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HYDROFINING OF LUBRICATING OIL FRACTIONS

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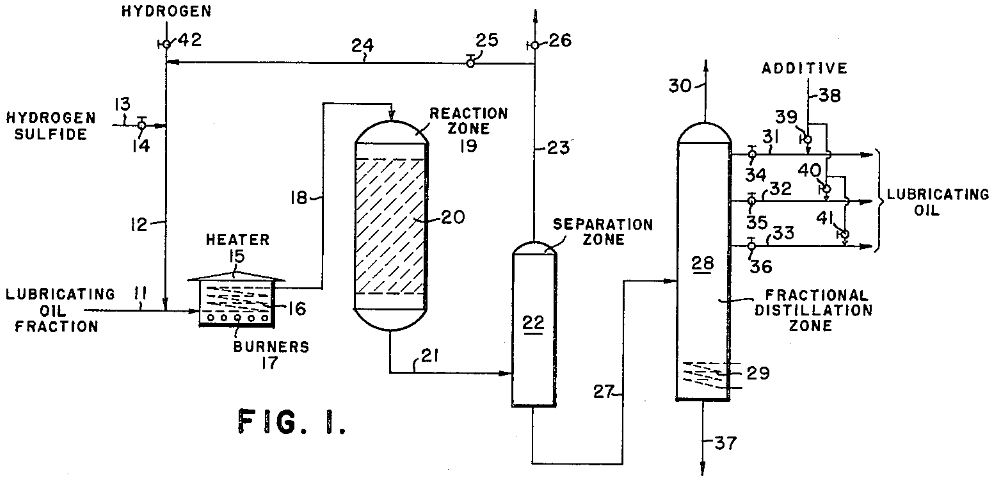
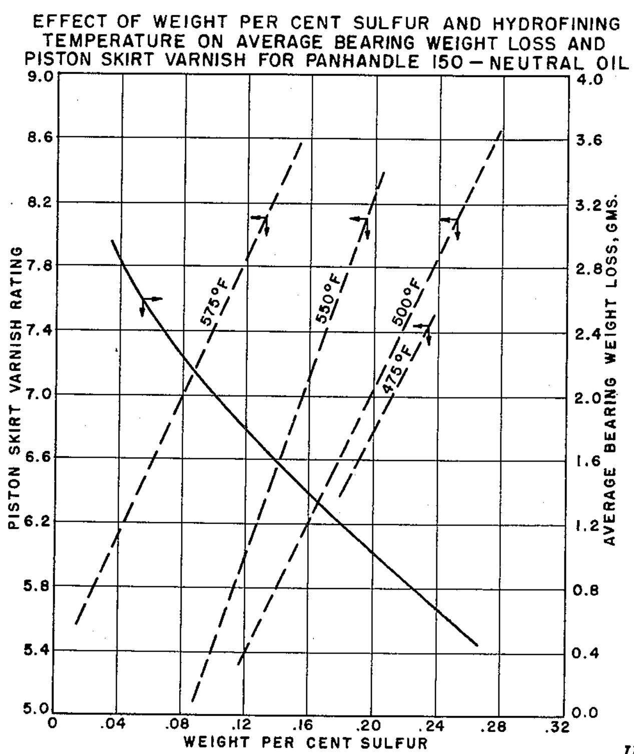


FIG. 1.

FIG. 2.



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HYDROFINING OF LUBRICATING OIL FRACTIONS

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The present invention is directed to hydrofining of lubricating oil fractions. More particularly, the invention is concerned with treating a lubricating oil fraction in the presence of hydrogen to form an improved lubricant. In its more specific aspects, the invention is concerned with the formation of a lubricating oil which contains sulfur.

The present invention is directed to the production of improved lubricating oil in which a lubricating oil fraction is hydrofined in the presence of a sulfur-resistant catalyst at a temperature within the range from about 400° to about 650° F. under a pressure within the range from about 200 to about 1,000 pounds per square inch and at a space velocity within the range from about 1 to about 10 v./v./hr. in the presence of sufficient free hydrogen-containing gas to provide from about 50 to about 5,000 standard cubic feet of hydrogen per barrel of the lubricating oil fraction, the hydrogen-containing gas also containing from about 5% to about 95% by volume of hydrogen sulfide to form a product containing sulfur and of improved lubricating quality.

The feed stock employed in the present invention is a lubricating oil fraction which may boil in the range from about 800° to about 1,200° F. and ordinarily will comprise a fraction of crude petroleum. Higher boiling fractions may also be used. Such lubricating oil fractions are known as neutral oils, light motor oils, medium motor oils, and bright stocks. It is contemplated that the lubricating oil fraction employed in the present invention may suitably be a solvent raffinate of a lubricating oil fraction obtained from crude petroleum. Examples of the crude petroleum from which the lubricating oil fraction may be obtained are the Gulf Coastal crudes, Panhandle crudes, Pennsylvania type crude oils, and California crude oils and the like.

The invention is suitably practiced with a suitable sulfur-resistant catalyst, of which many are known to the art. As examples of suitable catalysts are the oxides and sulfides of metals such as vanadium, chromium, manganese, iron, cobalt, nickel, molybdenum, tungsten, and the like. Specific examples of such catalysts are cobalt molybdate, nickel-tungsten sulfide, cobalt sulfide, molybdenum sulfide, molybdenum oxide, nickel sulfide, tin sulfide, and the like. The catalysts are preferably employed on a support or a suitable carrier such as alumina, magnesia, silica, zirconia, spinels, and the like. The catalyst may be employed as a fixed bed catalyst, in the form of a fluidized bed, or as a slurry in the lubricating oil, or in any other suitable manner.

The present invention is suitably conducted in the presence of hydrogen, and an amount of hydrogen within the range from about 50 to about 5,000 standard cubic feet per barrel is employed. A preferred amount of hydrogen is from about 65 to about 500 standard cubic feet per barrel. The hydrogen for the operation is provided by charging a hydrogen-containing gas to the catalyst along with the feed stock. The hydrogen-containing gas may be added from an extraneous source and may be pure hydrogen or may comprise a mixture of hydrogen and gaseous material such as light hydrocarbons. For example, gaseous material from the operation may provide at least a part of the hydrogen-containing gas as a source of the hydrogen for the reaction.

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The amount of hydrogen sulfide which is added with the hydrogen is within the range from about 5% to about 95% by volume of the total gas with a preferred range from about 20% to about 70% by volume based on the total gas. In the present invention the hydrogen sulfide may largely be provided from an extraneous source since ordinarily the amount of hydrogen sulfide provided in a hydrofining operation is not sufficient for best results. However, recycle of tail gas may provide sufficient hydrogen sulfide build up.

The temperatures employed in the practice of the present invention may suitably range from about 400° to about 650° F. with desirable results being obtained at about 500° F. A preferred temperature range is from about 475° to about 575° F.

Pressures may suitably range from about 200 to about 1,000 pounds per square inch with good results being obtained at about 750 pounds per square inch. A preferred range is from about 400 to about 800 pounds per square inch.

The space velocity may range from about 1 to about 10 volumes of feed per volume of catalyst per hour with a preferred space velocity from about 3 to about 5 v./v./hr.

In accordance with the present invention, improved results are obtained in that the present invention provides a lubricating oil product which contains sulfur in an amount greater than that usually present in a hydrofined lubricating oil product. The presence of sulfur confers unusual properties on the lubricating oil in that in the present invention the response of the product to lubricating oil additives and inhibitors is enhanced. In other words, for a given amount of a lubricating oil additive or inhibitor, a greater response is had with the product of the present invention that with a conventionally hydrofined product. Furthermore, the product hydrofined according to this invention performs more satisfactorily than conventionally hydrofined products without inhibitors. This means that with the present invention, amounts of additives can be reduced and yet obtain beneficial results.

The present invention will be further illustrated by reference to the drawing in which:

Fig. 1 is a flow diagram of a preferred mode of practicing the invention, and

Fig. 2 is a graphical presentation of data showing the effect of sulfur and hydrofining temperature on bearing weight loss and piston skirt varnish for a Panhandle 150 neutral oil.

Referring now to the drawing and particularly to Fig. 1, numeral **11** designates a charge line by way of which a lubricating oil fraction is introduced into the system from a source not shown. This lubricating oil fraction may suitably be a phenol raffinate of a petroleum lubricating oil fraction. The fraction charged by line **11** may suitably be and preferably is either a neutral oil, light motor oil, medium oil, or a bright stock, or the total fraction may be charged. For purposes of this description only, a neutral or light motor oil is charged. Introduced into line **11** by line **12** is a hydrogen-containing gas in which hydrogen sulfide is suitably added by way of line **13** controlled by valve **14**. The mixture of hydrogen, hydrogen sulfide, and lubricating oil is suitably introduced into a heater **15** provided with a heating coil **16** and with burners such as gas burners **17**, by way of which the temperature of the mixture is raised to a temperature within the range given before. The heated mixture, under the conditions set out herein, is discharged from heater **15** by line **18** and introduced thereby into a reaction zone

19 containing a bed of catalyst **20** such as cobalt molybdate. Under the conditions for the practice of this invention, the lubricating oil fraction is suitably hydrofined and a product is formed which is withdrawn by line **21** and discharged thereby into a separation zone **22**, which is of suitable capacity to provide a residence time for separation of normally gaseous products from the liquid products, the gaseous products being withdrawn from separation zone **22** by line **23** for recycling to line **12** by branch line **24** controlled by valve **25**. This recycled gas provides at least a portion of the hydrogen and may provide a portion of the hydrogen sulfide for the process. A portion of the gas may suitably be discharged from line **23** by manipulation of valve **26**.

When the total lubricating oil fraction is charged, the liquid products from zone **22** are withdrawn therefrom by line **27** and introduced into a fractional distillation zone **28**, which is shown as a single fractional distillation tower but which may be a plurality of fractional distillation towers, each equipped with all auxiliary apparatus usually incident to a modern fractional distillation tower. Thus, zone **28** is provided with suitable internal, vapor-liquid contacting means, cooling and condensing means, means for inducing reflux and the like, not shown. Zone **28** is equipped with a heating means **29**, illustrated by a steam coil, for adjusting temperature and pressure for distillation of the liquid product. Line **30** is provided for removal of light fractions boiling above lubricating oil and lines **31**, **32**, and **33** controlled, respectively, by valves

34, **35**, and **36** for withdrawal and recovery of the lubricating oil fractions. Line **37** is provided for discharge of heavier fractions which may be of bright stock quality. It will be understood, however, that when one of the components of the total lubricating oil fraction is charged, zone **28** may be used only to remove light ends and to recover the desired product through line **37** with lines **31**, **32**, and **33** being closed. While the inhibitor may be added directly to the distilled product, the inhibitor is preferably added to the final blended motor oil.

Since the product of this operation has enhanced response to lubricating oil additives or inhibitors, provision is made for adding a lubricating oil additive by way of manifold **38** which connects into lines **31**, **32**, and **33** and into which flow is controlled by way of valves **39**, **40**, and **41** as may be desired. Where a selected oil such as neutral oil is hydrofined and withdrawn by line **37**, inhibitor may be added thereto as desired.

If the recycled gas does not provide sufficient hydrogen, this may be provided from an extraneous source by opening valve **42** in line **12**.

In order to illustrate the present invention further, a number of hydrofining runs were made employing Panhandle 150-neutral raffinate, Panhandle light motor oil raffinate, and Panhandle 150–X bright stock raffinate using 10 to 20 mesh cobalt molybdate as a catalyst.

The following table I sets out the several conditions and the product inspections resulting from the hydrofining operations.

TABLE I

Hydrofining conditions and product inspections

Type of Catalyst	Cobalt Molybdate, 10-20 Mesh													
Run Number	Feed	465	Feed	474	475	476	477	478	498	499	Feed	527	528	529
Feed Stocks	Panhandle 150-Neutral Raffinate													
Reactor Temperasure, ° F	------	475	------	500	500	475	475	550	575	550	------	475	500	550
Reactor Pressure, P.s.i.g	------	300	------	750	750	700	700	700	750	750	------	750	750	750
Feed Rate, v./v./Hr	------	3.1	------	3.2	3.1	3.2	3.2	3.2	4.8	5.0	------	3.3	3.3	3.2
Total Gas Rate, s.c.f./Hr	------	27	------	24	26	26	24	30	23	23	------	22	26	23
Hydrogen Sulfide Injected, Volume Percent of Total Gas	------	11	------	5	11	10	5	22	68	68	------	60	66	79
Hydrogen Gas:														
Volume Percent of Total Gas	------	89	------	95	89	90	95	78	32	32	------	40	34	21
S.c.f./Bbl. Feed	------	342	------	337	345	340	339	339	71	69	------	126	126	72
Product Inspections:														
Gravity, ° API	33.2	33.3	32.4	32.6	32.6	32.6	32.6	32.7	32.7	32.7	33.1	33.0	33.0	33.1
Flash, O.C. ° F	400	415	430	425	425	425	425	410	420	420	415	405	410	410
Viscosity, SSU/100° F	139.6	137.7	148.0	146.3	146.1	146.5	146.4	146.2	146.4	146.0	141.7	142.0	141.7	139.7
Viscosity, SSU/210° F	42.9	42.8	43.4	43.2	43.3	43.3	43.2	43.3	43.3	43.3	42.9	43.0	43.0	42.8
Color, Tag Robinson	9¾	19½	9½	19¾	18½	19	18¼	19¾	19¾	21	10¼	19	21¼	22¼
Color Hold Tag Robinson	------	17½	9½	19	18	18¼	18	19½	19	20¼	------	18½	19½	21
Pour, ° F	15	15	15	25	20	20	25	30	30	30	10	10	15	25
Cloud, ° F	16	24	24	30	26	28	28	42	44	45	20	16	25	28
Sulfur, Wt. percent	0.21	0.20	0.27	0.14	0.16	0.20	0.19	0.10	0.14	0.18	0.24	0.28	0.27	0.16
Con. Carbon, Wt. percent	0.01	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Aniline Point, ° F	224	222	220	221	221	221	221	221	221	221	221	221	221	222

Type of Catalyst	Cobalt Molybdate, 10–20 Mesh								
Run Number	Feed	479	480	481	382	494	495	500	501
Feed Stocks	Panhandle Light Motor Raffinate								
Reactor Temperature, ° F	------	500	500	425	425	575	575	575	625
Reactor Pressure, P.s.i.g	------	700	700	700	700	750	750	750	750
Feed Rate, v./v./hr	------	3.1	3.1	3.1	3.1	3.1	3.1	4.7	4.7
Total Gas Rate, s.c.f./hr	------	24	26	26	25	28	35	23	24
Hydrogen Sulfide Injected, Volume Percent of Total Gas	------	5	11	12	6	50	60	68	70
Hydrogen Gas:									
Volume Percent of Total Gas	------	95	89	88	94	50	40	32	30
S.c.f./Bbl. Feed	------	347	349	346	349	212	212	72	72
Product Inspections:									
Gravity, ° API	30.7	30.9	30.9	30.7	30.8	31.0	31.0	31.0	31.0
Flash, O.C. ° F	465	460	470	470	465	455	450	455	455
Viscosity, SSU/100° F	324	316	318	323	322	311	311	312	306
Viscosity, SSU/210° F	54.6	54.2	54.3	54.7	54.6	54.0	54.1	54.1	53.7
Color, Tag Robinson	5	13	12	10¼	10	17½	17½	16	14
Color Hold Tag Robinson	4½	12	11½	9¾	9¾	17½	17¼	14¼	12½
Pour, ° F	15	25	25	20	20	35	35	35	35
Cloud, ° F	20	26	28	22	26	45	42	40	45
Sulfur, Wt. Percent	0.32	0.22	0.24	0.33	0.33	0.14	0.16	0.18	0.11
Con. Carbon, Wt. Percent	0.04	0.04	0.04	0.02	0.04	0.02	0.02	0.02	0.03
Aniline Point, ° F	231	232	232	232	231	234	234	233	234

TABLE I—Continued

Hydrofining conditions and product inspections—Continued

Type of Catalyst	Cobalt Molybdate, 10–20 Mesh											
Run Number	Feed	483	484	485	486	496	497	Feed	521	522	525	526
Feed Stocks	Panhandle 150-X Bright Stock Raffinate											
Reactor Temperature, 9F	--------	500	500	550	600	575	575	--------	450	500	500	450
Reactor Pressure, P.s.i.g	--------	700	700	700	700	750	750	--------	750	750	750	750
Feed Rate, v./v./hr	--------	3.1	3.0	3.0	3.0	2.9	4.3	--------	3.1	3.2	3.2	3.2
Total Gas Rate, S.c.f./Hr	--------	24	26	29	29	36	30	--------	14	14	20	20
Hydrogen Sulfide Injected, Volume Percent of Total Gas	--------	5	11	22	22	61	76	--------	0	0	28	30
Hydrogen Gas:												
Volume Percent of Total Gas	--------	95	89	78	78	39	24	--------	100	100	72	70
S.c.f./Bbl. Feed	--------	349	353	362	356	224	80	--------	207	206	206	206
Product Inspections:												
Gravity, ° API	27.4	27.3	27.3	27.5	27.7	27.4	27.4	27.5	27.5	27.5	27.5	27.5
Flash, O. C. ° F	595	590	590	570	570	565	580	580	575	570	570	575
Viscosity, SSU/100° F	2,410	2,362	2,422	2,324	2,258	2,350	2,333	2,120	2,094	2,064	2,090	2,113
Viscosity, SSU/210° F	157.2	155.7	155.9	154.4	151.3	153.7	154.7	145.0	143.8	142.2	143.8	144.7
Color, Tag Robinson	2¼	4	4½	4¾	5¾	+9+	+9+	2½	3	4½	5¾	4
Color Hold Tag Robinson	2	3	3¾	3½	4¾	+9+	8½	2	1¾	3¼	4¼	3¼
Pour, ° F	20	20	20	25	30	30	25	15	15	15	10	15
Cloud, ° F	22	18	18	--------	--------	52	50	26	28	31	31	29
Sulfur, Wt. Percent	0.47	0.45	0.46	0.42	0.29	0.42	0.43	0.48	0.47	0.36	0.45	0.47
Con. Carbon, Wt. Percent	0.64	0.70	0.72	0.59	0.56	0.68	0.74	0.64	0.70	0.73	0.63	0.65
Aniline Point, ° F	261	261	264	264	264	262	262	260	260	260	260	260

Selected products from the several runs illustrated in Table I were then subjected to a 36-hour L–4 Chevrolet engine test and these products were compared with similar products produced by clay contacting only and with lubricating oils hydrofined in the absence of hydrogen sulfide in the entering gas. In Table II the test results in Panhandle 150 neutral oils of Table I are presented.

TABLE II

36-hour, L–4 Chevrolet engine test results on Panhandle 150-neutral

Sample Number	SX-4174	SX-4400	SX-4401	SX-4577	SX-4505	SX-4803
Hydrofining Temp., ° F	(2)	575	575	575	475	500
Hydrofiner Run Number	--------	413	413	413	465	474
Percent in Entering Gas	--------	0	0	0	11	5
Wt. Percent Sulfur (Before Additive)	0.22	0.04	0.04	0.04	0.20	0.14
Additive	0	0	0.5% (1) L-1060	0.7% (1) L-1060	0	0
36-Hr., L–4 Results:						
Piston Skirts SRI (Southwest Research Institute)	8.8	6.1	6.1	9.1	6.8	5.8
Varnish, Total	46.3	40.1	40.6	46.6	43.8	42.3
Sludge, Total	47.5	46.0	48.0	48.0	46.5	45.0
Avg. BWL, gms	0.728	2.854	1.233	0.015	1.032	1.627
Used Oil Data (36-Hrs.):						
Percent Viscosity Increase SSU/100° F	23.3	30.9	3.12	--------	--------	46.1

Sample Number	SX-4804	SX-5150	SX-4962	SX-5479	SX-4805	SX-4806
Hydrofining Temp., ° F	550	550	575	500	475	550
Hydrofiner Run Number	478	499	498	528	476	478
Percent H_2S in Entering Gas	22	68	68	66	10	22
Wt. Percent Sulfur (Before Additive)	0.10	0.18	0.14	0.27	0.20	0.10
Additive	0	0	0	0	0.5% (1) A-930	0.5% (1) A-930
36-Hr., L–4 Results:						
Piston Skirts SRI (Southwest Research Institute)	5.4	7.7	8.3	8.5	8.2	9.5
Varnish, Total	39.4	43.7	45.8	46.0	45.7	46.0
Sludge, Total	44.0	45.0	47.5	47.5	47.5	48.0
Avg. BWL, gms	1.997	0.820	1.632	0.458	0.092	0.020
Used Oil Data (36-Hrs):						
Percent Viscosity Increase, SSU/100° F	53.7	38.3	31.2	18.7	15.7	15.7

(1) Zinc dialkyl dithiophosphate.
(2) Clay contacted.

Referring to Table II, it will be seen that sample No. SX–4962 has a piston skirt varnish of nearly equal quality to that of SX–4174, where the oil was finished by clay contacting. In this rating, the higher the value, the better the rating. Furthermore, SX–4962 is of better quality than the conventionally hydrofined oil as represented by SX–4400. It is to be noted that the sulfur content of the conventionally hydrofined oil of SX–4400. It is to be noted that the sulfur content of sample SX–4962 is greater than the sulfur content of the conventionally hydrofined oil of SX–4400. It is to be further noted that samples SX–4803 and 4804 where the present invention was also practiced had higher sulfur contents than the conventionally hydrofined oils of SX–4400. Sample SX–5479, on the other hand, had a piston skirt varnish which was substantially the same as that of the clay-contacted oil and had a lower average bearing weight loss than any of the oils and yet the sulfur content of this fraction is substantially greater than any of the oils.

As stated before, hydrofining in accordance with the present invention improves the additive response of the oil when compared to conventional hydrofining. Again referring to Table II and specifically to samples SX–4401, 4577, and 4806, it will be clear that the additives response of the conventionally hydrofined oil SX–4401 was not as great as SX–4806, representing the present invention. Comparing SX–4806 with SX–4577, where a greater amount of additive was used, it will be used that a higher piston skirt varnish was obtained with the present invention than where a greater amount of additive was used in a conventionally hydrofined product. It may be seen from the data of Table II that at the preferred hydrofining temperature, a lesser amount may be sufficient to give the same quality as was obtained with 0.5% as in SX-4806. Hence, the additive requirements might be reduced anywhere from about 50% to about 85% by the practice of the present invention.

TABLE III

36 hour, L-4 Chevrolet engine test results on Panhandle LMO

Sample Number	SX-3922	SX-3923	SX-3924	SX-4963	SX-4019	SX-4145
Hydrofining Temp., ° F	----	625	425	425	625	425
Hydrofiner Run Number	Clay Contacted	351	383	481	351	383
Percent H_2S in Entering Gas	----	0	0	12	0	0
Wt. Percent Sulfur (before additive)	0.29	0.02	0.25	0.34	0.02	0.25
Additive	0	0	0	0	+0.5% [1] L-1060	+0.5% [1] L-1060
36-Hr., L-4 Results:						
Piston Skirts, SRI	9.5	9.3	9.0	9.2	9.1	9.5
Varnish, Total	47.5	47.3	47.0	47.2	47.1	47.5
Sludge, Total	48.0	48.0	47.5	48.0	48.0	48.5
Avg. BWL, gms	0.669	3.163	0.893	0.698	0.587	0.054
Used Oil Data (36-Hrs.):						
Percent Viscosity Increase—						
SSU/100° F	17.4	52.6	22.9	19.8	27.7	7.2
SSU/210° F	6.1	21.7	8.2	6.8	8.4	3.3

[1] Zinc dialkyl dithiophosphate.

In order to show the improved results further, referring to Table III, it will be seen that oils of a quality substantially identical with clay-contacted produced oils are obtained. Comparing SX-3922 with SX-4963, which represents the present invention, the product of the present invention was substantially the same as the clay-contacted oil comparing the clay-contacted oil, as represented by SX-3922, and the oil produced in accordance with this operation, SX-4963, with SX-3924, which is the conventionally produced oil, it will be seen that the practice of the present invention produces an oil which has a lower bearing weight loss and a higher sulfur content.

Referring to Fig. 2, the sulfur content of the Panhandle 150-neutral is plotted against piston skirt varnish rating and average bearing weight loss. These data show that the bearing weight loss decreases as sulfur content of the hydrofined product increases and that the piston skirt varnish rating is dependent on the sulfur content and the hydrofining temperature. By way of explanation as stated supra, a low bearing weight loss and a high piston skirt varnish rating are desirable.

From these results, it is clear that the present invention gives substantially improved results over conventional hydrofining operations where hydrogen sulfide is not employed in the hydrogen-containing gas.

The lubricating oil additives employed in the practice of the present invention may suitably include the well-known lubricating oil antioxidants and corrosion inhibitors, such as described by Kalichevsky and Kobe in their work "Petroleum Refining with Chemicals," Elsevier Publishing Co., New York, 1956, in Tables 159 and 166. Examples of such compounds are barium salt of alkyl phenol sulfide, cadmium, copper, or lead oleate or naphthenate, copper compounds, calcium salt of alkyl phenol sulfides or disulfides, metal alkyl xanthates, alkaline earth and alkaline metal salts of mahogany acids, aluminum diphenate, aluminum naphthenate, bivalent metal sulfonates, and the like. It is contemplated that these additives and those mentioned by Kalichevsky et al. supra may be employed in the practice of the present invention.

These several antioxidants and corrosion inhibitors are given by way of illustration and not by way of limitation.

In the practice of the present invention, the sulfur content of the hydrofined product is greater than that obtained with a conventional hydrofined product. By providing hydrogen sulfide in the inlet gas, it is possible to substantially improve the quality of the lubricating oil and increase its response to additives.

The nature and objects of the present invention having been completely described and illustrated, what we wish to claim as new and useful and secure by Letters Patent is:

1. A method for producing an improved lubricating oil which comprises hydrofining a lubricating oil fraction in the presence of a sulfur-resistant catalyst at a temperature within the range from about 400° to about 575° F. under a pressure within the range from about 200 to about 1,000 pounds per square inch and at a space velocity within the range from about 1 to about 10 v./v./hr. in the presence of sufficient free hydrogen-containing gas to provide from about 50 to about 5,000 standard cubic feet of hydrogen per barrel of said lubricating oil fraction, said gas also containing from about 5% to about 95% by volume of hydrogen sulfide, to form a product containing an increased amount of sulfur and of improved lubricating quality over conventionally hydrofined oils.

2. A method in accordance with claim 1 in which the catalyst is cobalt molybdate.

3. A method in accordance with claim 1 in which an inhibitor is added to the product.

4. A method in accordance with claim 1 in which the lubricating oil fraction is obtained from Panhandle crude.

5. A method for producing an improved lubricating oil which comprises hydrofining a lubricating oil fraction in the presence of cobalt molybdate at a temperature within the range from about 475° to about 575° F. under a pressure within the range from about 400 to about 800 pounds per square inch and at a space velocity within the range from about 3 to about 5 v./v./hr. in the presence of sufficient free hydrogen-containing gas to provide from about 65 to about 500 standard cubic feet of hydrogen per barrel of said lubricating oil fraction, said gas also containing from about 20 to about 95% by volume of hydrogen sulfide to form a product containing sulfur an increased amount of and of improved lubricating quality over conventionally hydrofined oils.

6. An improved lubricating oil containing sulfur formed by hydrofining a lubricating oil fraction in the presence of a sulfur resistant catalyst at a temperature within the range from about 400° to about 575° F. under a pressure within the range from about 200 to about 1,000 pounds per square inch and at a space velocity within the range from about 1 to about 10 v./v./hr. in the presence of sufficient free hydrogen-containing gas to provide from about 50 to about 500 standard cubic feet of hydrogen per barrel of said lubricating oil fraction, said gas also containing from about 5% to about 95% by volume of hydrogen sulfide.

7. An improved lubricating oil in accordance with claim

6 in which the lubricating oil fraction is derived from Panhandle crude.

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