

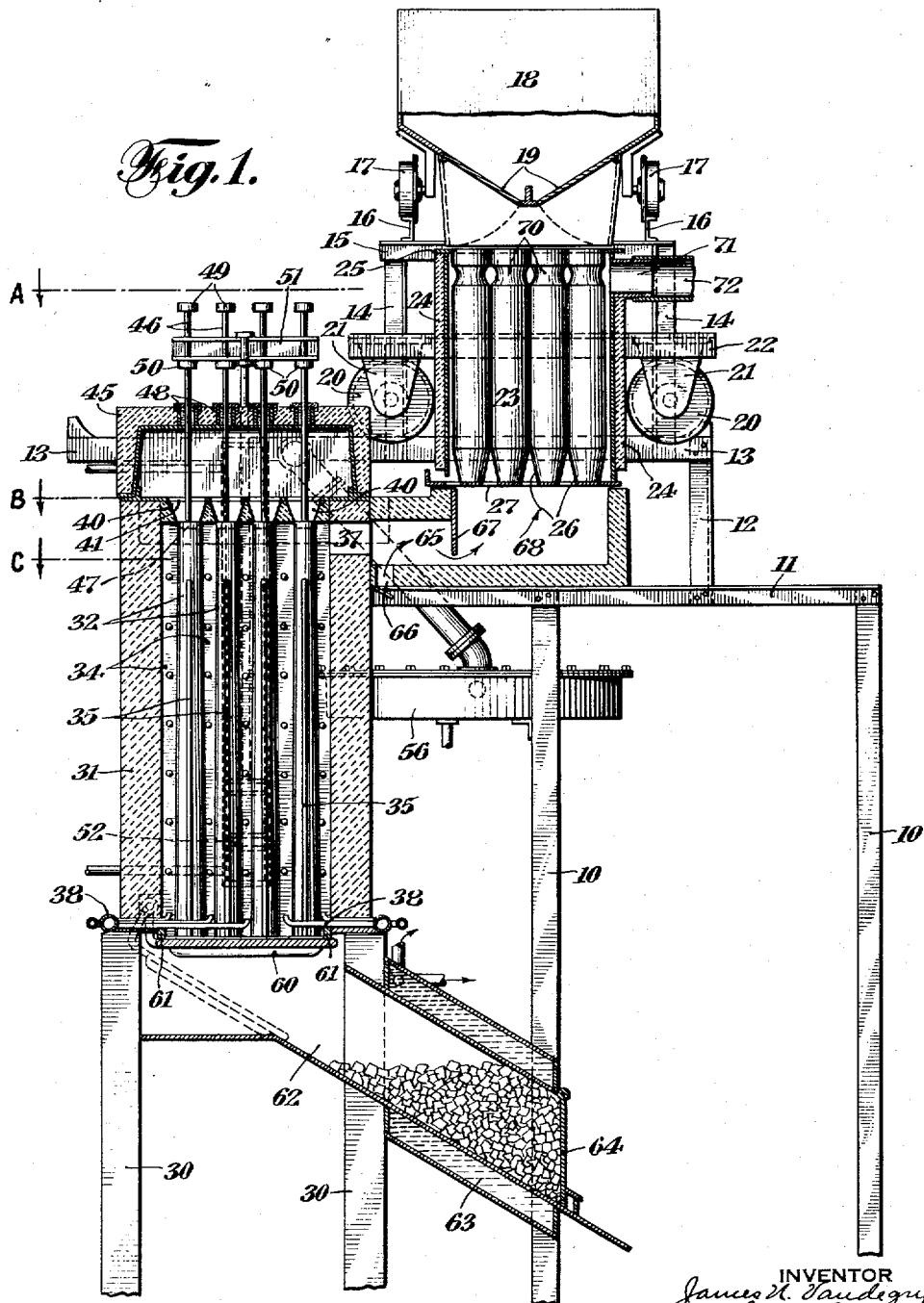
Dec. 29, 1936.

J. N. VANDEGRIFT ET AL

2,066,082

APPARATUS FOR PRODUCING FUEL

Original Filed May 29, 1930 4 Sheets-Sheet 1



INVENTOR
James N. Vandegrift
Carl Postel
BY
Levy & Levy
ATTORNEYS.

Dec. 29, 1936.

J. N. VANDEGRIFT ET AL

2,066,082

APPARATUS FOR PRODUCING FUEL

Original Filed May 29, 1930 4 Sheets-Sheet 2

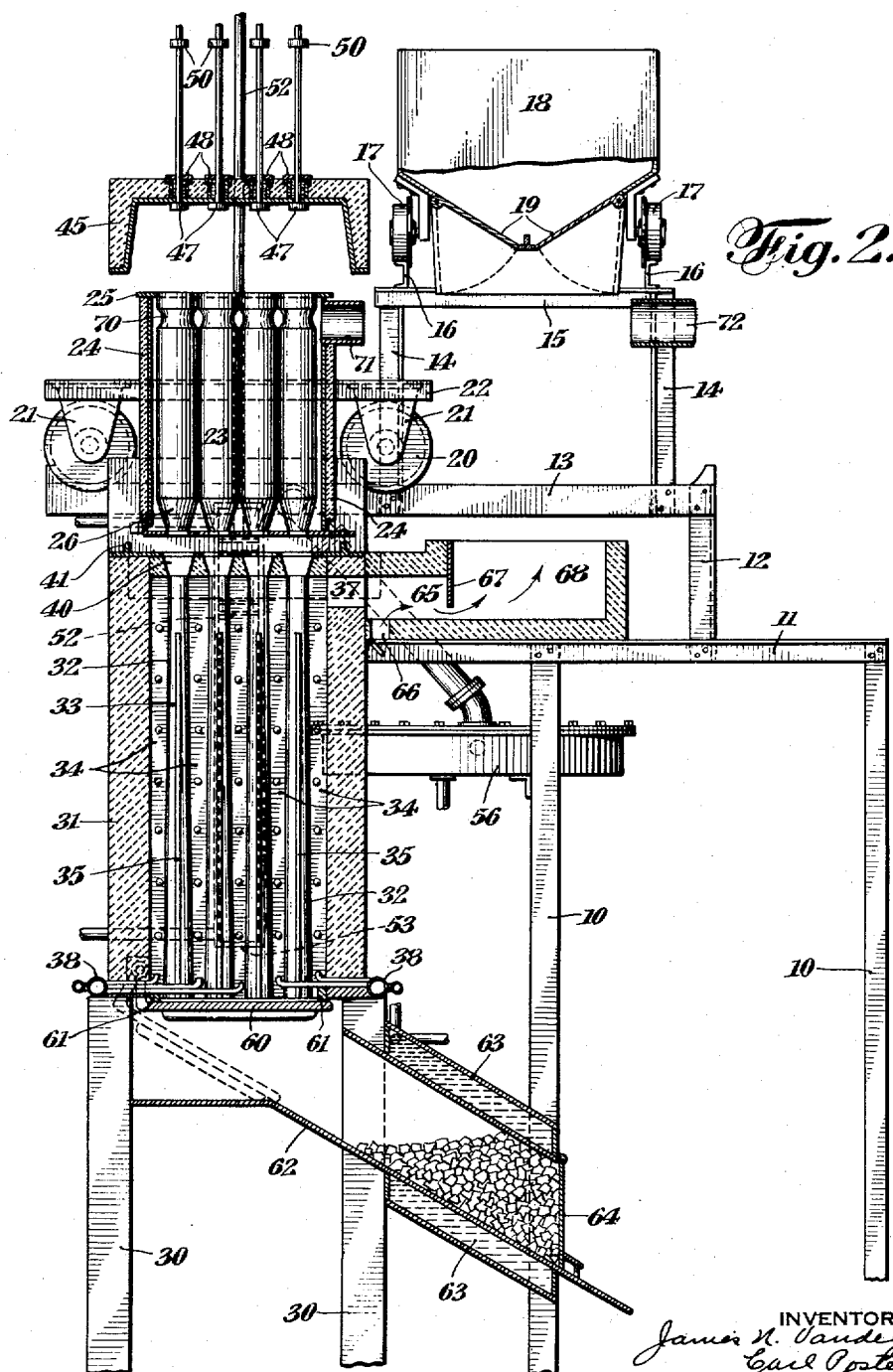


Fig. 2.

INVENTOR
James H. Vandegrift
BY Earl Postel
Kuyper Kuyper
ATTORNEYS.

Dec. 29, 1936.

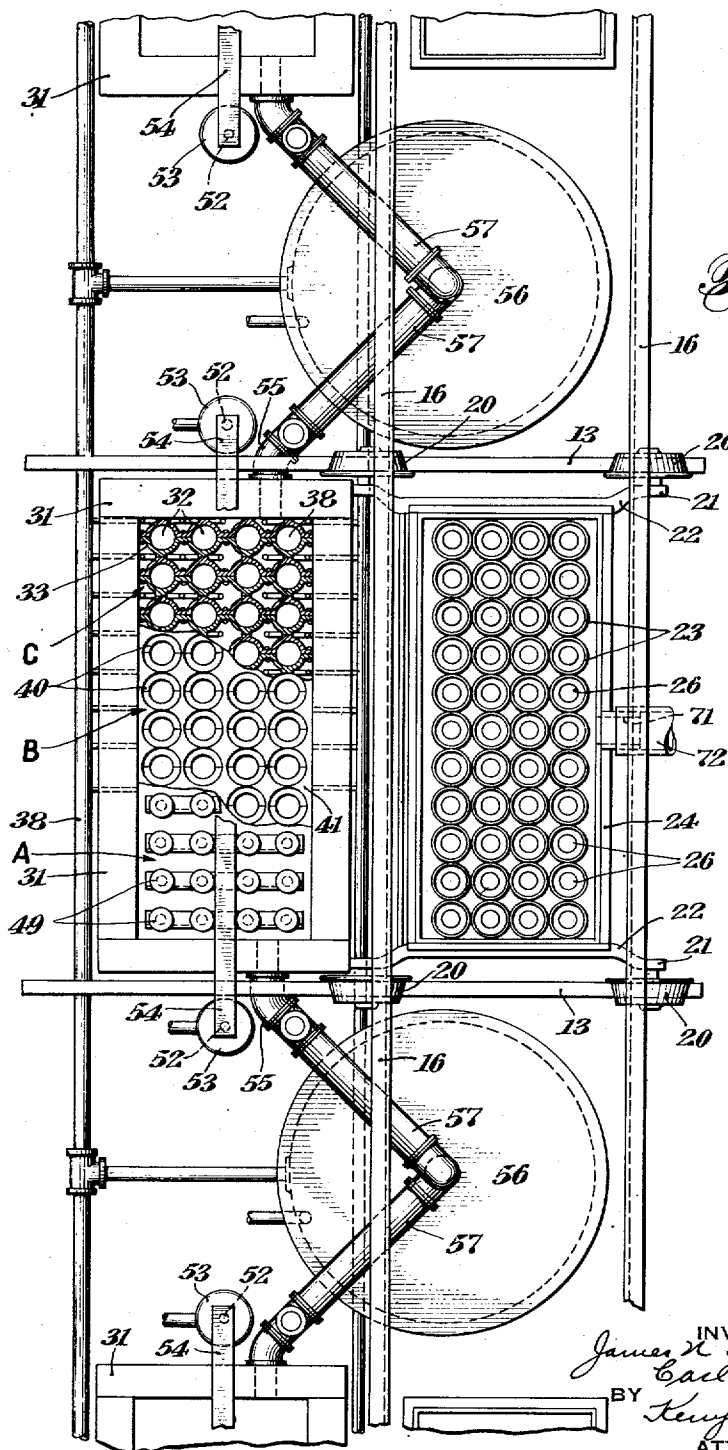
J. N. VANDEGRIFT ET AL

2,066,082

APPARATUS FOR PRODUCING FUEL

Original Filed May 29, 1930

4 Sheets-Sheet 3



Dec. 29, 1936.

J. N. VANDEGRIFT ET AL

2,066,082

APPARATUS FOR PRODUCING FUEL

Original Filed May 29, 1930 4 Sheets-Sheet 4

Fig. 4.

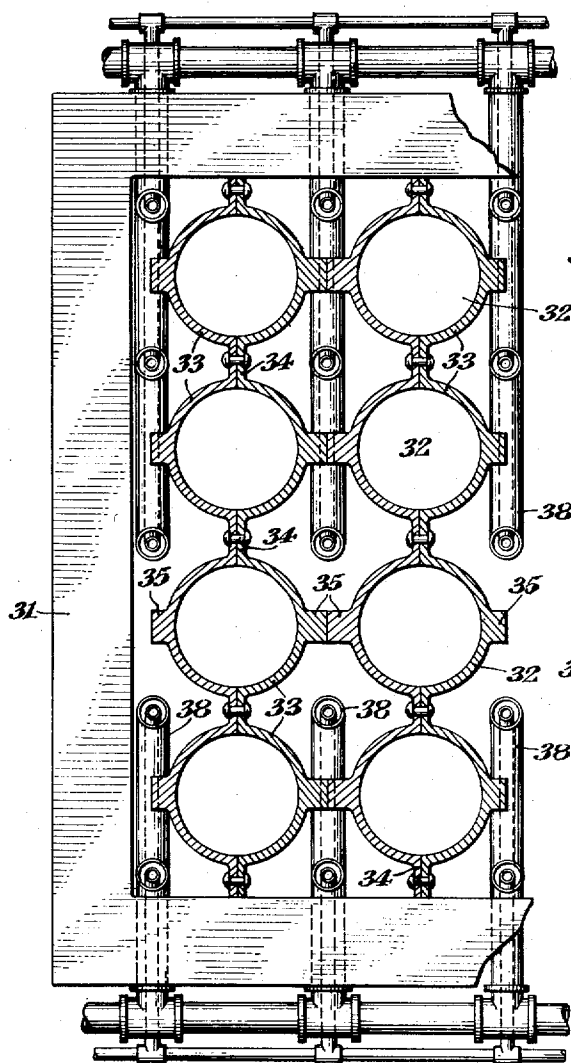


Fig. 5.

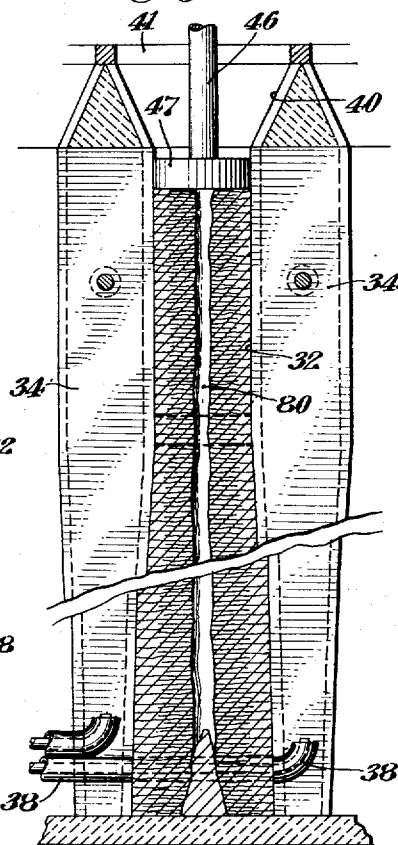
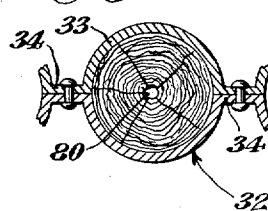


Fig. 6.



INVENTOR
James N. Vandegrift
Carl Postel
BY
Kevyn Kevyn
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,066,082

APPARATUS FOR PRODUCING FUEL

James N. Vandegrift and Carl Postel, New York, N. Y., assignors, by mesne assignments, to Coal Products Company of Delaware, Philadelphia, Pa., a corporation of Delaware

Original application May 29, 1930, Serial No. 457,466. Divided and this application February 11, 1932, Serial No. 592,302

26 Claims. (Cl. 202—110)

This invention relates to means for producing a new type of domestic fuel and more particularly to means for producing a smokeless domestic fuel from slack or waste from screened bituminous coking coals, and is a divisional application with respect to our co-pending application, Serial No. 457,466, filed May 29, 1930, for Method of and apparatus for producing fuel. Apparatus embodying this invention is especially adapted for making a new, domestic, substantially smokeless fuel in lump form and of high heating value at low cost from inexpensive carbonaceous material.

Heretofore coke has been produced by the so-called high temperature distillation process wherein the temperature is utilized in producing the coke ranges from approximately 1800 to 2000° F. The coke produced at these temperatures is metallurgical coke with a very low volatile content; for example, about one per cent., with the result that the coke is unsuitable for domestic fuel. The object in producing such fuel is mainly to recover as large a quantity of gas as possible and also to recover a relatively small volume of tar. This coke is suitable for metallurgical purposes.

Coke can also be produced by a process known as low temperature distillation employing temperatures of 1000° to 1100° F. wherein a fuel in the nature of a semi-coke having a volatile content of from eight to ten per cent. is obtained, but such fuel is usually light in weight and very friable and requires briquetting before the same can be advantageously used for domestic purposes. In this process, there is a relatively large recovery of oil and tars and a relatively small recovery of gas.

According to the present invention, the new fuel which forms a part thereof is produced as a result of what may be called intermediate temperature distillation in apparatus wherein the most efficient temperature has been found to be approximately 1400° F. The intermediate temperature range between the so-called high temperature distillation above referred to and the so-called low temperature distillation also above referred to, to which it is preferable to heat the coking mass in the practice of this invention, is about 1200° F. to 1500° F. Moreover, other novel features such as means for subjecting coking coal or coking coal dehydrated as herein described to instantaneously applied intermediate temperature distillation temperatures as by introducing coal into and bringing it into contact with a retort previously heated to such

temperatures, maintaining the coking mass under pressure during distillation, and the like, comprise parts of this invention which will be described more fully hereinafter.

In the practice of the invention, advantageous results can be obtained from the use of slack bituminous or the waste from screened bituminous coking coal, although run of mine coal including lumps as well as fines may be used. A coking coal containing about eighteen per cent. volatile matter and not over two per cent. moisture and four per cent. ash is advantageous for this process in yielding a maximum quantity of domestic fuel. As a result of the process forming part of this invention, the resultant fuel for domestic purposes from a coking coal of the character above described will be approximately eighty-eight per cent. of the weight of the fuel treated with approximately three per cent. in coke fines, three per cent. in tar and about six per cent. gas per ton of weight. As distinguished from high temperature distillation where gas or metallurgical coke are the objectives and low temperature distillation where oil and tars are the principal products; the fuel or semi-coke obtained is the primary object in view in the present invention. The gas obtained as a result may very well be used to supply the heat necessary for the operation of the process. It is to be understood in the following specification and in the claims that the term "coking coal" comprises not only true bituminous coking coals of varying content of volatile matter, but also mixtures of coking coals with non-coking coals and materials such as finely divided anthracite, lignite or sub-bituminous coals.

The fuel obtained as a result of this process is of size corresponding to the so-called "stove" and "chestnut" sizes of anthracite supplied for domestic purposes. This fuel ordinarily contains approximately eight per cent. volatile matter as compared with four per cent. for average anthracite coal; contains approximately 14,300 B. t. u. heat value per pound as compared with about 12,000 to 13,500 B. t. u. for anthracite and has an ash content of approximately five per cent. as compared with seventeen per cent. for anthracite. Moreover, the ash from the new fuel has been found in practice to fall through the grate in powdery form without clinkers while the average anthracite coal contains twelve to fourteen per cent. of unburnt carbon. It will thus be seen that the new fuel with the consumption of all the carbon averages twenty per cent. to thirty per cent. higher in heat value

than anthracite and as a result of the new process this fuel can be manufactured from cheap bituminous coals, available in enormous and widely distributed deposits, at a much cheaper cost than anthracite can be mined. Moreover, as the amount of volatile content of the individual lumps is greatest in the point of the wedge or sector shape in which the lumps are formed in using the preferred form of apparatus hereinafter described, the lumps are readily ignitable at that point but burn slowly throughout the remainder of the body thereof.

An object of the invention is to provide a new and useful apparatus for obtaining a new domestic fuel from low volatile bituminous slack or waste, although it should be understood that by treating higher volatile bituminous coals a relatively large recovery of gas with less solid fuel may be obtained.

Another object of the invention is to provide means for making the new fuel in very large scale production with a minimum labor cost.

In accordance with the present invention, the new fuel is produced in the following manner. The slack or waste from screen bituminous coal, preferably of a low volatile content (16 to 20%) is first preheated to drive off all the moisture or nearly all of the moisture, after which it is instantaneously subjected to a temperature of approximately about 1200° F. at the top and about 1400° F. at the bottom of the retort, these temperatures being the temperatures within the retort tube rather than the furnace temperatures which must be maintained from 100° F. to 150° F. higher than the temperatures mentioned. As distinguished from the present processes of low and high temperature distillation wherein the heat is usually applied gradually, the present invention utilizes means for instantaneously subjecting the coal to the temperatures above mentioned, thus starting the immediate expulsion of vapors from the preheated coal. In order that the preheated coal will not form a solid mass as a result of this intermediate temperature, use is made of vertical retorts with a short cylindrical section at the top from which it tapers to a slightly enlarged diameter at the lower end. To illustrate, it has been found that when the preheated coal is dumped into a battery of such round tubular retorts previously heated to afford instantaneous application of heat to the coking coal brought into contact therewith, and confined under pressure to prevent swelling while in a plastic condition, the immediate expulsion of gas and vapor from the material in radial lines to the centre causes the forming and maintaining of a central core in the mass of a size sufficient to permit the vapors to escape during the entire process of carbonization. Likewise, we have in operation by applying heat and pressure as above described caused the mass to break along irregular radial lines from the core to the walls of the retort and also to break irregularly along substantially uniformly spaced horizontal planes, producing a hard dense smokeless fuel of which 70% is stove and 20% chestnut sizes.

The preheated coal is subjected to this intermediate temperature for approximately an hour as compared with twelve to twenty-four hours in the present processes, during which time the heat applied to the walls of the battery of vertical tubes causes the expulsion of nearly all the volatile matter from that portion of the coal resting against the walls, but a sufficient amount of volatile matter remains in the central part of

the mass to cause the material to have an average volatile content of about seven per cent. with a maximum of ten per cent. in the portion of each lump adjacent the central core. After the material has been treated for approximately an hour, it may be dumped and cooled while sealed from air. It is then ready for domestic purposes.

One form of apparatus embodying this invention and illustrative thereof, which has been found in practice to operate very satisfactorily, is shown and described in connection with the accompanying drawings. The apparatus consists briefly of a novel type of charging car holding a measured quantity of coal which it delivers to a battery of preheating vertical tubes in which the bituminous coking coal is subjected to a relatively low temperature for the purpose of driving off the moisture content; burners to maintain desired temperature the height of the retort tubes; a battery of intermediate temperature distillation retort tubes into which the preheated coal may be introduced; means for preventing the coke mass from expanding while in a plastic condition in the retort tubes; a chamber for cooling the coke while sealed from air; and a member for collecting the vapors and gases evolved in the distillation process. These vapors may be conveyed to a condenser or other suitable recovering apparatus while the gases may be utilized for supplying heat to the retort or for other purposes.

Apparatus comprising this invention may be employed separately and when so employed constitutes separate parts of this invention. Individual parts of apparatus embodying this invention may also be employed conjointly and when so employed co-operate with one another to produce special advantages resulting from their cooperative relations.

Other features and objects of the invention will become apparent by reference to the accompanying drawings illustrating apparatus for carrying out the process and the description pertaining thereto, in which—

Fig. 1 is a transverse section through an installation for accomplishing the desired results;

Fig. 2 is a similar section of the same apparatus in a different phase of the operation thereof;

Fig. 3 is a top view of a battery of retort tubes, preheating tubes and condenser apparatus used in connection with the invention;

Fig. 4 is an enlarged top sectional view of a portion of a battery of retort tubes with details of their novel construction shown in relation to the burners for supplying heat thereto;

Fig. 5 is a vertical section through one of the retort tubes showing the manner in which the coke structure is formed into lumps of the desired size by natural lines of cleavage and also showing the formation of a hollow core in the material for the conduct and escape of vapors from the mass; and

Fig. 6 is a top sectional view of the coked mass within a retort tube showing the hollow core for escape of vapors and the natural lines of irregular radial breakage or cleavage of the mass into lumps suitable for domestic purposes.

Referring now to the drawings, 10 indicates vertical beams supporting a horizontal beam 11 which in turn supports a vertical beam 12 to which is fastened a horizontal track 13 which is supported at its other end by agencies not illustrated. Extending upwardly from track 13 are beams 14 between the tops of which is a bar 15.

It is to be understood that this construction is duplicated at the other end of the mechanism and that a similar bar 15 is likewise provided. Extending between the bars 15 are a pair of rails 16 along which wheels 17 of a coal charging car 18 may roll. This car 18 as shown has a slanting bottom composed partly of drop doors 19 which are movable to the position shown in dotted lines in Fig. 1 and which in combination with the fixed ends of the car which extend downward to clear the plate 25 form a chute to uniformly fill all the preheating tubes 23. It is to be understood that the charging car shown in the drawings is illustrative merely and that other charging cars with various dumping mechanisms or other charging devices, either movable or immovable, may be employed to charge the battery of preheating tubes 23 with material.

Movable along the rails 16 are spaced wheels 20, the journals of which rotate in hangars 21 secured to cross-beams 22. The respective cross-beams 22 at each end of the mechanism serve as supports for a battery of preheating tubes 23 encased in a refractory material 24. The plurality of tubes 23 may be secured within the casing in any desired manner so long as they are restrained from vertical movement. Across the top of the casing provided by the walls 24 is a plate 25 having openings corresponding to the tops of the respective tubes 23, thereby producing a plane flat surface broken only by the respective openings into the various tubes. The bottoms of the tubes 23 are each formed with reduced diameter as indicated at 26, and a plate 27 having alternate openings is provided for closing the bottoms of the tubes. This plate is slidable so that the openings may register with the bottoms of the tubes when the material in the tubes is to be dumped.

The end plates with which the dumping car 18 is provided extend down almost into contact with the top plate 25 for the purpose of removing any excess coal resting on this plate.

Mounted on supports 30 is a casing 31 of refractory material within which are positioned a number of retort tubes forming a battery. As shown in the drawings, each tube 32 of the battery is preferably so shaped as to have a portion of uniform diameter extending a slight distance from the top thereof, while the remainder tapers gradually outward to the bottom. For example, the portion of uniform diameter may be approximately 4" diameter while the tapered portion extends to a bottom diameter of 5". While the tubes 32 have been described as having portions of uniform diameter adjacent the tops thereof, it is apparent that tubes which are tapered from the extreme top to bottom may be used. Moreover, while tubes of uniform cross-sections may also be used, it has been found that tapered tubes are preferable to tubes of uniform cross-section because they facilitate the discharge of treated material therefrom.

The tubes are preferably formed by casting a number of half sections integrally as shown in Fig. 4. Each section is then composed of a plurality of semi-cylindrical parts 33 joined by integral flanges 34 which may be riveted to similar flanges of another section. Extending from each portion 33 and at right angles to flanges 34 are ribs 35 extending from the bottom of the tubes along the tapered portion to the bottom of the cylindrical section. When assembled, the ribs 35 of one section contact with ribs of another section to form a continuous wall from near the top to the bottom between the banks of tubes thus con-

structed. It will be seen that the provision of the flanges 34 and the ribs 35 causes the formation of a vertical channel between the respective tubes, which channels may well serve as flues causing the uniform distribution of heat around the various tubes. The ribs 35 terminate at approximately the point of beginning of outward taper of the tubes, so that the products of combustion may be withdrawn through a single outlet 37 positioned in one of the walls 31 near the top thereof. A plurality of burners 38 are positioned in the bottom of the casing, one in each of the channels or flues formed by the flanges 34 and ribs 35. These burners may be supplied with gas and air mixture, each under separately controlled pressures to maintain a flame adapted to heat approximately the full height of the retort tubes, or other suitable fuel, preferably by gas obtained as a result of the distillation process employed.

The above described battery of retort tubes affords a particular construction illustrative of this invention. It is to be understood, however, that other retort tube constructions may also be employed. Thus, the tubes may be in the form of individual castings, drawn alloy steel tubes or welded sheet steel tubes, and the like, which are adapted to be heated so as to subject material therein to heat treatment. Moreover, while vertical, tapering, circular retort tubes have been described by way of illustration, it is apparent that the tubes do not have to be exactly as described but that tubes having other curved or angular shapes or positions may be employed.

In order that the hot gases and products of combustion may not escape from the top of the retort casing, each section of tubing is so cast as to form a conical out-flaring portion 40 which also permits preheated coal to be dumped into the respective tubes more readily. A plate 41 is fastened over the top of the retort casing and this plate is provided with openings corresponding to the top of the cones 40. The plate necessarily is welded or otherwise tightly secured to the tops of the cones to prevent the escape of gases and its bottom surface may be lined with refractory material.

Movable into position directly over the tops of the retort tube and vertically thereaway from is a hood 45 preferably of sheet steel covered with some refractory material. This hood is composed of a top and two side walls. In conjunction with the end walls of the retort casing, which extend upwardly beyond the top of the retort tubes, the hood 45 in the position shown in Fig. 1 forms a chamber for the collection of the gases and vapors evolved from the treatment of material in the retort tubes. These gases and vapors pass from this chamber through openings 55 in the stationary end walls of the retort casing. Extending through the top of the hood 45 are a plurality of plunger rods 46 corresponding in number to the number of retort tubes forming the battery. The lower end of each plunger 46 is supplied with a piston 47 which is of such size and shaft as to fit fairly closely within the cylindrical portion of each tube 32 of uniform diameter. The fit of the piston within the tube is such as to permit the escape of gases and evolved vapors therearound, at the same time preventing the escape or expansion of the coal while tending to swell in volume in a plastic condition. Stuffing boxes 48 are necessarily supplied in the top of the hood 45 to prevent the escape of any gases from the hood. The top of each plunger rod 46 is provided with an enlarged head 49 and a short dis-

tance below the top is a similar head 50. The portion of each plunger rod 46 between the respective enlargements 49 and 50 is movable through a cross-head 51 which may be raised or lowered through the agency of a pair of pistons 52 operating in cylinders 53 either through the agency of hydraulic pressure, air pressure or other suitable arrangements. The cross-head 51 may be secured to the respective pistons 52 in any desired manner such as by means of a beam 54 extending between the two pistons. The purpose of this hydraulic piston arrangement is to permit the entire hood 45 to be lifted at the proper time so that the preheating battery may be moved into place to be emptied into and fill the retort tubes.

Extending from the openings 55 (before mentioned) in the end walls of the retort casing are conduits 57 leading to suitable collecting apparatus 56 which may serve as condensers or perform any other desired function.

The bottoms of the retort tubes 32 are closed by means of a swinging trap door 60 which fits tightly against the ends of the tubes to prevent the escape of gas therefrom. Packing 61 of any desired suitable character is utilized for preventing the escape of products of combustion from the retort downwardly. This trap door 60 is movable into the position shown in dotted lines in Figs. 1 and 2 to permit the dumping of the coked material from the retort tubes.

Extending below the retort proper is a collecting and cooling chamber 62 formed of side walls of sheet metal, parts of which are surrounded by a water jacket 63. This chamber is maintained in a closed position by means of door 64 movable to permit the coke cooled therein to be emptied into a suitable receptacle.

The hot gases resulting from combustion in the chambers of flues defined by the various retort tubes as before mentioned are withdrawn from the retort through opening 37 into a mixing chamber 65 into which air can be introduced through opening 66 to reduce the temperature and add to the volume of the gases. After the gases have been cooled to the proper temperature by the addition of air, they are led under a baffle 67 into an opening 68 directly below the battery of preheating tubes 23 when in the position shown in Fig. 1. These gases of reduced temperature serve to heat the tubes 23 an amount sufficient to drive off practically all of the moisture in the coal introduced into these tubes and bring it to a temperature below the point at which it becomes plastic. In order that the gases can be withdrawn from the preheating chamber readily, each tube 23 has a small portion 70 near the top thereof of reduced diameter to permit the escape of the gases out through an opening 71 in the wall of the preheating chamber. This opening 71 in the nature of a tube is of such shape and size as to fit telescopically within the flue 72.

The operation of the apparatus hereinbefore described is substantially as follows. A measured quantity of slack or waste coal, preferably low volatile content bituminous coal, is fed from a hopper (not shown) into the dumping car 18. This car is then rolled into position over the preheating tubes 23 which are in the relative position shown in Fig. 1. When properly placed above the preheating tubes, the drop doors 19 are swung downwardly, dumping the coal directly into the tubes. When all the coal has been dumped, the car is withdrawn and, due to the fact as before mentioned that each end of the car extends down almost into contact with the top plate

25, any excess coal is scraped therefrom. At the time the coal is dumped into the tubes, the slide plate 27 necessarily is in such position that the solid portions are in register with the openings at the bottom of these tubes to prevent escape of the coal. The coal is then heated for the desired length of time corresponding to the time required to carbonize the material in the retort tubes, driving off substantially all the moisture contents thereof and heating it to a temperature of about 350° F. After the coal has been preheated, it is emptied into the retort tubes. For this purpose, the pistons 52 are operated to raise the cross-head 51, which in turn raises the plungers 46. When the pistons 47 of these plungers engage the hood 45, this hood also is raised and the movement is continued an amount sufficient to lift the hood into the position shown in Fig. 2. As soon as the hood has been raised to this upper position, the battery of preheating tubes 23 is rolled over along the tracks 13 into position directly above the battery of retort tubes. When the tubes of the two respective batteries are properly aligned vertically, the plate 27 is moved horizontally to permit the openings therein to register with the ends of the preheating tubes. The preheated coal falls by gravity into the respective retort tubes, the flared portion 40 thereof serving to aid in trapping all of the material. As soon as the preheated tubes are empty, the battery is rolled back into its former position and the hood 45 immediately lowered into position on top of the retort casing.

It is thus seen that the battery of preheating tubes affords a charging device for charging the battery of retort tubes with material to be subjected to heat treatment therein. The battery of preheating tubes also affords means whereby material may be preheated, as to dehydrate same, and whereby the material thus preheated may be quickly charged into a battery of retort tubes which may also be preheated so as to substantially instantaneously subject the material charged therein to desired distillation temperatures. While a particular form of charging device for the retort tubes has been shown, i. e. a movable battery of preheating tubes, other charging devices may be used according to this invention in association and co-operation with the other parts of the novel apparatus of this invention.

The pistons 52 are then moved to the position shown in Fig. 1, forcing the plungers 46 downwardly until pistons 47 rest on top of the preheated coal in the retort tubes. The temperature of the inner wall of the retort tubes at the time the preheated coal is dumped thereinto is approximately 1400° F. at the bottom and 1200° F. at the top or smaller section, so that within the few seconds time required for the withdrawal of the preheating tubes 23 and lowering of hood 45 the evolution of gas and volatiles commences. In order to preheat the tubes and maintain them during the coking operations at the temperatures mentioned, the furnace temperatures at the bottom and top of the retort tubes should preferably be maintained about 100° F. to 150° F. higher than the temperatures above given. The pistons maintain the material in the retort tubes under pressure during the heat treatment stage and prevent the material from expanding. Since the pistons fit loosely into the cylinders the annular space between the pistons and the tubes provides an outlet permitting the escape of gases and vapors

generated in the retort tube during the heat treatment.

The above-described treatment of the coal is continued for the desired length of time; that is, until the volatile content of the coke has been reduced to about an average of 7%. This necessarily means that the coke near the centre of the tube has a higher volatile content than that near the walls of the retort. The radial sector lumps at the surface may approximate high temperature coke and toward the centre low temperature coke of the higher volatile content to readily ignite the lump.

Due to the instantaneous application of heat within the retort tubes, the effect is to produce a core 80 within the mass almost instantaneously, which core is caused by the release and presence of gases and vapors which must find an outlet. The core thus formed acts as an outlet for these gases which pass around the edges of the various pistons 47; are collected in the chamber partially formed by hood 45, and withdrawn therefrom through outlet pipes into the various receivers 56. During the continued heat treatment within the retorts, the mass of coal naturally becomes somewhat plastic, but the continued treatment causes a natural cleavage of the coal along almost uniformly spaced horizontal lines as shown clearly in Fig. 5. Likewise, there results irregular radial cleavages as shown in Fig. 6. Since the material has been maintained under pressure during the plastic stage of treatment, the resultant lumps of fuel are of hard, dense structure throughout. Moreover, with retort tubes of about five inches as their greatest dimension the lumps of coke formed by these various lines of cleavage are of a size admirably suited for domestic fuel purposes.

When the heat treatment has continued for the proper interval of time, the door 64 opens and drops the cooled coke from a previous charge, the door 64 is closed and the drop door 60 is moved into the position shown in dotted lines in Figs. 1 and 2 and pressure applied to force the plungers 46 downwardly. This downward forcing of the plungers serves to dislodge any fuel sticking to the retort tubes, and once it has been dislodged it falls from the tube by gravity. It is to be understood, however, that these plungers and their associated pistons have other functions than that of merely dislodging the finished fuel. As above mentioned, the plungers prevent expansion of the material during the treatment thereof out of the top of the retort tubes since the plungers and pistons 47 cannot be moved upwardly due to the abutment of enlargements 50 upon the lower surface of cross-head 51. Furthermore, should there be any shrinkage of the material during the heat treatment, the weight of the pistons and their plungers is sufficient to compress the material into a compact mass and aid in forming a dense structure in the fuel. The "material" here referred to and referred to in the claims is understood to be material in the nature of cokable material such as bituminous coking coal. While such material is normally solid, it may become plastic during coking in the retort tubes, but nevertheless the pistons are adapted to prevent such material in either solid or plastic condition from expanding in the retort tubes during coking.

After the material in its new form is dumped from the retort tubes, it falls naturally into the cooling chamber where it is allowed to remain until the next batch of material is ready to be dumped. Inasmuch as it has been found in practice that about one hour of treatment is sub-

stantially sufficient to produce the desired results, it will readily be seen that the same length of cooling will lower the temperature of the fuel to a temperature preventing combustion when discharged.

From the foregoing, it will be seen that by the practice of the present invention a new type of fuel especially adapted for domestic purposes is produced. The invention makes possible the utilization of bituminous slack coal which has heretofore been practically unsalable.

While this invention has been described in connection with specific embodiments thereof, it is to be understood that this has been done for purposes of illustration merely and that the specific constructions shown can be varied considerably without departing from the scope of this invention. Moreover, while specific dimensions, temperatures, periods of treatment and the like have been mentioned, it is to be understood that this has been done for the purpose of illustration merely and that the specific figures above mentioned can be varied without departing from the scope of this invention. In this connection, for example, while specific mention has been made of retort tubes which have an internal diameter of four inches at the top and five inches at the bottom, it is apparent that these figures can be varied somewhat without departing from the scope of this invention. Thus, tubes of somewhat greater or lesser internal cross-section may be used, though it is preferable to employ tapered retort tubes which average less than six inches in internal diameter. If a tube of slightly greater diameter is used, the time taken to coke the material to proper degree may be somewhat greater than one hour and may be as long as 80 to 120 minutes. Moreover, the period of treatment and temperatures employed may be varied somewhat, depending upon the nature of the coking coals or mixture of coking and non-coking coals which are processed, and depending upon the volatile content and other properties which it is desired to obtain in the finished product. In this connection, higher temperatures tend to produce more rapid evolution of volatile matter from the coking mass and longer periods of treatment tend to result in more complete distillation of volatile matter. The apparatus herein described and temperatures, periods of treatment, etc. employed in using same, which have been illustrated above, are, however, preferable according to this invention and are adapted to produce from very cheap materials, in a simple way, a new fuel having remarkable properties as a domestic fuel and for other purposes.

It is to be understood that the relative positions of the various parts of the apparatus and their particular form may be varied considerably in the practice of this invention. Thus, other closures for the battery of retort tubes and other sealing means for preventing the escape of vapors and gases may be used. Also, other means than pistons may be used for maintaining the material in the retort tubes under pressure and means for permitting the escape of vapors and gases generated in the retort tubes other than an annular space about the edge of pistons inserted in said tubes may also be used. Moreover, the apparatus may be built in many different sizes. For example, installations may be used ranging from a single retort tube having a small capacity to installations having a great many retort tubes and having a very large capacity. This invention is

therefore to be limited only by the scope of the following claims.

We claim:

1. Apparatus of the character described comprising a plurality of rows of retort tubes, each row composed of a pair of similarly shaped sections, each section being made up of a plurality of substantially semi-cylindrical members joined by flanges formed integrally therewith, said rows being spaced apart by means of ribs extending from said substantially cylindrical members forming a plurality of flues between said retort tubes, and means for introducing hot gaseous products of combustion into and through said flues to heat said retort tubes.

2. In apparatus of the character described having a plurality of retort tubes mounted in a battery and a preheater, the combination comprising a plurality of preheater tubes maintained in a battery, means for heating material in said preheater tubes while said material is contained in said preheater tubes, means for mounting said preheater tube battery for movement with respect to said retort tube battery into and out of position for charging the contents thereof into tubes of said retort tube battery, means for charging preheated material from said preheater tubes into said retort tubes when said preheater tubes are moved into position for charging material therefrom into said retort tubes, and means for retaining material in said preheater tubes when moved out of position for charging material therefrom into said retort tubes.

3. Apparatus including a preheater for charging a plurality of substantially vertically extending retort tubes mounted in a battery in apparatus of the character described, comprising a plurality of substantially vertically extending preheating tubes maintained in a battery and about equal in number and corresponding in center-to-center spacing to the number and center-to-center spacing respectively of the retort tubes in said retort tube battery, each individual preheating tube being adapted to register with a corresponding individual retort tube of said retort tube battery, means for externally heating a plurality of the preheating tubes of said preheating tube battery substantially simultaneously and substantially equally in a common chamber, closures for the bottoms of said preheater tubes, and means for substantially simultaneously removing said closures from the bottoms of a plurality of said preheating tubes and to charge material from said preheating tubes into a plurality of said retort tubes in registration therewith.

4. In apparatus of the character described having a plurality of substantially vertically extending retort tubes fixedly mounted in a battery and a preheater, the combination with said retort tube battery of a plurality of substantially vertical extending preheater tubes fixedly maintained in a battery and about equal in number and total capacity and corresponding in center-to-center spacing with the number, total capacity and center-to-center spacing respectively of the tubes of said retort tube battery, each individual preheater tube being adapted to register with a corresponding individual retort tube of said retort tube battery, means for charging the said preheater tubes with predetermined substantially similar amounts of material, means for substantially equally heating said preheater tubes by external application of heat to said preheater tubes, and means for mounting said battery of preheater tubes for movement as a group

with respect to said retort tube battery into and out of registering position over the tubes of said retort tube battery for charging material from said preheater tubes into said retort tubes.

5. In apparatus of the character described having a battery of substantially vertically extending retort tubes, the combination comprising a hood forming in conjunction with a casing for and about said battery of retort tubes a chamber above said retort tubes adapted to collect gases and vapors evolved in and escaping from the upper ends of said retort tubes, a battery of substantially vertically extending preheater tubes, means for heating material in said preheater tubes while said material is in said preheater tubes, means for mounting said battery of preheater tubes for horizontal movement into and out of position for charging material from said preheater tubes into said retort tubes, means for elevating said hood above and out of the path of horizontal movement of said preheater tube battery and means for charging the contents of said preheater tubes into said retort tubes when said preheater tubes are moved into position for charging material therefrom into said retort tubes.

6. In apparatus of the character described having a plurality of substantially vertically extending retort tubes mounted in a battery, the combination comprising a plurality of preheater tubes mounted in a battery, means for moving said battery of preheater tubes as a group into position for charging material therefrom into said retort tubes and for moving same away from said position, means for charging material from said preheater tubes into said retort tubes when said battery of preheater tubes is moved into position for charging material from said preheater tubes into said retort tubes, means for heating the preheater tubes when moved away from position for charging said retort tubes, charging means adapted to charge said preheater tubes with material when said preheater battery is moved away from position for charging said retort tubes, and means for moving said charging means into and away from position for charging material therefrom into said preheating tubes.

7. In apparatus of the character described having a plurality of retort tubes mounted in a battery and a preheater therefor, the combination comprising a battery of preheater tubes, a casing, means for directing hot waste gases of combustion from combustion means for heating said retort tubes through said casing, means for mounting said preheater tube battery in said casing to be heated by hot waste gases of combustion, said preheater tube battery not being in position for charging material therefrom into said retort tube battery when said preheater tube battery is in position to be heated by hot waste gases of combustion, means for moving said battery of preheater tubes from position where said preheater tube battery is heated by hot waste gases of combustion and into position for charging material therefrom into said retort tube battery, and means for charging material from said preheater tubes into said retort tubes when said preheater tube battery is moved into position for charging material from said preheater tubes into said retort tubes.

8. In apparatus of the character described having a plurality of substantially vertically extending retort tubes mounted in a battery and a preheater, the combination which comprises a

battery of substantially vertically extending preheater tubes with flues therebetween, a casing about said preheater tubes, said casing having inlet and outlet openings, means for mounting
 5 said battery of preheater tubes in said casing, combustion means, a passage having a mouth adapted to register with said inlet opening in
 10 said casing said passage being adapted to direct hot gases of combustion from said combustion means to said mouth, means for directing hot
 15 combustion gases through said inlet opening and said flues to externally heat said preheater tubes and from said outlet opening, means for moving
 20 said preheater tubes as a group and casing out of position for registration of said inlet opening with said mouth and into position for charging
 25 the contents of said preheater tubes into said retort tubes, means for charging material from said preheater tubes into said retort tubes when
 said battery of preheater tubes is moved into position for charging material from said preheater tubes into said retort tubes and means for
 returning said preheater tubes as a group and said casing to position for registration of said
 inlet opening with said mouth.

9. In apparatus of the character described having a plurality of substantially vertically extending retort tubes mounted in a battery and a preheater, the combination which comprises
 30 a battery of substantially vertically extending preheater tubes mounted with substantially vertically extending flues therebetween, a casing about said preheater tubes, said casing having
 35 inlet and outlet openings, combustion means, a passage having a mouth adapted to register with said inlet opening in said casing, said passage being adapted to direct hot gases of combustion
 40 from said combustion means to said mouth, means for directing hot combustion gases through said inlet opening and said flues to externally heat said preheater tubes and from
 45 said outlet opening, means for moving said preheater tubes and casing out of position for registration of said inlet opening with said mouth
 50 and into position for charging the contents of said preheater tubes into said retort tubes, means for charging material from said preheater tubes into said retort tubes when said battery of preheating
 55 tubes is moved into position for charging material from said preheating tubes into said retort tubes, means for returning said preheater tubes and said casing to position for registration
 of said inlet opening with said mouth and a flue adapted to register with said outlet opening for conducting away waste combustion gases when
 said mouth is in registration with said inlet opening, said outlet opening being removed out of registration with said flue when said inlet
 60 opening is moved out of registration with said mouth.

10. In apparatus of the character described having a battery of substantially vertically extending retort tubes, the combination comprising
 65 a battery of substantially vertically extending preheater tubes means for moving said battery of preheater tubes into and out of position for charging material from said preheater tubes into
 70 said retort tubes, means for charging material from said preheater tubes into said retort tubes when said battery of preheater tubes is in position to charge material from said preheater tubes
 into said retort tubes, flues formed by and between said preheater tubes, combustion means for heating externally the tubes of said retort
 75 tube battery by hot combustion gases, means for

directing hot combustion gases from said retort tube battery to said preheater tube battery to heat the tubes of said preheater tube battery when said preheater tube battery is out of position for charging material from said preheater
 5 tubes into said retort tubes, means for mixing air with said hot waste combustion gases prior to heat exchange between said hot waste combustion gases and said preheater tubes, and
 10 means for substantially uniformly distributing and directing said mixed air and hot waste combustion gases through said flues between said preheater tubes to substantially equally and
 15 externally heat said preheater tubes of said preheater tube battery, when said preheater tube battery is out of position for charging material from said preheater tubes into said retort tubes.

11. In apparatus of the character described having a battery of retort tubes, the combination comprising a battery of preheater tubes movable
 20 relative to said retort tube battery, said preheater tubes being mounted in a common chamber, combustion means for externally heating the tubes of said retort tube battery by hot gases
 25 of combustion, means for directing hot waste gases of combustion from said retort tube battery to said preheater tube battery and into said chamber, means for introducing air into said hot
 30 combustion gases to increase the volume and reduce the temperature thereof prior to heat exchange with the tubes of said preheater tube battery, means for blending the hot gases and
 35 air to form a substantially uniformly heated mixture thereof and thereafter introducing said mixture into said chamber, and means for externally heating the said preheater tubes of said
 preheater tube battery by contact with said uniformly heated mixture.

12. In apparatus of the character described having a battery of retort tubes and a furnace
 40 for heating said retort tubes by hot gaseous products of combustion, the combination comprising a removable hood adapted to cover an end of said battery of retort tubes and to collect and
 45 conduct away gases and vapors escaping from ends of said retort tubes at said end of said battery and evolved from material under distillation in said retort tubes, means for substantially sealing
 50 the interior of said hood from the air and from furnace gases, when said hood is in position to collect and conduct away gases and vapors evolved from said retort tubes, a plurality of
 55 movable pistons adapted to prevent material in said retort tubes from expanding, means for maintaining said pistons in said retort tubes to prevent material in said retort tubes from
 60 expanding when said hood is in substantially sealed position for collecting and conducting away evolved gases and vapors escaping from said retort tubes, means for removing said hood from
 position for collecting gases and vapors evolved from said ends of said retort tubes, and means for removing said pistons from said ends of said retort tubes.

13. In apparatus of the character described having a battery of substantially vertically extending retort tubes and a furnace to heat said
 65 retort tubes by hot gaseous products of combustion, the combination comprising a removable hood for the upper end of said retort tube battery adapted to collect and conduct away gases and
 70 vapors evolved from said retort tubes at said end of said battery from material under distillation in said retort tubes, means for substantially sealing the interior of said hood from the outside
 75

air and from the furnace gases, when said hood is in position to collect and conduct away gases and vapors evolved from said retort tubes, a plurality of movable pistons adapted to prevent material in said retort tubes from expanding beyond a predetermined limit, means for maintaining said pistons in said retort tubes to prevent materials in said retort tubes from expanding when said hood is in substantially sealed position for collecting and conducting away evolved gases and vapors escaping from said retort tubes, means for removing said hood from substantially sealed position for collecting gases and vapors evolved from said retort tubes, means for removing said pistons from said retort tubes and means for actuating said pistons in said retort tubes to dislodge the contents of said retort tubes without moving said hood.

14. In apparatus of the character described having a battery of substantially vertically extending retort tubes and a furnace to heat said retort tubes by hot gaseous products of combustion, the combination comprising a removable hood for the upper end of said retort tube battery adapted to collect and conduct away gases and vapors evolved from said retort tubes at said end of said battery from material under distillation in said retort tubes, means for substantially sealing the interior of said hood from the outside air and from the furnace gases when said hood is in position to collect and conduct away gases and vapors evolved from said retort tubes, a plurality of movable pistons adapted to prevent material in said retort tubes from expanding upwardly, means for maintaining said pistons in said retort tubes to prevent material in said retort tubes from expanding upwardly when said hood is in position for collecting and conducting away gases and vapors evolved from said retort tubes, a movable preheater adapted to discharge preheated material from above said retort tubes into said retort tubes, means for moving said preheater into and away from position above said retort tubes for charging material therefrom into said retort tubes, means for removing said hood from position for collecting gases and vapors evolved from said retort tubes and means for removing said pistons from said retort tubes so that said preheater may be moved into position for charging material therefrom into said retort tubes.

15. In apparatus for the character described having a battery of substantially vertically extending retort tubes and a furnace adapted to heat said retort tubes by hot gaseous products of combustion, the combination comprising a removable hood for the upper end of said retort tube battery adapted to collect and conduct away evolved gases and vapors escaping from the upper ends of said retort tubes, pistons in the upper ends of said retort tubes adapted to prevent material in said retort tubes from expanding, substantially vertically extending plungers passing through said hood means for maintaining said plungers and pistons in a substantially fixed position relative to said retort tubes to prevent material in said retort tubes from expanding, means for imparting vertical movement to said plungers with respect to said hood, means for maintaining a substantially vapor tight seal between said plungers and hood and between said hood and said retort tube battery, and means for withdrawing said pistons from said retort tubes and for removing said hood from position for collecting gases and va-

pors evolved from said retort tubes without removing said plungers from assembled relation with respect to said hood.

16. In apparatus of the character described having a battery of substantially vertically extending retort tubes, the combination comprising a battery of substantially vertically extending preheater tubes substantially equal in number and corresponding in center-to-center spacing to said retort tubes and having removable closures for the bottoms thereof, means for moving said battery of preheater tubes over said battery of retort tubes so that the tubes of said preheater tube battery are brought into substantially vertical center-to-center registration with said retort tubes, means for removing the closures from the bottoms of said preheater tubes to discharge material therefrom into said retort tubes when said preheater tubes are moved over said retort tubes, means for moving said preheater tubes away from position over said retort tubes, means for heating said preheater tubes externally when moved away from position over said retort tubes, a removable hood adapted to collect and conduct away evolved gases and vapors escaping from the upper ends of said retort tubes, pistons adapted to be inserted in the upper ends of said retort tubes and to prevent material in said retort tubes from expanding, means for maintaining said pistons in position for preventing material in said retort tubes from expanding while said hood is in position for collecting gases and vapors escaping from the tops of said retort tubes, means for withdrawing said pistons from said retort tubes, and means for moving said hood and said pistons out of the path of said preheater tube battery upon movement of said preheater tube battery into position for charging material from said preheater tubes into said retort tubes.

17. In apparatus of the character described having a battery of substantially vertically extending retort tubes, the combination comprising a removable hood adapted to collect and conduct away evolved gases and vapors escaping from the upper ends of said retort tubes, a plurality of pistons adapted to prevent material in said retort tubes from expanding upwardly in said retort tubes adjacent the top thereof, a plurality of plungers passing through said hood attached to said pistons, means for preventing said plungers and pistons from being moved upwardly with respect to said retort tubes, means for moving said plungers relatively to said hood when said hood is in position for collecting and conducting away evolved gases and vapors escaping from the upper ends of said retort tubes, means for moving said hood and said plungers and pistons away from the upper end of said retort tube battery, and means for maintaining a substantially vapor-tight seal between said hood and said plungers and between said hood and said retort tube battery when said hood is in position for collecting and conducting away evolved gases and vapors escaping from the upper ends of said retort tubes.

18. The combination with apparatus of the character described having a furnace, a battery of substantially vertically extending retort tubes in said furnace, mounting means joined to said tubes adjacent the upper and lower portions thereof for maintaining said tubes in spaced relation to one another and a combustion chamber confined between said upper and lower mounting means, of burners adapted to form a combustible mixture of air and gas positioned adjacent the bottom of said combustion chamber and substan-

tially uniformly throughout both longitudinally and laterally with respect to said battery of retort tubes and between same, means for controlling the volume and the pressure of both the air and the gas flowing to said air-gas burners, and air and gas pipes for directing the air and the gas under controlled pressure and volume to said air-gas burners.

19. The combination with apparatus of the character described having a battery of substantially vertically extending retort tubes having open upper ends, a furnace for heating said battery of retort tubes by hot combustion gases, and covering means adapted to cover the upper end of said battery of retort tubes and to collect and conduct away gases and vapors escaping from the upper ends of said retort tubes of said retort tube battery when in position to cover the end of said retort tube battery, of means for confining cokable material in said retort tubes against expansion including members adjacent the upper ends of said retort tubes, means for permitting the escape from said retort tubes into said covering means of gases and vapors generated by coking cokable material in said retort tubes while said cokable material is confined against expansion by said confining means, means for substantially sealing the interior of said covering means from the outside air and from furnace gases when said covering means is in position to cover the end of said retort tube battery and while cokable material is confined against expansion in said retort tubes by said confining means, and means for moving said covering means and said member so that said retort tubes of said retort tube battery may be charged with cokable material charged into the upper ends of said retort tubes.

20. In apparatus of the character described having a vertical retort tube tapered so as to be larger in internal cross section at the bottom than at the top, means for heating said retort tube, a furnace for heating said retort tube by hot gaseous products of combustion, and a removable closure for the bottom of said retort tube, the combination comprising a removable piston adapted to be inserted in the upper end of said retort tube which permits the escape thereby of gases and vapors generated in said tube, a removable hood adapted to collect and conduct away evolved gases and vapors escaping from the upper end of said retort tube, a plunger attached to said piston passing through said hood and movable longitudinally through said hood, means for sealing the interior of said hood from the air and from the furnace gases when said hood is in position to collect and conduct away gases and vapors escaping from said retort tube and when said piston is in position for confining material in said retort tube against expansion, means for moving said plunger and said piston downward with respect to said retort tube to eject material from said retort tube without moving said hood, and means for moving said hood and said piston from said retort tube while assembled with said plunger passing through said hood so that said retort tube may be charged with material.

21. In apparatus of the character described having mounted in a battery substantially vertically extending retort tubes having open upper ends, and a furnace for heating said retort tubes by hot gaseous products of combustion, the combination comprising pistons adjacent the upper end of substantially each of said retort tubes, a hood to cover the upper end of said retort tube

battery and to collect and conduct away gases and vapors escaping from the upper ends of said retort tubes, plungers passing through said hood adapted to impart longitudinal movement to said pistons with respect to said retort tubes, means for sealing the interior of the hood from the outside air and from the furnace gases when the said hood is in position to cover the end of said retort tube battery and when said pistons are in position to prevent material in said retort tubes from expanding, means above said hood cooperating with said plungers to prevent upward movement of said pistons with respect to said retort tubes, means above said hood cooperating with said plungers for elevating and lowering said pistons out of and into said retort tubes, means for elevating and lowering said hood out of and into sealing relation with respect to said retort tube battery, preheater tubes mounted in a battery containing vertically extending preheater tubes about equal in number and capacity to the number and capacity of the retort tubes of said retort tube battery, and corresponding in center-to-center spacing and adapted to register with the retort tubes of said retort tube battery so that material can be charged from the individual preheater tubes of said preheater tube battery into corresponding retort tubes of said retort tube battery therebelow, means for moving the preheater tubes of said preheater tube battery as a group into and out of registration with the retort tubes of said retort tube battery, means for charging material from said preheater tubes into the upper ends of said retort tubes when said preheater tube battery is moved into position for registration of said preheater tubes with said retort tubes, means for moving said hood and said pistons and plungers while said plungers are assembled passing through said hood out of the path of said preheater tube battery when said preheater tube battery is moved into position for registration of said preheater tubes above said retort tubes, means for externally heating said preheater tubes when said preheater tube battery is moved out of position for registration of said preheater tubes above said retort tubes, and means for moving said preheater tube battery out of the path of said pistons and said hood when said pistons are returned to position for confining material in said retort tubes and when said hood is returned to position for covering said retort tube battery.

22. Apparatus of the character described which comprises a plurality of substantially vertical retort tubes mounted in a battery, means for externally heating said retort tubes, means for closing the bottoms of said retort tubes, removable covering means adapted to collect and conduct away gases and vapors escaping from the upper ends of said retort tubes, removable confining means adjacent the upper ends of said retort tubes adapted to confine material in said retort tubes against expansion while permitting the escape of gases and vapors generated in said retort tubes, said confining means and said covering means being adapted to confine material in said retort tubes while gases and vapors escaping from the upper ends of said retort tubes are collected and conducted away by said covering means, means for removing said covering means and said confining means from the upper ends of said retort tubes, so that said retort tubes may be charged with fresh material, and means for placing said covering means and said confining means over the upper ends of said retort tubes

for collecting gases and vapors escaping from the upper ends of said retort tubes and for confining material in said retort tubes.

23. In apparatus of the character described having a plurality of substantially vertically extending retort tubes mounted in a battery, the combination with said retort tube battery of separate preheaters for said retort tubes of said retort tube battery, each individual retort tube of a plurality of said retort tubes having an individual preheater adapted to suddenly substantially fill each of said retort tubes about to capacity, means for moving said preheaters as a group into and out of position over the tops of said retort tubes for charging material from said preheaters into said retort tubes, and means for suddenly charging material from said preheaters into said retort tubes when said preheaters are moved into position for charging material therefrom into said retort tubes.

24. In apparatus of the character described having a plurality of substantially vertically extending retort tubes mounted in a battery, the combination with said retort tube battery of a plurality of preheaters mounted in a battery, each retort tube of a plurality of said retort tubes having an individual preheater adapted to suddenly substantially fill each said retort tube about to capacity, means for moving said preheaters horizontally as a group into and away from position for discharging material from said preheaters into said retort tubes, means for suddenly charging material from said preheaters into said retort tubes when said preheaters are moved into position for charging material from said preheaters into said retort tubes, combustion means, and means for directing hot combustion gases from said combustion means about the exterior of said preheaters to heat same when said preheaters are moved away from position for discharging material from said preheaters into said retort tubes.

25. Apparatus of the character described comprising a battery of substantially vertically extending retort tubes mounted rigidly together in a furnace chamber, a battery of substantially vertically extending preheater tubes mounted rigid-

ly together, means for moving said preheater tube battery as a group relatively to said retort tube battery into and out of position for charging material from said preheater tubes into said retort tubes, combustion means adapted to heat all of said retort tubes substantially equally by hot gases of combustion in said furnace chamber, flues formed by and between said preheater tubes, and means for conducting hot combustion gases from said furnace chamber and substantially uniformly distributing said hot combustion gases among the flues of said preheater tube battery so as to heat all of said preheater tubes of said preheater tube battery substantially equally when said preheater tube battery is moved out of position for charging material from said preheater tubes into said retort tubes.

26. Apparatus of the character described comprising a stationary battery of substantially vertically extending retort tubes mounted as a group in a common furnace chamber, a battery of substantially vertically extending preheater tubes mounted as a group outside of said furnace chamber, means for moving said battery of preheater tubes as a group into and out of position for charging material from said preheater tubes into said retort tubes, means for charging material from said preheater tubes into the upper ends of said retort tubes when said preheater tube battery is in position for charging material from said preheater tubes into said retort tubes, confining means adjacent the upper ends of said retort tubes for confining material in said retort tubes and against expansion, and means for moving said confining means from position for confining material in said retort tubes against expansion when said preheater tube battery is moved into position for charging material from said preheater tubes into said retort tubes and for returning said confining means to position for confining material in said retort tubes against expansion when said battery of preheater tubes is moved out of position for charging material from said preheater tubes into said retort tubes.

JAMES N. VANDEGRIFT.
CARL POSTEL.

CERTIFICATE OF CORRECTION.

Patent No. 2,066,082.

December 29, 1937

JAMES N. VANDERGRIFT, ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, second column, line 11, after "unsalable" and before the period insert the words except at very low prices; page 8, first column, line 64, claim 15, after "hood" insert a comma; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 23rd day of March, A. D. 1937.

(Seal)

Henry Van Arsdale
Acting Commissioner of Patents.

for collecting gases and vapors escaping from the upper ends of said retort tubes and for confining material in said retort tubes.

23. In apparatus of the character described having a plurality of substantially vertically extending retort tubes mounted in a battery, the combination with said retort tube battery of separate preheaters for said retort tubes of said retort tube battery, each individual retort tube of a plurality of said retort tubes having an individual preheater adapted to suddenly substantially fill each of said retort tubes about to capacity, means for moving said preheaters as a group into and out of position over the tops of said retort tubes for charging material from said preheaters into said retort tubes, and means for suddenly charging material from said preheaters into said retort tubes when said preheaters are moved into position for charging material therefrom into said retort tubes.

24. In apparatus of the character described having a plurality of substantially vertically extending retort tubes mounted in a battery, the combination with said retort tube battery of a plurality of preheaters mounted in a battery, each retort tube of a plurality of said retort tubes having an individual preheater adapted to suddenly substantially fill each said retort tube about to capacity, means for moving said preheaters horizontally as a group into and away from position for discharging material from said preheaters into said retort tubes, means for suddenly charging material from said preheaters into said retort tubes when said preheaters are moved into position for charging material from said preheaters into said retort tubes, combustion means, and means for directing hot combustion gases from said combustion means about the exterior of said preheaters to heat same when said preheaters are moved away from position for discharging material from said preheaters into said retort tubes.

25. Apparatus of the character described comprising a battery of substantially vertically extending retort tubes mounted rigidly together in a furnace chamber, a battery of substantially vertically extending preheater tubes mounted rigid-

ly together, means for moving said preheater tube battery as a group relatively to said retort tube battery into and out of position for charging material from said preheater tubes into said retort tubes, combustion means adapted to heat all of said retort tubes substantially equally by hot gases of combustion in said furnace chamber, flues formed by and between said preheater tubes, and means for conducting hot combustion gases from said furnace chamber and substantially uniformly distributing said hot combustion gases among the flues of said preheater tube battery so as to heat all of said preheater tubes of said preheater tube battery substantially equally when said preheater tube battery is moved out of position for charging material from said preheater tubes into said retort tubes.

26. Apparatus of the character described comprising a stationary battery of substantially vertically extending retort tubes mounted as a group in a common furnace chamber, a battery of substantially vertically extending preheater tubes mounted as a group outside of said furnace chamber, means for moving said battery of preheater tubes as a group into and out of position for charging material from said preheater tubes into said retort tubes, means for charging material from said preheater tubes into the upper ends of said retort tubes when said preheater tube battery is in position for charging material from said preheater tubes into said retort tubes, confining means adjacent the upper ends of said retort tubes for confining material in said retort tubes and against expansion, and means for moving said confining means from position for confining material in said retort tubes against expansion when said preheater tube battery is moved into position for charging material from said preheater tubes into said retort tubes and for returning said confining means to position for confining material in said retort tubes against expansion when said battery of preheater tubes is moved out of position for charging material from said preheater tubes into said retort tubes.

JAMES N. VANDEGRIFT.
CARL POSTEL.

CERTIFICATE OF CORRECTION.

Patent No. 2,066,082.

December 29, 1937

JAMES N. VANDERGRIFT, ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, second column, line 11, after "unsalable" and before the period insert the words except at very low prices; page 8, first column, line 64, claim 15, after "hood" insert a comma; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 23rd day of March, A. D. 1937.

(Seal)

Henry Van Arsdale
Acting Commissioner of Patents.