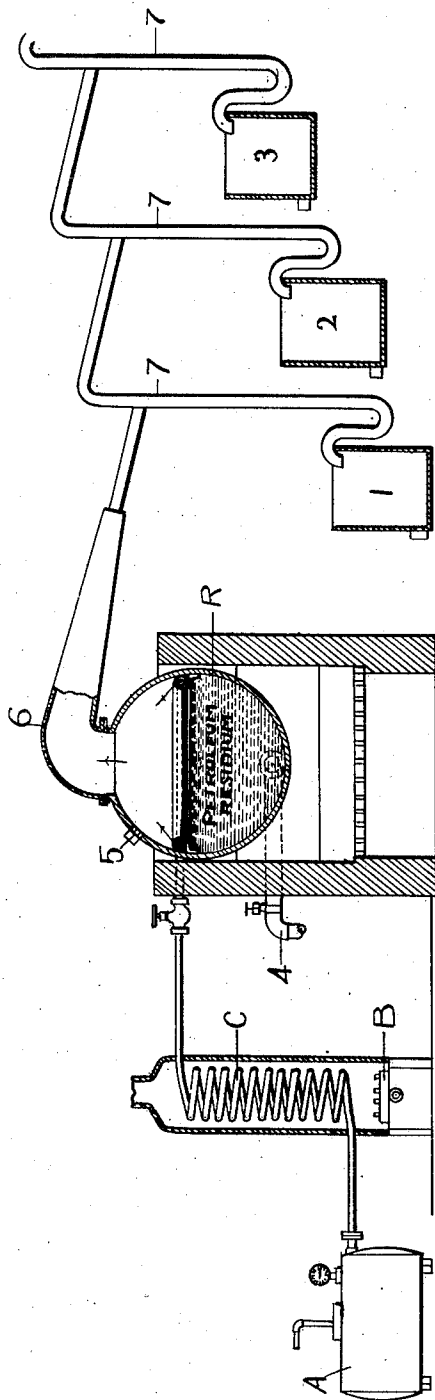


C. B. FORWARD.  
PROCESS FOR THE MANUFACTURE OF ASPHALT.  
APPLICATION FILED JULY 11, 1910.

998,569.

Patented July 18, 1911.



ATTEST  
*E. M. Fisher*  
*J. C. Muscum*

INVENTOR  
CHAUNCEY B. FORWARD

BY *Fisher & Muscum* ATYS.

# UNITED STATES PATENT OFFICE.

CHAUNCEY B. FORWARD, OF URBANA, OHIO.

PROCESS FOR THE MANUFACTURE OF ASPHALT.

998,569.

Specification of Letters Patent. Patented July 18, 1911.

Application filed July 11, 1910. Serial No. 571,293.

*To all whom it may concern:*

Be it known that I, CHAUNCEY B. FORWARD, citizen of the United States, residing at Urbana, in the county of Champaign and State of Ohio, have invented certain new and useful Improvements in Processes for the Manufacture of Asphalt, of which the following is a specification.

My invention relates to a process for the manufacture of asphalt from petroleum residuum or from crude petroleum from which the lighter oils have been removed and the residuum remains.

It is well known that the oils produced in various fields throughout the world vary in gravity, consistency and value according to the quantity and quality of the distillates derived therefrom. We have the so-called paraffin base oils of Ohio, Pennsylvania, and other States or sections, and the asphalt base oils of Texas, California, and elsewhere, as well known. I have in a satisfactory way demonstrated that asphalt is in reality the base of all the so-called paraffin base oils, and have made a superior grade of asphalt suitable for paving, roofing and insulating and in fact anything for which the natural asphalt can be used from this material. In fact I have made these from almost every known oil field in the world, and the product cannot be distinguished from natural asphalt by any method now known to the most scientific chemists.

In handling the crude oil, or residuum, in a commercial way for the production of asphalt, I first try out a small quantity of residuum, say about a gallon, in an open vessel and subject the same to a temperature of about 625 F. I have found by experience that this temperature is below the coking point, but I do not wish to be understood as claiming that this is the only temperature which, if maintained, could accomplish the desired result, as the same product can be secured at a lower temperature, say 550 to 575 F., but it would require much longer to accomplish the same end. The point to be observed is to keep it below the coking point which destroys the value of the resultant product. The lighter oils can be removed much more rapidly in an open vessel than in a closed retort or still. The asphalts to be used for roofing or paving or insulating or as a base for paints and so forth are all of a different consistency, and I stop my process when the

product in the open vessel has come to the desired consistency. Then I subject it for a number of hours, say five to twenty-four hours, to a temperature of about 100 degrees F. less. The resultant product is then ready for the purposes desired. There is practically no loss by exposure at the lower temperature as the lighter oils have all been previously removed. I then weigh the product and determine the amount of volatile oils that I have driven off. Thus, knowing the amount of volatile or lighter oils which I wish to remove from a quantity of crude oil or residuum to commence with, I proceed to make it in large quantities or on a commercial scale in the following manner,— As the first step I place the petroleum residuum in a retort indicated by R in the accompanying diagrammatic drawing. If there be considerable moisture in the stock I subject it to a temperature of about 175 degrees F. At this temperature the moisture will precipitate as water and can be drawn off from the bottom of the retort through a suitable opening or pipe 4, Fig. 4, for that purpose. If, however, there is but a small amount of moisture present I put the temperature up to 240 to 250 degrees F., and in the course of an hour and a half to two hours at this temperature the moisture will have all been evaporated. If I allow the temperature to rise to 400 or 500 F. before the moisture has been removed the residuum will foam and be forced out through the worm end of the retort. After all the moisture is driven off I increase the temperature to 625 F. and continue to subject it to this heat for a period of twenty-four to forty-eight or even up to sixty hours according to the gravity of the residuum originally started with. The lower the gravity the less time it will take to distil off the lighter products. The exact time of subjecting it to the temperature of 625 F. has to be determined in each instance by experiment with the residuums of different gravities. After the expiration of about thirty-six to forty eight hours at this temperature I commence to test the resultant material in the retort by withdrawing a small quantity of it from time to time through a suitable opening at the top of the retort, say as indicated at 5, and also check up at the same time the quantity of distillate which has been taken off. Then when the product has acquired the desired consistency, accord-

ing to the purpose for which it is being made up, I shut off the fire and withdraw the material to an open pan or vessel, not shown, for reasons hereinafter set forth, and allow it to be there subjected to a temperature of about 100 degrees F. less than it was in the still for a period of five to twenty-four hours according to the product I wish to acquire, such as hard, semi-hard or a thick liquid asphalt.

Now, as to the object and advantage of drawing the material off into an open vessel, I have discovered that if the process of distillation is continued in a closed still until the remaining product therein is of the proper degree of hardness (when cold) the product will not have the jet black luster of natural asphalt, but will be of a bluish cast and in fact will exhibit nearly, if not all, the colors of the rainbow and the material will not have the desired degree of toughness, or, in other words, will not have the desired adhesive, cohesive and lasting qualities. I have demonstrated this time and time again by continuing the process of distillation in the closed still, and I have found that it is impossible to get the quality of material I make except by the additional use of the open vessel. The product left in the still can of course be reduced to a semi-hard or hard pitch by continuing it therein, but, as above stated, the resultant product will not have the proper adhesive, cohesive and lasting qualities, and when the process in the still is carried far enough to make a pitch of a quality and hardness suitable for paints, for instance, I find it has not the jet black luster, but has a bluish cast and is varicolored, and it will not retain even this luster but will disintegrate and take on a dull black appearance in a short time when exposed to the atmosphere. In endeavoring to make a softer grade suitable for paving or roofing purposes, I find it impossible to perfect the product in the closed still as it will lack the distinctly characteristic qualities above mentioned and will disintegrate when exposed to the elements, and water or moisture deteriorates it rapidly. While I can, therefore, apparently get any degree of hardness desired by continuing the process in the closed still, as I said before, it lacks the proper qualities for the purposes desired, and also by so doing I am compelled to distil over a greater quantity of distillate to get that hardness so that I get less product of asphalt by so doing than when I draw it off in the open vessel.

After delivering the material in an open vessel I subject it to a temperature of about 100 degrees F. less than it was in the closed still, and this heat is not sufficient to drive off any additional oils by vaporization. The exposure of the product in the open vessel at about this temperature has the effect of

driving off some fixed gases but does not substantially lessen the material in weight, and through this exposure the material acquires the black luster of the refined natural asphalt and an additional degree of hardness or toughness with its adhesive, cohesive and lasting qualities which are lacking if the attempt be made to finish the material in the closed still.

The time for exposure in the open vessel varies according to the quality desired in the finished product which I am working to obtain. If I am making a soft liquid asphalt, five to eight hours in the open vessel is sufficient although a longer exposure would not be detrimental. But five to eight hours is sufficient in making the liquid asphalt to be used as a flux for the natural asphalt or any purpose for which such a flux can be used. If I desire a paving or roofing material I treat it in the open vessel for fifteen to eighteen hours, and if a harder material is wanted, such as is used as a base for paints and varnishes, I subject it to twenty-four to twenty-eight hours treatment. I have found by experience that the above time is sufficient in the open vessel in order to acquire the quality desired, but I do not wish it to be understood that any additional exposure would destroy the resultant product. These results are not only accomplished by my invention as herein set forth but the material so made cannot be distinguished from the natural asphalt by any expert chemist.

There is manifestly no hard and fast rule to be laid down as to the exact number of hours, either in the closed still or in the open vessel, as I am starting, possibly, each time with a residuum or oil of different gravity and character and may be working to get a different product at the finish according to the demand the market is calling for at that time. However, by reducing a small quantity, say a gallon, in an open vessel to commence with as originally described, I can then readily determine how long to subject the larger quantity in the closed still and open pan according to the product I am starting with and the consistency of the product I desire to make, my previous work with the small quantity enabling me to know just how much of the lighter or more volatile portions I want to take off when I am working with a larger amount. This of course can only be done by those who are accustomed to handling the product and know the end that they desire to accomplish. Experience alone will teach them.

A product for paving or roofing purposes would be of the consistency of chewing gum. That is, by removing a sample I determine by chewing it when it has arrived at the proper stage. When you can string it and pull it like gum and it does not disintegrate

and stick to the teeth it is ready for the market. To make the asphalt product harder it is simply necessary to subject it to the aforesaid temperature 625 F. for a longer period, depending on the gravity of the product originally started with. I keep on testing it from time to time until it has acquired the full degree of hardness that I desire. The very hard product is a very suitable base for asphalt paints and varnishes. The product between the hard and soft chewable material above mentioned is valuable for insulating purposes or for all purposes for which an insulating compound is used. In order to make a soft or thin liquid asphalt I expose the residuum to a temperature of 625 F., testing the product in the still from time to time until it has acquired about the desired consistency. Then I withdraw it to the pan or open vessel above described and subject it to a temperature of 450 to 550 F. more or less for about forty-eight hours, and during that period there is no appreciable loss of material by weight though some gases doubtless will be given off. The resultant product is an admirable flux to bring natural asphalt to a consistency for paving or roofing purposes or for the laying of dust on unpaved streets or any other purpose for which it might be used.

In subjecting the residuum to a temperature of 625 F. the heavy paraffin oils contained therein will be vaporized and carried off by the aid of superheated steam or compressed air according to which of the two is used, and will be condensed and caught in the outlet tanks numbered 1, 2 and 3, respectively, according to gravity. That taken from the opening nearest the retort is of course the lowest gravity, as the lower gravity oils will condense at a much higher temperature than the higher oils, and that the farthest away the lightest or highest. A suitable overflow or escape pipe 6 has a distended end or receiving mouth over the still and leads by successive down pipes 7 to tanks 1, 2 and 3.

I have found by experience that the product in the retort will not coke at a temperature of 625 F. and in order to get the asphalt as a product of such value as I require it is necessary to keep the temperature as before stated below the coking point. But the vapors of the heavy paraffin oils will not pass out from the retort into the said tanks at so low a temperature without assistance and hence I employ superheated steam or air as auxiliary means for this purpose. I say superheated, or at least heated to such a degree that the vapors will be carried out thereby and forward into the several condensing tanks according to their gravity. Otherwise, or without such aid the heavier vapors would not be or become sufficiently

volatile to float away, and a lower temperature of either steam or air would rather tend to chill and condense said vapors, particularly because the heavy paraffin oil I desire to eliminate condenses at a very high temperature.

In introducing the superheated steam or air into the still I have the inflow pipes placed at a point above the surface of the oil or residuum as the case may be and all the openings in the pipe, which should completely encircle the still, point toward the outlet or overflow provided for the escape of the vapor.

The foregoing description and process obviously deal with a condition in the retort which renders outside aid necessary for the reason that if a temperature be employed in the retort itself high enough to expel all volatilizable constituents it will coke the material or make it of no value for asphalt, and if a lower temperature than say 625° F. be used, as described, the said constituents will simply condense and fall back into the material in the retort and the process will fail. This is true whether the material under treatment be derived in the still from crude petroleum or be brought to it as a residuum from treatment elsewhere or under different conditions. Hence the value of supplemental means or agencies for getting rid of the vapors in the still in a manner which does not enter into or agitate the mass in the still but is delivered over the same and with a sustained pressure of about forty-five pounds to the inch, which pressure or movement simply forces the said vapor forward into the condensing passages and receptacles provided there. We thus recover all the oils of heavy gravity (which are valuable), so that there is practically no appreciable loss in quantity of material from that originally started with.

As shown in the drawings I have a plant employing compressed air stored in a tank or vessel A, a heating coil C with a gas burner B to heat the same and from which coil the superheated or highly heated air is drawn under a considerable pressure into the annular distributing pipe D in retort R.

By the word residuum as herein employed I mean the product remaining in a still after the crude oil has been subjected therein to the processes of distillation as commonly practiced by all refiners of crude oil. This product is well known on the market as petroleum residuum or petroleum tar. This residuum may vary in gravity from seventeen degrees Baumé to twenty to twenty-two degrees Baumé, more or less, depending altogether on the character of the crude petroleum originally placed in the still, and also on the quantity and quality of the distillate that the refiner desires to take from the crude. By way of illustra-

tion, suppose that the refiner of Lima crude oil has a demand for the naphtha, kerosene and the lighter gravity of paraffin oils, but not for the heavy paraffin oils, he then stops the process of distillation after the lighter paraffin oils have come over and the resultant product left in the still is a residuum or tar of a gravity from twenty to twenty-two degrees Baumé. Should he have a market at the time for the heavier grades of paraffin oils he will carry the process of distillation still farther and take off the heavier paraffin oils and he will then have left in his still a residuum or tar of a gravity from seventeen to nineteen degrees Baumé.

It is obvious then that when I start to make asphalt from a residuum of twenty to twenty-two degrees gravity, it will take longer than if I had started with the seventeen to nineteen degrees gravity tar, as the heavy paraffin oils have already been removed from the seventeen to nineteen degrees gravity tar before I commence operations, and when I start with the twenty to twenty-two degrees gravity, I have to take the time necessary to remove these heavy oils by distillation. The residuum or tar of seventeen to nineteen gravity still contains a quantity of the very heavy oils which must be removed to make my product, asphalt. I remove these heavier products at the lower temperature and below the coking point by the use of superheated air or steam, air being preferable, as that avoids the necessity of the separation of distillate from the water (condensed steam), which is required to bring over the vapors at the temperature which I apply.

While I may start with the tar or residuum from the so-called paraffin base oils, the process is just as applicable to the so-called asphalt base oils, the only difference being that the residuum or tar would be the product left in the still after the heavy lubricating or cylinder oils have been removed from the crude oil by previous distillation instead of the heavy paraffin oils. While this heavy lubricating oil will in a way correspond with the heavy paraffin oil, it is much lower in gravity and of course does not contain the paraffin. However, in dealing with the so-called asphalt base oils this heavy low gravity lubricant must be removed from the crude oil or tar as the case may be before I can get my product, asphalt. The same is true of the so-called asphalt base oils as of the so-called paraffin base oils. If the refiner of the asphalt base oils had no market at the time for the heavy low gravity lubricant, he would stop his process of distillation when the lighter lubricants had been removed, and his residuum

would then be of much higher gravity than if he continued his process of distillation until the heavy lubricants had been removed. If, therefore, I started to make asphalt from residuum or tar from the so-called asphalt base oils, it is again obvious that it would require more time to make it from the residuum from which only the lighter lubricants had been removed than from the residuum where the heavier lubricants had also been removed by previous distillation. It can, therefore, be readily seen that my process for making asphalt could just as well start from the crude oil as from the residuum or tar, the only point being the longer time necessary to take off the lighter oils before getting down to the residuum or tar.

What I claim is:

1. The method herein described of making asphalt from petroleum residuum, which consists, first, in subjecting the same to a temperature of approximately 625° F. in a vessel until substantially all the volatilizable substances are driven off and then drawing the material off into an open vessel and boiling the same therein at a temperature considerably below 625° F. as explained and for a period dependent on the quality of the product desired.

2. The method herein described of making asphalt from petroleum residuum which consists in subjecting the residuum to a heating process in a vessel having a free discharge for the vapors at a temperature approaching a coking heat and at the same time injecting a fluid such as steam or air, into the vessel over the material therein and at a temperature high enough to carry off the vapors liberated in the boiling operation, thereby ridding the residuum of oil, and, lastly, boiling the material remaining in an open vessel for a brief period at a temperature of approximately 400° to 500° F.

3. The method herein described of making asphalt from petroleum residuum which consists in subjecting the residuum to a heating process at a temperature of approximately 625° F. in a vessel until the volatilizable substances are driven off and at the same time applying superheated steam or air under pressure next above or over said residuum and thereby carry off the vapors liberated from the residuum so treated and then subjecting the residuum to a heating process in an open vessel as described.

In testimony whereof I affix my signature in presence of two witnesses.

CHAUNCEY B. FORWARD.

Witnesses:

E. M. FISHER,  
F. C. MUSSUN.