UNITED STATES PATENT OFFICE.

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IMPROVEMENT IN APPARATUS FOR DISTILLING PETROLEUM.

Specification forming part of Letters Patent No. **56,852**, dated July 31, 1866.

To all whom it may concern:

Be it known that I, M. P. EWING, of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Distilling Petroleum *in Vacuo;* and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, making part of this specification.

Figure 1 is a side elevation of my improved apparatus; Fig. 2, a central vertical section of the same.

Like letters of reference indicate corresponding parts in both figures.

In the ordinary process of distilling petroleum it is necessary, in order to raise the vapor and overcome the pressure of the atmosphere, to bring the heat to a comparatively high temperature, the effect being usually accomplished by the direct application of fire to the retort or still. The oil, also, is deposited in the still in charges, it being impracticable to apply a continuous feed to a retort where so high a degree of heat is used as is necessary to raise the vapor against atmospheric pressure. In this manner not only is the material in the retort to be distilled liable to burn on the sides and produce lamp-black, that discolors the oil, but a large amount of gas is evolved by this excess of heat, imparting to the oil offensive odors and increasing its liability to explode; and, furthermore, the process is not complete without deodorization by the employment of acids and alkalies after the products have passed from the still. The residuum is also greatly injured by the same excess of heat.

In order to obviate these difficulties I employ the process of distillation *in vacuo*, which, by removing the pressure of the atmosphere, allows the vapor to evolve at a much less degree of heat, so that the simple application of steam, preferably superheated, accomplishes all that is required without liability of burning. By this method, also, I am enabled to complete the distillation, so that the naphtha and oil will be combined in one product, and to avoid the necessity of deodorization and the contamination of the oil with acids and alkalies. At the same time the product of the distillation is of a far superior character, being of less gravity and capable of enduring a higher fire or cold test.

My invention consists, first, in the combination of a continuous feed with a vacuum-still, so arranged that the oil can be made to stand at nearly the same level in the retort at all times, while the vaporization is produced with the minimum amount of heat; second, in the combination of a jet-condenser with a vacuum, still for rapidly condensing the vapor; third, in the combination of two or more condensers with the still, so arranged that each may be used alternately to preserve the vacuum and insure a constant action of the still; fourth, in the particular arrangement of the apparatus as a whole.

As represented in the drawings, A is a retort made air-tight and provided with a steam-jacket, B, at the bottom. Into the retort opens a feed-pipe, C, for admitting the oil, and a steam-pipe D, for admitting steam. The steam-pipe preferably ends in a coil inside and discharges into the steam-jacket, whence it escapes by an eduction-port, E. From the bottom of the retort also extends a pipe, F, for discharging the retort of the residuum of the distillation.

From near the top of the retort, on opposite sides, extend tubes or passages G G, connecting at the opposite ends with condensing-chambers H H.

The condensing-chambers are provided at the top with induction-tubes I I, that extend upward to a water-receptacle or fountain, K, and at the bottom with eduction-tubes L L, which rest over a suitable tank, M, and are made of such length that a column of water or oil therein will be balanced by the atmosphere below the condensers. The condensers are also provided with steam-pipes N N and air-openings O O.

The several tubes and pipes above mentioned are provided with cocks *a*, *b*, *c*, *d*, *f f*, *g g*, *h h*, *i i*, and *k k*.

The action of the apparatus will be readily understood. It is necessary, first, to exhaust the air both from the condensers and the retort. To accomplish this the cocks are all closed except *g g* of the induction water-pipes and *k k* of the air-pipes, connected with the condensers. The opening of the cocks *g k* al-

lows the condensers to fill with water and the air to escape. When the condensers are full these cocks are closed and the cocks *h h* of the eduction water-pipes are opened. The liquid then falls in the tubes, leaving a vacuum in the condensers. The cocks *h h* are now closed, and the cocks *f f* opened, which allows the air in the retort to pass into the condensers. The cocks *f f* are again closed, and *g h* again opened, to exhaust the condensers in the same manner as before. This process is repeated till an effective vacuum is formed in the whole apparatus.

It is obvious that instead of this method of exhaustion an air-pump might be connected with the condensers, or the vacuum might be made by the admission of steam from the pipes N N, acting on the same principle of the water-exhaustion above described.

When the vacuum has been established the crude oil is admitted to the retort by opening the cock *a* of the feed-pipe. No pump is required, since the pressure of the atmosphere is sufficient, by reason of the vacuum, whether the oil is drawn from above or below the level at which it stands in the retort. Steam is now let on through the pipe D, and the vapor evolved passes through the tubes G G into the condensers. Here the vapor is condensed by allowing jets of water to flow into the condensers by opening slightly the cocks *g g*.

The condensed oil and the water pass off together through the pipes L L into the tank M, where the oil rises on top and is easily separated.

In the distillation of petroleum the use of the vacuum-still secures several very important advantages. In order to produce boiling of petroleum in the open air a temperature of about 600° is required; in a vacuum the same effect is produced at about 200° to 250°. Vaporization does not effectively commence till the boiling-point is reached, and if this point can be reached at less than the ordinary temperature a great gain will be effected in a general way. Where so great a heat is employed as in the ordinary still, (and especially where fire is applied directly to the retort,) the material burns upon the sides and produces lamp-black, that passes into the oil, and not only discolors it, but imparts a disagreeable odor, and also injures its quality. This is especially the case when the oil is introduced through the top or sides of the still at intervals and in given quantities, each of which are distilled before the addition of another. In this case, when a new quantity is added, its contact with the highly-heated surface of the retort that was before uncovered will cause it to scorch; or where the oil is boiled low the same effect will be produced.

I obviate this difficulty, first, by employment of the vacuum, by which I am enabled to reduce the temperature, so that it is less liable to burn; and, second, by the employment of the feed-pipe C, which enables me to allow a constant flow of the material into the retort to supply the place of that which is distilled. In this manner it will be seen that I can gage the flow through the feed-pipe, so that the material will stand at nearly the same level in the retort at all times, and therefore the material never comes in contact with a bare heated surface, either by overflow or by diminution. This combination of the continual flow with the vacuum-retort is of the utmost importance, and was never known before my invention, to the best of my belief. In addition to this the action of a given quantity of heat upon a given quantity of liquid, or a quantity standing always at the same level, produces a uniformity in the action that is of great importance in distilling so volatile a material as petroleum. If the quantity in the still under action should materially increase or diminish, a corresponding effect would be produced in the product. Thus, in an increase of the quantity in the still, with a given degree of heat, the first product would be simply naphtha, since that element is the most volatile, and the oil would be raised afterward, forming thus two products, as is now the case in the ordinary still. By preserving a given temperature and a uniform and unvarying quantity of the liquid in the still, as by my method, I am enabled to pass both the naphtha and oil as one product, which is of a far superior quality to the oil ordinarily produced. This result depends in a great measure, however, upon the employment of the vacuum.

Although a certain degree of vapor is raised at a slight heat, vaporization does not become effective till the boiling-point is reached. Thus in the ordinary process the first action of the heat raises naphtha; but as soon as the tension of the vapor overcomes the pressure of the atmosphere boiling commences, and the oil is raised. In the use of the vacuum the pressure of the atmosphere is removed, and there is no resistance to boiling and the rapid evolution of vapor, and the whole naphtha and oil therefore passes off in one body. This effect of the vacuum is special in the distillation of petroleum.

The jets of water constantly flowing into the condensers H H from the pipes I I condense the vapor of the oil in the same manner that the jet condenses the steam in the condenser of a steam-engine. In this manner the vapor is condensed as fast as formed and escapes downward. This enables me to run off the still very rapidly. Where the ordinary worm is employed the condensation is necessarily slow, and would not answer in application to the vacuum-still, where the vaporization is so rapid. In this case there would be an accumulation of vapor, which would interfere very materially with the efficiency of the apparatus. The employment of the jet-condensers removes all difficulties of this kind.

In addition to this, the moment the jets open into the condensers they are broken into spray and effectively intermingled with the oil vapor in such a manner as to thoroughly wash it.

This action has a tendency to deodorize the oil and purify it, saving the application of chemicals of any kind for the purpose.

The employment of two or more condensers enables me to use them alternately, if desired. Thus one can be employed to preserve or restore the vacuum as it becomes impaired by the gradual admission of air, or they can be used alternately in this way, thus avoiding the suspension of distillation; or, where a series of stills are employed, a series of condensers may be employed with them, connected together, in which case a less proportional number of condensers may be employed, and the whole number of condensers made to bear at any time upon a single still, or the whole may be made to act on all the stills.

By the process herein described I produce the most beneficial results. The process of evaporation *in vacuo* is old, but the object has been to reduce a liquid to a semi-liquid or solid form, the aqueous matter being passed off as worthless, while the residuum was retained. The opposite is the object in distillation, for the vapor is retained, while the residuum is the least valuable product. In this much, then, the two processes differ.

The effect of the vacuum process in distilling petroleum is special. The naphtha and oil are produced in one body instead of two, as by the old method. There is no admixture of acids and alkalies, since there is no need of deodorization. The oil is therefore purer and better. By using a low temperature, and this produced only by steam or heated air, the chemical changes are avoided that are produced by a high temperature. The still can run constantly without stopping to clean, and no incrustation forms on the inside. A larger amount of oil is produced and of a better quality. It is of one quality, of 50° specific gravity, bearing a heat-test of 135° and a cold-test of 30° below zero, while ordinary oil, 45° gravity, will stand a heat-test of but 110°, and congeals at a cold-test of 3° below zero. The residuum, also, not being burned or scorched by overheating, is rendered a very valuable product.

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

1. The combination of a continuous feed with a vacuum-still for petroleum, operating substantially as and for the purpose herein set forth.

2. The combination of a jet-condenser with a vacuum-still for petroleum, operating substantially in the manner and for the purpose herein specified.

3. The combination of two or more condensers, H H, with each other and a vacuum-still, A, in such a manner that the action may be alternated from one to another to preserve the vacuum and to allow the constant running of the still, as set forth.

4. The arrangement as a whole, consisting of the retort A, condensers H H, connected by the tubes G G, and pipes I L, operating substantially as and for the purpose specified.

M. P. EWING.

Witnesses:
R. F. OSGOOD,
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