W. H. FROST.
PROCESS OF MAKING LAMPBLACK.
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PROCESS OF MAKING LAMPBLACK.

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To all whom it may concern:

Be it known that I, WARREN H. FROST, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Process of Making Lampblack, of which the following is a specification.

This invention relates to a process whereby lampblack is produced from carbonaceous materials.

An object of the invention is to produce lampblack of superior grade in commercial quantities.

Another object is to provide a process whereby relatively heavy carbonaceous materials, not ordinarily capable of producing lampblack of good grade, may be utilized.

Another object is to make it possible to utilize cheap and impure materials in the manufacture of a fine grade of lampblack.

Another object is to provide a process whereby all of the lampblack produced will be of substantially uniform quality.

Another object is to recover a maximum amount of the carbon present in the carbonaceous material treated by the process.

Another object is to provide a process in which a mixture of carbonaceous materials and air will be heated to a relatively high temperature, to decompose the carbonaceous materials into highly heated carbon and gases, and suddenly chill or cool the hot carbon and gases while they are at substantially the temperature caused by combustion so as to prevent such reactions as ordinarily take place in gas making retorts and result in the union of the carbon and carbon dioxide gas to form carbon monoxide gas.

In the generally accepted methods of manufacture a good quality of lampblack from heavy carbonaceous materials such as coal tar, petroleum by-products or heavy crude petroleum, it has heretofore been deemed necessary to distill off the oils possessing qualities which allow partial combustion at comparatively low temperatures. These lighter oils are used for the production of lampblack and therefore in the operation involved in making the lampblack the tarry products, oily particles and other objectionable matter which remain after the lighter oils have been distilled off do not interfere with the production of the lampblack and the lampblack so produced is comparatively free of such tarry products. By such prior methods of producing lampblack it is obvious that a considerable residue results having little commercial value and generally of a pitchy or tarry character.

I have discovered that by heating or otherwise liquefying the relatively heavy carbonaceous materials mentioned above, then atomizing the liquid carbonaceous materials and at the same time surrounding the particles of carbonaceous matter in the atomized form with the correct proportion of air to insure the right degree of combustion and proper temperature to effect the desired changes, then suddenly cooling the hot gases and carbon while they are disassociated, I obtain from relatively cheap and abundant materials a lampblack of the very finest grade and one possessing all of the characteristics now recognized as necessary in lampblack used by color grinders and others requiring a lampblack of high grade.

In using liquid oils, for example, preheating of the oils is advisable but not necessary, but in using heavy and cheap carbonaceous materials, such as tar and pitch said materials should be heated to a temperature which liquefies but does not decompose the material.

Gas makers employing oil to make gas in accordance with the Lowe process wash from the gas extractor tar which is quite heavily loaded with tarry matter and possibly with oil particles and other materials which make it unsuitable for the production of lampblack for the use of painters and others who employ true lampblack. It is not to this lampblack that my process refers and it is understood that the term lampblack employed herein relates to a nearly pure carbon, free of oil, fats, tarry matter, and practically free of other foreign substances.

In making lampblack by the process mostly employed at present, an oil, which has been freed of objectionable materials such as pitch and tar, is utilized and such oil is partially consumed at a comparatively low temperature. The air supplied is sufficient to maintain combustion at low temperature but is not sufficient to produce high
temperatures and therefore a sooty smoke results. This smoke drifts into a series of settling chambers where it collects and from which the lampblack is cleaned out at intervals. By this old process several grades of lampblack result. The lampblack settling near the furnace is quite oily and of low grade and does not show a deep shade of black. The lampblack from the other chambers grades higher the farther the chamber is from the furnace, the best grade being farthest from the furnace. Generally, all of this lampblack contains some oil and must be calcined before it is marketed.

This is done by heating the lampblack red hot in an air tight iron container having a small vent for the escape of the vapors generated by the heat.

At the present time the material preferred for making a good grade of lampblack, suitable for painters, is oil distilled from coal tar, creosote and similar products. So far as I am aware, no one has heretofore succeeded in making a high grade of lampblack from petroleum and other relatively heavy carbonaceous materials.

The accompanying drawings illustrate one form of apparatus which may be employed in performing the operations in the new process.

Figure 1 is a front elevation of the apparatus with the liquid-seal shown in section. Fig. 2 is a sectional elevation on line indicated by $x^2-x^3$, Fig. 1, the exhaust pump being omitted.

It is understood that this process is not limited to being performed by the apparatus disclosed in the drawings, but that said apparatus is shown and the process described in connection therewith only for the purpose of making clear how the process is performed.

The apparatus comprises a retort 1 of any suitable shape. The retort 1 is reduced toward its forward end which is provided with an atomizer 2, the tip of said atomizer projecting into the retort and there being an air passage 3 surrounding the atomizer.

The air passage 3 is provided with tuyères 40 opening into the retort 1. Any suitable type of atomizer may be employed, the one illustrated being analogous in construction and operation to the burner shown in my Patent No. 1,136,113, dated April 20, 1915.

The atomizer 2 receives air from a pipe 4 provided with a valve 5 and also receives liquid carbonaceous materials through a pipe 6. The pipe 6 is connected by a pipe 7 to a supply of liquid hydrocarbon such as crude oil, and the pipe 6 is also connected by a pipe 8 to a liquefying chamber 9 above the retort 1, said chamber being heated by heat radiating from the retort. The pipe 6 is provided with a needle valve 10, and the pipes 7 and 8 are provided with valves 11, 12 respectively. The main part of the atomizer 2 is surrounded by a steam jacket 13 which receives steam from a pipe 14 provided with a valve 15.

The air passage 3 is supplied with air through a pipe 16 having a valve 17, said pipe being connected to a blower or fan, not shown, so that the air may be forced into the tuyère under some pressure. Also water which may be in the form of vapor may be admitted to the tuyère by a pipe 18 which has its discharge end forming a nozzle 19 in the discharge end of the pipe 18. The pipe 14 is provided with a valve 20. The pipe 15 may be connected with a steam boiler and the pipe 18 may be connected to a water tank or steam boiler. The air passage may be provided with a pipe 6 hole 21 through which the interior of the retort and the contents thereof may be observed.

The larger rear end of the retort 1 forms an outlet 22 surrounded by a water jacket 23 through which water 24 is circulated. The circulating water 24 may be cooled by any well known means, not shown. The outlet 22 is connected directly with the upper portion of a cooling chamber 25 in the form of a tower. The water 24 prevents the transmission of heat from the retort walls to the tower walls. Into the upper end of the tower 25 discharges a column of spray of water 26 from a pipe 27 which extends to a suitable water supply. The lower end of the tower 25 communicates with a liquid-seal box 28 containing water 29. At the discharge end of the liquid-seal box 28 is placed a tank 30.

At its top the seal box 28 is connected by a pipe 31 with a washer 32, a shower or spray of water 33 being produced in the washer 32 by water admitted through a pipe 34 which connects with a suitable water supply. The bottom of the washer 32 is provided with a liquid-seal box 35, the outlet of said box being connected with a conduit 36 which discharges into the tank 30. The washer 32 is provided with a gas-discharge pipe 37.

To perform the new process so as to produce a lampblack the apparatus above described operates as follows: Liquid fuel will be admitted from the burner 2. Also compressed air will be supplied to the burner by opening the valve 5. The air and liquid fuel from the burner discharge into the retort and the atomized fuel is lighted by any suitable means so that combustion of some of the materials ensues. Air is also admitted through the pipe 16 in sufficient volumes to produce a good degree of combustion of the fuel but not perfect combustion, the flame varying in color from yellowish white to white. Relatively high temperatures are thus quickly secured in the retort 1. Steam admitted through the
pipe 14 to the steam jacket 13 will prevent the solidifying of any fuel admitted to the burner and having such tendency when cool.

Fuel such, for example, as tar, pitch and other cheap carbonaceous materials, which require considerable heat to liquefy, may be admitted to the chamber 9 through the opening 38 that is closed by a cover 39. The air furnished to the burner through the pipe 4 atomizes the liquid carbonaceous materials of whatever character and throws said materials in the form of a fine spray into the retort 1. In practice I have used an air pressure of about five pounds per square inch in the burner. The air supplied to the tuyère by the pipe 16 is under comparatively light pressure and this supplemental air enters the retort around the sprayed fuel issuing from the burner. The velocity of the air supplied to the burner is substantially spent in atomizing the carbonaceous materials and throwing them into the retort, and the supplemental air supplied by the pipe 16 produces sufficient pressure to prevent the heated contents of the retort from blowing back to the burner. This supplemental air can also be regulated so as to change the proportion of air to fuel. Furthermore this supplemental air insures burning of fuel which may be sprayed against the retort walls, thus preventing the accumulation of coke and the like on the walls of the retort.

A portion of the mixture of carbonaceous materials and air thus admitted to the retort flashes quickly into a flame of relatively high temperature and the remaining portion of hydrocarbon, or other carbonaceous material present, is decomposed to form highly heated free carbon and combustible gases, carbon dioxide being present in relatively large volumes. The flaming-hot gases and carbon strike the water spray 26 before the gases and carbon have cooled to any substantial degree. The contact of the hot carbon and gases with the water spray produces sudden chilling of the carbon and gases, thus preventing the taking place of any reaction which would ensure if the cooling or chilling were more gradual.

While it is not new to discharge gases against or into a falling column of water to wash the gases free from the tar, this being done in the well known scrubber, it is to be noted that in this lampblack process the free carbon and gases produced in the retort 1 are discharged directly from the retort against the water spray; that said water spray is sufficiently close to the plane of combustion to prevent the free carbon and carbon dioxide gas produced by the combustion from combining in any considerable quantity to form carbon monoxide gas; and that thus the spray not only causes the free carbon to be thrown down but prevents the combining of the carbon dioxide gas with the hot carbon to form the combustible gas carbon monoxide. Thus this process prevents the formation of any very great volume of carbon monoxide gas and, instead, causes chilling of the carbon and gas before those reactions can take place which ordinarily occur in a gas making retort in the manufacture of carbon monoxide gas.

I find that a relatively high temperature is necessary to effect the production of the lampblack in accordance with this new process and this is contrary to the established practice. I have employed for different materials temperatures which read on the pyrometer from about 1200° to 2400° F., and it is therefore seen that the temperatures may vary considerably within certain limits, but in any event the temperatures are much higher than those employed in gas making and in the old methods of making lampblack. The heavy carbonaceous particles must be heated to such a temperature as to thoroughly decompose them.

When oils and oxygen from decomposed steam or from the air are heated together in an internally fired retort to produce a combustible gas, in a manner well known in the gas making art, it is desirable that all the heat values possible go over to the retort with the gas. The lighter hydrocarbons such as methane and hydrogen are desirable constituents of combustible gases and to obtain the maximum volume of such desirable gases the temperature is maintained below the point at which the tarry matter is decomposed, and the by-product scrubbed from the gas is a tarry carbon differing materially from commercial lampblack and incapable of use in place of said lampblack for paint and many other purposes.

In the manufacture of producer gas, high in carbon, the gases and free carbon are maintained in proximity to one another at relatively high temperatures for sufficient time to allow the carbon dioxide gas to combine with the carbon to form carbon monoxide gas, the highest efficiency in making carbon monoxide or “producer” gas is obtained when using a temperature lower than that used in making the highest grade of lampblack.

The spray or shower of water 26 carries most of the carbon down with it into the liquid-seal box 29 and passes with the water from said seal-box into the collecting tank 30 and the carbon floats to the surface of the water in the tank 30 and is collected therefrom.

The carbon still held in suspension in the gases, which pass from the tower 25 into the upper portion of the liquid-seal box 28 passes from said box through the pipe 31.
into the washer 32 where it is showered or sprayed with water supplied through the pipe 34. This second shower precipitates the most of the remaining lampblack out of the gases and the water and lampblack pass from the washer through the seal 35 and conduit 36 to the collecting tank 30. This carbon is then skimmed from the water in the tank 30. The gases pass off from the washer 32 through the pipe 37.

On account of the water seal 29 it is clear that more or less pressure may be maintained on the retort and tower, the degree of pressure depending upon the depth of water used in the seal. Powdered coal or other forms of lampblack producing carbonaceous materials may also be injected into the retort 1 and decomposed as described. The powdered coal may be injected in any suitable manner now or heretofore known in the art pertaining to combustion of such fuel.

I prefer to employ a pressure in the retort, since such pressure permits of more exact regulation of the volumes of air, thus insuring the securing of a uniform product. However the process may be performed at substantially atmospheric pressure, or with a partial vacuum in the retort. To provide for operation under atmospheric pressure and under a partial vacuum the air supply pipe 16 is provided with a branch 40' open to the atmosphere, said branch 40' having a valve 41. Also the pipe 37 is provided with a valve 42 and with a branch 43 having a valve 44. The branch pipe 43 connects with an exhaust pump 45.

It is now readily understood, that to work the process above atmospheric pressure, the valves 41, 44 will be closed and the valves 17, 42 will be opened; and also that, to work the process with a partial vacuum, the valves 17, 42 will be closed and the valves 41, 44 will be opened.

In an old method of producing lampblack the oil was atomized mechanically, whereas in this new process compressed air is employed so as to produce a very fine subdivision of the fuel and intimate mixture of the fuel particles with air, each particle of oil being surrounded by the proper quantity of air in order to secure the requisite high temperatures. Due to this the quality of the product is uniform and decomposition of all of the fuel is effected so that practically no oily particles are carried over into the lampblack precipitated in the tower.

In the old processes there was no provision made for supplying supplemental air under pressure, and the volume of air depended upon the degree of suction of the exhauster or chimney. Said suction varies constantly in accordance with the varying amounts of oil supplied to the burner and from other causes such as stoppage of the cleaning or washing devices or filling up of the carbon chambers. Thus under the old processes it was very difficult to obtain a constant volume and quality of lampblack. In this new process not only is the fuel atomized by air under pressure, but a supplemental supply of air enters the retort around the burner at sufficient pressure to hold back the retort contents from the burner. The supplemental air also furnishes the right amount of extra air required to properly decompose any given volume of fuel entering the retort. This supplemental air supply also makes possible the production of a maximum quantity of lampblack.

When pulverized coal or other pulverized lampblack producing carbonaceous material is used in the apparatus, said coal or other material will be injected into the retort 1 and dispersed or diffused by compressed air so that an intimate mixture of the air and pulverized material will result suitable for being decomposed by the combustion of a portion of the mixture.

Heavy carbonaceous material such as coal tar pitch may be employed for producing lampblack in my process and to effect this the pitch will be placed in the chamber 9 and heated so as to liquify it. The liquefied pitch is then atomized by injecting it with compressed air into the retort 1. Since lampblack is a more valuable product than pitch, I thus increase the commercial value of the pitch which has not heretofore been used for the production of high grade lampblack such as my process produces.

I claim:
1. The process of making lampblack, which consists in diffusing and commingling lampblack-producing carbonaceous material and air in an enclosed space, burning a portion of the diffused carbonaceous material to cause decomposition of another portion of said carbonaceous material into free carbon and gas, and discharging the free carbon and gas thus produced into a shower of water close to the point of highest temperature of the carbon and gas.
2. The process of making lampblack, which consists in diffusing and commingling lampblack producing carbonaceous material and air in an enclosed space, burning a portion of the diffused carbonaceous material to cause decomposition of another portion of said carbonaceous material into free carbon and gas, and chilling the free carbon and gas thus produced close to the point of highest temperature of the carbon and gas and gas to prevent to a large extent the combining of the carbon with the gas.
3. The process of making lampblack, which consists in applying compressed air to lampblack producing carbonaceous ma-
material to diffuse said material, burning a portion of the diffused carbonaceous material at a relatively high temperature to decompose another portion of the material into free carbon and gases, and then suddenly cooling and precipitating most of the carbon from the gases before said carbon combines with said gases.

4. The process of making lampblack which consists in heating lampblack-producing carbonaceous material to a relatively high temperature in the presence of air to burn a portion of the carbon and to decompose another portion into free carbon and gases, and discharging the carbon and gases at substantially their maximum temperature into a chilling fluid column.

5. The process of making lampblack, which consists in heating lampblack-producing carbonaceous material to a relatively high temperature in the presence of air to burn a portion of the carbon and to decompose another portion into free carbon and gases, and discharging the carbon and gases at substantially their maximum temperature into a chilling water spray.

6. The process of making lampblack, which consists in injecting and commingling lampblack-producing carbonaceous material and air in an enclosed space, burning a portion of the injected carbonaceous material to cause decomposition of another portion of said carbonaceous material into free carbon and gas, and chilling the free carbon and gas thus produced close to the point of highest temperature of the carbon and gas to prevent to a large extent the combining of the carbon with the gas.

7. The process of making lampblack, which consists in feeding a flame with air and lampblack producing carbonaceous material in volumes sufficient to produce combustion of only a part of the carbonaceous material at a comparatively high temperature to form large volumes of free carbon and carbon dioxide gas, and then while the carbon and gas are substantially at full heat and before said carbon and gas can combine in any substantial quantities passing said carbon and gas into a shower of water to precipitate the carbon.

8. The process of making lampblack, which consists in heating lampblack-producing carbonaceous material to a relatively high temperature in the presence of air and water vapor to burn a portion of the carbon and to decompose another portion into free carbon and gases, and suddenly chilling the carbon and gases before they have cooled to any substantial degree.

9. The process of making lampblack, which consists in diffusing and commingling lampblack-producing carbonaceous material and air and water vapor in an enclosed space, burning a portion of the diffused carbonaceous material to cause decomposition of another portion of said carbonaceous material into free carbon and gas, and discharging the free carbon and gas thus produced into a shower of water close to the point of highest temperature of the carbon and gas.

10. The process of making lampblack, which consists in diffusing and commingling lampblack-producing carbonaceous material and air and water vapor in an enclosed space, burning a portion of the diffused carbonaceous material to cause decomposition of another portion of said carbonaceous material into free carbon and gas, and chilling the free carbon and gas thus produced close to the point of highest temperature of the carbon and gas to prevent to a large extent the combining of the carbon with the gas.

11. The process of making lampblack, which consists in feeding a flame with air and water vapor and lampblack-producing carbonaceous material in volumes sufficient to produce combustion of only a part of the carbonaceous material at a comparatively high temperature to form large volumes of free carbon and carbon dioxide gas, and then while the carbon and gas are substantially at full heat and before said carbon and gas can combine in any substantial quantities passing said carbon and gas into a shower of water to precipitate the carbon.

12. The process of making lampblack, which consists in applying compressed air and water vapor to lampblack-producing carbonaceous material to diffuse said material, burning a portion of the diffused carbonaceous material at a relatively high temperature to decompose another portion of the material into free carbon and gases, and suddenly chilling the carbon and gases while they are substantially at their maximum temperature.

13. The process of making lampblack, which consists in heating pulverized lampblack-producing carbonaceous material in the presence of air and water vapor to a temperature sufficient to burn a portion of the carbon and to decompose another portion into free carbon and gases, and then suddenly cooling and precipitating most of the carbon from the gases before said carbon combines with said gases.

14. The process of making lampblack, which consists in applying compressed air to lampblack-producing carbonaceous material to diffuse said material, supplying additional air under pressure around the diffused material, burning a portion of the diffused material at a relatively high temperature to decompose the remaining portion into free carbon and gases, and chilling the carbon and gases close to the flame of combustion to prevent any substantial amount of carbon combining with the carbon dioxide.

15. The process of making lampblack,
which consists in applying water vapor and compressed air to lampblack-producing carbonaceous material to diffuse said material, supplying additional air under pressure around the diffused material, burning a portion of the diffused material at a relatively high temperature to decompose the remaining portion into free carbon and gases, and chilling the carbon and gases close to the flame of combustion to prevent any substantial amount of carbon combining with the oxygen.

16. The process of making lampblack, which consists in applying heat to pitch to liquefy it, atomizing the liquefied pitch in the presence of air to effect burning of a portion of the atomized pitch at a relatively high temperature and to decompose another portion of the pitch into free carbon and gases, and then suddenly cooling and precipitating most of the carbon while the carbon and gases are substantially at their maximum temperatures.

Signed at Los Angeles, California this 14th day of November, 1921.

WARREN H. FROST.

Witnesses:

GEORGE H. HILES,
L. BELLE WEAVER.