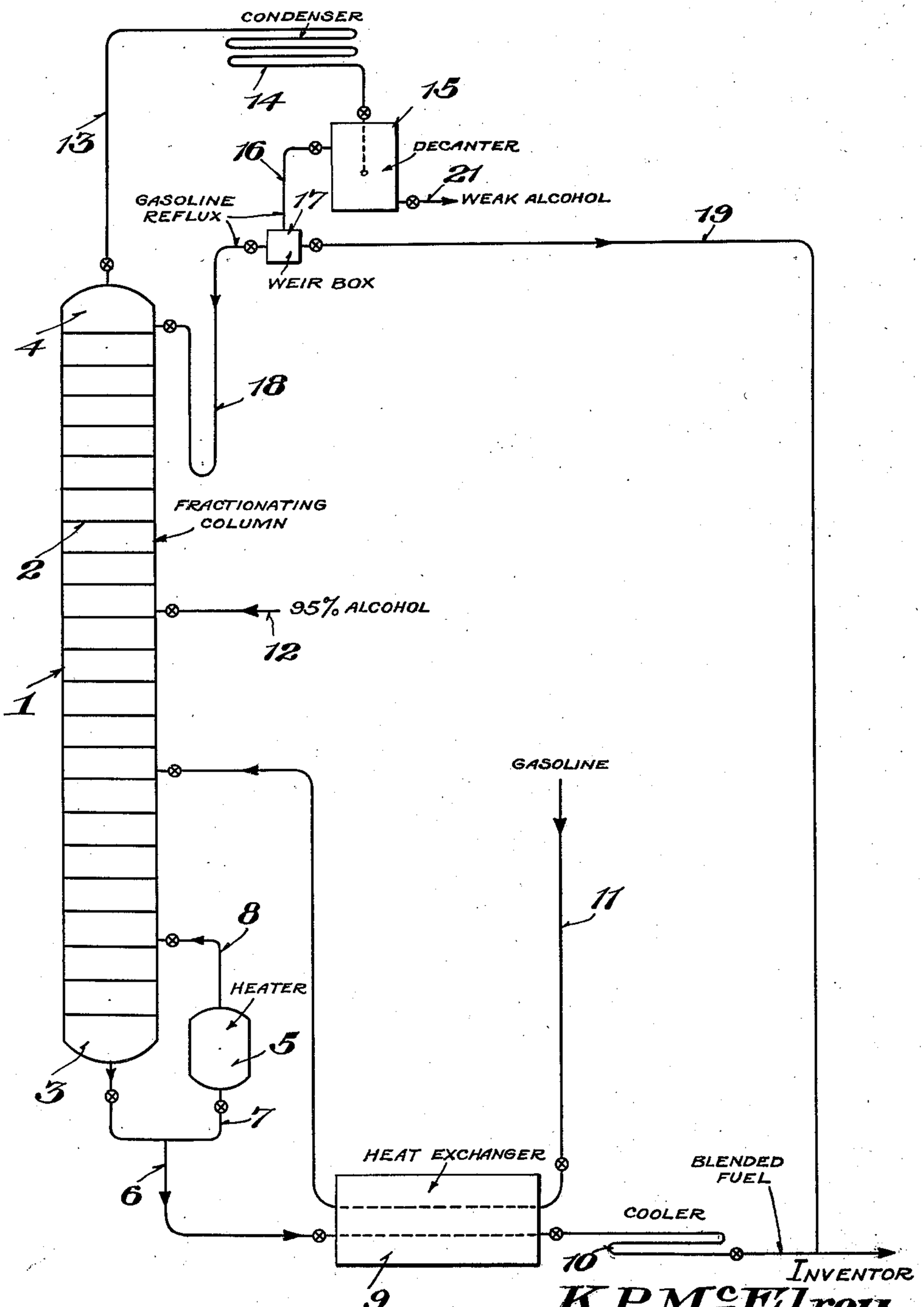
Aug. 20, 1935. K. P. McELROY 2,012,199

MAKING BLENDED FUELS

Filed March 15, 1933



INVENTOR

K. P. McElroy,

By G. M. Houghton

Attorney

Patented Aug. 20, 1935 2,012,199

UNITED STATES PATENT OFFICE

2,012,199

MAKING BLENDED FUELS

Karl P. McElroy, Washington, D. C., assignor to Gulf Refining Company, Pittsburgh, Pa., a corporation of Texas

Application March 15, 1933, Serial No. 660,905

10 Claims. (Cl. 202—42)

This invention relates to making blended fuels; and it comprises a method of making blended fuels comprising ethyl alcohol and motor oils, of the type of ordinary gasoline, wherein the desired proportions of ordinary commercial wet alcohol and commercial gasoline, are heated together in an apparatus of the type of a fractionating still to produce a homogeneous liquid fuel containing alcohol and gasoline at the base of the still and a two-layer distillate, one layer being aqueous and the other layer being oily and the homogeneous liquid is cooled and withdrawn, the separated oily layer formed in distillation being ordinarily returned to the homogeneous liquid formed in the still; all as more fully hereinafter set forth and as claimed.

There is some demand for admixture of alcohol with gasoline and similar motor fuels made from petroleum oils, the demand being for gasoline with some alcohol in it; for a blended motor fuel with gasoline as a major constituent. Ordinary commercial grain alcohol or ethyl alcohol, however, does not contain more than 95 to 96 per cent real alcohol, the rest being water. Alcohol can be concentrated in a column still until this percentage is reached when the liquid in the still distills as a whole. Alcohol of commercial strength is a wet material not miscible with petroleum oils although it will blend with benzol and tar oils. In order to meet the demand for mixed fuels containing alcohol and petroleum oils it is therefore the custom to use blending agents, such as benzol. While gasoline and commercial alcohol will not mix, an addition of benzol, which is soluble in both, will produce a homogeneous liquid. The use of a blending agent is, of course, not permissible where a mixture consisting only of alcohol and gasoline is wanted. Absolute alcohol can be made by various more or less laborious processes and mixed with gasoline; but this is relatively expensive and not very satisfactory.

I have found that while a mixture of gasoline and commercial alcohol separates into two layers and does not give a homogeneous fluid, this can be obviated by submitting the mixture to a heating operation for a time, the heating being such as to produce a limited amount of distillation with the greater proportion of the mixture remaining undistilled. On heating in this way the water in the mixture escapes together with a small part of the gasoline while the liquid in the still becomes a homogeneous mixture of alcohol and gasoline. This homogeneous mixture is withdrawn and cooled. The vapors coming from the operation can be condensed and will separate into two layers, one of water containing some alcohol and the other of gasoline components. The weak alcohol can be re-concentrated in a fractionating still to obtain alcohol of commercial strength which returns to the process. The separated gasoline can be, and usually is, returned to the homogeneous liquid coming from the still.

In the described method, complete miscibility is obtained between alcohol and gasoline in any desired proportions and there is no loss of gasoline. Some alcohol is lost but this can be recovered and returned to the process.

As just described, the operation is a batch process, but in practice it is better to use continuously operating devices of the nature of a column still ("beer still"), with continuous feed of gasoline and commercial alcohol in the right proportion and a continuous withdrawal of blended fuel at the base of the still (from the "kettle") in an amount nearly equal to that of the two liquids fed in. It is advantageous in continuous operation of such an apparatus to deliver the commercial alcohol and the gasoline to be blended at different levels in the column; the gasoline being delivered to a lower plate and the alcohol feed to a higher plate in the column. The gasoline fed into the still is advantageously preheated somewhat at the expense of the outgoing hot blended fuel. In so feeding the alcohol, it is delivered into a vapor atmosphere derived from the gasoline, and an azeotropic mixture of water vapors and hydrocarbons is directly formed. The ingoing alcohol trickles down the plates of the column against ascending hydrocarbon vapors and is dehydrated in its progress. There is formed on the plates a mixture of alcohol with some hydrocarbons and this joins the ingoing gasoline. It is directly miscible with gasoline.

In the accompanying illustration I have shown, more or less diagrammatically, certain apparatus adapted for use in the continuous process described and embodying the principles of the batch operation. In this showing, the figure is a view in central vertical section of a complete apparatus. certain parts being shown in elevation.

Element 1 is a column still or fractionating column of any ordinary type with cross plates 2 indicated. These cross plates may be of any of the well known constructions used in column stills. At the bottom, the still has a kettle 3 and at the top, a dome 4, both being conventionally shown. The column may be provided with heating ele-

ments at the base, or, as shown, with an outside heater 5 imposing a cyclic circulation on part of the liquid withdrawn from the kettle. As shown, withdrawal pipe 6 is provided with a branch 7 leading to the heater. Heated liquid returns through pipe 8 to the still on a plate above the kettle. The rest of the blended fuel passes via pipe 6 through a conventionally shown heat interchanger 9 and thence through a cooler 10. Gasoline is supplied to the system through pipe 11, passing through the heat interchanger and leading into the still on a plate well above the kettle. Commercial alcohol is introduced into the system through pipe 12 communicating with the column on a plate some distance above that where the gasoline enters. Vapors coming from the still leave the dome through pipe 13 and go to cooling condenser 14. A 2-phase condensate enters a decanting vessel 15 and separates into two layers, a lower layer of weak alcohol and an upper layer of light gasoline components. The latter is tapped off through pipe 16 and goes to a weir box 17. Some portion of this gasoline goes back to the top of the still through valved pipe 18, while the residue is drawn off through pipe 19 and sent back to pipe 20 for admixture with the blended mixture coming from the base of the still and going to storage. Weak alcohol is removed from the decanting vessel through valved pipe 21 and sent out of the system. It usually goes to another column still (not shown) where is is reconcentrated to give 95—96 per cent alcohol (cologne spirits). This strengthened alcohol goes back to the system for reuse.

It will be noted that in this apparatus and in this operation, as shown, the composition of the gasoline to be blended with alcohol is not changed, although temporarily some portions of the light fractions are used in the still for removing water.

The maximum temperature at any point in the column still is somewhat below the boiling point of dry alcohol, about 172° F.; this maximum temperature being of the homogenized liquid in the base of the still. In order to form a stable azeotropic vapor mixture in the column, it is necessary to have in the upper part of the column a substantial proportion of petroleum hydrocarbons of a boiling point near that of alcohol. These hydrocarbons always occur in commercial gasoline. Where extremely light hydrocarbons of much lower boiling point form a part of the gasoline, it is possible to modify the still somewhat to take care of them, this being done by taking the gasoline and water vapors off at a plate somewhat below the top of the column, while providing an auxiliary vapor outlet in the dome of the still for the lightest vapors. However, this is not necessary, though sometimes desirable. The gasoline treated ordinarily contains hydrocarbons boiling much above the boiling point of alcohol, but with the arrangement shown and the operation described, these do not take part in the distillatory functions of the column; they simply go away with the homogeneous liquid at the base of the column. Hydrocarbons boiling much lower than alcohol do not form desirable ternary mixtures of vapors; but under the conditions obtaining in the present operations, they are not vaporized. With the still functioning in the proper manner, the maximum temperature occurring is, as stated, not above 172° F. and is in the base of the still. The homogeneous blend in the base of the still should not be at a temperature above the boiling point of dry alcohol. The temperatures above the base decrease more or less regularly toward the top of the still. The desirable temperature at the outlet for the azeotropic vapor mixture of weak alcohol and petroleum hydrocarbons will vary somewhat, but is usually between 145° F. and 155° F. This is a rather narrow range, but there is litle difficulty in maintaining fairly exact temperatures by correlating the heat applied at the base of the still, the cooling in the condenser and the proportion of cooled gasoline refluxed to that withdrawn from the system.

What I claim is:

1. In the continuous manufacture of a physically homogenized motor fuel from commercial alcohol and light volatile petroleum oils such as gasoline, etc., the process which comprises continuously supplying commercial alcohol to a column still at one point, continuously supplying gasoline in major amount to said still at a point somewhat below, continuously withdrawing a homogenized blend of alcohol and gasoline from the base of the still in amount about equal to the supply of gasoline and alcohol and withdrawing, cooling and condensing the azeotropic mixture of vapors of gasoline and weak alcohol going to the top of the column, permitting the condensate to stratify, withdrawing the upper layer consisting substantially of gasoline and mixing this layer with said homogenized mixture from the base of the still.

2. In the continuous manufacture of a physically homogenized motor fuel from commercial alcohol and light volatile petroleum oils such as gasoline, etc., the process which comprises continuously supplying commercial alcohol to a column still at an upper plate, continuously supplying such a light volatile petroleum oil to said still at a lower plate in the amount sufficient to form a blended fuel with the alcohol, continuously withdrawing a homogenized blend of alcohol and petroleum oil from the base of the still and withdrawing, cooling and condensing the azeotropic mixture of vapors of petroleum hydrocarbons and weak alcohol going to the top of the column, and maintaining the head of the still at temperatures ranging between about 145° to 155° F. and the bottom of the still at a maximum temperature of about 172° F.

3. In the continuous manufacture of a physically homogenized motor fuel from commercial alcohol and light volatile petroleum oils such as gasoline, etc., the process which comprises continuously supplying commercial alcohol to a column still at an upper plate, continuously supplying such a light volatile petroleum oil to said still at a lower plate in the amount sufficient to form a blended fuel with the alcohol, continuously withdrawing a homogenized blend of alcohol and petroleum oil from the base of said still and withdrawing, cooling and condensing the azeotropic mixture of vapors of petroleum hydrocarbons and weak alcohol going to the top of the column, the said commercial alcohol being introduced at a point sufficiently above the point of introduction of said petroleum oil to allow substantially complete dehydration of said alcohol as it passes downwardly from plate to plate of said still prior to reaching the point of introduction of the said petroleum oil.

4. The process of claim 1 wherein the gasoline introduced into the still is preheated by heat exchange with the blend of alcohol and gasoline coming from the base of the still.

5. The process of claim 2 wherein the petro-

leum oil introduced into the still is preheated by heat exchange with the blend of alcohol and gasoline coming from the base of the still.

6. The process of claim 3 wherein the petroleum oil introduced into the still is preheated by heat exchange with the blend of alcohol and gasoline coming from the base of the still.

7. In the manufacture of blended fuels from light volatile petroleum oils and wet commercial alcohol, by improved processes involving a blending of the said oil and alcohol with simultaneous dehydration of the alcohol, the improvement which comprises flowing liquid wet alcohol counter-current to hot vapors containing said oil to dehydrate the alcohol and then introducing into the so treated liquid alcohol a substantial amount of said oil in a liquid heated condition to form a homogeneous blend and finally passing the blend so produced counter-current to hot vapors containing volatilized alcohol and said oils to strip said vapors of their alcohol content and collecting the homogeneous dry blend of said oil and alcohol thus produced.

8. In the manufacture of blended fuels from light volatile petroleum oils and wet commercial alcohol, by improved processes involving a blending of the said oil and alcohol with simultaneous dehydration of the alcohol, the steps which comprise adding hot liquid volatile petroleum oil to substantially dehydrated liquid alcohol, flowing the mixture so obtained counter-current to hotter mixed vapors of alcohol and light petroleum oil to strip the alcohol from said vapors and enrich their petroleum oil content, and then passing the hot enriched vapors counter-current to wet liquid alcohol, to remove water from said liquid alcohol and produce a substantially dehydrated alcohol, the substantially dehydrated alcohol being united with hot light petroleum oil as specified in the first step.

9. The process of claim 8 wherein the hot mixed vapors of light petroleum oil and water containing a little alcohol, obtained from said dehydration of wet alcohol, are washed with cooler liquid light petroleum oil to strip said vapors of alcohol.

10. The process of claim 8 wherein the substantially dry blend of light petroleum oil and alcohol after contact with the mixed vapors and petroleum oil and alcohol are cooled and recovered as a blended fuel.

K. P. McELROY.