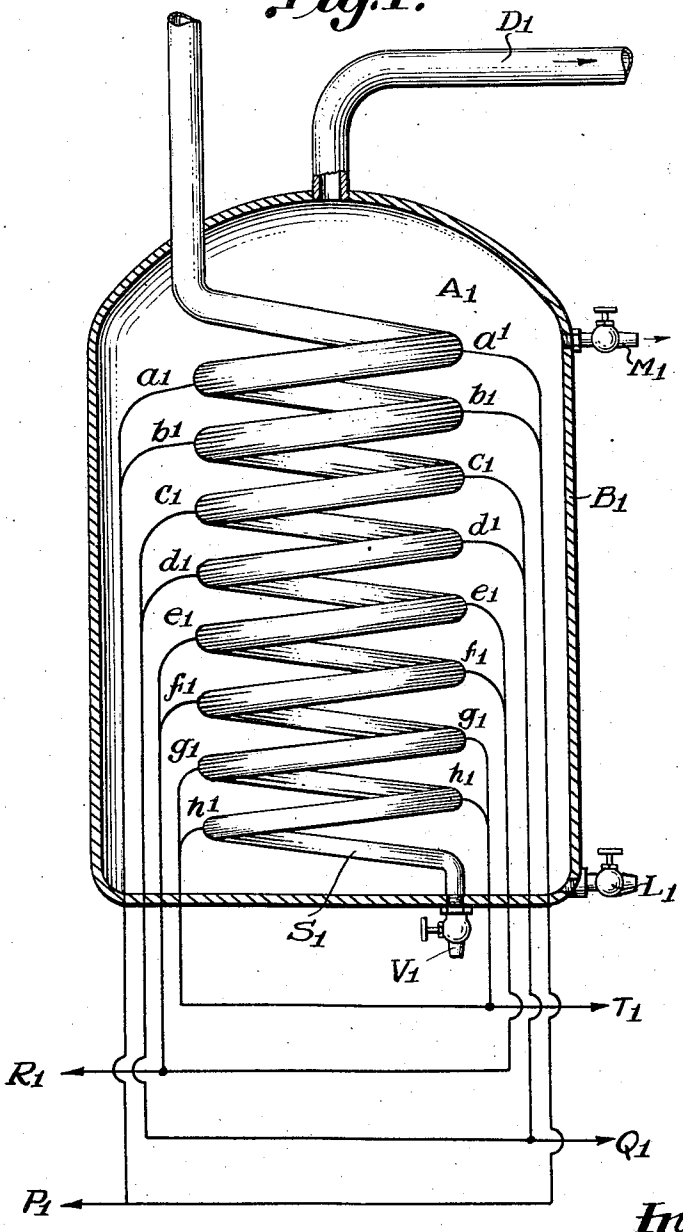
March 12, 1940. J. LOUMIET ET LAVIGNE 2,193,460

SEPARATOR

Filed Sept. 3, 1936 2 Sheets-Sheet 1

Fig. 1.



Inventor.

Jean Loumiet et Lavigne

By Thomas Holt

his Attorneys.

March 12, 1940. J. LOUMIET ET LAVIGNE 2,193,460

SEPARATOR

Filed Sept. 3, 1936 2 Sheets-Sheet 2

Fig. 2.

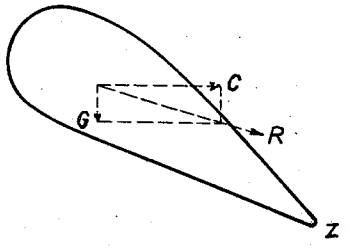


Fig. 3.



Fig. 4.

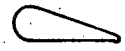


Fig. 5.

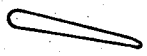


Fig. 6.

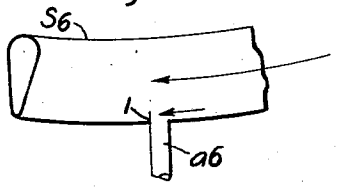


Fig. 7.

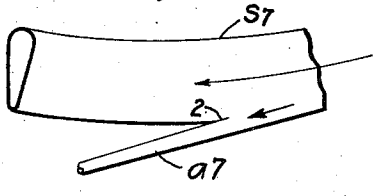


Fig. 8.

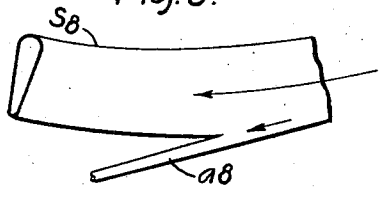


Fig. 9.

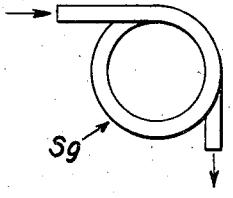


Fig. 10.

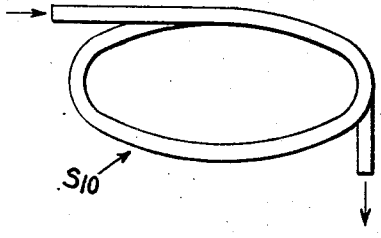
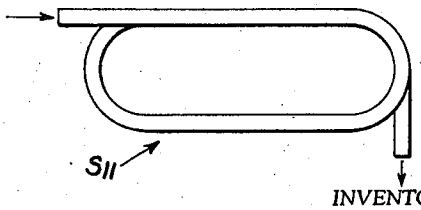


Fig. 11.



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UNITED STATES PATENT OFFICE

2,193,460

SEPARATOR

Jean Loumiet et Lavigne, Playa de la Teja, Itabo, Cuba

Application September 3, 1936, Serial No. 99,317
In Cuba March 10, 1936

2 Claims. (Cl. 183—119)

This invention relates to the separation of the different constituents of a vaporizable liquid by fractional condensation together with mechanical separation of the condensate fractions from the vapor by means of centrifugal force.

To these ends vapors containing fractions which are liquefiable at different temperatures are made to pass through a progressively cooled helical coil. The progressive cooling of the coil induces the successive condensation of the constituents of the vapor beginning with those constituents which are condensed at the highest temperature. The motion of the mixed vapor and liquid particles in the helical coil induces a centrifugal force which acts upon each particle in proportion to its mass, driving the condensed liquid particles toward the outer side of the coil thus separating them from the vapors which remain in the coil.

In order to obtain the highest efficiency a coil with a vertical axis is utilized, and the coil tubing should desirably be of a cross-sectional shape to incline downward and outward to a liquid collecting trough, the outer wall of the coil being so inclined as to intersect the resultant of gravity and centrifugal force at a slight acute angle.

Other objects and advantages will hereinafter appear.

In the drawings forming part of this specification and illustrating certain preferred embodiments of the invention;

Fig. 1 is a diagrammatic view in front elevation of a fractional condenser and separator embodying features of the invention;

Fig. 2 is a view showing a preferred coil shape;

Figs. 3, 4 and 5 are views similar to Fig. 2 showing other coil shapes which may be advantageously used;

Figs. 6, 7 and 8 are fragmentary views each showing a different form of drain connection to a section of the coil; and

Figs. 9, 10 and 11 are plan views showing different coil configurations which may be employed to advantage, the form of Fig. 9 being the preferred form.

Referring first to Figs. 1 and 2, provision is made of a helical coil S1 through which mixed condensable vapors are caused to pass from the top downward. The coil S1 is disposed vertically in tank B1 through which cooling liquid is circulated from the bottom upward. The cooling liquid may be, and desirably is, liquid which is being heated for vaporization. The cooling liquid is admitted to the bottom of the tank A1 through a valve L1 and is discharged from the upper part of the tank through a valve M1. Vapors given off from the cooling liquid in the tank A1 are carried away through a conduit D1. The vapors which are being condensed are progressively deprived of their heat as they travel downward through the coil S1 so that the hottest part of the vapor is in the upper part of the coil S1. The cooling liquid gradually takes up the heat from the vapors traveling in the coil S1 as the cooling liquid travels upward through the tank. Hence the hottest part of the cooling liquid is in the top of the tank and the coldest in the bottom. There is no tendency for convection currents of the cooling liquid to be set up in opposition to this condition. The vapors are therefore subjected to a progressive cooling effect as they travel downward through the coil S1.

The least volatile vapor fraction is condensed in the upper part of the coil S1, and the successively more volatile vapor fractions are condensed in the successively lower turns of the coil S1.

It is an important object of the present invention to so adjust the various factors which control the velocity of the vapors through the coil S1 that the vapors will be caused to travel at a high velocity through all portions of the coil sufficient to effect a classification of the vapors, in part at least, and also to throw out at once to the outer side of the coil by centrifugal force any condensate which may be formed.

A series of drains are provided to remove the condensed fractions at intervals along the coil, the drains *a1* and *b1* being arranged to discharge into a conduit P1 for collecting one vapor fraction and keeping it separate from the others. Similarly the drains *c1* and *d1* discharge into a conduit Q1 for collecting a second vapor fraction and keeping it separate from the others. Drains *e1* and *f1* discharge into a conduit R1 for collecting a third vapor fraction and keeping it separate from the others. Drains *g1* and *h1* discharge into a conduit T1 for collecting a fourth vapor fraction and keeping it separate from the others.

It is important that the velocity of the vapors traveling through the coil S1 be sufficient at all points to cause any condensate which may be formed to be immediately thrown to the outer side of the coil for extraction. This requires that the velocity of the vapors at all points along the coil shall be sufficient to generate a centrifugal component which is at least several times as great as the gravity component acting upon the condensate and which is desirably more than twenty times as great as the gravity component.

The factors which tend to influence the velocity of the flow of the vapors and entrained condensates at various points along the coil are (1) the original or source pressure of the vapors, (2) the exit or discharge pressure of the vapors, (3) the intensity of the cooling effect applied to the coil, that is to say the temperature of the cooling liquid and (4) the cross sectional area of the coil at any given point.

The vapors necessarily undergo depletion through condensation as they progress along the coil S1. It is a point of the present invention that the coil is diminished in cross sectional area from top to bottom to compensate for such depletion and to prevent loss of velocity in the later turns of the coil. The purpose of reducing the cross-section of the coil is to render the pressure gradient within the coil substantially independently of depletion by condensation, so that the centrifugal force will be maintained throughout the length of the coil. The reduction of coil section may occur continuously or step by step.

It may be assumed that the cooling liquid is controlled and regulated to maintain the temperature conditions of the cooling liquid at any given point substantially uniform so that the cooling and condensing effect of the liquid does not vary from time to time. Likewise, the dimensions of the coil S1, once they have been selected are unalterable. With these two conditions fixed or substantially fixed, however, the rate of transmission of the vapors per unit cross sectional area along the coil may still be adjusted by adjusting either the source pressure or the valve V1 which controls the discharge of uncondensed vapors from the coil S1, or by adjusting both the source pressure and the valve V1.

In Fig. 2 disclosure is made diagrammatically of a coil having a cross sectional shape which is regarded as practical and highly advantageous. As diagrammatically illustrated in Fig. 2, the centrifugal component will be horizontal and may be represented by the dash line marked C, while the gravity component will be vertical and may be represented by the vertical dash line marked G. The resultant force will be in the direction of the line marked R and will be equal in magnitude to a diagonal of the rectangle GC. The outer wall of the tube is desirably inclined downward and outward throughout its entire length at a slight angle to the direction of the resultant of the gravity and centrifugal forces. The tube terminates at its outer, low side in a liquid collecting trough of restricted cross sectional area which is discharged through drains *a1* to *h1* inclusive disposed at frequent intervals along the coil.

Each drain may desirably be of the form shown in Fig. 6, where the drain *a6* arises into the coil S6 at right angles to the coil wall and includes a baffle 1 at the lower side of the drain opening which extends across the trough to facilitate the diversion of all liquid collected above the drain.

In Fig. 7 a drain *a7* is shown as extending substantially tangentially from the wall of the coil S7. In this form also a baffle 2 is provided at the lower side of the drain opening for diverting liquid into the drain.

In Fig. 8 a drain *a8* is provided which extends substantially tangentially from the wall of the coil S8 but which does not include any baffle extending within the trough portion of the coil.

Any one of the coil cross sectional shapes of Figs. 2, 4 and 5 may be utilized but the form of Fig. 2 is preferred.

Similarly, any one of the drain arrangements of Figs. 6 to 8 may be utilized but the form of Fig. 7 is preferred.

The coils may be shaped in plan like the coil S9 in Fig. 9, S10 in Fig. 10 or S11 in Fig. 11, the circular form of Fig. 9 being the preferred form.

Ordinarily the cross sectional shape and the drain connections of the coils S1, S2 and S3 will all be alike. These features can be varied, however, in accordance with the quantity of the condensed liquid in each coil and the variety of the products which it is desired to separate in each turn or each half turn or in any selected number of complete turns.

In order to prevent the discharge of the uncondensed vapors through the drain pipes, these pipes are connected with steam-traps of well known construction which allow liquid but not vapor to pass.

I have described what I believe to be the best embodiments of my invention. I do not wish, however, to be confined to the embodiments shown, but what I desire to cover by Letters Patent is set forth in the appended claims:

1. A method of fractionally condensing mixed vapors and separating the condensate into different constituent parts, which comprises passing the vapors through a totally or partially curvilinear condensing coil, subjecting the vapors to progressively lower temperatures in the coil to condense the vapors fractionally, controlling the conditions of transmission of the vapors to subject them to a pressure drop of an order sufficient to create in the vapors and condensed liquid concurrently a velocity suitable to develop in the curvilinear parts of the coil a component of centrifugal force which is at least several times as great as the force of gravity, for separating the condensed liquids immediately from the vapors, and separately discharging such liquids from the outer side of the coil at intervals along the coil along a path diverging from the path of the vapor body in a direction limited by the direction of travel of the vapor within the coil and the direction of centrifugal force and separately collecting the liquids condensed and separated at different temperatures, all while progressively reducing the cross-section of the vapor body as it passes through the coil to maintain the velocity of the vapor and the centrifugal separating action notwithstanding the progressive depletion of the vapors by condensation.

2. An apparatus for separating vapors into different constituent parts comprising a condensing coil which is curvilinear, in part at least, for cooling the vapors and centrifugally separating condensed liquid from the vapors, means for cooling the coil progressively from the inlet end to the opposite end thereof, and separate liquid drains communicating with the coil at intervals to collect and keep separate the liquids condensed in different temperature zones of the coil, the coil being of progressively diminishing cross section to compensate for the depletion of the vapors by condensation, and means for delivering the vapor constituents to one end of the coil and for advancing the vapors through the coil from end to end thereof, under a pressure drop of an order sufficient to create in the vapors and condensed liquid concurrently a velocity suitable to develop a component of centrifugal force which is at least several times as great as the force of gravity, for classifying the vapors, and for separating the condensed liquid immediately from the vapors, said coil having a cross section which tapers outwardly and downwardly, and said drains being connected to the outermost portion of the respective turns of the coil to lead the liquid along lines limited by the direction of travel of the vapor within the coil and the direction of centrifugal force.

JEAN LOUMIET ET LAVIGNE.