(No Model.)

G. L. BENTON.

PROCESS OF REFINING CRUDE PETROLEUM OIL.

No. 342,564. Patented May 25, 1886.

Fig. 1

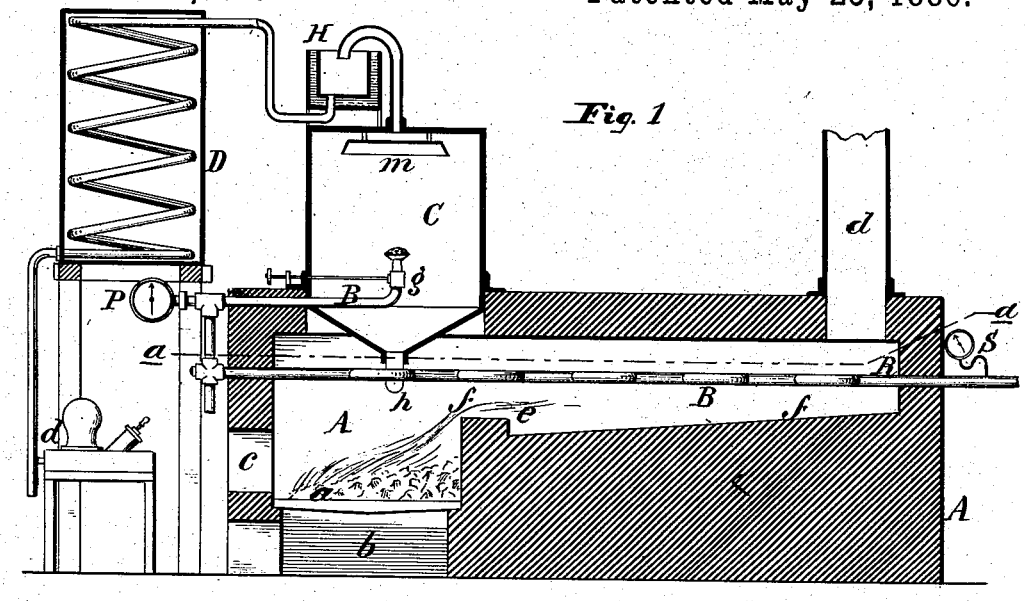


Fig. 2

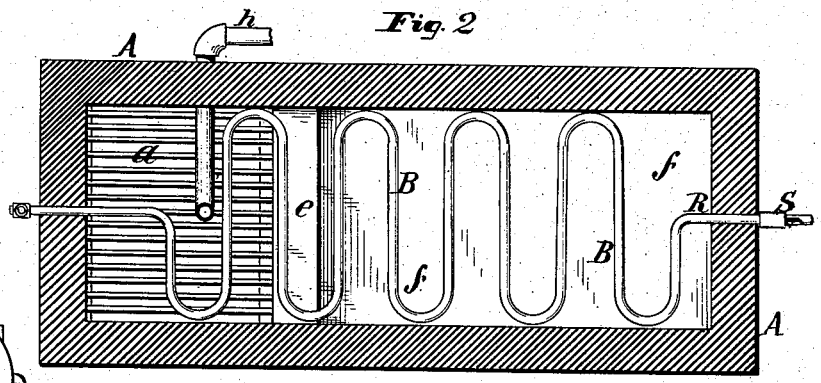
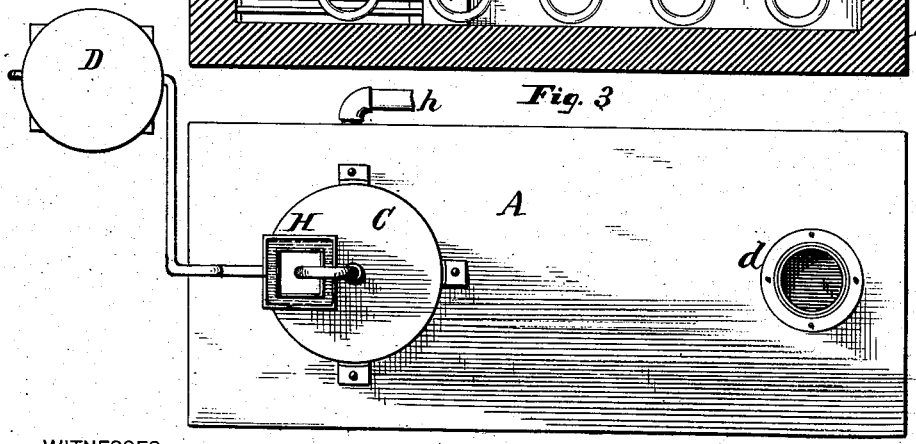


Fig. 3



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GEORGE L. BENTON, OF TITUSVILLE, PENNSYLVANIA.

PROCESS OF REFINING CRUDE PETROLEUM-OIL.

SPECIFICATION forming part of Letters Patent No. 342,564, dated May 25, 1886.

Application filed February 25, 1885. Serial No. 156,993. (No model.)

To all whom it may concern:

Be it known that I, GEORGE L. BENTON, of Titusville, in the county of Crawford and State of Pennsylvania, have invented certain new and useful Improvements in Processes of Refining Crude Petroleum, of which improvements the following is a specification.

My invention relates to an improved method of refining crude petroleum that is extracted directly from the earth in contradistinction to that which has undergone the usual primary distillation before refinement.

The object of my invention is to confine the crude petroleum under high heat and pressure so as to cause a thorough chemical union or combination of the different homologous hydrocarbons comprising the same, so that when allowed to expand under a uniform temperature these different hydrocarbons or the component parts of the petroleum will vaporize simultaneously, forming a homogeneous vapor and containing in its bulk the benzine which has heretofore ordinarily been expelled therefrom and utilized for other than illuminating purposes, and this vapor, when condensed, producing a homogeneous illuminating-oil, such as hereinafter more particularly explained.

Crude petroleum is chemically defined as "consisting almost entirely of a mixture of homologous hydrocarbons," these hydrocarbons having different specific gravities, and when such petroleum is refined to a certain degree it is called "burning" or "illuminating" oil. This refined petroleum is still a compound of hydrocarbons having different specific gravities, and, this degree of refining being effected by treating the crude oil in stills or apparatus of similar character, the petroleum of commerce is generally designated as a "distillate."

The refining of petroleum as ordinarily conducted is simply a fractional distillation by heat gradually increased at each stage, and the first product is what is designated as "benzine," which, while rich in illuminating properties, is too volatile to be so used with safety, and is therefore sold for other applications and at a less price than the heavier distillates. The benzine as it is driven off from the main body of the oil is condensed in the condensing-chamber, and thence conducted to a separate tank, while the remainder of the oil is subjected to further continuous heat until another and heavier class of the hydrocarbon compounds is vaporized and likewise condensed and conducted to a separate chamber, this second product of the distillation being known as "illuminating-oils," and the residuum which is of too great specific gravity for such purposes, and which includes paraffine and other substances, all comprised technically under the designation of "tar," is then drawn off and utilized in various ways after treatment by different processes.

While the proportion of benzine varies in crude petroleum it is always considerable, and in some cases reaches as high as twelve per cent., so that it occasions a serious loss of the raw material used to have the benzine unavailable for illuminating purposes, and its value reduced, as already mentioned, and it is one of the objects of my invention to avoid this loss, and thereby increase the quantity and improve the quality of the illuminating-oil produced from a given quantity of crude material.

My invention consists, essentially, in subjecting the crude petroleum to high heat and pressure in a chamber or pipe or vessel, and so regulating the heat applied as to raise the temperature of the crude liquid to about 700° Fahrenheit or higher while maintaining a pressure of about five hundred pounds per square inch, more or less. Under this pressure the liberation of any vapor from the highly-heated crude liquid is prevented until the heat shall have been continued long enough and raised high enough to bring the entire body of the oil confined in the chamber or pipe or vessel to a uniform temperature, when it is next discharged in a spray into a vapor-chamber, in which the previous high temperature is still maintained, but the pressure removed. The different hydrocarbons will vaporize simultaneously, forming a homogeneous vapor, (instead of first vaporizing the benzine, and then the next heaviest hydrocarbons, as heretofore mentioned,) and these liberated vapors will be kept homogeneous by the intimate chemical affinity of their constituents, while any unvaporizing portions of the mass accumulating precipitate in this intermediate vessel, from the bottom of which they may be drawn off through a suitable pipe and cock. The final step consists in conduct-

ing the homogeneous vapors from this vapor-chamber to an ordinary condenser, which may consist of a coil of pipes immersed in water in a tank or other containing-vessel, and this condensation reduces the vapor to a homogeneous fluid possessing all the most desirable properties of high-test illuminating-oil, and containing in its homogeneous bulk substantially all of the benzine, which has heretofore ordinarily been expelled from it, as previously mentioned.

In the accompanying drawings I have represented an apparatus such as I have used with practical success in the conduct of my improved process.

Figure 1 is a vertical longitudinal section through the apparatus. Fig. 2 is a horizontal longitudinal section on the line *a a* of Fig. 1, and Fig. 3 is a plan or top view.

This apparatus consists of a furnace, A, constructed of brick-work, and provided with a grate, *a*, an ash-pit, *b*, a door, *c*, a chimney, *d*, a fire-bridge, *e*, and a chamber space, *f*, extending from end to end and from side to side of the interior of the furnace, as seen in Figs. 1 and 2.

In the chamber-space *f* is arranged the coiled pipe B, Fig. 2, connected at the rear end through the furnace-wall with the oil-supply, and provided at this end with a pressure-gage, S, and an overflow pressure-valve, *q*, of any suitable construction to prevent undue increase of pressure in the pipe B. This pipe extends at the front end through the furnace-wall, and is provided with a pyrometer, P. The pipe B is continued up into the vapor-chamber C, as shown, and this end of the pipe B is provided with a rose or perforated cap, through which the highly-heated crude oil can be sprayed into the chamber C. I prefer to connect with the pipe B, outside of the furnace, a waste-pipe, *i*, with a stop-cock, *k*, for a purpose to be presently described.

The vapor-chamber C is an inclosed metallic vessel of suitable strength and made air-tight. It is fitted into the top of the furnace, as shown, and has a dished bottom, which is exposed to the heat of the furnace or chamber *f*, and it has an outlet-pipe, *h*, leading off through the furnace to the outside. Underneath the top of this vapor-chamber C, and above the spray-pipe B, is a deflecting-hood, *m*, extending out toward the sides of the chamber, but having an annular space between the edge of the hood and the side of the vapor-chamber. In the top of the vapor-chamber is a pipe which leads off preferably to the manifold H, which is a condensing-box of the ordinary construction, and thence by pipes to the condenser D, or the vapor may pass directly from the chamber C to the condenser D; and at the lower end of this condenser an air-pump may be attached, as shown in the drawings, and for a purpose to be hereinafter specified. A stop-cock, *g*, is so arranged as to be operated from the outside of the vapor-chamber, and to be opened or shut, as it is desired, to regulate the discharge of the highly-heated oil from the pipe B into the chamber C, or to confine it to the pipe B.

In this apparatus the operation is conducted as follows: The stop-cock *g* being shut and the waste-pipe *i*, connected with the pipe B, being opened, a fire is started on the grate *a*, and the crude oil is let in from the supply to the coil-pipe B and allowed to flow out through the waste-pipe *i*, (from which it is led back to the supply,) while the pipe B and the chamber *f* attain the proper temperature, which will be ascertained by the observation of the workman in charge. When he finds that the furnace has attained the proper temperature, he shuts the waste-cock *k*, and the stop-cock *g* being already shut thus confines the oil in the pipe B under the pressure of the supply or of a pump, T, which feeds the oil to the pipes. The oil with which the pipe B is thus filled is kept in the pipe under this pressure until the pyrometer indicates that it has attained a temperature sufficiently high to have had the latent vaporizing effect upon the oil, (in practice I have found this temperature to range from 700° to 1,000° Fahrenheit,) when the stop-cock *g* is opened and the released vaporized oil rushes out through the rose in the end of pipe B and strikes on the under side of the hood *m*, from which it is deflected downward, and then rises through the annular space between the hood and the wall of the chamber C, and passes into the pipe which leads directly to the condenser D or to the manifold H, and thence by pipes to the condenser D, and through this condenser into a receiving-tank of any ordinary construction. It will be understood that the chamber C will have become heated before the admission of the vaporized oil into it, and that its temperature is maintained by the furnace to correspond substantially with that of the spray escaping into it from the coiled pipe B, through which the passage of the crude oil is now kept up continually under the regulated pressure at such velocity as to provide time for its required increase of temperature while passing through the furnace.

To promote the passage of the vapor from the chamber C to the condenser D, I connect an ordinary air-pump with the lower end of the coil D at *d'*, and thus facilitate the operation. By this process I have found that the oil is raised to and maintained at a sufficiently high temperature to vaporize it as soon as it is released from the pressure under which it is confined in the pipe B, while, until so released, it is prevented by the pressure from vaporizing at all, and, consequently, when it is permitted to escape into the heated chamber C it bursts into vapor, and this vapor is entirely homogeneous, so that, after being deflected in the chamber C and then rising again to pass off into the condenser D, it passes off in a homogeneous volume, while depositing in the bottom of the chamber C such heavy or non-volatilized impurities as may have been

in the crude petroleum. These accumulating impurities are drawn off through the pipe *h* in the bottom of the chamber C.

My improved apparatus, such as I have hereinabove described and have used with practical success in the conduct of this improved process, forms the subject-matter of a separate application for a patent (Serial No. 165,310) under date of May 13, 1885.

In the conduct of this improved process I do not confine myself to the degrees of high temperature, nor to the amount of high pressure hereinbefore mentioned, as both require to be changed, or their proportions relatively have to be varied to determine either the quality of the illuminating-oil to be made from a given quality of crude material or the quantity of oil to be obtained from a given amount of crude petroleum.

I am aware that hydrocarbon oils have been subjected to the action of heat under pressure while in a state of transit, whereby the oil has been raised to a temperature ranging from 100° to 330° Fahrenheit, to cause the separation of the lighter gases from the heavier oils on the removal of the pressure, and I therefore do not wish to claim any such process; but

What I do claim as my invention, and desire to secure by Letters Patent, is—

The process of refining crude petroleum, which consists in heating the oil to a temperature ranging from about 700° to 1,000° Fahrenheit, and under a pressure of about five hundred pounds, or more, to the square inch, then causing the heated oil to expand into a chamber of approximately the same temperature, and finally conducting it into an ordinary apparatus wherein it is condensed, substantially as described.

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