W. C. AND F. E. WELLS.

PROCESS OF REFINING PETROLEUM, SHALE OIL, COAL TAR, AND THE LIKE, COMMONLY CLASSED AS HYDROCARBONS.

APPLICATION FILED OCT. 27, 1919.

1,433,052.

Patented Oct. 24, 1922.

6 SHEETS—SHEET 1.

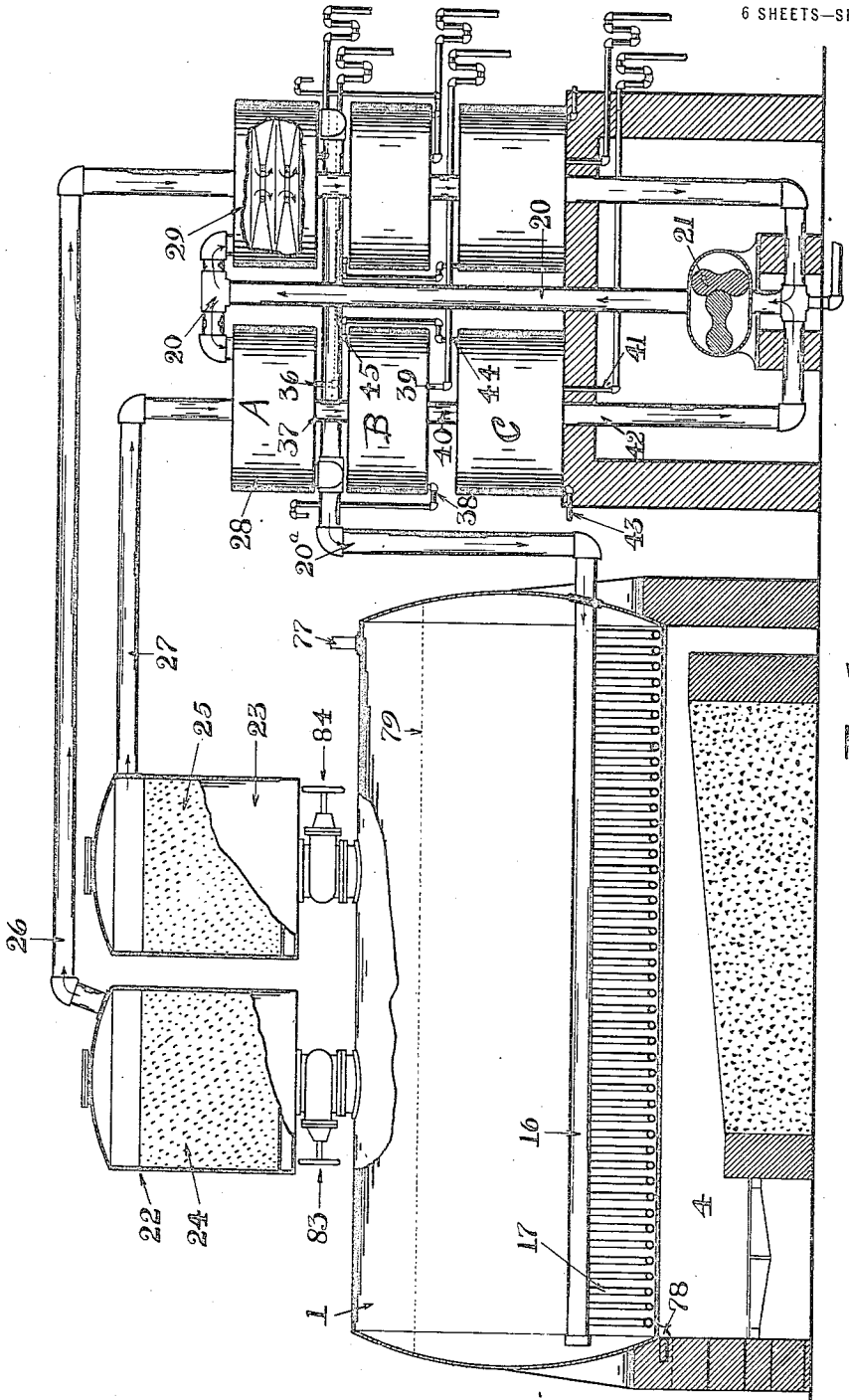


Fig. 1.

Willet C. Wells Inventors
Frank E. Wells
By Kolb Rightmire Atty.

W. C. AND F. E. WELLS.

PROCESS OF REFINING PETROLEUM, SHALE OIL, COAL TAR, AND THE LIKE, COMMONLY CLASSED AS HYDROCARBONS.

APPLICATION FILED OCT. 27, 1919.

1,433,052.

Patented Oct. 24, 1922.

6 SHEETS—SHEET 2.

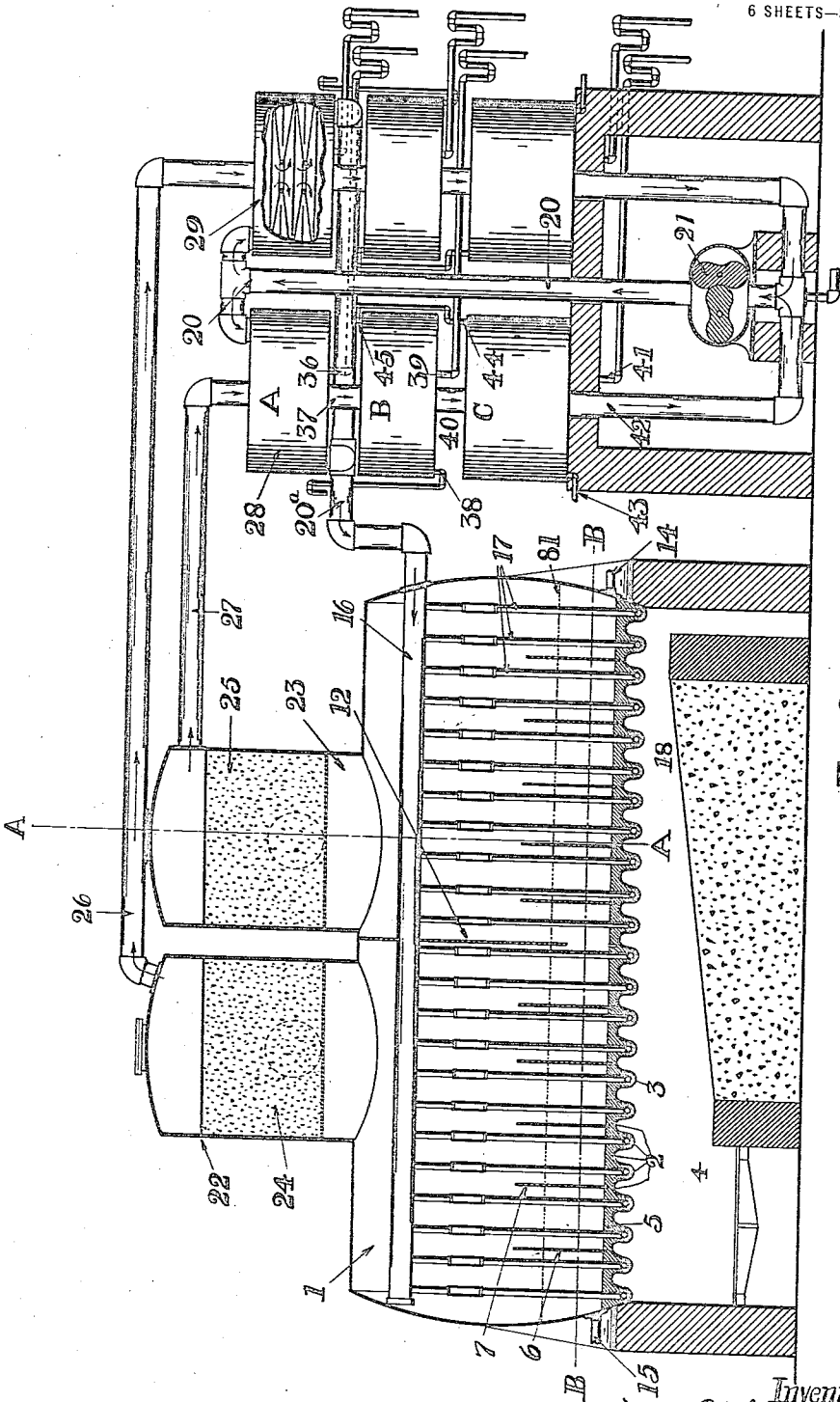


Fig. 2.

Inventors
Willet C. Wells
Frank E. Wells
By Geo. W. Rightmire Atty.

W. C. AND F. E. WELLS.

PROCESS OF REFINING PETROLEUM, SHALE OIL, COAL TAR, AND THE LIKE, COMMONLY CLASSED AS HYDROCARBONS.

APPLICATION FILED OCT. 27, 1919.

1,433,052. Patented Oct. 24, 1922.

6 SHEETS—SHEET 3.

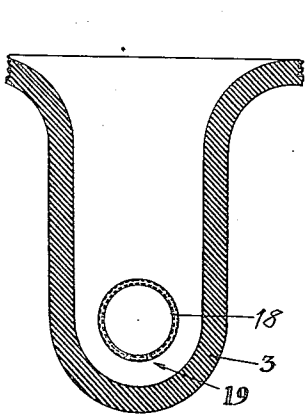


Fig. 3a.

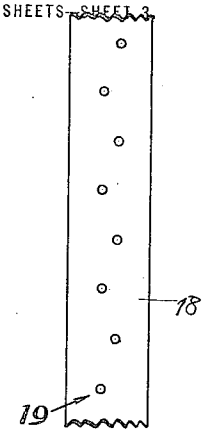


Fig. 3b.

Fig. 3.

Willet C. Wells Inventors
Frank E. Wells

By Geo. W. Rightmire Attorney

W. C. AND F. E. WELLS.

PROCESS OF REFINING PETROLEUM, SHALE OIL, COAL TAR, AND THE LIKE, COMMONLY CLASSED AS HYDROCARBONS.

APPLICATION FILED OCT. 27, 1919.

1,433,052. Patented Oct. 24, 1922.

6 SHEETS—SHEET 4.

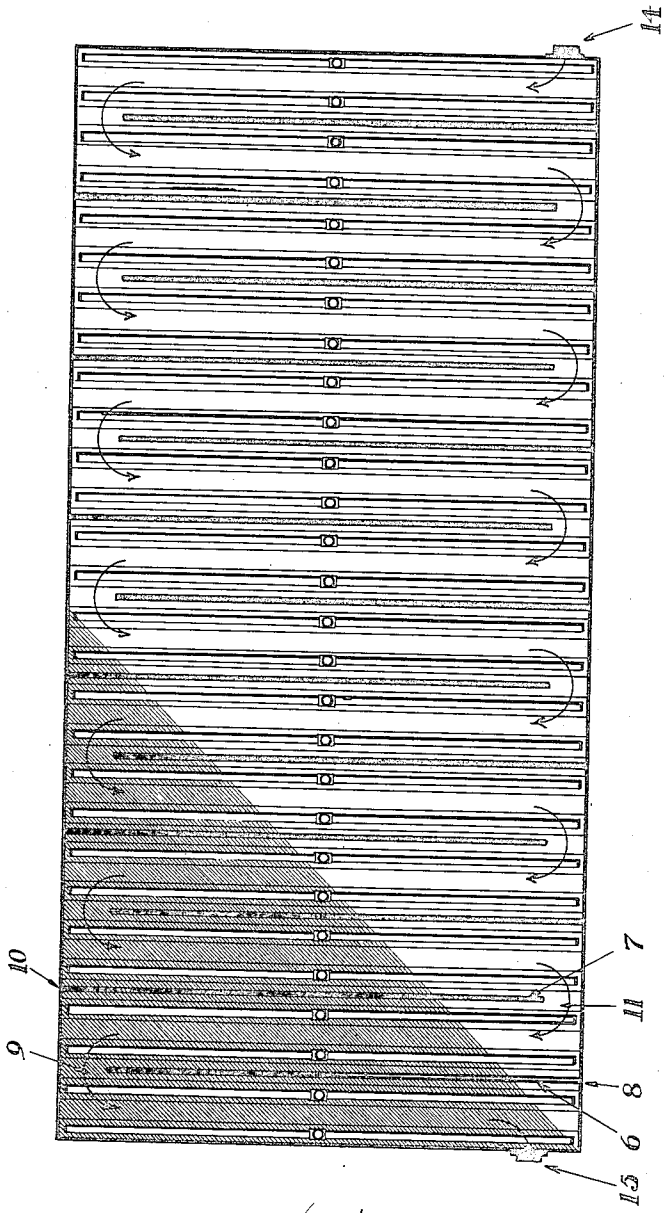


Fig. 4.

Witness: C. Curtis Inventors
Frank E. Wells
By Geo. W. Rightmire Atty.

W. C. AND F. E. WELLS.

PROCESS OF REFINING PETROLEUM, SHALE OIL, COAL TAR, AND THE LIKE, COMMONLY CLASSED AS HYDROCARBONS.

APPLICATION FILED OCT. 27, 1919.

1,433,052. Patented Oct. 24, 1922.

6 SHEETS—SHEET 5.

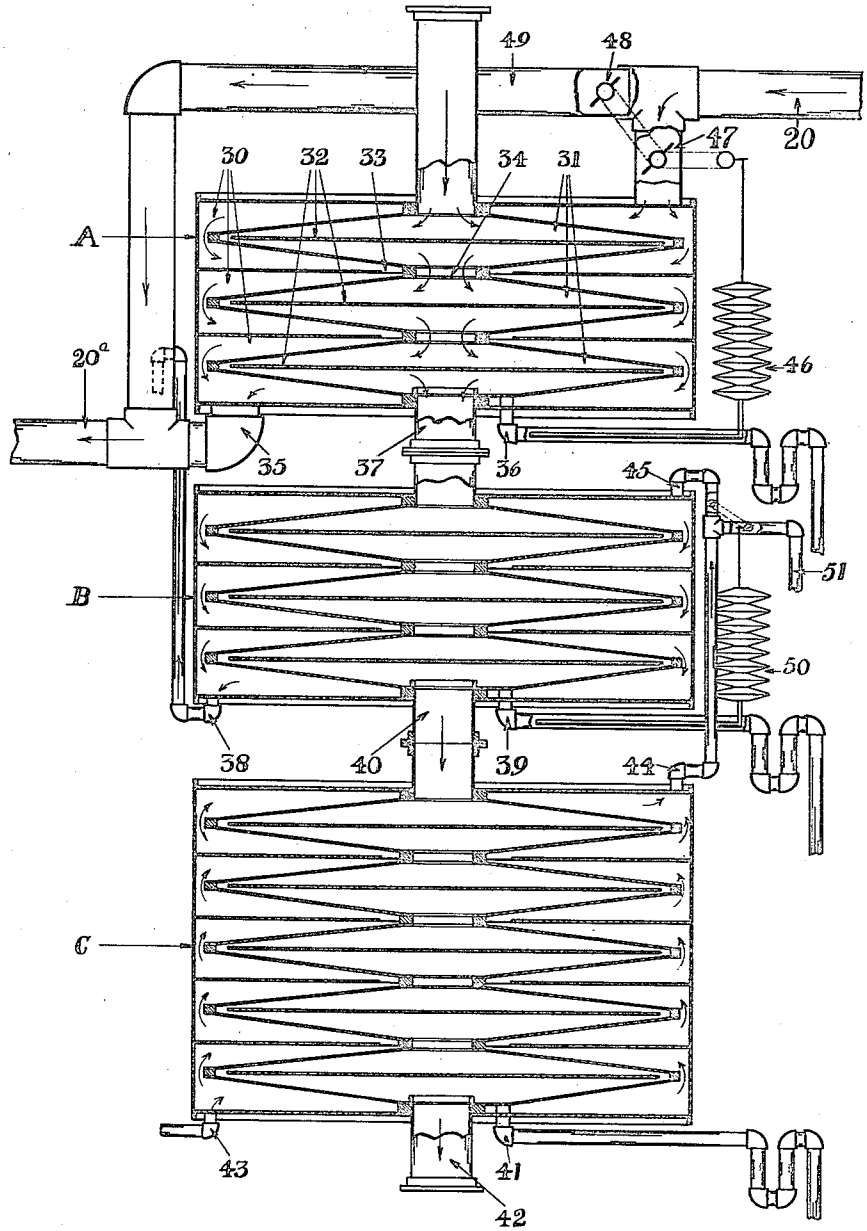


Fig. 5.

Inventors
Wilbert C. Wells
Frank E. Wells

By

Attorney
Geo. W. Rightmire

W. C. AND F. E. WELLS.

PROCESS OF REFINING PETROLEUM, SHALE OIL, COAL TAR, AND THE LIKE, COMMONLY CLASSED AS HYDROCARBONS.

APPLICATION FILED OCT. 27, 1919.

1,433,052. Patented Oct. 24, 1922.

6 SHEETS—SHEET 6.

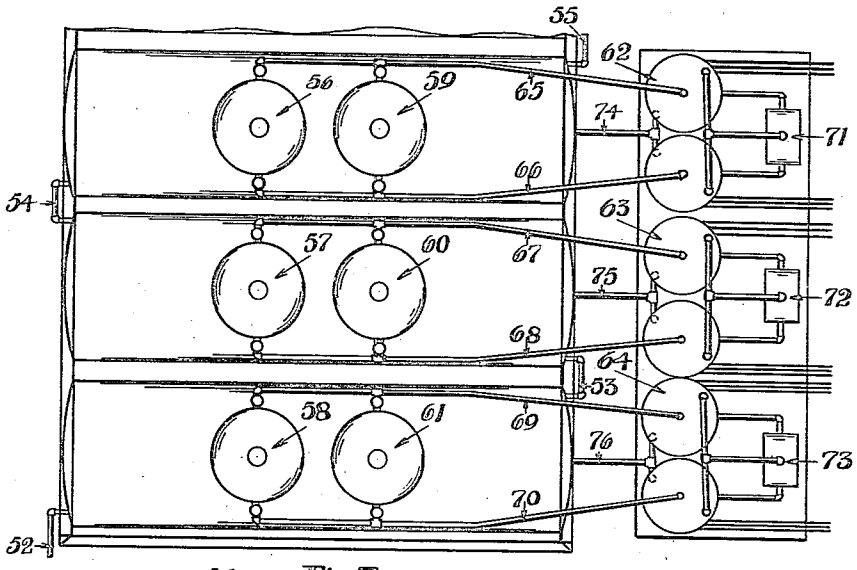


Fig. 7.

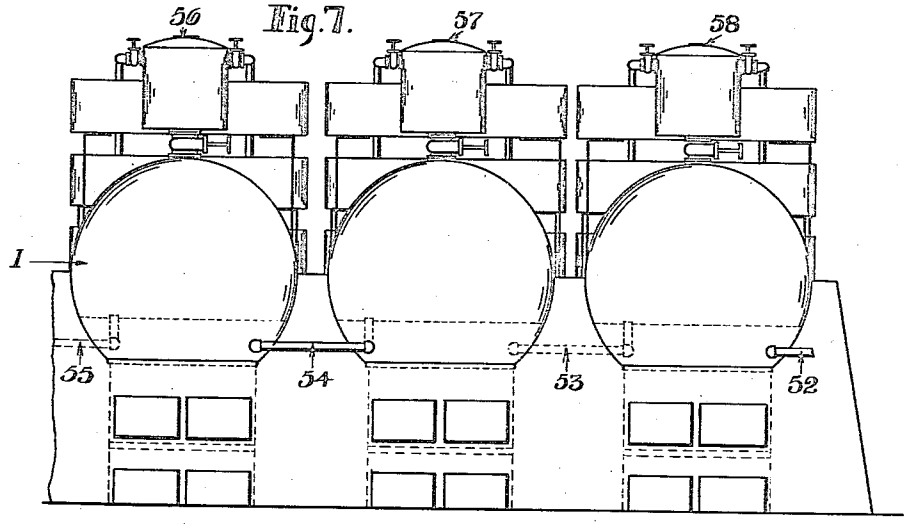


Fig. 6.

Willet C. Wells Inventors.
Frank E. Wells

By Geo. W. Rightmire Attorney

Patented Oct. 24, 1922. 1,433,052

UNITED STATES PATENT OFFICE.

WILLET C. WELLS AND FRANK E. WELLS, OF COLUMBUS, OHIO.

PROCESS OF REFINING PETROLEUM, SHALE OIL, COAL TAR, AND THE LIKE, COMMONLY CLASSED AS HYDROCARBONS.

Application filed October 27, 1919. Serial No. 333,501.

To all whom it may concern:

Be it known that we, WILLET C. WELLS and FRANK E. WELLS, citizens of the United States, residing at Columbus, in the county of Franklin and State of Ohio, have invented certain new and useful Improvements in the Processes of Refining Petroleum, Shale Oil, Coal Tar, and the like, Commonly Classed as Hydrocarbons, of which the following is a specification.

This invention is the outgrowth of development along natural lines of experiments and efforts to preserve the full inherent value and perfection of petroleums, shale oil, coal tar and the like, in their conversion in one operation into commercial products; the development of our ideas may be seen as they have progressed in our Patents Numbers 877,620 and 1,296,244, and our pending applications Serial Number 277,296, filed February 15th, 1919 for process of filtering vapors, and 281,701, filed March 10th, 1919, for process of condensing and separating vapors of variable volatility into homogeneous fractions of distillates, and in others.

Separating petroleum into commercial fractions of varying volatility for various commercial uses has ever been by evaporation by heat; but the degree of heat required to evaporate petroleum even if aided by a vacuum or by the use of steam, seriously decomposes the products thereof, producing thereby permanent gas and so-called unsaturated compounds—which means simply burnt products—accompanied by the production of carbon which forms in a residue of coke which must be removed from the still by hand tools. Consequently substantially all literature of a scientific nature pertaining to petroleum states that "the refining of petroleum is based on destructive distillation"; the distillates thus produced must undergo many changes in redistilling, chemical treatment, subdivision, or reduction by reevaporation of a portion thereof, and filtering, to prepare them for their intended purpose, and all these additional operations are expensive and wasteful of time and materials and do not result in utilizing all the commercially valuable portions of the petroleum and many of those produced are not of the best attainable quality.

Our process converts petroleum in one continuous operation into perfect commercial products fundamentally free of unstable compounds, and it consists in the use of the absorptive properties of heated neutral gas passed in fine streams through heated petroleum whereby the surface of each bubble of gas becomes a free surface upon which vapors can form within the body of the petroleum below its boiling temperature; under these conditions the thirst of the gas to saturate itself with vapors coacts with the vapor tension of the heated petroleum to evolve all the evaporable portions of the petroleum in vapor at such low temperatures that no constitutional change takes place therein. The vapors thus evolved are passed with and by means of the neutral gas that evolved and contains them, through a sufficient body of filtering material, such as fuller's earth, in the dome of the still, which atomizes the vapor and removes color and all tarry and bituminous matter, necessarily carried with the heavy vapors from the distillates thereof and produces much more pronounced crystals of wax therein.

As the filtering material receives heat solely from the gas and vapors passing therethrough, it is necessarily of lower temperature than the fluid which heats it, consequently a portion of the less volatile vapor condenses therein and this condensate is absorbed in the pores of the filtering material and is retained therein until the continuously increasing temperature of the succeeding vapors evaporates it therefrom, and in so doing continuously deposits more condensate of less volatility in its stead, thus very materially narrowing the range of volatility of any portion of distillate therefrom. By this means we obtain pure marketable products direct from the condenser, of good color and entirely free from tarry or bituminous matter, and having more pronounced crystals in the wax distillate and consequently less amorphous matter or petroleum jelly, and hence producing more commercial wax of a better quality.

We fractionally condense the vapors from the neutral gas which evolved and conveys them, and carry on this process, in chambers, the temperature of which is automatically controlled to give the desired volatility to each portion of the distillates; the neutral gas is thereupon returned, relieved of its vapors, to repeat its cycle of operation. We thus, at one operation, at the minimum of

expense and without appreciable loss of material, convert all of petroleums, shale oil and the like into perfect finished commercial products, except the removal of their natural odor.

The process herein described can be carried on continuously, beginning with the crude hydrocarbon and subjecting the same to progressive treatment in a variety of kinds of apparatus, preferable forms of which we show for treatment up to the point where the commercial products are realized ready for market.

Suitable apparatus is illustrated in the drawings herein, in which Fig. 1 is a complete system of apparatus partly in section wherein the evaporating, the filtering and the condensing may be carried on; Fig. 2 is a similar view of a complete system of apparatus partly in section, in which the still is provided with bottom convolutions, baffles, and provision is made for operating the two end compartments independently of each other so far as concerns the matter of conducting away the vapors from the hydrocarbon. Fig. 3 is a vertical transverse section through Fig. 2 along the line A—A; Fig. 3^a is an enlarged view of a sectional convolution 3 and Fig. 3^b is a bottom view of pipe 18; Fig. 4 is a view from above along the section line B—B in Fig. 2; Fig. 5 is a sectional elevation of the condensing apparatus disclosing the heat control in the two upper chambers; Fig. 6 is an end view of a series of stills associated so that the product issuing from one passes through the adjacent one and so on through the series, with the result that the evaporated fractions desired for commercial purposes are progressively obtained; Fig. 7 is a top plan view of the series of stills shown in Fig. 6.

Referring to the drawings, and directing attention especially to Fig. 2, 1 is a still provided with the corrugated or convoluted bottom 2, such still being usually designated a flat bottom still; the convolutions are seen at 3. The fire box appears at 4, and the heat therefrom plays on the bottom of the still and is much more effective by reason of the convolutions. The heavy fluid 5 which is preferably lead or an alloy thereof, lies on the bottom of the still and fills the convolutions; the lead will remain fluid under all degrees of heat requisite to carry on the process. The baffles 6 engage the sides of the still alternately and lie transversely thereof, and extend into the lead 5 at the bottom of the still. In other words, the baffle 6 as seen in Fig. 4 engages the side of the still at 8 at one end, but at its other end is not in engagement with the side of the still but stops short thereof and so leaves a passageway around the end from one side of the baffle to the other. Similarly the baffle 7 is secured in place at 10 to provide the passageway 11. In this manner communication around the baffles from one end of the still to the other is provided. A diaphragm 12 is provided about midway of the still to divide it into two compartments to prevent the vapors arising from the hydrocarbon in one compartment from mingling with those arising in the other, for a purpose subsequently explained. This diaphragm also functions as a baffle, being appropriately cut away as appears in dotted lines in Fig. 3 at one end, to form the passageway 13 for the hydrocarbon in passing from one end of the still to the other. The material to be treated is admitted at 14 and after traversing the still the residue is furnished an exit at 15. This residue is commercial asphalt and is of any melting point desired depending upon the desired degree and extent of the distillation carried on in the retort. Within the still 1 appears the manifold 16 opening into the down pipes 17 and at its lower end the latter communicates with the transverse pipes 18 which are provided with fine perforations 19; the manifold 16 is in communication with the pipe 20^a which opens out from the condenser as described below.

At 22 and 23 are filtering domes communicating with the interior of the still and provided with a filtering material 24 and 25 we have here shown this filter conventionally and make reference to copending application 277,296, filed February 15th, 1919, for preferable construction to permit ready filling and discharge of the filtering material when it becomes obstructed with impurities. Pipe 26 conducts the filtered vapors from dome 22 and pipe 27 furnishes the communication between dome 23 and the condenser system indicated generally at 28. It is seen that pipe 26 communicates generally with the condenser system indicated generally at 29.

The condenser system is best seen in Fig. 5 where it appears partly in vertical transverse section; the systems indicated generally at 28 and 29 are identical and only one need be described, and we shall assume that the one shown in Fig. 5 is 28. The system comprises as here shown the three sections A, B and C; each section includes a plurality of compartments designated at 30, and in each compartment there is a vapor chamber 31, divided by the diaphragm or baffle 32. The interior construction of all the sections is the same and no further description thereof is needed. The compartments in a section communicate with each other at 33 and the vapor chambers communicate with each other at 34. The exit from the compartments of section A is at pipe 35 into pipe 20^a, and the exit from the vapor chambers in section A for the condensate is pipe 36, and for uncondensed ma-

terial it is pipe 37 opening into section B. From the compartments of section B the exit is pipe 38 and from the vapor chambers it is pipe 39 for the condensate and pipe 40 for the uncondensed material on the way into section C, whence exit is provided for condensates at pipe 41 and the uncondensed material at 42. The cooling fluid enters the compartments of section C at 43 and issues therefrom into pipe 44 which conducts it into section B at 45, whence it passes through the compartments therein and issues therefrom at 38 as noted above.

Connected with the issue pipe is the thermostat indicated at 46, connected with the valve 47 which regulates the intake of gas from the pump 21 in accordance with the temperature of the condensate issuing from section A. Consequently a larger or smaller volume of gas depending upon the caloric condition is supplied to section A as a cooling or condensing agency. The thermostat 46 also controls valve 48 in the bypass pipe 49 so that when one valve is brought towards a closed position the other is turned towards an open position. It is seen that the gas bypassed through pipe 49 will mingle with the heated gas issuing from section A in the pipe 35 and so will pass on through pipe 20^a to the still.

A similar thermostat is shown at 50 to control the admission of the condensing agency coming from section C into section B, the remainder thereof being drawn off through pipe 51. The thermostat is not shown in Fig. 2, nor is the bypass pipe, for the reason that it seemed unwise to crowd that figure with any more detail; the connection with the construction shown in Fig. 2 of the thermostat and related parts is, however, quite evident.

In Figures 6 and 7 are shown stills arranged in a series, communicating with each other progressively, the intake for the hydrocarbon being in one of the stills, as at 52, and communicating pipes being shown at 53 and 54 and an exit pipe at the opposite end of the series. As shown, the series is broken at 55, but of course the series may be made to include any number of stills desired. The filter domes provided in pairs for each still appear at the numerals 56 to 61, and the associated condensing systems appear at 62, 63 and 64; the pipes 65 to 70 carry vapor laden gas from the domes to the condensers, and gas is pumped from the pumps 71, 72 and 73 into the condensers as indicated, and issues from the upper sections thereof into the pipes 74, 75 and 76 for transference to the stills. It should be stated that parts mentioned and included in Figures 6 and 7 are of a construction similar to the showings in the figures already described. Likewise the interior construction and arrangement of the stills in Figures 6 and 7 are the same as shown in Fig. 2 and described above, so that the hydrocarbon introduced into a still is subjected to heat and its progress through the still from entrance to exit is expedited and controlled in the same manner as shown in said Figure 2. Hence there need be no further description of this series of stills.

Referring now to Figure 1, the still is provided with the material intake pipe 77 and the pipe through which the residue is drawn off at 78; material may be introduced for evaporation until it rises say to the line 79. Heat may be applied thereto from the fire box 4 and the absorptive gas is introduced through the manifold 16 through the pipes 17 into the material operated upon. In this instance also the gas is furnished by the pump in the same manner as that described above, and the remainder of the construction and operation is the same except for the differences in operation produced by the differences in the interior construction of the stills. In Fig. 1 the still is a cylindrical still, but the bottom is not corrugated or fluted as shown in Fig. 2.

The stills shown in Figs. 1 and 2 are made for continuous operation and the evaporation continues until all the evaporable portions of the material are obtained, and as explained above the stills shown in Figures 6 and 7 are connected in series and the evaporation progresses from one to another through the series. However the evaporation may be effected the remaining features of our process are performed in the manner described above in part and now to be described consecutively and in detail.

Referring to Fig. 2 the material to be evaporated is introduced into the still 1 until it covers the bottom of the still to the line 81, and consequently overlies the lead coating on the bottom indicated at 5, and the upper surface lies somewhat below the upper edges of the baffles 6 and 7; heat is applied from the fire box 4 and when the temperature of the material has reached the desired point a neutral gas is driven from the pump 21 through the pipe 20 and condenser section A and pipe 20^a into the manifold 16, branch pipes 17 and 18 into the depths of the corrugations 3, and the gas there issues in fine streams and passes upwardly through the now molten lead or other highboiling substance into and through the material to be evaporated, and the coaction of the heat and the absorptive properties of the gas evolves from the material all the volatile portions thereof at temperatures below the point at which they would undergo chemical change, without the possibility of burning to the heating surface. As the evaporation is proceeding the material is moving along the bottom of the still and is held for a considerable period of time in contact with the heat by the baffles which direct the flow

from side to side of the still until the material progresses to the exit 15. The vapors of the lighter and more volatile portions are prevented from mingling with the vapors of the heavier and less volatile portions, which are evaporized later, by the diaphragm 12, and pass into the dome 23; the heavier portions pass into the dome 22, and the residue is continuously trapped off at 15.

In the domes 22 and 23 the vapors are passed through the filtering material 24 and 25 respectively and in their passage therethrough the vapors are atomized and color and all bituminous matter are removed therefrom, and much more pronounced crystals of wax are produced therein. After their passage through the filter the vapors pass on through the pipe 26 or 27, as shown, into the condensing apparatus. The diaphragm prevents the vapors from the more volatile portions from being subjected to the temperature of the vapors of the less volatile portions arising therefrom on the other side of the diaphragm and such vapors upon entering the domes, therefore, receive separate filtration.

In now describing the condensing and separating of the vapors it will be necessary to describe only what takes place in one system, as 28, which is more clearly seen in detail in the drawings in Fig. 5; referring to that figure, the vapors from dome 23 enter the section A through pipe 27 and pass into the upper chamber 31, strike the baffle 32, are deflected thereby and flow around the edge thereof into the lower portion of the chamber and pass out at 34 into the next chamber where the same movement occurs, and so on until the last section of the chamber is passed. The condensate produced by the cooling experience in passing through section A is trapped off at 36, and the uncondensed portion passes out through opening into pipe 37 and on into section B where a similar movement takes place and the condensate therein is trapped off at 39. The condensate resulting from the movement through section C is trapped off at 41.

The cooling agency employed in section A is gas pumped through pipe 20 into compartment 30 of section A through valve 47; here the gas contacts with the entire upper and lower surfaces of the chamber walls of each chamber and passes from one compartment into the next succeeding one through the annular opening 33. The gas issues from section A at 35 and is conducted through pipe 20^a and manifold 16 into the still where it loads itself with vapors and progresses through the operations just described, but inasmuch as it enters the section A vapor laden, it of course passes into the chambers and on through section A into section B.

In section B the vapor laden gas is subjected to the cooling action of water introduced at 45 into the upper compartment and conducted successively over and around the remaining compartments therein and out at 38. In section C the water used in condensing is introduced at 43 and passes through one compartment after another until it issues at 44 and passes on into section B as already described.

It will be noted that the water will exercise its maximum condensing effect at the lower end of section C where the distillate leaves the condenser, after having passed through the preceding sections A and B and the upper portions of section C. As the water flows upwardly it is heated by the counterflowing vapors and has reached a desirable degree of temperature when it is admitted into section B; here it encounters the vapors coming from section A and flows with the vapors through this section and issues from the lower end of the section as stated above.

The thermostat 46 having an ascertained heat reaction determined by the temperature required for the best results as tested by the character of the condensate trapped off at 36, regulates the admission of the cooling gas into section A by means of the valve 47; valves 47 and 48 are so associated that the quantity of gas admitted into section A determines the quantity that will be directed into the bypass 49 for delivery into pipe 20^a without the previous heating resulting from the passage through section A, described above.

A similar thermostat 50 is provided for controlling the admission of water from section C into section B, and said thermostat has a heat reaction determined by the desired temperature of the condensate trapped off at 39.

Additional sections of the condensing system may be provided if needed; the gas issuing from the last section at 42 enters the pump 21 and passes through the piping and accomplishes the functions already described.

In the process just described the operation is carried on continuously in one still, as appears in Fig. 2, and material to be evaporated is continuously being introduced at one end and the residue is continuously being trapped off at the other end when evaporation is completed.

In Figs. 6 and 7 a series of stills is shown in communication progressively, but the operation in each still is as above pointed out. This arrangement is merely an optional one; the entire process can be carried on in one still making a continuous performance as described.

In Fig. 1 we show a full charge or batch still in which the heat may be applied as above set forth. The material to be evapo-

rated fills the still to the line 79, for instance, and when heated to the desired temperature the gas is admitted through pipe 20ª into the manifold 16 and branch pipes 17 into the bottom of the body of material and in its passage upwards therethrough becomes laden with vapors as already described in connection with Fig. 2. The heat throughout the body of the material is as nearly uniform as possible and baffles are not employed as there is no current through the still. No reason exists in this kind of still for the diaphragm and all vapors are free to seek exit into either of the domes which may be in use at the time. The use of two domes on a still also enables the distillation to proceed while the filtering material in one of the domes is being removed and replaced by pure material.

Valves 83 and 84 are provided whereby the admission of vapors into the domes 22 and 23 may be discontinued as desired.

Although we have herein illustrated the domes on the stills as equipped with filtering material, yet it may be that in a particular case the filtering may not be desired, whereupon it may be readily dispensed with and the operation of recovering the commercial fractions of the material to be evaporated may proceed without reference thereto.

We have discovered that very highly desirable commercial results may be obtained without the use of the filter when our described fractional condensation process is utilized with our described process of the utilization of a neutral permanent gas to evolve and convey the vapors from the petroleum being treated, and we therefore operate our process with or without the filter as we deem best under particular circumstances.

What we claim is:—

1. The process of treating oil, which consists in heating the oil in the still having its bottom covered with a heavy inert material fusible but not evaporable at temperatures required, and passing a permanent neutral gas therethrough, passing the resultant mixture of vapors and gas upwardly through a filtering material which has the effect of fuller's earth in removing color and bituminous matter therefrom, said filtering material being maintained at a lower temperature than said oil, and then condensing the vapors.

2. The process of converting petroleum and the like into commercial products in a still having its bottom covered with a heavy inert material fusible but not evaporable at temperatures required, consisting in inducing a flow of the petroleum through the still by continuously introducing the petroleum thereinto and continuously taking off the asphaltic residue, passing a permanent neutral gas up through said covering material and through the overlying body of petroleum to take up the vapors thereof in their order of volatility as the flow progresses towards the exit, condensing the vapors from the neutral gas into commercial products according to their volatility, and returning the gas to repeat the cycle of operation.

3. The process of converting petroleum and the like into commercial products consisting in introducing the petroleum into a still having its bottom covered with a heavy inert material fusible but not evaporable at temperatures required, causing the petroleum to traverse the still, passing a permanent neutral gas up through the heated covering into and through the flowing petroleum to evolve the vapors therefrom in their order of volatility, baffling said flow to cause the petroleum to traverse the still repeatedly in its course to the exit, continuously discharging an asphaltic residue, passing the vapor laden gas through a porous body of filtering material to remove color and bituminous matter therefrom, condensing the vapors from the gas and returning the gas to repeat the cycle of operation.

4. The continuous process of converting petroleum and the like into commercial products consisting in continuously introducing the petroleum into the first of a series of associated stills having their bottoms covered with a heavy inert material fusible but not evaporable at temperatures required, continuously discharging the residue therefrom into the second still and so on through the series, passing a permanent neutral gas up through said covering material into and through the body of petroleum flowing thereover to take up the vapors therefrom in their order of volatility in each still, causing said flow to be directed to traverse each still repeatedly in its course to the exit, passing said vapor laden gas through a filtering material in the dome in each still, condensing the vapors into their commercial fractions from each still, and returning the gas to repeat the cycle of operation, and continuously discharging the asphaltic residue from the last still of said series.

In testimony whereof we affix our signatures in the presence of two witnesses.

WILLET C. WELLS.
FRANK E. WELLS.

Witnesses:
JNO. W. RIGHTMERE,
F. C. LONG.