

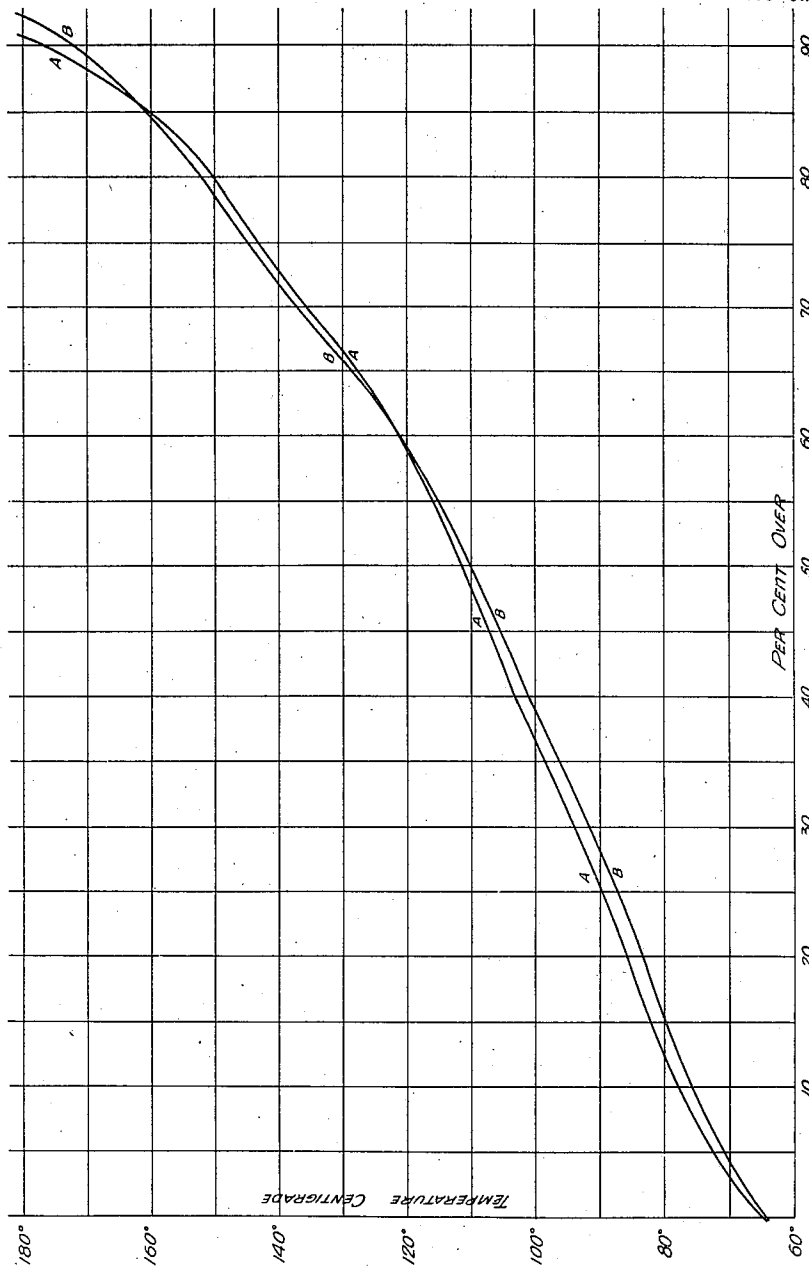
A. S. RAMAGE,
MOTOR FUEL.
APPLICATION FILED OCT. 27, 1921.

1,409,404.

Patented Mar. 14, 1922.

2 SHEETS—SHEET 1.

Fig. 1.



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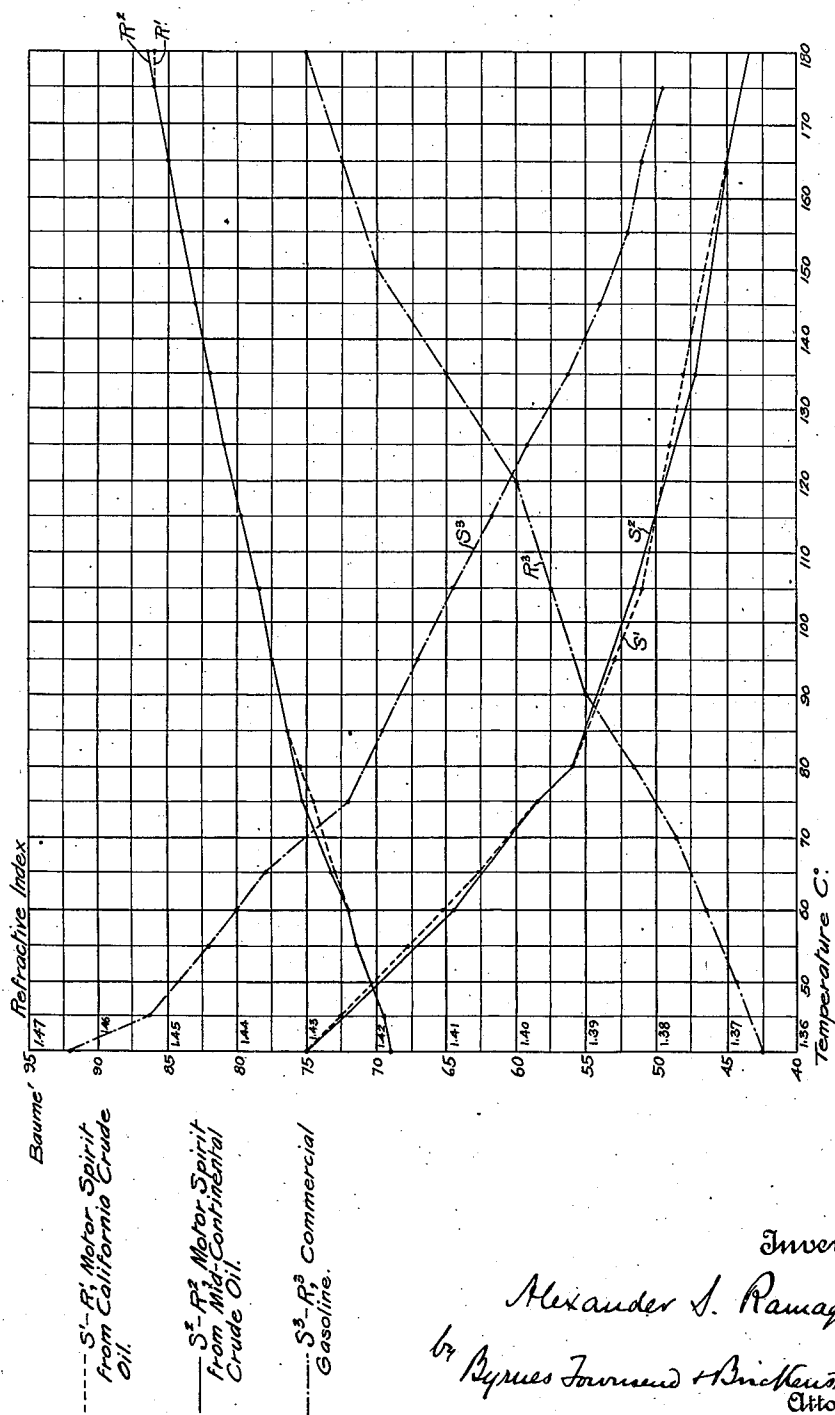
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2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

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MOTOR FUEL.

1,409,404.

Specification of Letters Patent. Patented Mar. 14, 1922.

Continuation of application Serial No. 440,743, filed January 28, 1921. Patent No. 1,403,194. This appli-
cation filed October 27, 1921. Serial No. 510,891.

To all whom it may concern:

Be it known that I, ALEXANDER S. RAMAGE, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Motor Fuels, of which the following is a specification.

This invention is a novel product suitable for use as motor fuel, said product consisting, in its undiluted or nonblended state, chiefly or largely of polymethylene bodies or partially or completely saturated cyclic hydrocarbons of higher boiling point and molecular weight than cyclohexane (C_6H_{12}). My invention comprises the said hydrocarbon product alone, or mixed or blended with other hydrocarbons, whether saturated or unsaturated, said mixtures being suitable for use as motor fuels.

The said product is prepared in the manner set forth in my co-pending application Serial No. 440,743, filed January 28, 1921, of which the present application is a continuation.

According to the process described in the said application, briefly summarized, hydrocarbon vapors, derived for example from heavy fuel or crude oils, including those of asphaltic type, are admixed with steam, and the mixture is caused to flow over ferrous oxid (FeO) in tubes maintained at a temperature which should not be substantially below $550^{\circ} C.$, the proportion of steam to hydrocarbon being so regulated as to maintain the oxid substantially in the ferrous condition. As pointed out in the said specification it is necessary to regulate carefully the proportion of steam to oil. If too much steam is supplied the ferrous oxid will undergo oxidation to ferric oxid, which will accumulate, and the production of the desired light saturated hydrocarbons will soon cease. If too little steam is supplied there will be a tendency to reduction of the ferrous oxid to metallic iron, which will result in the deposition of carbon in the tubes. Accordingly I so adjust the proportion between the hydrocarbon vapor and the steam as to avoid material oxidation of the ferrous oxid to ferric oxid on the one hand, or material reduction of metallic iron on the other. It is important also to avoid the formation of ferroso-ferric oxids of the magnetite type which are not operative in the process, and

which may tend to form in case the temperature is not sufficiently maintained.

A form of apparatus suitable for carrying the process into effect, as well as the preferred manner of operating the apparatus, are described and illustrated in my co-pending application above referred to: hence that description need not be here repeated.

The reactions taking place in the tube are undoubtedly very complicated, involving perhaps several simultaneous reactions: among such reactions the following are believed to occur, although no limitation of the invention is to be inferred therefrom:

The steam reacts with the ferrous oxid forming ferric oxid and hydrogen, the latter in highly reactive or nascent form: the ferric oxid is at once re-reduced to ferrous oxid by the hydrocarbon vapors with formation of carbon, hydrogen and hydrocarbons of a lower degree of saturation and probably of simpler constitution and lower boiling point. These unsaturated hydrocarbons react under the operating conditions with the hydrogen derived from the steam, the product being light hydrocarbons, mostly of the saturated cyclic type (cycloparaffins or polymethylenes). The oxygen from the steam ultimately appears largely as carbon monoxid and carbon dioxid formed by the oxidation of the carbon. The hydrogen equivalent of this carbon appears largely or entirely in the exit gases, being apparently almost non-reactive under the operating conditions.

The condensate yields a motor spirit which is nearly water-white. By ordinary refining with 1% of sulfuric acid and washing a water-white product of pleasant aromatic odor and containing only about 10 to 20% of unsaturated compounds is obtained.

A study of the physical constants of my novel product indicates the presence of predominating proportions of cycloparaffins or polymethylene bodies of higher boiling point and presumably therefore of higher molecular weight than cyclohexane. This latter substance, as is well known, may be prepared by hydrogenation of benzol in presence of a catalyst.

The motor spirit produced in the manner described yields upon distillation a series of fractions of which a large proportion, usually amounting to 90% or over, are comprised between the boiling point limits of

80° to 180° C. In specific instances the individual fractions (for corresponding temperature intervals) appear to be essentially identical in specific gravity and in refractive index, irrespective of the nature of the oil processed or of the precise temperatures within the tube, provided of course the temperature is sufficiently high to ensure decomposition of the steam. On the other hand the percentage of the several fractions varies according to the temperature in the tube, the higher temperatures tending to larger proportions of the low boiling fractions.

For a fuller understanding of the invention reference is made to the drawings accompanying this application, Figs. 1 and 2 being charts.

Referring to Fig. 1, the curves A and B represent a standard distillation cut of a typical motor spirit according to my invention. The motor spirit represented by curve A had a specific gravity of .7853 (48.3 Bé.); and that by curve B a specific gravity of .7882 (48.5 Bé.). In contrast with this, a high test commercial gasoline yielding a similar distillation curve will have a specific gravity of about .73 (61° Bé.). A characteristic of my product is therefore an extremely high gravity, considering its high volatility.

Fig. 2 is a chart indicating the specific gravities and refractive indices of corresponding fractions from:

1. A motor spirit prepared in accordance with my process from a California crude oil having an asphaltic base (curves S' and R');

2. A motor spirit prepared by my process from a Mid-Continental gas oil having a paraffin base (curves S² and R²);

3. A typical commercial gasoline consisting chiefly of paraffins with a minor proportion of unsaturated bodies (curves S³ and R³).

In each case the curve marked S represents the specific gravity in terms of the Baumé scale for liquids lighter than water, and the curve marked R the refractive index. The extremely close correspondence in the physical properties, specific gravity and refractive index, of the fractions prepared by my process, irrespective of the na-

ture of the original raw material, will be observed; also that in respect to these properties the material differs widely from the type of commercial gasoline represented by the curves S³ and R³.

The product has proven on practical test to give excellent results as a motor fuel for internal combustion engines, yielding some 25% additional power per unit of volume as compared with standard gasoline. For motor fuel use I prefer to employ the new motor spirit without admixture or blending with other hydrocarbons, although as above stated I regard the product when so mixed or blended as within the scope of my invention. The unblended distillate as prepared and used by me exhibits in a typical case, a boiling point range of about 40° to about 180° C.; a specific gravity of about .78 (49° Bé.) to .80 (45° Bé.); and a refractive index in the neighborhood of 1.44.

I claim—

1. A novel liquid hydrocarbon mixture suitable for use as motor fuel, consisting chiefly of polymethylene bodies of higher boiling point than cyclohexane, said mixture having a boiling point range of about 40°–180° C.; a specific gravity of about .78–.80; and a refractive index of about 1.44 and yielding by fractionation, fractions having the specific gravity, refractive indices, and distillation characteristics as shown in the accompanying charts.

2. A novel liquid hydrocarbon mixture suitable for use as a motor fuel such as is produced by the herein described process comprising subjecting heavy hydrocarbons in vapor form and admixed with steam to the action of an iron compound substantially maintained in the state of ferrous oxid at an elevated temperature not substantially below 550°, said hydrocarbon mixture having a boiling point range of about 40°–180° C.; a specific gravity of about .78–.80; and a refractive index of about 1.44 and yielding by fractionation, fractions having the specific gravity, refractive indices, and distillation characteristics as shown in the accompanying charts.

In testimony whereof, I affix my signature.

ALEXANDER S. RAMAGE.