

Aug. 31, 1937.

J. DANIELS

2,091,702

PRODUCTION OF LOW TEMPERATURE COKE

Filed Feb. 20, 1934

3 Sheets-Sheet 1

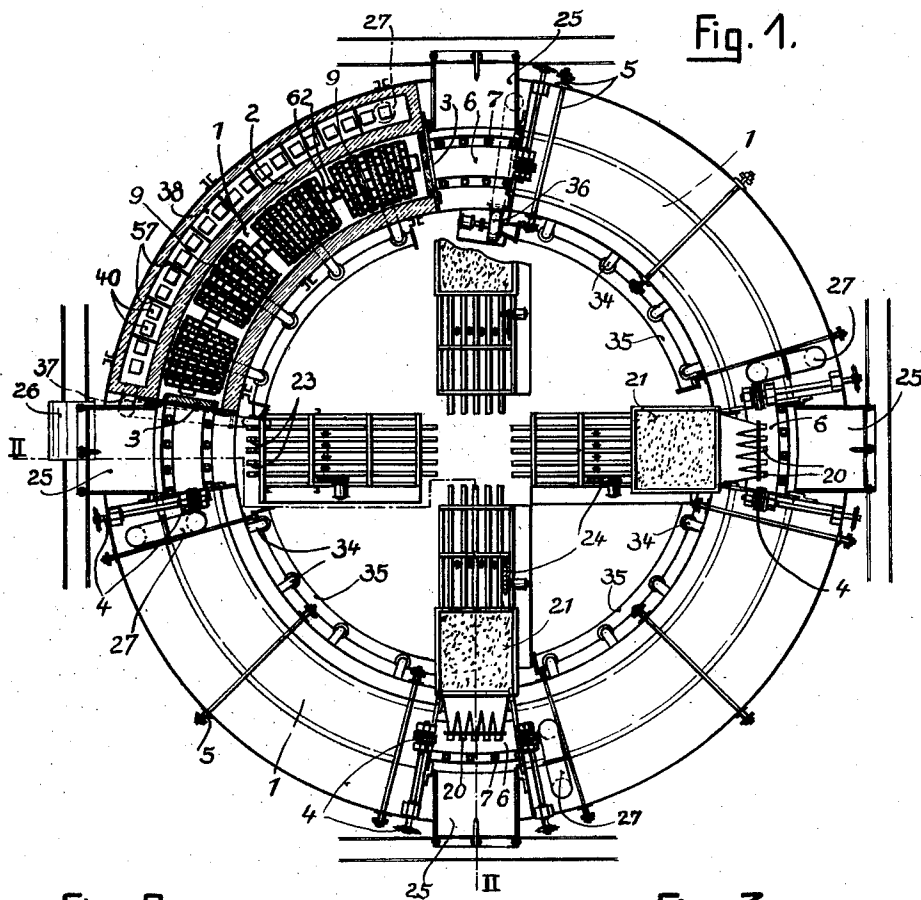


Fig. 2

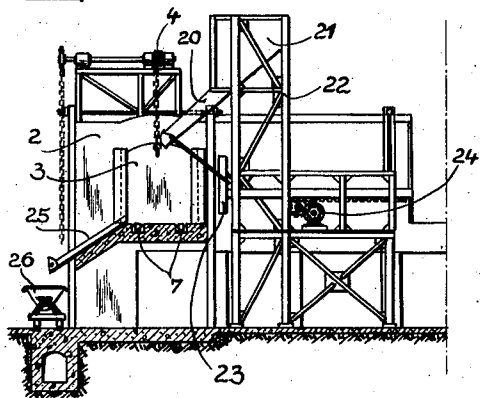
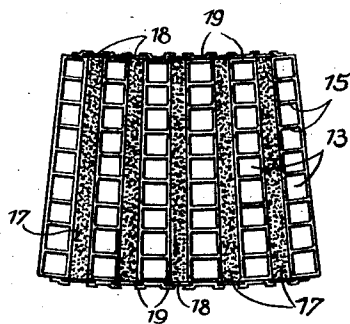


Fig. 3



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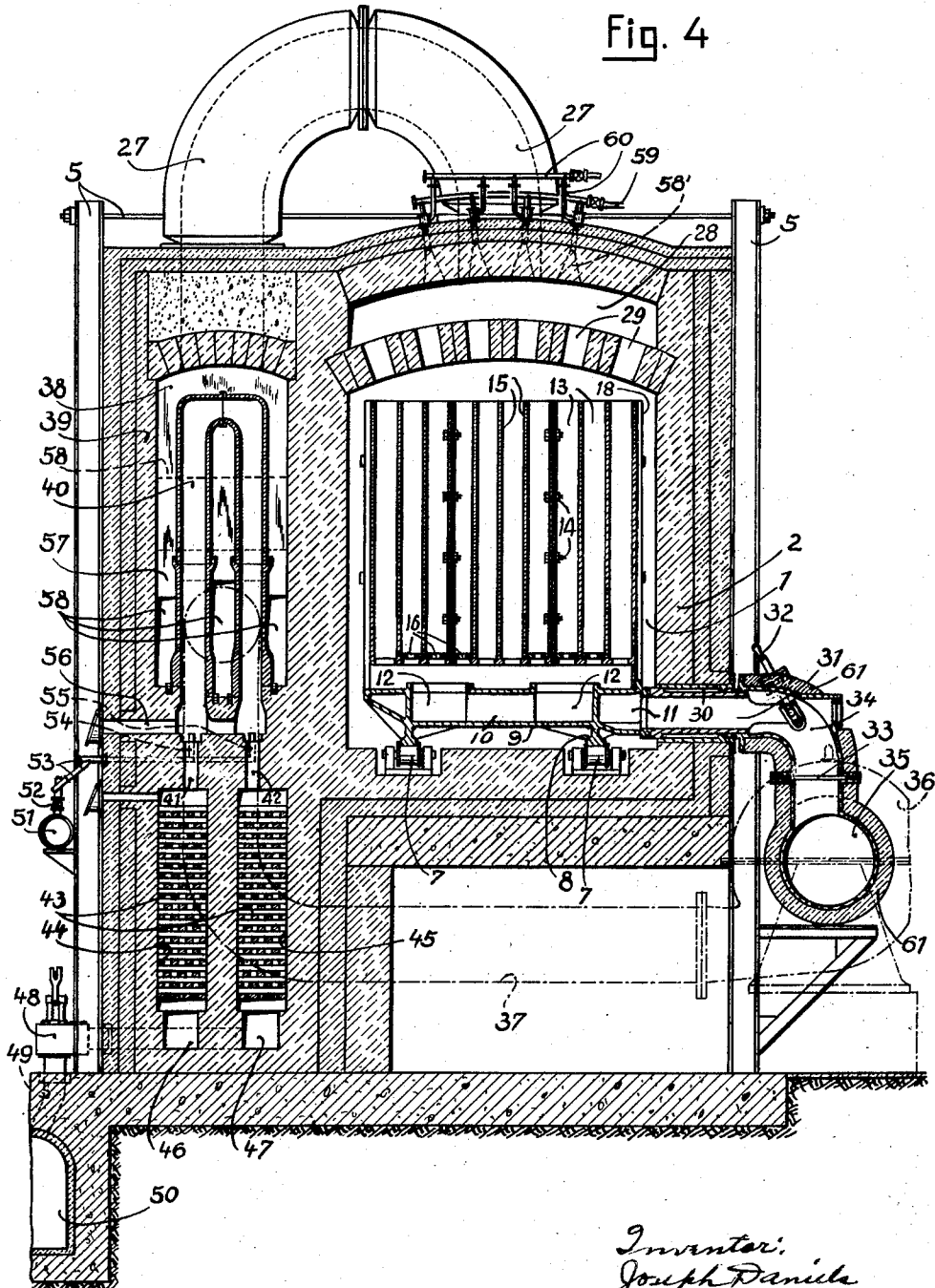
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Fig. 4



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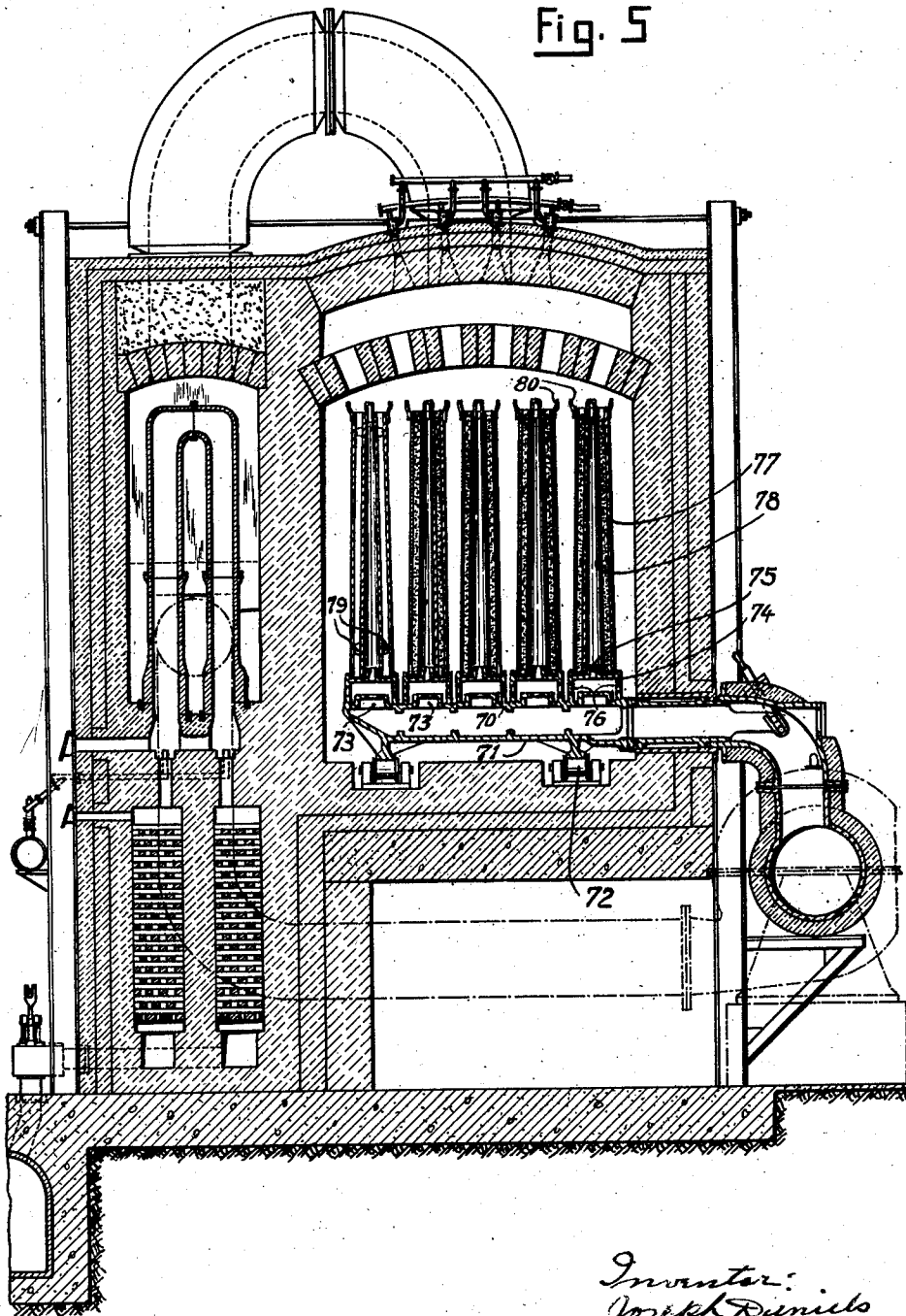
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PRODUCTION OF LOW TEMPERATURE COKE

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3 Sheets-Sheet 3

Fig. 5



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UNITED STATES PATENT OFFICE

2,091,702

PRODUCTION OF LOW TEMPERATURE COKE

Joseph Daniels, Essen, Germany, assignor, by
mesne assignments, to Koppers Company, a
corporation of Delaware

Application February 20, 1934, Serial No. 712,193
In Germany February 20, 1933

2 Claims. (Cl. 202—98)

My invention relates to the production of coke from caking coal, more particularly pit coal, at low temperatures, and has particular reference to the production of low temperature coke from coal, in which the coal during the carbonization is in a state of rest.

By the term low temperature carbonization of fuel is implied in general dry heating of the fuel for the purpose of carbonization, that means, the fuel is heated in an air-tight closed container, the temperature of the fuel during the carbonization, as a rule, substantially not exceeding about 650°, centigrade. By a carbonization of this kind a coke is obtained which is comparatively rich in liquid constituents, is highly reactive and has a comparatively low ignition point. Low temperature coke or semi-coke burns practically without smoke, in contradistinction to rough coal. It is thus a fuel which is particularly well suited for household purposes as it can be burned as well in the usual room stoves as also in kitchen ranges and open fireplaces. Also the use of semi-coke under the boilers of central heating plants affords great advantages because of the fact that a fire of semi-coke can be regulated within much wider limits than a fire of the known high temperature coke or blast furnace coke.

Furthermore, low temperature carbonization is of great importance, aside from the production of a high grade smokeless fuel, in that in carbonization of this type a number of high grade by-products are obtained which are burned away uselessly in the combustion of the rough coal, viz. in the first place the light hydrocarbons that form an excellent fuel for internal combustion engines.

In general, low temperature carbonization is carried on in retorts or chambers made from cast iron or any other suitable heat-resisting metal or metal alloy. Retorts of this kind are employed with advantage for low temperature carbonization, because the difference of temperature between the heated retort wall and the coal is comparatively small, whereby also a comparatively slow heat flow is caused. If retorts made from ceramic material are used like those employed in the usual high temperature carbonization, a comparatively high heat resistance would exist between the flame or the heating gases which serve to heat the retort and would prevent an advantageous rapid heating of the coal to be carbonized.

The reason for the fact that in spite of all these advantages low temperature carbonization hitherto has not been employed in the industry on a

large scale, is substantially the following: At the carbonization temperatures under consideration for low temperature carbonization the coke produced practically does not yet shrink. The coke thus completely fills the space of the retorts or chambers and therefore can be removed therefrom only difficultly. The low temperature coke cake cannot be pushed from the retorts, as it is usual in the high temperature carbonization.

Now the object of my invention is to provide improvements in the appliances serving for the production of low temperature coke, which enable the low temperature coke to be removed in a simple and easy manner from the retorts.

Another object of my invention is to provide improvements in the heating appliances of low temperature retorts, by which a uniform heating effect on the retorts without overheating the walls of the latter is obtained.

A further object of my invention is to provide improvements in ovens or apparatus for the production of low temperature coke which afford an easy attendance of the appliance and an economically satisfactory operation.

Finally, my invention provides improvements in the construction of the iron retorts or chambers serving for the production of low temperature coke.

Further incidental objects of my invention will be disclosed in describing in detail a practical embodiment of my present invention by way of example, with reference to the accompanying drawings.

In the drawings

Figure 1 is a top view of an annular tunnel oven designed according to the invention,

Figure 2 is a vertical section and side view on line II—II of Figure 1,

Figure 3 shows on enlarged scale the top view of the superstructure of one of the coking cars of the oven according to Figure 1,

Figure 4 is a vertical cross section of the oven represented in Figure 1, on enlarged scale, and

Figure 5 is a vertical cross section of a modified form of tunnel oven.

In the oven illustrated in Figure 1 the coking of the coal to be treated takes place in four curved chambers 1 which are arranged side by side and form a ring. The chambers 1 consist of refractory brickwork 2. On their ends they are provided with apertures that can be closed by doors 3. The latter can be lifted by means of lifting devices 4 mounted on the cover of the oven, the respective apertures then being open. The brick-

work of the chambers 1 is held together by iron anchor bars 5.

Between each two chambers 1 is provided a free space 6 of such a width that the charge of a coking car to be described hereinafter can be lodged in this free space. The spaces 6 serve to fill with coal the coking cars of the oven and to remove the coke produced from the cars.

As it will be seen in Figure 4, two circles of stationary supporting rollers 7 are provided on the floor of the oven chambers 1 on which rollers rest a series of coking cars 9 by means of rails 8. The cars 9 are provided with a bottom channel 10 which has a lateral aperture 11 and several top apertures 12.

Each coking car 9 has mounted on it a plurality of boxes 13 which preferably consist of several parts interconnected by screw bolts 14. Each box has two walls extending on the entire width of the car and interconnected by partitions 15, see Figure 3, in such a manner that each box 13 has an approximately sector-shaped cross section. The intermediate spaces formed by the vertical partitions 15 and the longitudinal walls 25 of the boxes 13 are open on top and bottom. They serve to uniformly distribute the hot gases required for heating the coal on the entire surface of the boxes 13. These heating gases are drawn off through the floor channel 10 in a manner described hereinafter. In order to uniformly draw off the gases from the individual hollow spaces of the boxes 13, the lower apertures of the intermediate spaces of the boxes, which lie immediately above the apertures 12, are narrowed, as denoted by 16.

The individual boxes 13 are arranged on the respective car 9 with a suitable mutual distance, so that intermediate spaces 17 are formed which serve to receive the coal to be coked. The spaces 17 are closed on their lower end by the bottom of the car, while on the sides they are closed by removable cover plates 18 which are held in position by guides 19 fixed to the boxes 13. On top the spaces 17 are open so that the gases produced during the distillation of the coal can escape.

The coal is charged into the car standing in the respective space 6 of the oven by means of a charging device 20 fitted with several spouts 21 arranged on a superstructure 22 above the spaces 6. The spouts 21 are constructed in such a manner that each one of them is situated above one of the spaces 17 of the cars 9 which spaces are intended to receive the coal.

The coke produced in the spaces 17 of the coking cars is withdrawn therefrom by means of a pushing device 24 comprising a plurality of pusher bars 23, one particular pushing device being provided for each of the spaces 6 of the oven, see Figure 1. The devices 24 are situated on the inner side of the annular oven brickwork.

The pushing devices 24 are of a construction which in principle is similar to the known pushing devices of horizontal chamber ovens for the production of gas and coke. They push the coke, after removal of the cover plate 18 of the coking car from the intermediate spaces 17 onto a wharf 25 and from there into coke cars 26.

The coal charged between the boxes 13 and introduced in the oven on the coking car 9 is heated by gases circulating through the chambers 1. The hot gases are supplied to an annular distribution top channel 28, Figure 4, and enter the chambers 1 through apertures 29. The gases then flow through the hollow spaces of the boxes

13 and thence through the apertures 12 to the floor channel 10 of the coking cars 9. A series of apertures 30 are provided in the outer wall of each chamber 1 exactly opposite to the lateral apertures 11 of the coking cars 9 when the latter are within the chamber. The apertures 30 are fitted with longitudinal tubes 31 that can be shifted from outside by means of setting levers 32, Figure 4. The tubes 31 serve to tightly connect the apertures 11 of the cars 9 with the apertures 30 of the oven wall. Before the cars 9 are to be shifted, the levers 32 are turned over, whereby the tubes 31 are withdrawn from the apertures 11 and the cars 9 are free to be moved.

The apertures 30 are attached through the intermediary of bent pipes 34 fitted with dampers 33 to the gas main 35 which extends on the inner side of the annular oven brickwork, see Figure 1. Each of the chambers 1 is provided with a gas main 35 and a blower 36 is mounted on the open end of the latter. The gases are blown by the blowers 36 into conduits 37 which lead to the heating appliance provided beside each chamber 1.

The heating appliances comprise each a plurality of chambers 38 of refractory brickwork 39. U-shaped heating pipes 40 made from any suitable ceramic refractory material are mounted in the chambers 38. To the lower openings of these heating pipes 40 are attached channels 41, 42 which lead to regenerators 44, 45 fitted with refractory chequer work 43. On the floor of these regenerators are arranged channels 46, 47 that lead to bent pipes 48 situated outside the oven and by channels 49 in communication with the waste gas collecting channel 50.

Furthermore, a gas feeding conduit 51 extends along the heating appliances from which conduit a pipe 53 governed by a throttle valve 52 leads to each of the legs of the U-shaped heating pipes 40. The burners are provided on the inner end of the pipes 53, one of these burners being situated below the one leg of the U-shaped pipe 40 while the other burner is below the other leg thereof, see Figure 4. The gas nozzles of these burners are denoted by 54 and 55. A peep hole 56 arranged at the level of the nozzles allows inspection of the burners during service.

The U-shaped heating pipes 40 are heated in the following manner:

The bent pipe 48 belonging to the one regenerator 44 connected with the respective pipe 40, of the couple of regenerators is set in such a manner that air can enter the regenerator 44. The air is heated by the refractory chequer work 43 of the latter and flows through the connecting channel 41 into the lower part of the heating pipe 40. Simultaneously the throttle valve 52 of the gas feeding conduit is regulated in such a manner that gas is fed to the burner nozzle 54. Gas and air now burn below the left-hand leg of pipe 40, Figure 4. The hot gases of combustion rise in the pipe 40 and descend in the other leg thereof. Thereupon through the channel 42 they enter the regenerator 45, where they give off part of their heat to the chequer work, and finally escape through the floor channel 46 of regenerator 45 and the bent pipe connected thereto, and situated behind the bent pipe denoted in Figure 4 by 48, into the waste gas channel 50.

As soon as the temperature of the chequer work in the regenerator 44 has lowered to such an extent that the air of combustion is not longer preheated therein as required, the direction of

flow of the media is reversed, that means, cold air of combustion is fed to regenerator 45 and heating gas to the nozzle 55, and the waste gases are drawn off through regenerator 44.

5 As to be seen in Figure 1, the heating appliances arranged on the outer sides of the coking chambers 1 are designed in such a manner, that two heating pipes 40 exist in each compartment formed by partitions 57. The latter are provided with apertures 58 alternatively on top and bottom, so that all heating chambers 38 are in communication with one another. As will be seen in Figure 1, to the one end of the heating chambers is attached the conduit 37 into which 10 the cooled heating gas is blown by the blower 36. The cold gas then flows through the apertures 58 of the partitions 57 in zig-zag through all heating chambers 38. In the last chamber 38 of the series the heating gas rises along the 20 heating pipes 40 and then flows through a double-bent pipe 27 over the oven cover through the distribution channel 28 into the adjacent coking chamber 1.

In the event that the temperature of the gas 25 flowing through the bent pipe 27 is not high enough, the temperature can be raised by auxiliary burners 58' to which gas is fed through a pipe 59 and air through a pipe 60, Figure 4. The hot gases escaping from the auxiliary burners 30 58' admix to the gas in the top channel 28.

The gases produced by the coking of the coal admix to the heating gas circulated in the cycle described above through the coking chambers and the adjacent heating appliances. Consequently, 35 the volume of the circulating quantity of gas permanently is increased. In order to keep this gas volume constant, part of the gas is withdrawn permanently from the circulation and conveyed to a usual washing and cooling apparatus, not shown. In this apparatus the condensable constituents are removed from the gas. Part of the purified gas serves to heat the heating pipes 40 and to feed the auxiliary burners 58. The gas in excess may be used for other 40 purposes, such as lightning.

Owing to the gases being cooled in the gas main 35, a small quantity of liquid hydrocarbons sometimes collects therein which must be drained from time to time. In order to maintain as 50 small as possible the condensation of gas constituents in the several pipe parts outside the oven brickwork, these outer pipe parts are enveloped by heat-insulating material 61, see Figure 4.

55 Instead of making the heating pipes 40 from ceramic material, as described above, they may consist of heat-resistant cast iron or of any other suitable material. Furthermore, it may be of advantage under certain circumstances, to 60 provide several double bent pipes 27 on the oven cover in lieu of one sole pipe, in order to maintain varying temperatures on various places of the oven chambers.

As it will be seen in Figure 1, the oven chambers 1 are of such a size, that four coking cars 9 with their boxes 13 can be lodged therein. The cars 9 are fitted on their front sides with buffer-like extensions that can be interconnected in any suitable manner (not shown).

70 The oven illustrated in Figure 1 is operated substantially as follows:

The coking cars 9 successively are charged with coal and are run with appropriate mutual distance into the chambers 1. As soon as the 75 fourth car 9 enters the respective chamber 1,

a hot car 9 is withdrawn on the other end of the chamber. The temperature in the chambers 1 and the period of time the cars remain in the chambers is so determined that during the passage of the cars the coal therein is converted to coke. As soon as the charge of the car situated on the one door 3 of the chamber has been coked, 5 the two doors 3 of the chamber are lifted and the series of cars upon entering a freshly charged car is urged forward so far that the freshly 10 charged car arrives in the chamber and the car ready for discharge arrives on the discharge place 6. This car is then uncoupled and the doors 3 are closed. Thereupon the shiftable tubes 31, which as above described previous to 15 shifting the series of cars, have been withdrawn, are shifted inwards until the apertures 11 of the cars 9 are tightly connected with the tubes 34.

While the production of coke is continued in 20 the coking chambers 1, the coke contained in the pushed car that is standing on the discharge place 6 is pushed. The pushing of the coke enclosed between the individual boxes 13 is facilitated by the space existing between the latter 25 slightly enlarging outwardly and by the boxes 13 being shiftable on the cars 9, so that upon pushing of the coke they can give way transversely of the pushing direction. After the coke has been pushed, the boxes 13 again are reset to normal position and the cover plates 18 inserted. The car is then again ready for being charged with fresh coal. This done, the car is run into the next following coking chamber. The direction of run of the cars thus permanently remains 35 the same. Within all coking chambers 1 the freshly charged cars 9 are supplied on one end and cars containing finished coke are withdrawn on the other end.

The motion of the cars may be carried on in 40 any suitable manner. In the oven illustrated they are moved by means of a wire cable disposed below the cars and actuated by a capstan situated on one of the discharge places 6. The cable preferably is endless and is put with several coils 45 around the drum of the capstan. The cars are detachably fixed to the cable in any suitable manner, for example by clamping devices known in the art. The means for moving the cars thus substantially are the same as in the usual cable 50 railways, as used in industrial works, collieries, coking plants and the like.

Figure 5 shows a modified form of the coking cars. In this modification a series of apertures 73 are provided on the floor 70 of the coking car 55 71, which like in the first embodiment rests on stationary rollers 72. The apertures 73 are surrounded by cylindrical supporting tubes 74 provided with a central opening 75 and lateral apertures 76. On the supporting tubes 74 are 60 mounted coaxial pipes 77, 78 which slightly taper upwardly. The inner pipes 78 carry outer lugs 79 that serve to hold the tubes 78 at a certain distance apart from the outer pipe 77.

The coal to be coked is charged into the annular space existing between the pipes 77, 78. In order to discharge the coke, the outer pipe 77 is extracted on the eyes 80 and the inner pipe 78 is lowered, whereupon the coke drops from the latter. 70

The coking pipes 77, 78 are uniformly distributed on the entire surface of the car 71. By the use of these pipes instead of the boxes 13 of the first embodiment the advantage is afforded that the coal can be coked in very thin layers 75

and is heated from all sides. Thereby a comparatively high coking speed is obtained and therewith also a higher yield of the oven plant.

5 Except the charging and discharging of the coal containers, the operation of this modified oven according to Figure 5 is exactly the same as that of the first-described embodiment.

What I claim is:—

1. Apparatus for production of reactive, easily
10 inflammable coke (semi-coke) by low temperature carbonization of fuel, comprising: a tunnel oven comprising a plurality of tunnel oven sectors arranged to form a circle with spaces between the sectors for charging and discharging;
15 a continuous endless circular trackway extending through all of said ovens; transporting cars adapted to run on said trackway; means for interengaging the cars for moving them in succession through each oven sector and through all
20 of the oven sectors in series; a series of metallic boxes adapted to be set and remain set in spaced side-by-side self-standing relationship on a base support therefor on the cars so as to form the heating walls of a group of coking chambers
25 alternating in position with the heating walls for coking coal in thin layers on said cars; said boxes being movably mounted at their bases on the cars so that they may be readily spread from each other on the cars for discharge of coke and may
30 be re-set on their base supports therefor on the cars for another series of coal charges in thin layers by merely resetting them up in self-standing relationship; said boxes being flued and having inlet and outlet openings for flow of heating
35 gases through the flues of the boxes; said cars being provided on their bottoms with base supporting means for supporting the bases of the boxes in self-standing relationship and with a channel communicating with the flues of the
40 boxes through flue openings therefor; each channel having a port; a conduit outside said oven sectors for circulation of heating gases; stationary ducts for communicably connecting said
45 conduit with the channels in the bottoms of the cars; longitudinally shiftable sleeves mounted in the walls of the oven sectors and each adapted to telescopically connect the port of the channel

of a car with one of the stationary ducts of the outside conduit; means for operating the sleeves to connect and disconnect them as aforesaid; a blower in communication with said outside conduit and with another conduit also communicating with said oven sectors; and means for heating gases connected with one of said conduits to provide hot heating gases for said conduits.

2. Apparatus for production of a reactive, easily inflammable coke (semi-coke) by low temper-
10 ature carbonization of fuel, comprising: a plurality of curved tunnel ovens arranged in series as sectors of a circle, adjacent ovens in the series being spaced from each other to provide between
15 the ends of the adjacent ovens accessible stations for discharging coke and recharging fuel for coking; a continuous endless circular track extending through all of said ovens; transporting cars adapted to run on said track and having
20 base supporting means for cooperation with the bases of the walls of coking receptacles so as to support the same in self-standing relationship on the cars; means for interengaging the cars for
25 moving the cars in succession through each oven and through all of said ovens in series; coking receptacles comprising walls adapted to be set and remain set in laterally spaced self-standing
30 relationship relative to each other on the base supporting means therefor on the cars so as to form a group of coking chambers for coking coal in thin layers on said cars, the walls forming
35 the coking receptacles being separable from each other and having their bases mounted on the cars for separating the walls forming the receptacles from each other and from the cars for discharge of finished coke; the walls of the receptacles being also adapted for being covered on one side by the fuel and to be traversed by heating
40 gases on the other side to coke the fuel; means for flowing heating gases through each of said ovens for low temperature coking as aforesaid; and means at each of said stations for discharging said receptacles after leaving one sector and for reloading them before re-entering the next
45 sector.

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