating the thus treated light fraction with fresh acid.

5. In a process of removing sulphur from petroleum distillates in which a total distillate is split into a plurality of fractions of varying degrees of volatility to provide a light fraction consisting of not more than 60% of the total distillate and a heavy fraction and of which fractions the light fraction is relatively low in sulphur and relatively high in unsaturated compounds when compared with the heavy fraction, the combination of steps which comprises: treating the heavy fraction with sulphuric acid of such concentration and at such a rate as to reduce its sulphur content a desired amount and to produce a reactive acid sludge, then treating the light fraction with said acid sludge.

6. A process of removing sulphur from hydrocarbon oils which comprises: fractionating a cracked distillate to yield a relatively low boiling range fraction relatively low in sulphur and high in unsaturated hydrocarbons and a relatively high boiling range fraction relatively high in sulphur and low in unsaturated hydrocarbons,

treating the high boiling fraction with as low as 10 pounds per barrel of concentrated sulphuric acid, removing the acid sludge, and treating the low boiling fraction with said removed acid sludge.

7. A process of removing sulphur from hydrocarbon oils which comprises: fractionating a cracked distillate to yield a relatively low boiling range fraction relatively low in sulphur and high in unsaturated hydrocarbons and a relatively high boiling range fraction relatively high in sulphur and low in unsaturated hydrocarbons, treating the high boiling fraction with as low as 10 pounds per barrel of concentrated sulphuric acid, removing the acid sludge, and immediately treating the low boiling fraction with said removed acid sludge.

8. A process of treating hydrocarbon distillates containing sulphur-bearing, color and gum forming compounds, said distillates being fractional condensates of a common vapor body including the steps of treating one of the distillates with acid and then treating a lighter one of the distillates containing a less amount of sulphur and color-forming compounds with acid sludge formed in the first treating step.

9. A process of treating hydrocarbon distillates containing sulphur-bearing, color and gum forming compounds, said distillates being fractional condensates of a common vapor body including the steps of treating one of the distillates with acid, then treating a lighter one of the distillates containing a less amount of sulphur compounds with acid sludge formed in the first treating step, removing the major portion of the sludge, and then treating the thus purified light distillate with an alkaline solution; thereby reducing the tendency of the sludge treated light distillate to become color unstable.

10. A process of treating hydrocarbon distillates containing sulphur-bearing, color and gum forming compounds, said distillates being fractional condensates of a common vapor body including the steps of treating one of the distillates with acid, then treating a lighter one of the distillates containing a less amount of sulphur compounds with acid sludge formed in the first treating step, and then treating the thus purified distillates, after removal of acid sludge therefrom, with an alkaline solution; thereby reducing the tendency of the treated distillates to become color unstable.

11. In a process of treating hydrocarbon distillates containing sulphur-bearing, color and gum forming compounds, said distillates being fractional condensates of a common vapor body; the steps of treating one of the distillates with sulphuric acid and then treating a lighter one of the distillates containing a less amount of sulphur compounds with the sulphuric acid sludge formed in the first treating step.

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