Dec. 23, 1924. 1,520,161

F. E. VAN TILBURG

APPARATUS FOR SEPARATING COMPOSITE OILS INTO COMPONENT PARTS

Filed Jan. 25, 1923 3 Sheets-Sheet 1

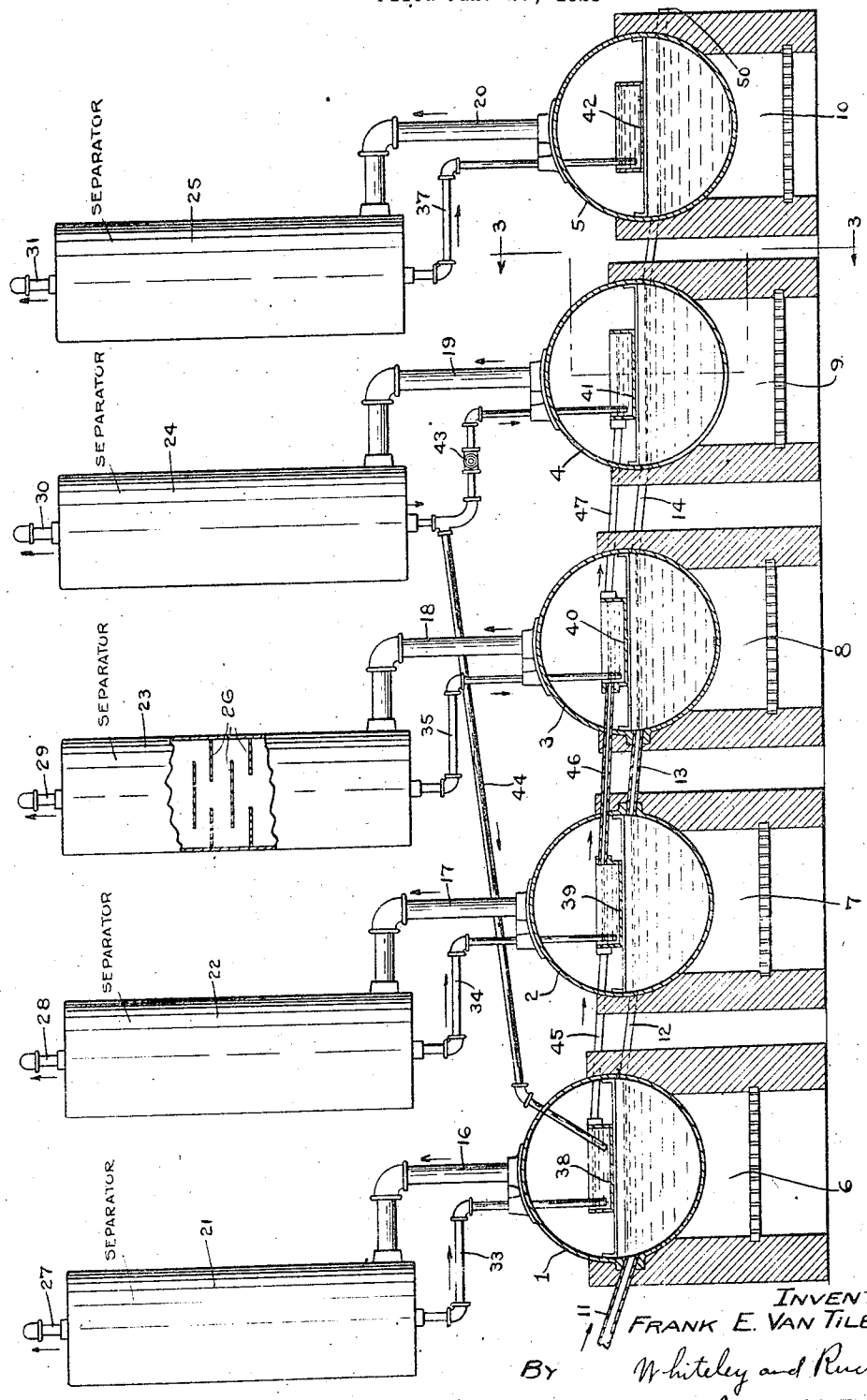


FIG. 1

INVENTOR:
FRANK E. VAN TILBURG.
BY Whiteley and Ruckman
ATTORNEYS.

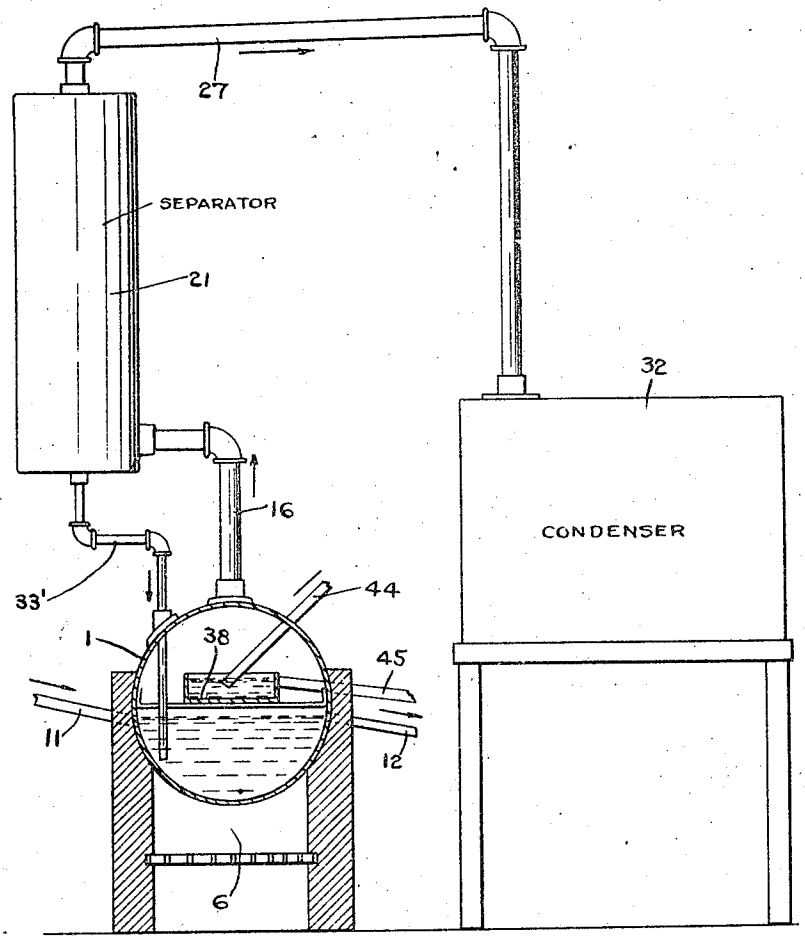
Dec. 23, 1924. 1,520,161

F. E. VAN TILBURG

APPARATUS FOR SEPARATING COMPOSITE OILS INTO COMPONENT PARTS

Filed Jan. 25, 1923 3 Sheets-Sheet 2

FIG. 2.



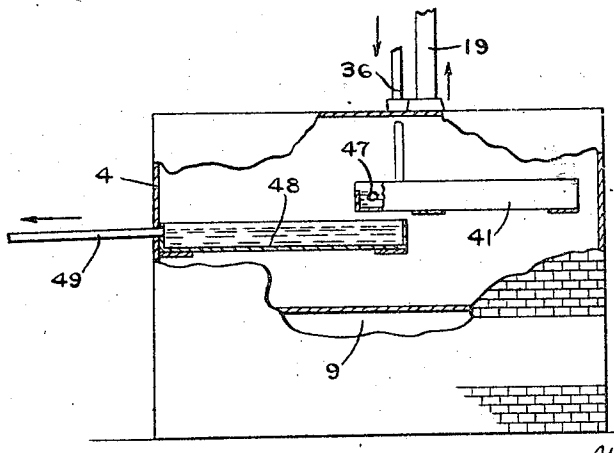


FIG. 3

INVENTOR.
FRANK E. VAN TILBURG
BY
Whiteley and Ruckman
ATTORNEYS.

Dec. 23, 1924. 1,520,161

F. E. VAN TILBURG

APPARATUS FOR SEPARATING COMPOSITE OILS INTO COMPONENT PARTS

Filed Jan. 25, 1923 3 Sheets-Sheet 3

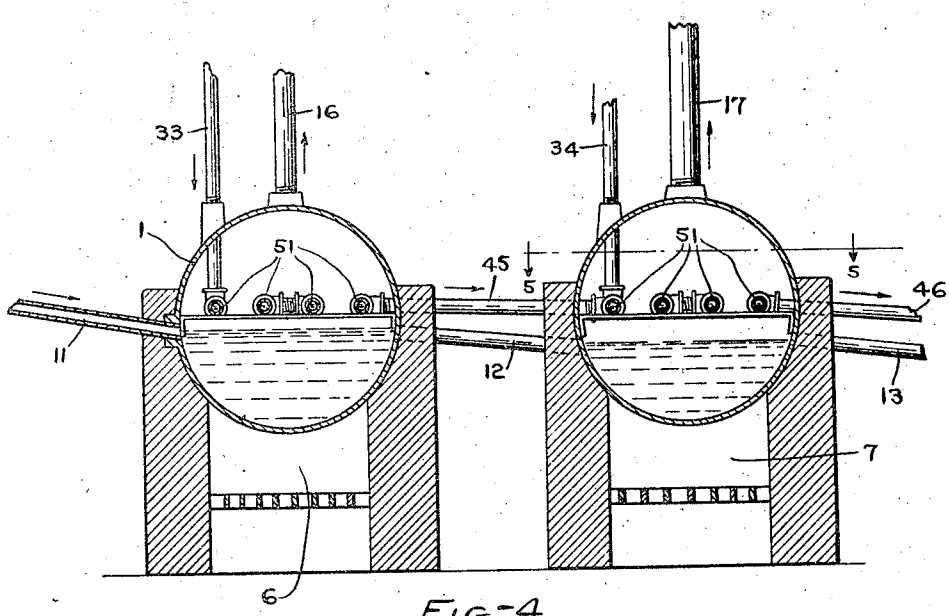


FIG. 4

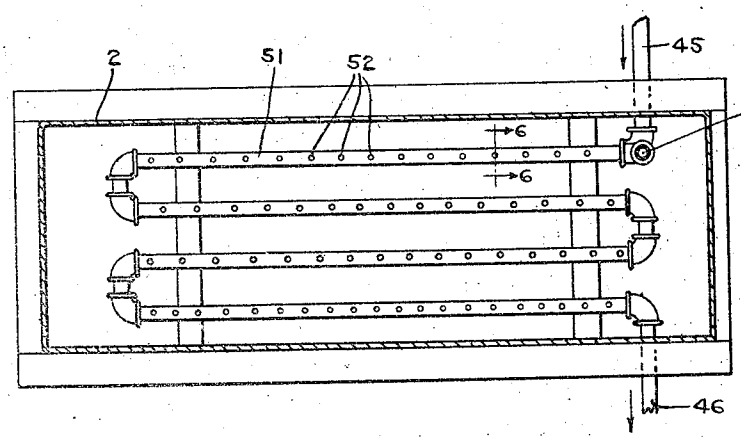


FIG. 5

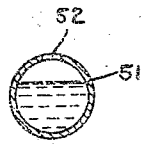


FIG. 6

INVENTOR:
FRANK E. VAN TILBURG.

BY

Whiteley and Ruckman

ATTORNEYS.

1,520,161

Patented Dec. 23, 1924.

UNITED STATES PATENT OFFICE.

FRANK E. VAN TILBURG, OF MINNEAPOLIS, MINNESOTA.

APPARATUS FOR SEPARATING COMPOSITE OILS INTO COMPONENT PARTS.

Application filed January 25, 1923. Serial No. 614,815.

To all whom it may concern:

Be it known that I, FRANK E. VAN TILBURG, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Apparatus for Separating Composite Oils into Component Parts, of which the following is a specification.

My invention relates to apparatus for separating composite oils into component parts. More particularly, it relates to separating the lighter petroleum products from the heavier petroleum products of crude oil. The objects of the invention are to increase the yield of gasoline or lighter products and to reduce the fuel consumption required for the operation. The invention is based on the principle that a petroleum distillate when once separated from the original mass of crude oil should not again be mixed with a heavier distillate or be allowed to mix with the original mass for the reason that it requires less heat to re-distill the light distillates when not mixed with heavier distillates than it requires when the lighter distillates are allowed to flow back into the still to mix with the original mass and be re-distilled when the mass reaches a higher temperature. The invention is also based upon the well known fact that when there is only a comparatively small difference in temperature between the initial boiling point and the end point of the distillate, it is possible to recover a larger percentage of light petroleum product or obtain an increased yield of products of what is known as low end points or low boiling points such as gasoline and naphtha. By "end point" is meant that characteristic of a so-called distillate which indicates the temperature at which the last of any particular sample is carried off in gaseous form. The general refinery practice has been to re-run the lighter distillates recovered from crude oil whose end points are higher than those of gasoline and when this is done, it requires extra fuel to bring the distillates to the temperature required for vaporization. In refineries which employ what is known as the "continuous system" or a battery of stills consisting of two or more, it has been customary to allow the distillates which flow back from the vapor lines of the stills to go into the original mass of oil with the result that these distillates become mixed with the original mass. It requires greater heat to re-distill them when thus mixed than it does to re-distill them when kept separate. I accomplish the objects of my invention by distilling the composite oil, trapping back the condensate from the distilled vapors and re-distilling the condensate unmixed with the original mass of crude oil by the same source of heat employed in the initial distillation.

The full objects and advantages of my invention will appear in connection with the detailed description and the novel features of my invention idea will be particularly pointed out in the claims.

In the accompanying drawings which illustrate the application of my invention,—Fig. 1 is a view partly in vertical section and partly in side elevation showing an apparatus for carrying out my invention. Fig. 2 is a view partly in vertical section and partly in elevation showing a slight modification. Fig. 3 is a view substantially in section on the line 3—3 of Fig. 1. Fig. 4 is a fragmentary view corresponding to Fig. 1 and showing a slight modification. Fig. 5 is a view in horizontal section on the line 5—5 of Fig. 4. Fig. 6 is an enlarged view in section on the line 6—6 of Fig. 5.

Referring to the construction shown in the drawings, I provide a plurality of stills or boilers 1, 2, 3, 4, and 5 which are placed above fireboxes 6, 7, 8, 9, and 10, respectively, which furnish heat for vaporizing the oils in the stills. The composite oil to be separated is fed into still 1 in suitable manner, as by means of a pipe 11 and the stills are connected in series by pipes 12, 13, 14, and 15 which incline downwardly as they extend from a still to the next one in the series. Pipes 16, 17, 18, 19 and 20 connect the upper portions of the stills in succession to places somewhat above the lower ends of separators 21, 22, 23, 24, and 25, these separators consisting of casings which are preferably cylindrical and which contain a series of baffles 26. From the top of the separators, pipes 27, 28, 29, 30 and 31 lead to condensers such as the condenser 32 shown in Fig. 2. From the bottoms of the separators, pipes 33, 34, 35, 36, and 37 lead back respectively into the stills 1, 2, 3, 4, and 5 so that liquid condensing in the expansion chambers of the separators will flow back into the stills. These pipes, however, instead of delivering this condensate into the original

mass in the stills are arranged to deliver into auxiliary stills such as the pans 38, 39, 40, 41 and 42 which are supported respectively in the upper portions of the stills so as to be above the liquid contained therein. The pipe 36 which extends into the still 4 is provided with a cock 43 and above this cock a downwardly inclined pipe 44 connects the pipe 36 with the interior of the pan 38 so that when the cock is closed the condensate forming in the separator 24 will be trapped back into the pan which is in the still 1. The pans 38, 39, 40 and 41 are connected in series by pipes 45, 46, and 47, which incline downwardly as they extend from one pan to the next in the series. The pan 41 in the still 4 instead of being connected with the pan 42 in the still 5 is provided at one end with a wall which is lower than the remainder of the vertical wall of the pan so that the condensate which is received in the pan 41 and is not vaporized may overflow into a pan 48 supported in the still 4 and provided with an overflow pipe 49 leading to any suitable container. The still 5 is provided with an overflow pipe 50 which may lead to any suitable container. Fig. 2 shows a slight modification in regard to the still 1, this figure showing a pipe 33' which leads back into the original mass of liquid in the still instead of leading into the pan 38. Figs. 4, 5, and 6 show a slight modification in which the pans are replaced by coils of pipe 51 lying in a horizontal plane in the stills and having perforations 52 in their upper sides for escape of vapor. The coils of pipe in the successive stills are connected by pipes in the same manner that the corresponding pans are connected.

The operation and advantages of my invention will now be obvious. In a battery of five stills such as shown in Fig. 1, the kerosene will be distilled from still 5 and it is contemplated that a temperature of about 500° F. will be employed which is sufficiently high to vaporize all light components of the oil so that none of these light components can pass into still 5 and go into the cheaper kerosene. While it may require a temperature of 500° F. to vaporize the lighter products from the original mass of oil, the condensate which flows back from the separators placed above the stills can be re-vaporized and made into a lighter product with a temperature of from 400° to 425° F. and by carrying these trapped-back condensates into the auxiliary still in the main still 1 and allowing portions of the condensates to flow into the auxiliary stills in the succeeding stills 2 and 3, the temperature in these latter stills will be sufficiently high to re-vaporize a portion of the condensates. Furthermore, by maintaining a temperature sufficiently high, it is impossible for any light components to pass into still 5 and the trapped-back condensates from the stills are kept circulating between still 1 and still 4 until such condensates become sufficiently heavy so that the temperature in still 4 will not vaporize them whereupon they flow into still 5 from which they are carried off by the use of a higher temperature in the form of kerosene. The condensates reaching the pan 48 in still 4 which are too heavy to be vaporized overflow through the pipe 49 so that they can be recovered while the oil reaching the still 5 which is too heavy to be vaporized is permitted to over-flow through the pipe 50 so that it can be recovered. It should be borne in mind that the condensate which is trapped-back from the separators is very hot and the redistillation of these components is continued without allowing them to cool. In the general practice now employed, it is customary to accumulate the components whose end points are higher than those of the different grades of gasoline and then re-run such components which, of course, means loss of fuel. An important feature of my invention consists in the use of auxiliary stills such as the pans or coils which prevent the trapped-back condensates formed in the separators or fractioning equipment from flowing back into the original mass of oil. The invention broadly considered includes the idea of returning the condensates trapped-back from any of the vapor lines to auxiliary stills placed in any of the main stills. The employment of this invention increases the yield of gasoline, saves fuel and increases the capacity of the plant.

I claim:

1. Apparatus for separating composite oils into component parts comprising a plurality of main stills connected in series, an auxiliary still in each of said main stills, the earlier of said auxiliary stills being connected with each other in series, a plurality of separators connected respectively with said main stills for receiving the vapors therefrom, and means for trapping back into said auxiliary stills the condensates forming in said separators whereby said condensates will be redistilled unmixed with the original mass of oil and by the same source of heat employed in the initial distillation.

2. Apparatus for separating composite oils into component parts comprising a plurality of main stills connected in series, an auxiliary still in each of said main stills, the earlier ones of said auxiliary stills being connected with each other in series, a plurality of separators connected respectively with said main stills for receiving the vapors therefrom, and means for trapping back into the first auxiliary still the condensates forming in the separator which is connected with the main still containing the last one of the connected auxiliary stills whereby said condensates will be redistilled unmixed with the

original mass of oil and by the same source of heat employed in the initial distillation.

3. Apparatus for separating composite oils into component parts comprising a plurality of main stills connected in series, an overflow pipe leading from the last one of said stills, an auxiliary still in each of said main stills, the earlier ones of said auxiliary stills being connected with each other in series, a plurality of separators connected respectively with said main stills for receiving the vapors therefrom, means for trapping back into said auxiliary stills the condensates forming in the separators connected therewith respectively, and means for trapping back into an earlier auxiliary still the condensates forming in one of the later separators whereby said condensates will be redistilled unmixed with the original mass of oil and by the same source of heat employed in the initial distillation.

4. Apparatus for separating composite oils into component parts comprising a plurality of main stills connected in series, an overflow pipe leading from the last one of said stills, an auxiliary still in each of said main stills, said auxiliary stills with the exception of the last one being connected with each other in series, a plurality of separators connected respectively with said main stills for receiving the vapors therefrom, means for trapping back into said auxiliary stills the condensates forming in the separators connected therewith, means for trapping back into the first of said auxiliary stills the condensates forming in next to the last of said separators whereby said condensates will be redistilled unmixed with the original mass of oil and by the same source of heat employed in the initial distillation, a second auxiliary still in next to the last of said main stills, and an overflow pipe leading from said last mentioned auxiliary still.

In testimony whereof I hereunto affix my signature.

FRANK E. VAN TILBURG.