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PROCESS OF AND APPARATUS FOR THE DISTILLATION OF OIL.

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1,408,242. **Patented Feb. 28, 1922.**

Fig. 1.

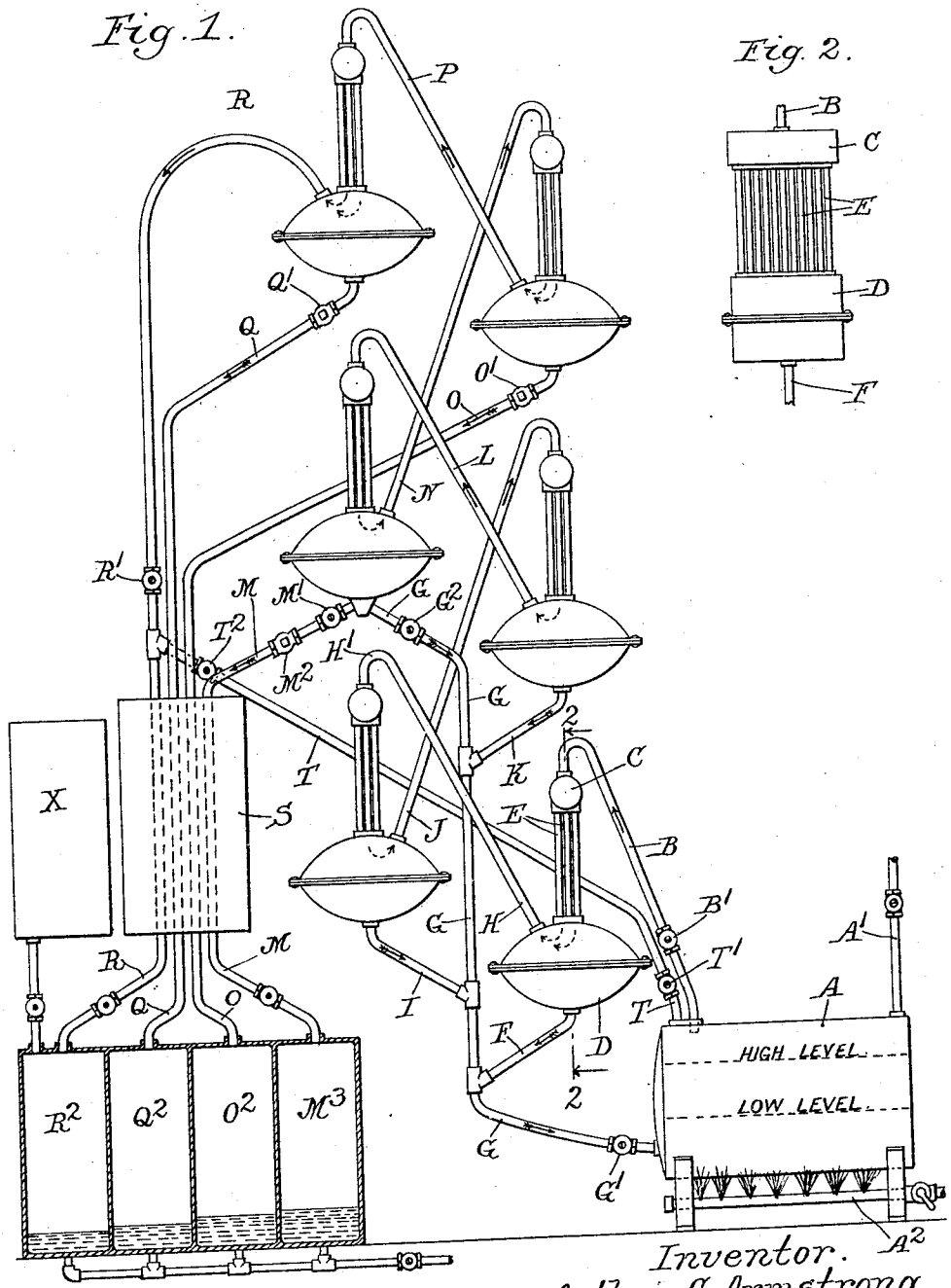


Fig. 2.

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PROCESS OF AND APPARATUS FOR THE DISTILLATION OF OIL.

1,408,242. Specification of Letters Patent. Patented Feb. 28, 1922.

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To all whom it may concern:

Be it known that I, ARTHUR C. ARMSTRONG, a citizen of the United States, residing at Hammond, in the county of Lake and State of Indiana, have invented new and useful Improvements in a Process of and Apparatus for the Distillation of Oil, of which the following is a specification.

My invention relates to improvements in apparatus for the distillation of hydrocarbons and the like, and the process of their distillation. It has for one object the separation in one process by sectional condensation and separation, of petroleum distillate of various vaporization points, and is particularly adapted for the refinement of gasoline. It has for further object to provide an apparatus and a process for refining gasoline which permits the operation of the still at a relatively low temperature, and thus allows its operation for a longer period without the risk of overheating the bottom of the still met with in the present apparatuses and processes. Another object is the provision of an apparatus for the distillation of hydrocarbons and the like in which the vapor can be passed through the condensing section at a lower pressure than is usually used. A further object is the provision of a still in which no low grade condensate can gather in the condensers and lie there, or be carried upward or forward by the pressure of the vapor or otherwise, so as to be mixed with the higher grade condensate. Another object is the provision of an apparatus and a process in which the necessary pressure is reduced by the fact that the vapor and the condensate always flow in the same direction, through the pipes and condensation passages. Other objects will appear in the specification from time to time.

My invention is illustrated in the accompanying drawings, wherein—

Fig. 1 is a side view with parts in section of the whole apparatus;

Fig. 2 is a section along the line 2—2 of Fig. 1.

Like parts are indicated by like letters throughout the several figures.

A is the usual type of still with a feed pipe A^1, and heating means A^2 of any preferred practical form. From the upper surface of the still extends the vapor pipe B closed shortly above the still by the valve B^1. The vapor pipe rises substantially vertically to the bend B^2, by which it is recurved to deliver its contents vertically downwardly into the lateral distribution pipe C. Lying directly below the lateral distribution pipe is a condensation chamber D, of approximately the same length as the distribution pipe, but of much greater breadth, height, and volume. Connecting the distribution pipe and the condensation chamber, are a plurality of series of parallel vertical radiation pipes E, preferably but not necessarily arranged in three parallel, vertical planes. The number of pipes may be varied, of course, to suit the individual requirements. This arrangement of distribution pipe, radiation pipe, and condensation chamber, is normally the same in all the various radiation sections illustrated in Fig. 1, though it will be understood that the size of the parts, and the number and length of the pipes can be varied if found necessary. From the bottom of the condensation chamber flows an oil return pipe F, which leads into the pipe G, down which drains back to the still the lower grade condensate from a plurality of the lower condensation sections. The condensate of the first condensation section flows through the pipe F and the pipe G, reaching the still at a point below the oil level. The pipe G is closed by a valve G^1 which is normally opened at a point adjacent the still. From the upper surface of the condensation chamber D, leads a vapor pipe H, which carries the uncondensed vapor upward around a band H^1 and downward into a radiation and condensation section normally identical with the one above described. At the bottom of the condensation chamber is a pipe I, through which passes the heavy condensate into the pipe already described, reaching the still in the same manner and at the same place as the condensate from the first section. A vapor pipe J carries the vapor again upwards and in the same manner to the top of a third similar condensation section, whence the heavy condensates escape through the pipe K, and then through the pipe G to the still. The vapor pipe L carries the uncondensed vapor upward to the top of a fourth condensation section. To the bottom of the condensation chamber of this section are connected two pipes, one G, closed by a valve G^2, which as already described, leads back to the still, and another M, closed by a valve M^1 which leads to a

storage tank M^3. On the pipe M below the valve M^1 is an automatic release valve M^2 set to release at such pressure as the operation of the system makes necessary. The vapor pipe N from the top of the same condensation chamber, leads upwards to the top of a condensation section from the bottom of which a pipe O, closed by an automatic pressure release valve O^1, leads to the storage tank O^2. The vapor pipe P leads upward from the top of the condensation chamber of this section to the uppermost condensation section, from the bottom of which the pipe Q closed by a pressure release valve Q^1, leads to the storage tank Q^2. The vapor pipe R leads from the upper surface of the condensation chamber of the last section to the storage tank R^2. Above R^2 is the gas storage tank X for uncondensed vapor. If preferred, the storage tanks may be replaced by direct meter connections to a central system. The pipes M, O, Q and R leading from the condensation section to the storage tank, have jacketed about them a cooler and condenser S, which may be brine coil, a water circuit, or the like. The automatic pressure release valves will be set normally to release at the same pressure. From the still A leads the pipe T, closed at either end by the valves T^1 and T^2. This pipe connects the still with the pipe R below a valve R^1, and thus with the storage tank R^2. This pipe is used to carry off the drippings or mixture of oil and water from the still, which is discharged through the pipe R to the tank R^2 when it is carried off by pipes not shown before the oil itself begins to flow. A separate pipe, also not shown, will of course be used to dispose of the oil which is later received by the tank R^2. It will be understood that the number of condensation sections in the apparatus, which is here described as six, can be varied, and that the number of sections connected directly to the storage tanks may be changed, without departing from the spirit of my invention, but experience indicates that the arrangement here described and illustrated will be preferable. I desire that my drawings be taken as in a sense diagrammatic, and it will be understood that many changes in number, shape, proportion, and disposition of parts can be made, all lying within the scope of my invention.

The use and operation of my invention are as follows:—

The liquid to be refined is introduced into the still and vaporized in the usual way. When vaporization has sufficiently advanced, the vapor rises to the pipe which leads from the top of the still, follows its curve, and enters the distribution pipe and radiator pipe of the first condensation section. There will be a considerable condensation in the radiator pipe, but as the condensate and the vapor are both flowing downwardly, there is a minimum interference of the flow of the one with the other. The drip of condensates from the pipe gathers in the bottom of the condensation chamber, and, with the condensate precipitated in the chamber, flows back to the still. It will be noted that the condensate is immediately removed from the chain or course of passage of the uncondensed vapor, and that the vapor is not impeded in its passage by condensates, except in the condensation pipes; and in that short stretch the condensate and the vapor are flowing in the same direction. The size of the condensation chamber, which allows a rapid expansion of the vapor, when the vapor is under pressure, promotes an immediate and complete separation of vapor and condensate. The vapor passes upwardly from the top of the condensation chamber, and the condensate flows out at the bottom to find its level in the pipe below at the level of the oil in the still. Since the pipe discharges into the still below the oil level, there is a constant circulation of oil, and no chance for the vapor under pressure to back up the oil in the run back pipe. This involves a great saving of fuel, since in the usual refining system the vapor has to be heated above the necessary point and kept under a higher pressure because it has to force itself through and against the course of the condensate. Of course no superfluous pressure is wasted in the actually harmful function of backing up the condensate in the run back pipe. An important result of this complete separation of vapor and liquid is, that it is absolutely impossible for the vapor to carry with it in its upward course condensates of the heavier grades, to mix with and reduce the value of the better grade of condensate of the upper radiation and condensation section. This is a difficulty met in the presently used systems where the vapor is filtered or forced through the condensate in a condensing tower, or through condensing sections. With my invention, no matter how great the pressure of the gas, no low grade condensate can be carried upwards or kept standing in the condenser. It drains off by gravity, undisturbed by any opposing flow of vapor, and an approximately complete separation of the varying grades of condensate is insured. The vapor passes successively through several radiation sections, the condensate in each case draining back to the still. Finally, in the fourth section as I have illustrated it, though the number might be greater or less, I provide for drawing off the condensate either to the still, or to a storage tank. It will be understood that this condensate will be normally of relatively low grade. In some conditions it may be worth while draining it off directly to the storage tank rather than re-refining it. When the

valve to the pipe returning to the still is closed, and after the storage tank pipe is opened the condensate will gather above an automatic pressure release valve which is provided below the gate valve, till its weight is enough to open the valve, and allow the liquid to drain off. I set the valve normally to open at a pressure as the operation of the system makes necessary, the pressure in the system being usually at from 73 to 95 pounds, though other pressures might be used, in both cases. The essential point is that the valve is released at a pressure greater than that of the system, so that the mixed vapor and condensate will not blow out through the pipe and into the storage tank instead of following the apparatus through to the end. For the same reason I provide the condensate discharge pipes of the upper section of my apparatus which drain directly into the storage tanks with similar pressure and release valves. The vapor pipes from the last uppermost condensation section carries off the residue of the high grade oil. This vapor is condensed by passage through the cooling and condensing section described earlier in the specification, which might be a system of brine coils, or cold water. In my apparatus fifty per cent of the condensate will be discharged through this uppermost vapor pipe, and will normally reach a specific gravity of 65 or higher. A further feature of my invention is the fact that by the passage of gas or vapor through the condenser box in which condensate backed up by the pressure valve is normally flowing, I add to the volume of this condensate through the absorption into the liquid of some of the vapor through which it passes. The slower the oil passes through the coils of the condenser box the greater will be the increase in its volume by absorption since in my apparatus the condensate is always carried off by gravity, and since the course of the vapor is unimpeded, I can operate my system at a pressure lower than that normally used. All I require is that the vapor rise and flow through the various condensation sections. This involves a saving in fuel, and through the reduction of the heat, less danger of overheating the bottom of the still. This, of course, allows a longer continuous operation of the still. By the reduced pressure and the arrangement of the condensation sections to separate the condensate from the vapor, all danger of carrying the lower grade distillate along with the vapor is obviated. Conversely, no excess pressure is required to force the vapor through the condensate, and all these factors act together to reduce the heat and pressure needed, and at the same time to insure a higher grade of condensate from the upper condensation sections.

When the still is run at higher pressure, that is to say at higher heat and with an exceedingly more rapid run of vapor and oil through the condensation sections the quality of the distillate from the top section will not be materially decreased in quality. There will be a slight decrease in quality but a corresponding increase in volume from the two sections next the top section. There will, of course, be a far greater run back from the lower sections. Any dirt or foreign substance which is in the oil will gather in the lower condensation chambers with the heavy oils and cannot be carried upward through the various passages and upper condensation chambers. Such matter cannot be vaporized and the pressure of the vapor passing upward through the system is not sufficient to carry it far. This permits the delivery of oil to the storage tanks free from settlings.

I claim:—

1. In an apparatus for distilling hydrocarbons comprising a still and means for heating it, and a reservoir for receiving the distillate, a plurality of condensation sections arranged in series, a vapor pipe from the still to the first section, a vapor pipe from each section leading to the next section, condensate pipes leading from each section, those of the first sections leading back to the still, and those of the later sections leading to the reservoir, a condenser, a vapor pipe on the last section leading therethrough to the liquid reservoir, automatic pressure relief valves in the condensate pipes leading from the sections to the reservoir, said valves set at a pressure substantially above that of the condensation system.

2. The process of distilling hydro-carbons which consists in vaporizing the liquid and passing it through a series of condensation zones, in returning for redistillation the condensate formed in some of the zones and in allowing the condensate from other zones to escape into a storage zone by gravity, against pressure substantially higher than that of the condensation zones.

3. In an apparatus for distilling hydrocarbons comprising a still and means for heating it, and reserviors for receiving the distillate, a plurality of condensation sections arranged in series, a vapor pipe from the still to the first section, a vapor pipe from each section leading to the next section, condensate pipes leading from such sections, automatic pressure relief valves in the condensate pipes, set at a pressure substantially above that of the condensation system.

4. In an apparatus for distilling hydrocarbons, a still and means for heating it, and a condensation section connected thereto, said section comprising a distribution member, a separation chamber beneath it, said chamber of far greater volume than said

distribution member, and a radiation member connecting the distribution member with the separation chamber, an oil run off pipe from the bottom of the chamber, an automatic relief valve in said pipe, set at a pressure substantially above that of the condensation system.

5. The process of distilling hydro-carbons which consists in vaporizing a liquid and passing the vapor through a plurality of condensation zones, the vapor passing first through a restricted radiation zone and then directly into an enlarged separation zone, and then through a series of radiation and separation zones similar to the first pair, and passing off the accumulated liquid formed in the separation zones, against pressure higher than that of said zones.

6. The process of distilling hydro-carbons which consists in vaporizing a liquid and passing the vapor through a condensation zone, downwardly through a restricted radiation zone and then directly through an enlarged separation zone, and then upwardly from the top of said separation zone, and passing off the liquid accumulated in said separation zone against pressure higher than that of said zone.

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Witnesses:
GRACE MACNAB,
MARGARET LUSBY.