S. B. SHELDON.

PROCESS OF COKING COAL.

APPLICATION FILED OCT. 23, 1907.

953,351.

Patented Mar. 29, 1910.

2 SHEETS—SHEET 1.

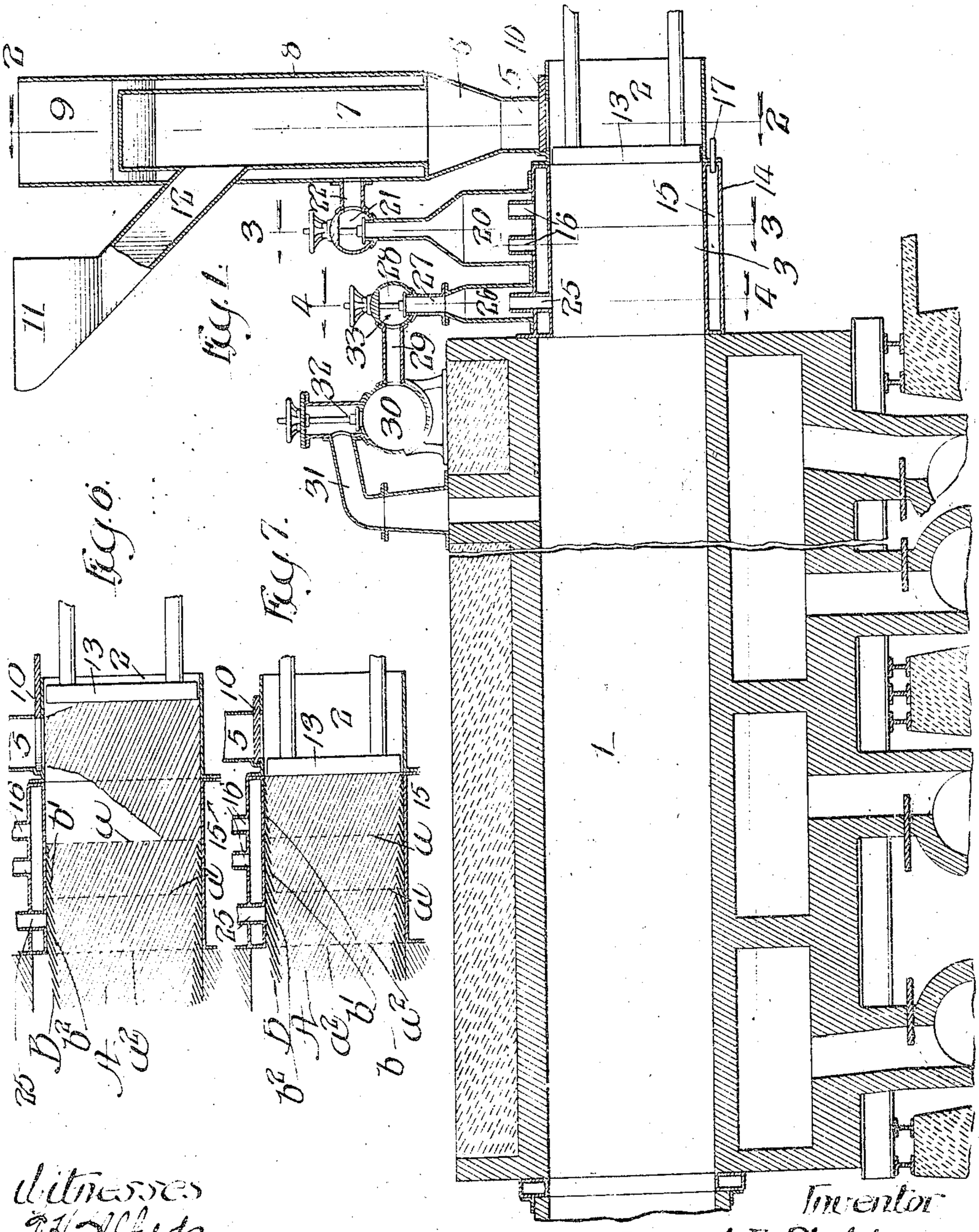

Fig. 1.

Fig. 6.

Fig. 7.

Witnesses
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2 SHEETS—SHEET 2.

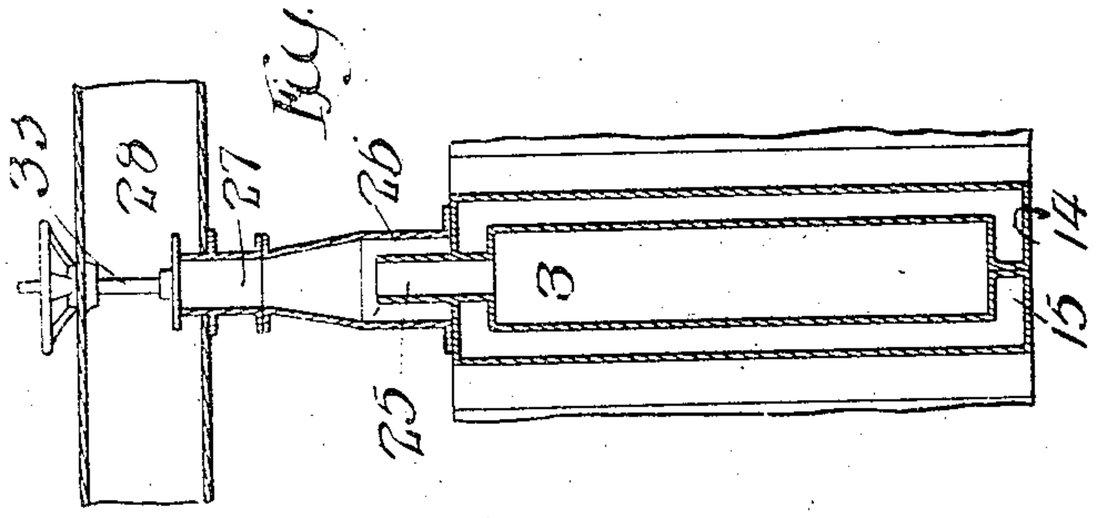

Fig. 4.

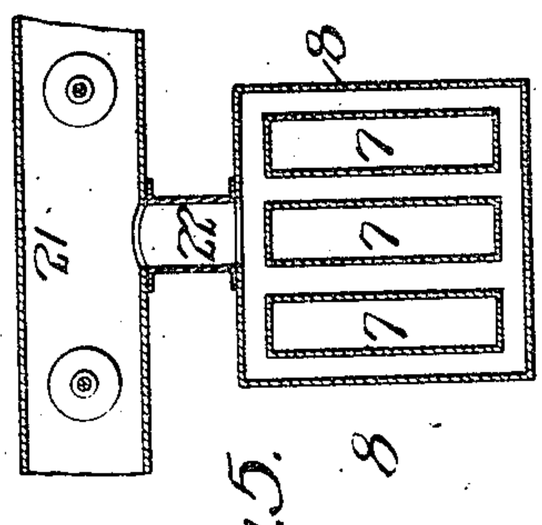

Fig. 5.

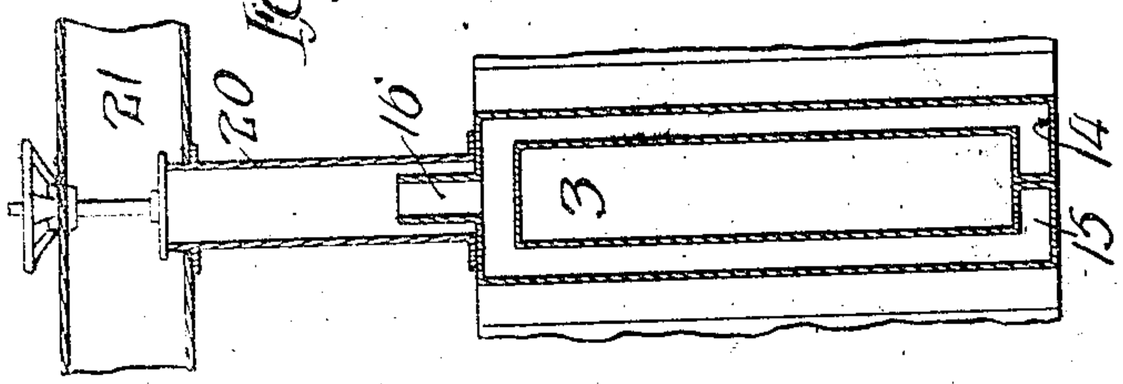

Fig. 3.

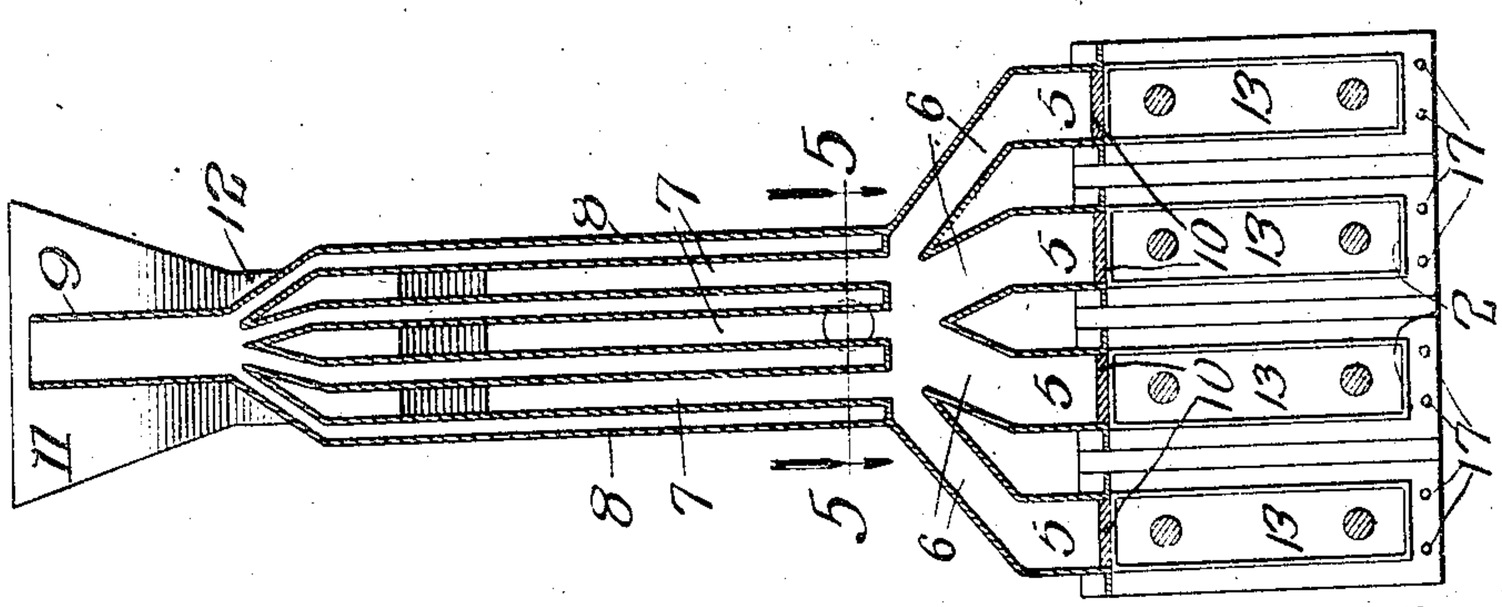

Fig. 2.

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UNITED STATES PATENT OFFICE.

SAMUEL BERTRAM SHELDON, OF BUFFALO, NEW YORK.

PROCESS OF COKING COAL.

953,351. Specification of Letters Patent. Patented Mar. 29, 1910.

Application filed October 23, 1907. Serial No. 393,746.

To all whom it may concern:

Be it known that I, SAMUEL BERTRAM SHELDON, a citizen of the United States, and a resident of Buffalo, in the county of Erie and State of New York, have invented certain new and useful Improvements in Processes of Coking Coal; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the characters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in the art of distilling coal for the manufacture of coke and the production of gas and more especially to improvements in the method of effecting the coking or distillation of coal and at the same time saving the gases produced in the operation, which is set forth in Letters Patent No. 855,069, granted to me May 28th, 1907.

The process set forth in my said prior patent No. 855,069 embraces generally the steps of applying pressure to one end of a mass of coal to compress the coal and to advance the mass horizontally toward and into a coking retort or oven, applying heat to the mass during its movement toward the retort or oven and applying coking heat to the portion of the mass within the retort or oven.

The apparatus illustrated in my said prior patent No. 855,069, for carrying out the process therein set forth, embraces a metal passage which is connected with the receiving end of the coking oven and through which the coal is advanced into the coking oven or chamber; heat being applied to the walls of said passage to effect preheating of the coal before the delivery of the same into said coking retort or chamber.

As an improvement upon the process set forth in my said prior patent, my present invention contemplates the compression of fresh charges of coal, the superficial coking of the compressed charges and the subsequent application of pressure to advance the superficially coked charges toward and into the coking retort or oven.

In carrying out my improved process, charges of coal, introduced into the receiving end of a metal pre-coking passage, connected at its discharge end with the receiving end of the coking retort or oven, are compressed and advanced through said passage, by the action of a reciprocating plunger. Said plunger, after the completion of each advance movement thereof, is withdrawn, and the space in front of it filled with a fresh charge of coal. The plunger is then advanced sufficiently to compress the coal into a compact mass in contact with the preceding charge and the side walls of the pre-coking passage. No further forward movement of the plunger then takes place until the charge so compressed has been subjected to coking heat, transmitted through the metal walls of the passage, for a length of time sufficient to secure the formation thereon of an external or superficial layer of coke strong enough to prevent rupture or crumbling of the mass under the pressure required to effect the advance movement of the entire mass of partly coked coal and coke contained in the pre-coking furnace through said passage and into the coking oven. After such superficial coking has been effected the plunger is then given a further advance movement to force the new charge of superficially coked coal and the previously introduced charges in advance of it forwardly through the said passage into the coking oven. The performance of the process in this manner is found to be highly advantageous for the reason that pressure for advancing the entire mass of the partially coked and coked coal in the pre-coking chamber and oven is applied to the freshly introduced charge, and if pressure sufficient to so advance the entire mass were applied to a fresh charge of loose or entirely uncoked coal, lateral or outward pressure would be exerted by the same on the walls of the passage, in a manner to prevent any advance movement of the mass under the degree of pressure that it would be ordinarily practicable to apply. When, however, the fresh charge of coal is, while held in a compact mass, superficially coked before pressure is applied for advancing it through or along the passage, the surrounding layer of coke on the mass serves to give the same capacity to resist crushing strain and sufficient rigidity withstand the pressure required for advancing both the mass in the precoking passage and the material in the coking oven or chamber.

As a still further improvement upon the process set forth in my said prior patent, I subject the charges of fresh coal, before the same are subjected to the precoking operation proper, to a preliminary heating by the

application of non-coking heat, or without applying such degree of heat as to soften or fuse the particles of coal, or to cause adherence thereof to each other. For this purpose, the fresh coal will usually be heated to about 400° F., although in some cases, or with some kinds of coal, a much higher degree of heat may be applied without producing any coking effect; it being intended in all instances that such preliminary heating shall be effected by a non-coking heat so that the coal will remain in a condition to flow into, or to be readily delivered to, the precoking passage in which the coal is contained while being compressed and superficially coked. The coal thus subjected to a preliminary heating by the application of non-coking heat, will be heated to such extent that it may be quickly raised to the higher temperature required for the superficial coking thereof, with consequent saving of time in the precoking operation.

My invention also includes as a still further improvement in the process set forth in my said prior patent, the withdrawal directly from the precoking passage of gases generated in the partial or superficial coking which results from the precoking operation.

An apparatus devised by me for carrying out my present invention is shown in the accompanying drawings, in which,—

Figure 1 is a view in vertical longitudinal section, taken vertically through the coking chamber and precoking passage of an apparatus embodying my invention. Fig. 2 is a transverse section, taken through the supply bins and receiving chambers of a series of four ovens, on line 2—2 of Fig. 1. Fig. 3 is a transverse section taken through the precoking passage and the passage connecting the jacket of said precoking passage with the jacket of the supply bin, taken on line 3—3 of Fig. 1. Fig. 4 is a like transverse section taken through the precoking passages and the passage leading from the top of the same to the collecting main, taken on line 4—4 of Fig. 1. Fig. 5 is a detail, horizontal cross-section taken on line 5—5 of Fig. 2. Figs. 6 and 7 are sectional views of the precoking passage showing the operation of the plunger and the manner in which the layer of coke is formed on the mass of coal in the said passage.

The coking oven illustrated in the accompanying drawings is provided with a series of longitudinal, parallel, coking chambers arranged side by side, as common in the construction of "Otto Hoffmann" ovens. Only one of said coking chambers is illustrated in the drawings (Fig. 1) and is there indicated by 1. Each coking chamber is equipped with coal feeding, compressing and precoking devices at the receiving end thereof and with a delivery device at its exit or discharge end. The drawings (Figs. 2, 3 and 4) show in cross-section the coal feeding, compressing and precoking devices associated with four coking chambers arranged side by side, as common in the construction of "Otto Hoffmann" and like ovens.

The coking chamber 1, as illustrated, is continuous and of uniform internal dimension from its receiving to its discharge end and is like those illustrated in applicant's prior patent No. 847,614; each oven consisting in effect of two sections arranged end to end, each of which is provided with heating means, separate from the heating means of the other section, so that the temperature maintained in the two sections may be independently or separately controlled. Each section of the oven therefore corresponds with a complete "Otto Hoffmann" oven; the two sections together constituting two complete "Otto Hoffmann" ovens, placed end to end with their coking chambers joined to form in effect one continuous coking chamber.

It is not deemed necessary to illustrate in the accompanying drawings the means for heating the two sections of the coking chamber, as said heating means may be like those illustrated in said prior patent, or may be otherwise constructed as may be desired or preferred.

Now referring to the coal feeding, compressing and precoking devices at the receiving end of the oven, these parts embrace features of construction as follows:

2 indicates a coal receiving chamber and 3 a precoking passage which forms a continuation of the receiving chamber and is connected at its discharge end with the coking chamber. The coal receiving chamber 2 and the precoking passage 3 are made of metal and form a continuous passage within which the coal is compressed and superficially coked, and through which it is advanced by the devices hereinafter described. The bottom wall of the precoking passage is on a level with the bottom of the coking chamber, while its side walls are parallel with each other and located at a distance apart somewhat less than the distance between the side walls of the coking chamber, so as to leave clearance spaces at the sides of the mass of superficially coked coal advanced from the said precoking passage into the chamber. The op wall of the precoking passage is located somewhat below the level of the top wall of the coking chamber so as to give clearance space at the top of said chamber. At the top of the receiving chamber 2 is located an inlet or feed passage 5 and the several feed passages associated with the four adjacent precoking passages are connected by means of radially arranged, inclined tubes 6, 6, 6 (Fig. 2) with the lower end of a supply bin which, as shown, consists of a plurality of sections or compart-

nients 7, 7, 7 arranged vertically and parallel with each other and of which three are shown in the drawings. Each of said sections or compartments consists of an upright, rectangular tube open at its bottom and communicating with the upper ends of the several passages 6, 6, 6. The tubes constituting said compartments 7, 7, are separated from each other by spaces and the several tubes are surrounded by an inclosing wall or jacket 8 forming around the said several compartments, a space which is in communication with the spaces between the said compartments, The casing 8 extends at its upper end above the several compartments 7, 7 and terminates in an exit flue of stack 9. At the top of each receiving chamber is a horizontally sliding valve or gate 10 for closing the lower end of the feed passage 5. For delivering coal to the upper ends of the several bin compartments 7, 7, 7 a feed hopper 11 is provided, the same having an inclined spout 12 which extends downwardly from the lower end of said feed hopper through the jacket or casing 8, and is in communication at its lower end with the upper ends of the said bin compartments. The side and bottom walls of said receiving chamber 2 of the said precoking passage are parallel with each other and in said receiving chamber is located a horizontally reciprocating plunger 13 which fits and slides in contact with the sides, top and bottom walls of said passage. Power actuated means for giving reciprocatory motion to the plunger 13 may be of any desired form or construction, and are not illustrated in the drawings.

The precoking chamber or passage 3 is surrounded by a wall or jacket 14, forming a combustion chamber or space 15, to which is supplied an admixture of vapor or gas and air and in which said admixture is burned for the purpose of heating the metal walls of the said passage. Said combustion chamber is provided at its top with exit tubes or pipes 16, 16 for the exit therefrom of products of combustion. Fuel gas may be supplied to the bottom of said chamber 14 by means of a fuel supply pipe 17.

The exit pipes 16, 16, associated with each precoking passage, discharge into a hood 20. The several hoods are extended upwardly to and connected with a common transverse flue 21 which is connected by a pipe 22 with the jacket 6 which surrounds the bin compartments 7. Said pipe 22 discharges into the lower part of the space which surrounds said compartments. The heated products of combustion passing from the top of the combustion chamber 15 after circulating around the walls of the bin compartments finally rise to and are discharged from the stack 9 at the top of the casing 8. In the construction described it will be manifest that coal delivered to and contained within the bin compartments 7, 7 will be heated by heat transmitted thereto from the heated products of combustion passing from the top of the combustion chamber.

In the operation of the apparatus described the fresh coal introduced into the bin compartments 7, 7, 7 is subjected to a non-coking heat by which the said coal is preliminarily heated to such a degree that the particles of coal will not become softened or adhere to each other, so that the coal will remain in condition to flow by gravity from the said bin compartments to the receiving chamber 2. When the plunger 13 is retracted the space in front of said plunger, left vacant by its backward movement, is filled by a charge of coal from the bin compartments, introduced by withdrawing the sliding valve or gate 10 by which the feed opening in the top of said receiving chamber is controlled, to permit the loose coal to descend by gravity into the receiving chamber. By a partial or preliminary advance movement of the plunger 13 the charge of fresh coal thus introduced into the receiving chamber is brought into contact with the mass of coal in advance of it and with the surrounding walls of the precoking passage, and to some degree compressed. In such preliminary movement, the plunger is moved far enough only to so compress the charge. The charge of coal so introduced is subjected to the action of heat from the burning fuel in the combustion chamber 15, transmitted through the metal walls of the precoking passage during this compression and subsequently thereto. By reason of the great conductivity of said walls, rapid superficial coking of the charge takes place. In a subsequent further advance movement of the plunger the charge of coal, superficially coked as aforesaid, is forced forwardly through the preheating passage 3, the mass of coal in advance of the last introduced charge being correspondingly advanced through the said passage. No advance movement of the freshly introduced charge takes place until the superficial layer of coke therein is thick enough to resist the crushing strain exerted thereon by the plunger, and permit free movement of the mass through the precoking passage: the surrounding layer of coke having the characteristics of a box girder in giving rigidity to the mass. After the backward or return stroke of the plunger, a new charge of fresh coal is introduced into the receiving chamber and is similarly forced into the precoking passage and superficially coked while the portion of the mass previously advanced is further heated and the layer of coke thereon increased in thickness. The coal in the precoking passage is thus advanced intermittingly within the latter and is finally deliv-

ered to the coking oven. The metal walls of the precoking passage are adapted to resist the outward pressure occurring in the first or preliminary movement of the plunger and are so smooth as to offer a minimum amount of frictional resistance to the movement of the mass therethrough. The length of said precoking passage is so proportioned with respect to the stroke of the plunger and the frequency of its advance movements that sufficient time will be given, before the advance end of the mass enters the coking oven, to insure the formation thereon of an external layer of coke of sufficient thickness to insure the mass retaining its form when it passes from the precoking passage into the coking retort or oven. It has been found that, under usual conditions, by an exposure for one hour, a sufficient thickness of coke will be formed on the surface of the mass to allow free movement of said mass between the metal walls of the precoking passage. The mass will be advanced at each complete forward stroke of the plunger a certain part of the length of the precoking passage, the distance of the advance being adapted to the length of the chamber and of the oven. Assuming, for instance, that the formation of a layer of coke of required thickness will require the application of coking heat for three hours, the mass will be advanced one-third of the length of the passage at each stroke of the plunger.

Figs. 6 and 7 show the walls of the precoking passage with its contained mass of coal, together with the plunger 13. In Fig. 6, the plunger 13 is shown in its retracted position and the space in front of the same partially filled with a fresh charge of coal. In Fig. 7, the plunger 13 is shown as advanced to carry the fresh charge of coal into the precoking passage and to compress the same. In said Figs. 6 and 7, A indicates the central portion of the mass of coal and B the external layer of coke formed thereon. The dotted lines a, a^1 a^2 indicate the extent to which the mass of coal is advanced by each stroke of the plunger. b indicates the layer of coke resulting from the action of the heat in first heating period of one hour, b^1 indicates the thicker part of the layer of coke at the end of two hours, and b^2 indicates the still thicker layer of coke produced at the end of three hours. The formation of such external layer of coke upon the mass of coal, preparatory to its introduction into the coking oven, not only enables the mass to move freely through the precoking passage, but greatly increases the rapidity of the coking operation as a whole, because shortening the time required for the complete coking of the mass after it enters the coking oven.

For the purpose of withdrawing from the precoking passage the gases generated in the superficial coking process, the apparatus is illustrated as provided with devices as follows: A gas exit pipe 25 is connected with the top wall of the precoking passage. Said pipe leads upwardly through the combustion chamber 15 and opens at its upper end into a hood 26. Said hood is connected at its upper end by a pipe 27 with a tube or pipe 28 which extends across the top of the several precoking chambers and is connected by means of a horizontal pipe 29 with a gas collecting main 30, by which the gases produced in the several coking ovens are conveyed from the apparatus. Said collecting main 30 is shown as connected with each of the coking chambers by means of a duct 31 provided with a valve 32. Each of the discharge pipes 27 is provided with a valve 33 by which the connection between any of the precoking chambers and the collecting main may be cut off when desired. The gases driven off from the fresh fuel in the precoking chamber by the effect of the heat thereto applied, are of better quality or higher in fuel value than those generated in the coking oven itself under the higher temperature required to complete the coking operation, and for this reason an important advantage is gained by withdrawing directly from said precoking chamber, through the walls thereof, the gases therein produced, instead of permitting such gases to pass into the main coking chamber and withdrawing from said main coking chamber all of the gases generated in the apparatus.

By the preliminary heating of the coal in the bin compartments 7, 7, 7, the operation of superficially coking the coal may be effected in a much shorter time than would otherwise be the case, it being manifest that when the coal within said bin compartments is heated to a point just below a coking temperature, it will, when introduced into the receiving chamber, require the transmission thereto of only a relatively slight additional quantity of heat to effect superficial coking.

It is to be understood that my novel process, in its broader aspects, may be carried out and the more important advantages of the process will be gained when the heating of the coal to produce superficial coking thereof is effected solely in the precoking passage and no preliminary heating of the coal is effected. It is preferred, however, to subject the fresh coal to preliminary heating before the precoking operation, because the performance of this additional step in the process results in a much more rapid and economical carrying out of the coking operation as a whole.

I claim as my invention:

1. The process of coking coal which consists in applying non-coking heat to the coal

to be coked, transferring the heated coal to a precoking passage, applying pressure to one end of the mass of heated coal while the same is confined laterally in said passage to compress the coal and advance the mass toward and into a coking retort or oven, applying heat to the compressed mass in degree sufficient to effect superficial coking of the mass before the beginning of its advance movements toward the coking retort or oven, and applying coking heat to the entire mass after the same has entered said coking retort or oven.

2. The process of coking coal which consists in confining the mass of coal to be coked in a bin or receptacle, applying to the walls of said bin or receptacle non-coking heat to heat the coal therein, transferring the heated coal to a precoking passage, applying pressure to the end of the mass of coal in said passage to compress the mass and advance the same from said passage into a coking retort or oven, applying heat to the walls of said passage, in degree sufficient to effect superficial coking of the mass, before the beginning of its advance movement through said passage, and applying coking heat to the entire mass after the same has entered the said coking retort or oven.

3. The process of coking coal which consists in applying non-coking heat to the coal to be coked, transferring the preheated coal into a metal precoking passage, applying pressure intermittingly to one end of a mass of coal in said passage to compress the coal and advance the same at intervals through said passage into a coking retort or oven, applying coking heat to the walls of said passage in degrees sufficient to effect superficial coking of the compressed mass of coal therein during the intervals between its advance movements toward the oven, applying coking heat to said mass of coal after its entrance in said coking retort or oven, withdrawing from said coking retort or oven gases therein produced and withdrawing directly from said precoking passage, through the walls thereof the gaseous products of distillation therein generated, to avoid subjecting the same to the higher temperature of the coking oven.

In testimony, that I claim the foregoing as my invention I affix my signature in the presence of two witnesses, this 19 day of October A. D. 1907.

SAMUEL BERTRAM SHELDON.

Witnesses:
A. C. BYANE,
W. J. BRYAN.