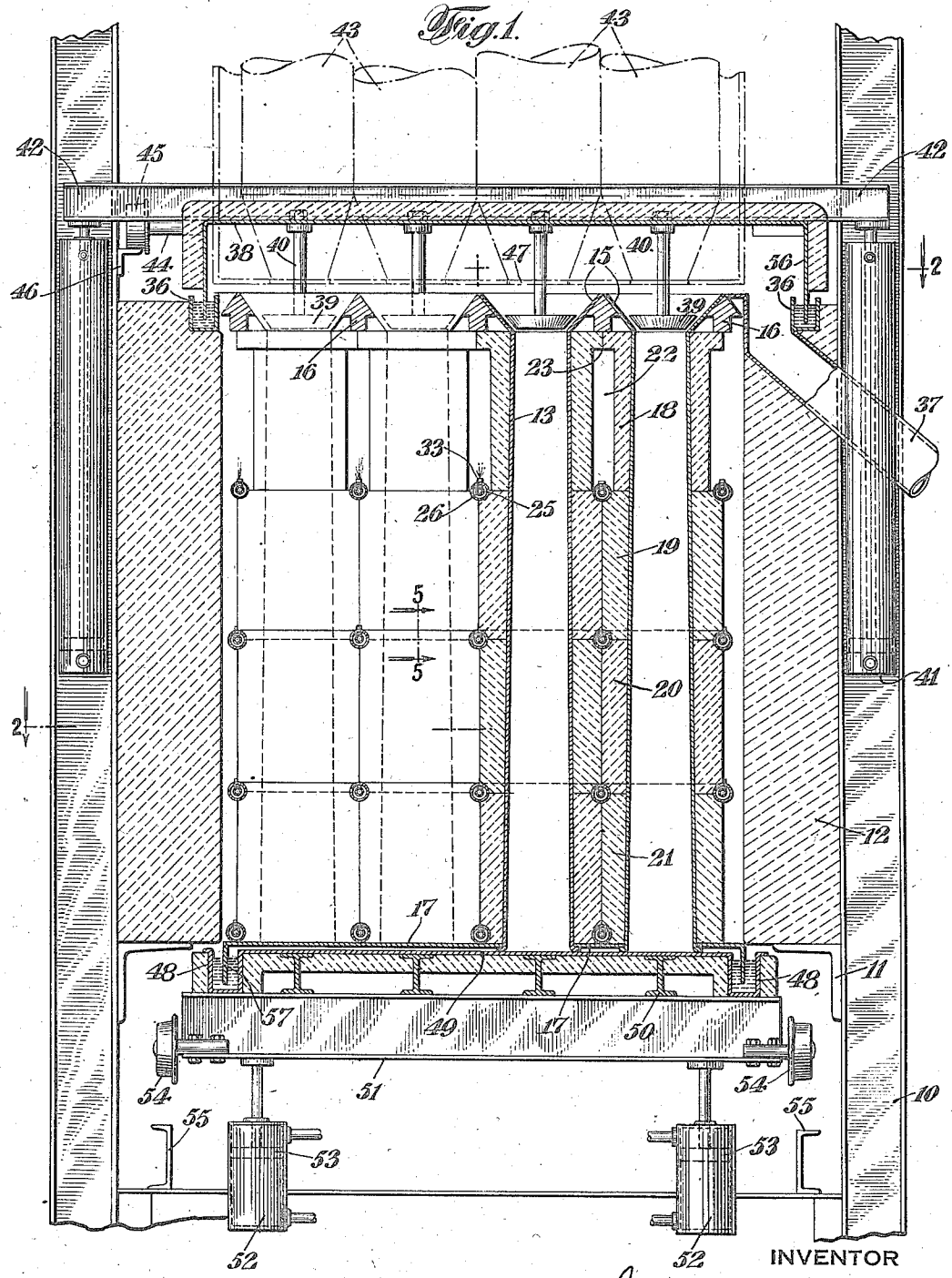
May 26, 1936. J. N. VANDEGRIFT 2,041,882

RETORT CONSTRUCTION

Filed March 5, 1931 2 Sheets-Sheet 1

Fig. 1.



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Filed March 5, 1931 2 Sheets-Sheet 2

Fig. 2.

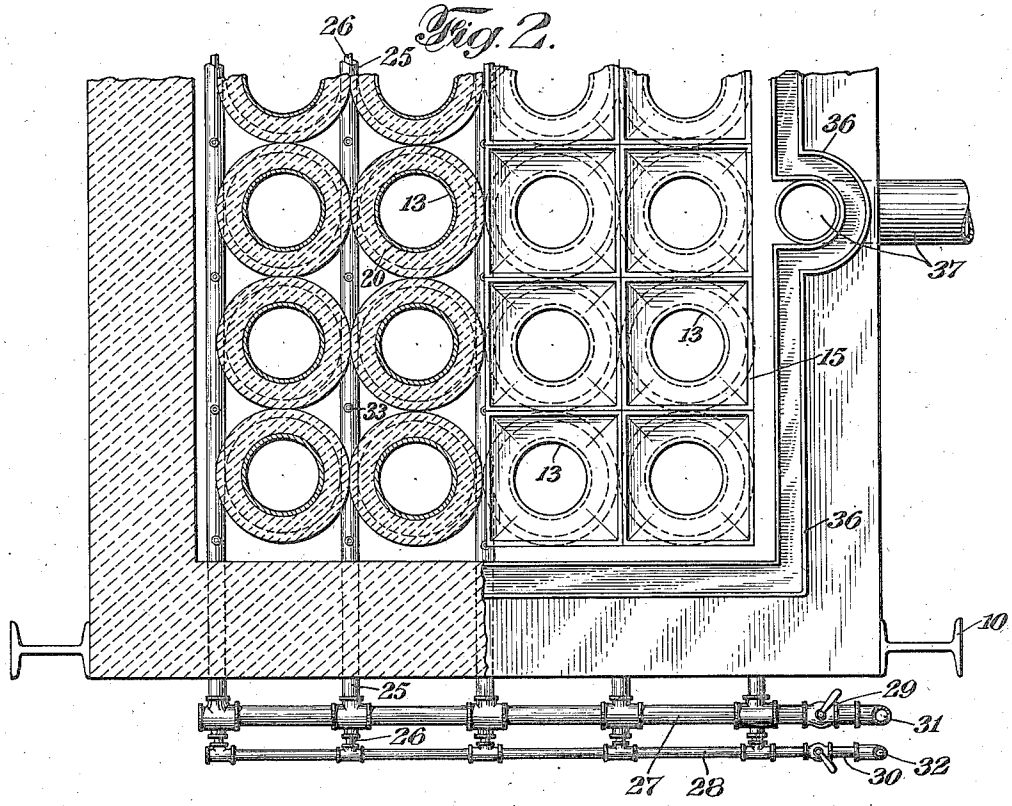


Fig. 3.

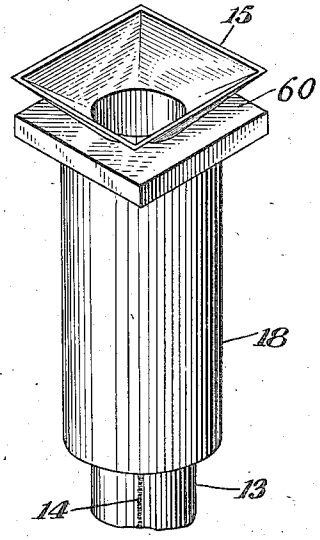


Fig. 4.

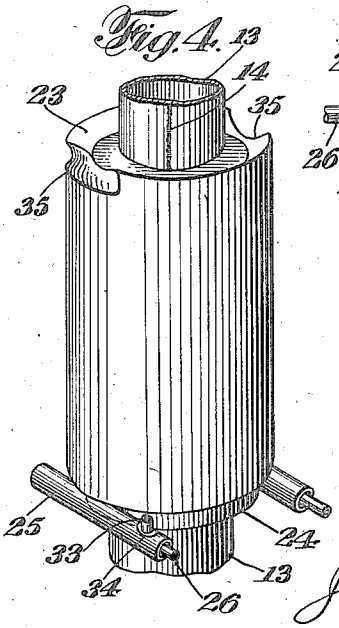


Fig. 5.

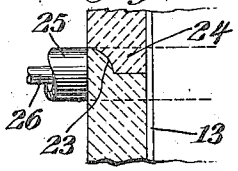
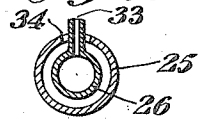


Fig. 6.



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Patented May 26, 1936 2,041,882

UNITED STATES PATENT OFFICE

2,041,882

RETORT CONSTRUCTION

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Application March 5, 1931, Serial No. 520,268

13 Claims. (Cl. 202—114)

The invention relates to retort construction and relates particularly to retort construction comprising one or more retort tubes. It is applicable, for example, in connection with retort and coke oven construction shown in co-pending United States application of Vandegrift and Postel, Serial No. 457,466, filed May 20, 1930.

It is a purpose of this invention to improve construction of retorts by means which afford greater durability at less cost and which afford better application of heat. It is a further purpose of this invention to greatly improve standard types and designs of retorts and byproduct coke ovens.

It is an advantage of this invention that means are provided for making retorts and coke ovens of fire brick and cement construction which are vapor tight. At the same time retort tubes are provided which may have a smooth inner surface free from cranks or distortion and which thereby facilitate the discharge of coked or carbonized material. It is a further advantage of this invention that cracking and distortion and expensive replacement of retorts is substantially avoided. This is of great practical importance as retorts heretofore made, especially when constructed of heavy castings, have been very objectionable on this account.

Features of this invention relate both to individual retort tube construction and to retort tubes as mounted in a battery. Features of this invention also relate to other methods of retort construction comprising means for effecting vapor seal, arrangement of flues, alignment of tubes, means for conducting away spent gases of combustion, means for collecting and conducting away gases and vapors generated in the retort, means for charging the retort with material, means discharging material therefrom and the like.

Features of retort tube construction according to this invention are that a tube of sheet metal is used, preferably a tube of sheet steel and that this tube of sheet metal is preferably employed as a lining which may be encased within a protective material preferably of a heat equalizing and refractory nature.

In retort construction heretofore employed, upon which this invention improves, retort tubes have been made from cast steel or from cast or wrought iron. However, even in small retort tube construction the minimum thickness of wall is about one-half inch when cast or wrought metal is used. The tubes are therefore heavy, and retort tube batteries made up with such tubes are very heavy. Moreover, the manufacture of iron and steel casting is expensive as is also the making of wrought iron retorts. The excessive weight and cost of metal required in such retort tube construction adds to the expense. Such tubes are subject to flaws therein even when made about one-half inch thick, and the making of thinner tubes from iron or steel castings or wrought iron is impractical. Moreover, it has heretofore been regarded as impractical to operate even cast steel tubes at temperatures above about 1300° F. Wrought iron tubes have to be used at even lower temperatures.

Iron or steel castings and wrought iron are to be distinguished from "sheet metal" as this term is used in the specification and claims. Sheet metal is made from metal that is adapted to be rolled and is pressed by rolling or equivalent means into thin sheets about $\frac{1}{16}$ to $\frac{1}{8}$ of an inch in thickness for example. The material is normally placed on the market in thin flat sheets which are rolled to smooth and semi-polished surface.

Retort tubes of the above construction have many advantages. In the first place the construction is relatively inexpensive. Due to the fact that the sheet metal can be relatively thin, only a small amount of metal is necessary. Thus great savings can be effected according to this invention over retort tube construction which comprises heavy metal castings and which therefore use large quantities of metal. Moreover while sheet metal tubes may be made in a variety of ways, they can be conveniently made of a single sheet of metal by shaping the sheet of metal into a tube and welding the edges thereof with a single longitudinal welding. As sheet metal can be readily made with a very smooth surface it is apparent that retort tubes having sheet metal linings can be very inexpensively made which have a very smooth inner surface. This feature is of great advantage as it facilitates the removal of substances from the tube. For example, the smooth walls present so little friction that material treated therein such as coke can be discharged from vertical tubes merely by gravity. Moreover the sheet steel is of superior hardness, durability, and heat resistance. It is also not subject to cracking and does not contain flaws which are commonly found in castings.

Sheet metal retort tube construction, with its attendant advantages, is preferably employed in combination with protective casings for the sheet metal. If the casings were not employed, the sheet metal retort tubes would heat through too

rapidly with resultant local overheating, would not have requisite mechanical strength, and would tend to warp in use. The combination of sheet metal linings with protective casings such as fire brick affords the advantages of sheet metal construction, with superior heat equalizing properties and requisite mechanical strength and resistance to warping. While the usual types of heavy cast steel or cast iron tubes and wrought iron tubes have heretofore been mounted with refractory material thereabout in distillation apparatus, the combination of thin sheets of sheet metal such as the sheet steel of commerce shaped into tubes with casings which reinforce the sheet metal tubes and equalize the heat applied thereto is new and affords many advantages over the prior art constructions, as hereinabove stated.

In retort tubes embodying this invention, it is preferable to employ a sheet metal lining which resists oxidation and attack from vapors containing sulphur or other deteriorating elements and compounds. I have found that alloy sheet steel such as a chromium-alloy steel may be advantageously employed. For example, a chrome alloy sheet steel containing about 20% to 30% of chromium has been found to be a satisfactorily resistant to such destructive elements. Inasmuch as linings of alloy steel may be used which are only about one-sixteenth of an inch thick, a minimum of metal is used. Moreover, since metals which resist oxidation and attack by vapors are in ordinary cases required and are relatively expensive, it is apparent that retort tubes embodying this invention afford great economy over the use of castings, for example.

A further advantage of retort tube construction according to this invention is that the casing material for sheet metal lining can be of a heat equalizing nature and thus transmit heat to material in the tubes with superior uniformity, and avoidance of local overheating. Moreover satisfactory casing materials, such as fire brick, are relatively inexpensive.

While the shell may be made of various materials, it is preferable to employ a shell of fire brick. The shell may be made up in various ways. A satisfactory shell for a retort tube may be made up in a number of sections of convenient and suitable lengths placed end to end encasing the sheet steel lining. In order to insure against the flame and hot gases coming directly in contact with the sheet steel lining, the sections of casing may be suitably interlocked. Where the sections are interlocked the use of cement is rendered unnecessary.

A feature of this invention relating to retort tube construction as arranged in a battery, is that a plurality of casings may be maintained with respect to one another so that the casings of different tubes will be wholly or partially in contact with one another. By this arrangement the casings reinforce one another and form an integral unit or battery wherein axial deflection and radial distortion of the individual tubes is impossible and wherein the sheet metal linings are maintained in perfect alignment. This is of great practical importance as retort tubes heretofore used have been subject to undesirable warping, deflection, and cracking. Moreover freedom from cracks and distortion facilitates removal of material from the tubes.

It is a further feature relating to retort tube construction arranged according to this invention in a battery that flues of novel character can be disposed between the casings of retort tubes. Thus circular casings of four tubes, for example, may be arranged so as to form a combustion flue. A battery of tubes may contain a plurality of such flues. By continuously contacting the lower portions of the casings substantially separate combustion flues between the casings can be had. By having the upper portion of the casings out of contact, spent gases of combustion can be withdrawn from the flues. Suitable burners can be disposed in the flues. Where gas burners are arranged at different levels in the flues, the burnt gases from the lower levels rise and envelop the flames from burners at higher levels and serve to lengthen the flames without the introduction of such gases from extraneous sources for this purpose as in other types of retorts and coke ovens. Moreover, grooves or notches in said casings may be provided which support the air and gas lines leading to the burners, thus affording a very advantageous construction wherein sagging of the air and gas lines due to intense heat is eliminated.

A further feature of this invention is that retort tubes having the features and advantages above described may be mounted in connection with means affording simple vapor seal construction. For example, the sheet metal linings of the tubes may be welded to sheet metal adjacent the ends of the tube so as to form a vapor seal between the linings. Moreover, funnels may be mounted on the upper ends of linings of vertical tubes and their edges secured together as by welding so as to form at once a vapor seal between the tubes and means for charging material into the tubes.

A battery of retort tubes constructed according to this invention may be advantageously combined with a removable hood for collecting and removing gases and vapors generated in the retort tubes and with means for vapor sealing the hood when placed in position over said tubes. This invention also comprises novel features relating to means for charging retort tubes and discharging material therefrom.

For the purpose of illustrating this invention, it will be described and shown as incorporated in the type of retort and coking apparatus shown in the above mentioned application Ser. No. 457,466 and as improving thereon. The apparatus comprises briefly a battery of retort tubes of novel construction, a removable vapor sealed hood over the tops of said tubes, means for charging the tubes with material to be treated therein, and vapor sealed means for discharging material from tubes. Apparatus comprising this invention may be employed separately and when so employed constitute separate parts of this invention. Parts of this invention may also be employed conjointly with other parts and when so employed co-operate with one another to produce special advantages resulting from their co-operative relation.

Other purposes, features and advantages will become apparent in the following more detailed description of this invention in connection with the accompanying drawings, wherein:

Fig. 1 is a vertical view of apparatus embodying this invention with the right half in section;

Fig. 2 is a plan view with the hood removed taken on the line **2—2** of Fig. 1;

Fig. 3 is an isometric view of the upper part of one of the tubes showing funnel and an upper section of casing;

Fig. 4 is an isometric view of part of one of

the retort tubes showing an intermedial section of casing and burner;

Fig. 5 is a sectional view of part of one of the retort tubes at the point of contact between adjacent sections of casing taken on the line 5—5 of Fig. 1; and

Fig. 6 is a cross section of air gas pipes and burner.

Apparatus comprising this invention may be supported on a frame 10. Brackets 11 secured to frame 10 may support furnace walls 12 which may be of any suitable refractory material.

Within the furnace walls are a plurality of vertical sheet metal tubes 13 which are preferably made of alloy sheet steel. Each of tubes 13 is preferably made by shaping a sheet of alloy sheet steel in the form of a tube, bringing the edges together and securing the edges by a single longitudinal external welding 14. In this connection it is to be understood that the word "tube" is not to be limited strictly to hollow cylindrical bodies but also comprises analogously shaped bodies, e. g. square, which may serve an analogous purpose. Retort tubes 13 are preferably slightly greater in diameter at the bottom than at the top in order to aid material contained therein in dropping out by gravity. Welded to the top of tubes 13 are funnels 15 which are square at the top and which are preferably also of alloy sheet steel. The edges of the square upper portions of funnels 15 may be joined as by welding so as to form a vapor seal between the tubes 13 and prevent furnace gases on the outside of tubes 13 from escaping into the vapor chamber above the open ends of tubes 13. The funnels 15 welded together at their edges and welded to the sheet metal tubes, comprise mounting means for the individual tubes forming a vapor seal between said tubes adjacent the upper ends thereof. The lower ends of retort tubes 13 may protrude slightly through and be externally welded to bottom plate 17 which may also be of sheet steel so as to form a vapor seal between tubes 13 at the lower ends thereof and affording mounting means therefor.

The above construction affords an integral battery of sheet metal retort tubes and sheet metal mounting means therefor which may be supported as by rectangular trough 36 which is welded to funnels 15 and which rests on furnace walls 12. As the welding between the edges of funnels 15 and between the funnels and trough 36 has been found to afford a very rugged construction, no further support for the battery of retort tubes is ordinarily required. If additional support should be desirable, as for example in very large units, one or more suspension bars 16 may be used which may be supported at their ends by furnace walls 12.

Surrounding retort tubes 13 are casing sections 18, 19, 20 and 21, which may be of fire brick or other suitable refractory and/or heat equalizing material and it is to be understood that specific terms such as "firebrick" and the like are to be given a broad interpretation covering analogous materials of a protective and refractory nature serving a similar purpose. The casings may be single or multiple and of any suitable shape. Moreover, it is apparent that casings of a heat equalizing nature such as shells containing a molten metal and the like may also be employed according to this invention.

Sections 21 may rest upon plate 17. Casing sections 19, 20, and 21 are preferably maintained so that the casing sections of one retort tube will be in substantially continuous contact with adjoining retort tubes, thus forming a plurality of individual flues. Casing sections 18 may be constructed with portions thereof of restricted diameter so that there will be openings 22 between adjacent casing sections 18 through which spent gases of combustion may be withdrawn horizontally from the furnace by any suitable passage not shown. The upper portion of casing sections 18 may have flares or shields 60 shaped, for example, in the form of squares of sufficient size to permit the shields 23 of adjoining retort tubes to come in contact with each other forming a roof for the flues and preventing the flame and hot gases from coming directly into contact with funnels 15 and suspension bars 16.

By the above arrangement it is apparent that the contacting casing sections of the various sheet steel tubes 13 reinforce one another and form an integral unit or battery wherein axial deflection and radial distortion of the tubes is impossible and wherein the sheet metal linings are maintained in perfect alignment with avoidance of warping and cracking.

The inner diameter of the casings 18, 19, 20 and 21 is preferably such as to allow for the relative heat expansion of sheet steel tubes 13 and the casings surrounding them, as the heat expansion of the metal of tubes 13 is greater than the expansion of the fire brick, for example, used in the casings. It is preferable therefor to have a slight clearance between casings 18, 19, 20 and 21 of fire-brick and sheet steel tubes 13 when the apparatus is cold but to have the casings and tubes in contact at operating temperatures. Casings 18, 19, 20, and 21 may be placed in position, for example, prior to welding funnels 15 to the tops of tubes 13.

In order to make the points of contact between sections 18, 19, 20 and 21 tight and thereby insure against the flame and hot gases in the furnace from coming directly in contact with the tubes 13, the sections of fire brick are preferably provided with interlocking means consisting of recess 23 and lip 24. While a specific form of casing has been described, it is apparent that other constructions for the casing may be employed than that above shown by way of illustration and that other materials than fire-brick may be used therefor.

The heat may be supplied to the furnace by a plurality of gas burners. The gas burners may be placed at a number of different levels and are here shown placed at four levels. The air and gas are supplied by means of air tubes 25 and gas tubes 26 which respectively carry air and gas under regulated pressure from mains 27 and 28 in which the pressure is regulated respectively by valves 29 and 30 for each level. The air and gas for each level is received from risers 31 and 32.

The concentric air and gas tubes 25 and 26 may pass horizontally through the furnace and have burners in each of the flues thereof. These burners may consist of gas nipples 33 placed in and rising slightly above the center of holes 34 of air lines 25. The nipples 33 may be placed in position through air pipes 25. The gas-air pipes are supported and prevented from heat deflection by grooves 35 in fire brick casings 18, 19, 20 and 21.

The vapors escaping from retort tubes 13 may be collected and made to pass out through pipe 37 by means of hood 38. Hood 38 may be provided with downwardly extending flange 56 adapted to engage sealing trough 36 which may

contain molten metal or other means for making a vapor seal such as heat resisting fibers or resilient steel wool packing. The vapors are prevented from escaping by the vapor seal and are forced from the hood through outlet **37** by pressure developed within the retort tubes and may pass to any suitable means for receiving same such as condensers and gas scrubbers not shown.

In order to prevent solid material in the tubes from expanding upon the application of heat and rising vertically out of tubes **13** disks **39** are held in position over retort tubes **13** by means of rods **40** attached to hood **38**. Sufficient clearance is provided between disks **39** and funnels **15** to permit vapors generated in tubes **13** to escape therefrom into hood **38**.

It is to be understood that in charging the retort tubes **13** hood **38** may be removed from position as by raising the hood out of the way. This can be done by any suitable means such as hydraulic cylinder pistons **41** which raise bar **42** to which hood **38** is attached. The retort tubes may be charged by any suitable means such as a hopper or a battery of preheating tubes, such as shown in copending application Serial No. 457,466. A battery of preheating tubes **43** has been indicated which may be moved into position over retort tubes **13** by carrier **44** mounted on wheels **45** adapted to roll on angle bars **46** fixed to frame **10**. In charging retort tubes **13**, preheater tubes **43** are centered with respect to retort tubes **13**. Openings in the slide **47** at the bottom of the preheater tubes allow coal or other material to drop into funnels **15** and fill retort tubes **13**.

In order to keep the material in tubes **13** from dropping out, removable discharging plate **49** of alloy sheet steel or other suitable material is maintained under the lower ends of tubes **13**. In order to have a vapor seal between the vapors in tubes **13** and plate **49**, plate **49** may be provided with a sealing trough **48** around the outer edges thereof which may be similar to sealing trough **36**, and bottom plate **17** may be provided with a downwardly extending flange **57** adapted to engage sealing trough **48** when plate **49** is in position.

Discharge plate **49** may be supported by I beams **50** resting upon parallel girders **51** which are preferably placed outside the line of the battery of retort tubes. Suitable means such as hydraulic pressure cylinders **52** with pistons **53** may be provided in order to raise plate **49** and to close and seal the bottom of the retort tubes **13** or to lower the plate **49** away from tubes **13**. By lowering plate **49** until rollers **54** rest upon rails **55**, plate **49** can be rolled out of the way so that the coke from the retort tubes may be discharged therefrom to any suitable chamber or coke cooling device, not shown, such, for example, as is set forth in copending application Serial No. 457,466 above mentioned.

While the operation of the above described apparatus embodying this invention is apparent, it will be described in connection with the making of coke from slack or waste screen bituminous coal according to copending application Serial No. 457,466. A measured quantity of coal is placed in preheating tubes **43** where it is heated by spent gases of combustion passing from the flues and vertical passages **22** of retort furnace **12** which may be brought into contact with the exterior surfaces of preheater tubes **43** by any suitable means not shown. After the coal has been substantially dehydrated, the preheater tubes **13** are then moved into position over retort tubes **13**, the lower ends of which are closed and sealed by plate **49**. The coal can then be discharged from preheater tubes **43** into retort tubes **13** whereupon the preheater tubes are removed and hood **14** lowered into place. The material in the retort tubes may then be subjected to the desired coking treatment.

The temperature at which the coking takes place may be regulated in any desired manner. In the method of treatment set forth in copending application Serial No. 457,466, the retort tubes may be maintained, for example, at a temperature of about 1400° F. at the time of introduction of the coal therein and during the distillation. Where retort tubes are used which are larger at the bottom than at the top more heat will be required to carbonize the mass of material at the bottom so that ordinarily a temperature of about 1600° F. is maintained at the bottom while a temperature of about 1400° F. is maintained at the top. The air and gas pressures for the gas burners at the various levels of the furnace can be regulated to accomplish desired temperature regulation.

Where the coal is introduced into tubes **13** while they are in a heated condition, the material is at once acted upon by the heat and volatile matters begin to be expelled. Accordingly, as soon as possible after the introduction of the coal, the preheating tubes **43** are moved out of the way and hood **38** is dropped into a vapor sealing position. The small annular clearance between disks **39** and funnels **15** permit the vapors formed in tubes **13** to pass into hood **38** and to escape out through outlet **37**. The disks **39** at the same time hold the mass of swelling plastic material in tubes **13** under compression to form a coke of firm dense structure, according to copending application Serial No. 457,466.

After the material in tubes **14** has been heated for a sufficient period of time, for example about an hour, it may be removed from retort tubes **13** by lowering plate **49** and rolling it out of position so that the coke in tubes **13** may be discharged into the coke receiving chamber. As the sheet steel linings **13** of the retort tubes are smooth and free from cracks and distortion the force of gravity alone has been found sufficient to cause the coke to drop out of the tubes and it has not been found necessary to push the material therefrom by plungers or other means.

While this invention has been described in connection with specific embodiments thereof, it is to be understood that this has been for purposes of illustration merely and that the true scope of this invention is not limited thereby.

I claim:

1. In apparatus of the character described, a tubular retort including a tubular body of refractory material adapted to be heated by externally applied hot gases of combustion, said retort being characterized by a sheet of sheet steel shaped into a tube about 5 to 7 inches in diameter as a liner for said tubular body of refractory material, a funnel shaped top of sheet steel for said liner, and a shield member of refractory material of greater diameter than said tubular body for shielding said funnel from hot gases of combustion externally applied to said tubular body of refractory material.

2. In apparatus of the character described, a battery of vertical retort tubes, said battery of retort tubes being characterized by a battery

of tubular casings of refractory material and sheet metal formed into liner tubes as liners for said casings, means for maintaining said liners in alignment while permitting similar heating of said liners including means for maintaining the exteriors of said tubular casings in contact relation with one another throughout the major portion of the longitudinal extent thereof, vertical flue spaces between said tubular casings, and a burner in each of substantially all of said flue spaces.

3. In apparatus of the character described, a battery of vertical retort tubes, said battery of retort tubes being characterized by a battery of tubular casings of refractory material and sheet metal formed into liner tubes as liners for said casings, headers joined to said sheet metal liners adjacent the ends thereof in vapor tight relation, the said casings being maintained by said liners and said headers in contact relation with one another to form a battery in which the relative positions of said casings is preserved by said contact relation and in which the casings reinforce and hold in alignment said liners, vertical flue spaces between said casings, and a burner in each of substantially all of said flue spaces.

4. In apparatus of the character described, a battery of vertical retort tubes, said battery of retort tubes being characterized by a battery of tubular casings comprising a plurality of tubular fire brick sections and sheet steel about $\frac{1}{16}$ inch in thickness formed into liner tubes as liners for said casings, headers adjacent the upper and lower ends of said retort tubes joined in vapor tight relation to said liners, said fire brick casings being maintained by said liners and headers in contact with one another substantially continuously throughout the lower portions thereof and said casings preserving the alignment of said liners, substantially individual vertical flues between the lower portions of said casings, combustion means, means for directing hot combustion gases through said flues, and openings between the said casings near the upper ends of said casings adapted to permit the horizontal withdrawal of spent gases of combustion from said combustion flues.

5. In apparatus of the character described, a battery of vertical retort tubes, said battery of retort tubes being characterized by a battery of tubular casings of refractory material and sheet metal formed into liner tubes as liners for said casings, means for maintaining said liners in alignment and for similarly heating said liners including means for maintaining the exteriors of said tubular casings in contact relation with one another throughout the major portion of the longitudinal extent thereof, vertical flue spaces formed by and between said tubular casings, individual burners in substantially all of said flue spaces, and pipes leading to said burners, said casings being grooved to allow said pipes to pass therebetween and to support said pipes.

6. In apparatus of the character described, a retort battery, said retort battery being characterized by a battery of tubular casings and sheet chromium-alloy steel shaped into liner tubes as liners for said casings, sheet steel headers joined to said liner tubes adjacent the ends thereof in vapor tight relation, said casings extending substantially throughout the length of said liner tubes between said casings and being maintained in contact relation with one another by said liner tubes and said headers to form a battery in which the position of said casings is preserved by said contact relation substantially throughout the length thereof and in which said linings are reinforced and held in alignment by said casings, vertical combustion flues between said casings extending substantially the length thereof between said headers, and a burner in each of substantially all of said combustion flues.

7. In apparatus of the character described, a battery of vertical retort tubes comprising a battery of fire brick casings, sheet steel shaped into liner tubes as liners for said casings, means for maintaining said fire brick casings in contact relation with one another at the lower portions thereof, substantially individual vertical combustion flues between said casings at the lower portions thereof, burners in a plurality of said combustion flues, pipes leading to said burners in said combustion flues, grooves in said casings supporting said pipes, and openings between said casings near the upper ends thereof permitting horizontal withdrawal of spent gases of combustion from said combustion flues.

8. In apparatus of the character described, a battery of vertical retort tubes comprising a battery of tubular casings of refractory material, sheet steel shaped into liner tubes as liners for said casings, sheet steel headers joined to said liner tubes adjacent the ends thereof in vapor tight relation, said liner tubes and said headers maintaining said casings in contact relation to preserve the position of said casings throughout a major portion of the length thereof, vertical flues formed by and between said tubular casings and extending substantially the length thereof, and a roof of refractory material for the upper ends of said flues adapted to protect said upper sheet steel header, said casings being spaced apart horizontally adjacent the upper ends thereof for the lateral withdrawal of waste combustion gases from the upper ends of said flues.

9. In apparatus of the character described, a battery of vertical retorts comprising a battery of tubular casings, sheet metal shaped into liner tubes as liners for said casings, funnel shaped tops joined in vapor tight relation to the upper ends of said liner tubes, flue spaces between said casings adapted to contain hot combustion gases, and shields for said funnels adapted to protect said funnels from hot combustion gases in said flues and to afford a roof for said flues.

10. In apparatus of the character described, a battery of vertical retort tubes comprising a battery of tubular casings of refractory material, sheet steel shaped into liner tubes for said casings, funnels rectangular in shape and of sheet steel joined in vapor tight relation to said liner tubes, the edges of said funnels being joined substantially continuously in vapor tight relation, a header adjacent the bottom ends of said tubes, said casings being maintained in contact relation by said liner tubes, said funnels and said header to form a battery in which the position of said casings is preserved by said contact relation throughout the major portion of the length thereof and in which said casings reinforce and preserve the alignment of said liner tubes, vertical flues formed by and between said casings adapted to contain hot combustion gases, and a roof of refractory material for said flues adapted to shield said funnels from hot combustion gases in said flues, said casings being spaced from each other horizontally adjacent the top thereof and underneath said roof for the horizontal withdrawal of gases from the upper ends of said flues.

11. In apparatus of the character described having a battery of substantially vertically extending retort tubes and a hood over the upper ends of said retort tube battery adapted to collect and conduct away evolved gases and vapors escaping from the upper ends of said retort tubes, the combination comprising means for removing said hood from the upper ends of said retort tubes, disks adapted to confine material in said retort tubes, means cooperating between said disks and said hood for confining material in said retort tubes by said disks when said hood is in position for collecting and conducting away evolved gases and vapors escaping from the upper ends of said retort tubes and for removing said disks from position for confining material in said retort tubes when said hood is removed from position for collecting gases and vapors escaping from the upper ends of said retort tubes.

12. In apparatus of the character described having a battery of substantially vertically extending retort tubes and a hood over the upper ends of said retort tube battery adapted to collect and conduct away evolved gases and vapors escaping from the upper ends of said retort tubes, the combination comprising means for removing said hood from the upper ends of said retort tubes and out of the way so that said retort tubes may be charged with material and disks adapted to confine material in said retort tubes, said disks being rigidly attached to said hood so that said disks are adapted to be removed from said tubes when said hood is removed from position for collecting and conducting away gases and vapors escaping from said retort tubes and so that said disks are adapted to confine material in said retort tubes when said hood is returned to position for collecting and conducting away gases and vapors collected in said retort tubes.

13. In apparatus of the character described having a battery of substantially vertically extending retort tubes and a hood over the upper ends of said retort tube battery adapted to collect and conduct away evolved gases and vapors escaping from the upper ends of said retort tubes, the combination comprising means for removing said hood from the upper ends of said retort tubes and out of the way so that said retort tubes may be charged with material, disks adapted to confine material in said retort tubes, said disks being rigidly attached to said hood so that said disks are adapted to be removed from said tubes when said hood is removed from position for collecting and conducting away gases and vapors escaping from said retort tubes and so that said disks are adapted to confine material in said retort tubes when said hood is returned to position for collecting and conducting away gases and vapors collected in said retort tubes, and funnels at the tops of said retort tubes, said disks being adapted to be inserted into said funnels.

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