

Aug. 12, 1969

J. KNAPPSTEIN ET AL

3,461,037

INCLINED ROTARY FURNACE

Filed July 6, 1965

3 Sheets-Sheet 1

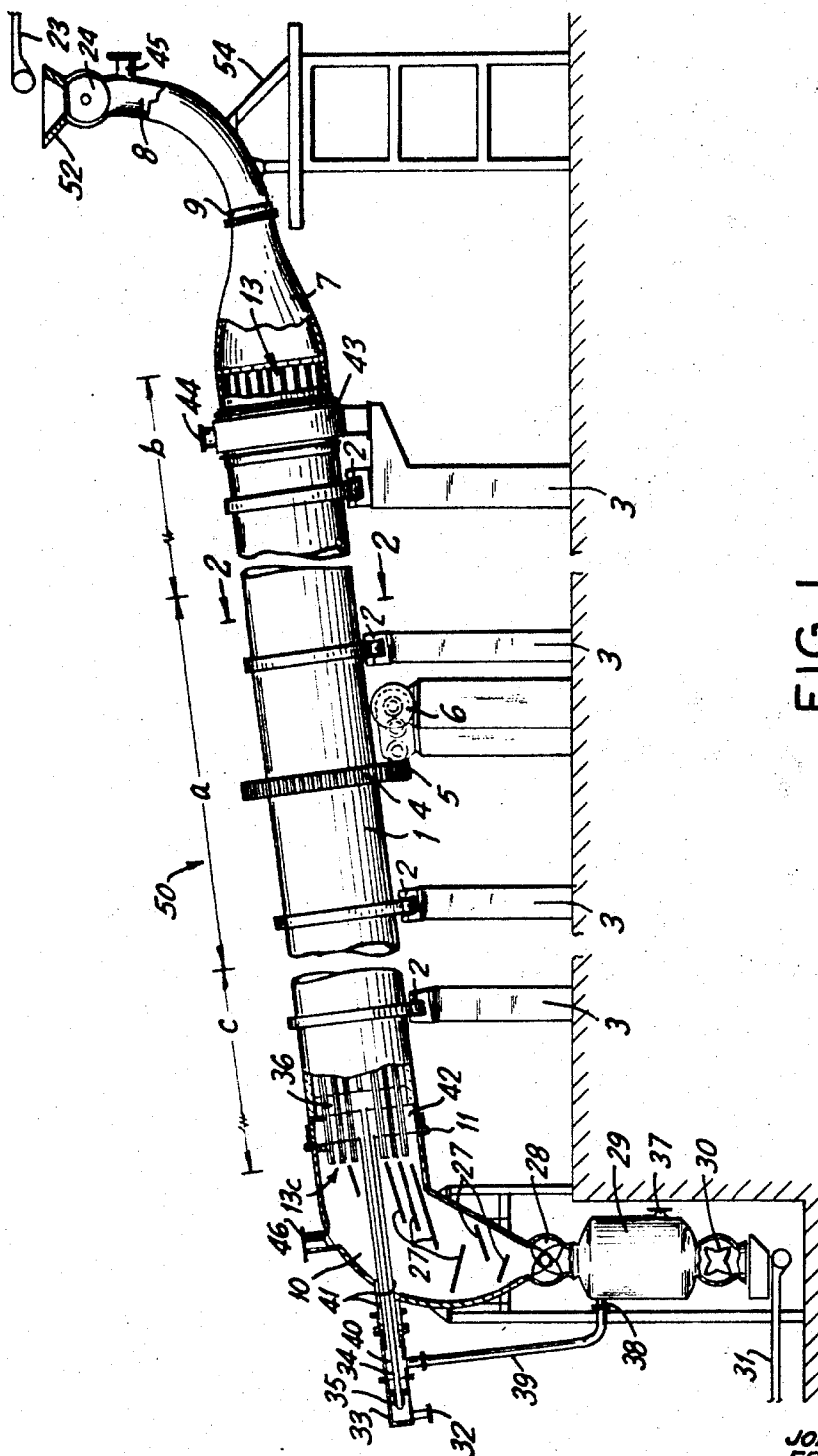


FIG. 1

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3 Sheets-Sheet 2

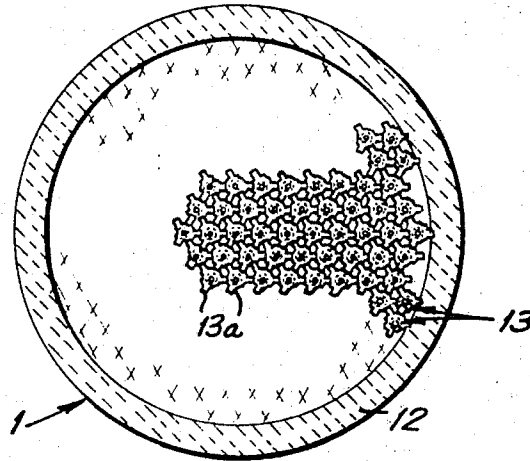


FIG. 2

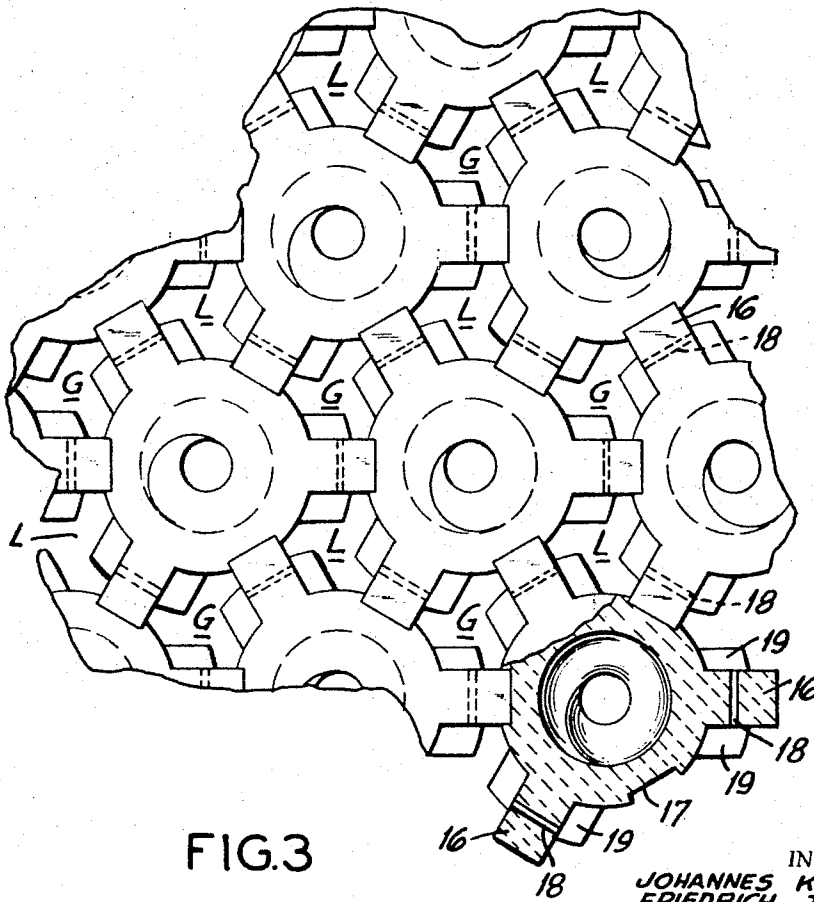


FIG. 3

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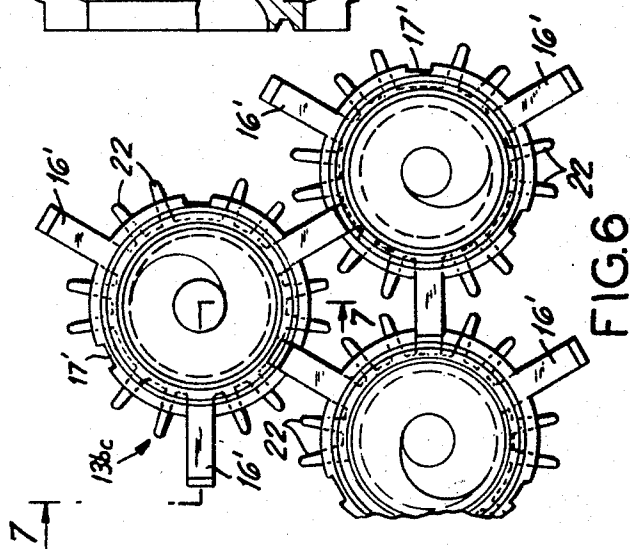
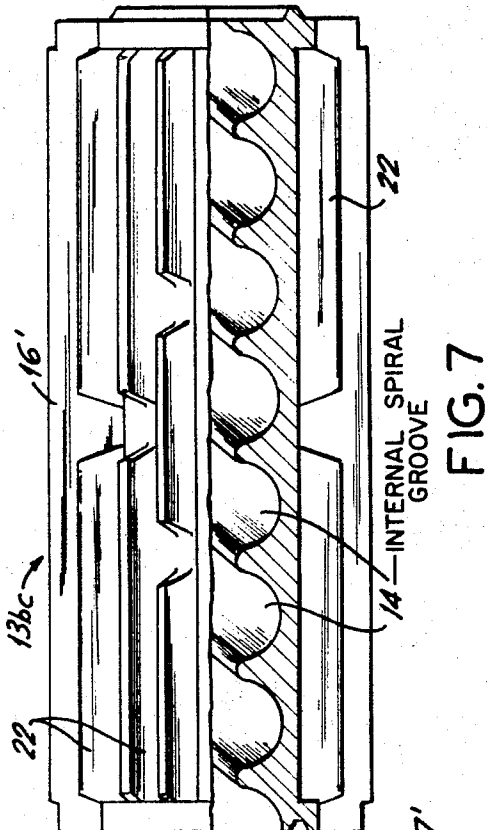
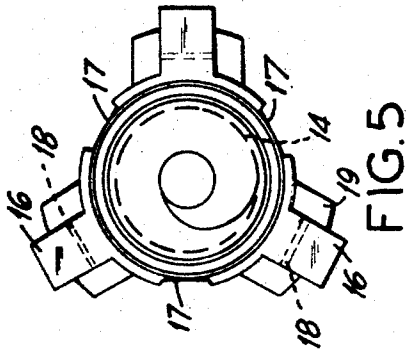
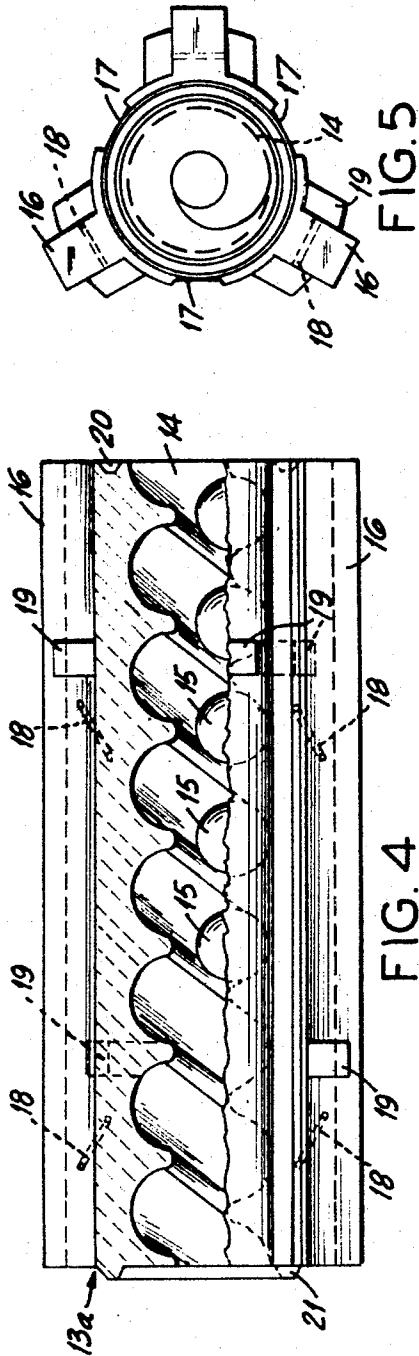
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3 Sheets-Sheet 3



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3,461,037

INCLINED ROTARY FURNACE

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10 Claims 10

ABSTRACT OF THE DISCLOSURE

A furnace for the continuous coking of fuel includes a large rotatable tube which is supported with its axis of rotation inclined. A plurality of tubes are disposed within the next outer tube and extend axially therealong. Each of the tubes have a bore with an axially progressing groove of a configuration of the briquet to be coked. The tubes have a plurality of projections and recesses for the interengagement of adjacent tubes therewith in a gas-tight manner and the tubes are in a spacial relationship such that a plurality of separate axially extending passages are defined therebetween. These latter passages are for the separate flow of combustion media and air. The briquets advance through the furnace by rotation of the outside tube.

This invention relates, in general, to an apparatus and method for the coking of coal and, in particular, to a new and improved method for the continuous coking of coal briquets from coal dusts, and to an improved apparatus for effecting the same.

At the present time there are a number of methods which are available for the continuous coking of coal briquets for coal dusts, for example, the coal dusts or particles may be continuously directed into the top of a shaft furnace and coked. The coke is then discharged at the bottom. Direct (autogenous coking) or indirect heating is possible. Difficulties are encountered in the systems with respect to the permeability of the coal briquets to be coked to gases, for example, air and to escaping coke-oven gases, particularly when caking coal is used. Shaft furnaces are not generally applicable for such a process, particularly since their height must be adapted to the properties of the coal. Such adjustment definitely impairs the economy of such furnaces.

Coal briquets can also be coked in so-called tunnel furnaces through which they are conducted in piles or stacks on moving stands. Such known methods, however, have not been too successful in the industry for various reasons, particularly because the technical expenditure for the apparatus is too high.

It has also been attempted to carbonize coal in revolving tubular furnaces which are provided with air tubes, and while using fine grained coal, but this process permits only the obtaining of fine grained coke or coked breeze. Such a process has produced a generally inferior product.

It was found that coal briquets can be coked continuously from fine coal with or without the addition of binders by using a space-time yield which is greater than that of chamber coking.

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Molded coke can be obtained therefrom if the coal is molded into the desired shapes (e.g., ball-shaped ellipsoid-shaped, barrel-shaped or cylindrical-shaped bodies) whose end faces may be either curved or flat. In accordance with the invention, such bodies may be heated in a slightly inclined tube which either rotates about its axis or in a direction parallel to its axis. The coal briquets perform a continuous rolling movement inside the tube and move down the inclined tube slowly from one end to the other.

In accordance with a feature of the invention, it has been found advantageous to control the continuous movement of the briquets by designing the tubes in their interiors in the manner of a large female thread or continuous spiral groove. When the tubes are rotated, the coal briquets are guided continuously and their path is prescribed by the outline of the groove in the tube.

Another feature of the process is that the heating of the briquets in such a tube can be effected either indirectly from the outside or by direct heat transfer, for example, by burning a part of the gases formed by the coal during coking (autogenous coking).

In a preferred construction for use with the method of the invention, it has been found desirable to combine a plurality of tubes into a nest of tubes which nest is arranged to rotate about a common slightly inclined axis. When using a nest of tubes, the tubes are provided with an outer jacket which is protected by insulation against heat losses. In a preferred construction, the tubes are provided in their interior with a continuous thread or groove having a cross section in the form of the briquet to be formed, for example, semi-circular, ellipsoidal, barrel-shaped or smooth.

In accordance with the invention, the apparatus for coking coal advantageously includes means for facilitating the orderly entrance of the coal briquets into the coking tubes at their upper ends which includes a feed hopper which is arranged to direct the briquets into the tubes. The tubes advantageously have an opening which is only slightly greater than the cross section of the coal briquets so that only one briquet can enter during a revolution of the tube. The tubes are preferably so designed that their female screw thread has a cylindrical core diameter which corresponds approximately to the cross section of the coal briquet.

In a preferred method of the invention, the nest of tubes is heated not over the entire length, but only in a certain section, for example, in a center section. In order to facilitate the process, the tubes are designed according to the invention as ducts both on their interiors and between adjacent tubes. The exterior space between adjacent tubes provided separate flow paths or conduits for combustion media and air. If the air and the combustion media, for example, poor gas are introduced at the lower end of the revolving tubular furnace, the separated cell chambers formed between the tubes serve as feed ducts for the combustion media. The glowing coke briquets move in the tubes toward the lower end of the revolving tubular furnace and the combustion media flows in an opposite direction upwardly in the passage formed between adjacent tubes. During the flow conditions outlined, the heat is exchanged and the combustion media is first preheated. By the time the combustion media advances over the outside of the tubes to the central section, the combustion media becomes ignited. In the center section, in particular, there are provided openings between

the separated cells formed by the exteriors or projections of adjacent tubes which permit mixing of the combustion media. The openings are provided over the entire length of the heating zone so that the combustion of the heating gas takes place in steps over the entire length of the heating zone.

In order to ensure the alternating entrance of the air into the gas ducts and the gas into the air ducts, which are advantageously formed as separated ducts between groups of tubes, baffles are arranged behind the openings in the direction of the flow of the combustion media in order to produce the necessary gradients for the desired flow conditions.

After combustion, the hot waste gases continue to flow upward from the heating zone to the preheating zone and the individual channels formed on the exterior of the tubes need no longer be sealed from each other. The gases are separated from the coal briquets which enter from the tops of the tubes and move through the interior of the tubes in heat exchange relationships. As the heating gases move upwardly around the exteriors of the tubes, the coal briquets move downwardly and arrive in a preheated state in the central coking zone. In this manner, it is possible to employ the sensible heat of the hot coke and that of the hot combustion gases for the coking process, and both the combustion media and the coal briquets arrive in a preheated state in the coking zone of the center of the tubular furnace.

In some instances, it is desirable to reverse the path of flow of the combustion media so that it too enters from the top in order to provide a direct flow heat exchange, which is not usually as good as a counter flow exchange.

In some instances, it is desirable to heat the revolving furnace by the use of a rich gas, instead of poor gas. In such a case, as well as in autogenous coking, the lower portions of the ducts only serve for preheating the air. Rich gas is supplied by means of known devices only at the start of the heating zone.

The device is advantageously constructed with tube walls which correspond in materials and thickness to the temperature of the gases encountered. In the combustion zone proper, in which temperatures of 1000 to 1200° C. prevail, the tubes and the ducts are made of a ceramic material such as a refractory material. In the superposed preheating zone for the coal briquets and also in the cooling zone for the hot coke briquets, the tubes are advantageously made of a metal, for example, cast iron. The complete furnace construction advantageously includes a plurality of tubes which are joined end-to-end and which include lugs or projections advantageously projecting at spaced locations, for example, equally spaced locations 120° apart to provide for the formation of ducts for combustion gas and air flow between the exterior peripheries of adjacent tubes. The tubes are advantageously provided with complimentary depressions which receive the projections or lugs of the next adjacent tube so that they may be fitted together in gas-type relationship to provide the defined gas and air paths which are necessary.

In the central high temperature area, the tubes are advantageously made with a refractory lining but the tubes in the preheating and cooling zone may be made of a metal construction with walls much thinner than the ceramic tubes in the coking zone. By such a construction, it is also possible to provide ribs, needles or pegs on the outer zones to increase the outer surface of the tubes and the heat exchange capabilities thereof.

In accordance with the process, it has been found possible to maintain the rotation of the furnace at a constant speed. It was found expedient, however, to superimpose on the uniform rotary movement, a periodic acceleration or retardation so that the coal briquets are moved or jarred in addition to their continuous rolling movement down the tube along the groove defined within the interior thereof. In this manner, the pelletizing effect is increased and the heat transfer between the coal briquets and the tubes is enhanced.

The complete furnace is advantageously constructed such that some of the chambers defined in the exterior of the tubes communicate with a common supply chamber for the combustion media and others communicate with a common supply chamber for the air.

At the upper end the ducts carrying the waste heat of the gases, which ducts are formed between the tubes, open into a collecting chamber which also connects to the interior of the coking tubes. From this collecting chamber, the waste heat gases are directed out a chimney. At temperature at around 300° C. the formation of the distillation products sets in. At coking temperatures of about 600° C. the coke oven gases contain some quantities of aliphatic hydrocarbons while in the range of about 800 to 1200° C. the aromatic character of the hydrocarbons predominates. In the coking process, according to the invention, using a revolving tubular furnace, all the temperature stages are traversed by the movement of the coal briquets. Depending on the side toward which the distillation products are withdrawn, the gases can be obtained having hydrocarbon contents which consist predominantly of aliphates or aromates. If the distillation products are withdrawn at the top in counter flow to the movement of the coal briquets being coked, they are conducted over the coal briquets which move toward the coking zone. Since these gases are relatively cool, the hydrocarbons are not cracked and the aliphatic hydrocarbons are maintained. When using a reverse path of coke-oven gases, the distillation products escape at the bottom and over the glowing coke. The aliphatic hydrocarbons are then cracked and are converted to aromates. By applying different underpressures at both ends of the coking tubes, the gases can also be withdrawn partly at the top and partly at the bottom. Depending on whether more aliphatic or more aromatic hydrocarbons are desired, the distillation products are withdrawn at either the top or the bottom or at both sides.

If the distillation products are withdrawn at the top, the coal briquets are not only preheated indirectly by the waste heat gases, but are also directed by the contact with the distillation products. Dust and tar are then deposited on the coal briquets to be preheated and the distillation products are thus cleaned, while the dust and tar move with the coal briquets into the coking zone where they are coked.

With the reversed withdrawal, the glowing coke briquets act as dust filters and the deposited tar is coked to a certain extent on their surfaces so that a relatively clean current of distillation products is obtained. Withdrawal of the distillation products at the top is preferred however.

In accordance with the inventive method and using the inventive apparatus, it was found surprisingly that the coal briquets showed no tendency to stick to the tube walls at any point of the furnace not even where their surface becomes plastic. The coke-oven gases need not be conducted in direct flow or in counter flow to the moving coal and coke briquets, respectively, but they can be withdrawn at the coking zone, that is, at their upper or lower end from the revolving tubular furnace. Using rich gas heating, the gas produced in the revolving tubular furnace itself is preferably used after condensation, possibly after separation of the hydrocarbons, ammonia and hydrogen sulphide. In order to improve heat regulation, it is possible to return the coke oven gases and the waste heat gases back to the cycle and in the furnace.

Heating can also be effective with other fuels, for example, a fuel like fuel oil. The necessary equipment is more complicated, however, than that for gas heating.

In the case of autogenous coking, the coking tubes are arranged close together so that the throughput of the revolving tubular furnace is increased. The heat required for the coking is then produced by partial combustion of the coke oven gas. The necessary air is fed to the coking tubes themselves. A revolving tubular furnace of the invention can be designed in a similar manner as for indirect heating with ducts arranged in the preheating part

between the individual coking tubes. In this case, the coking tubes are used only for preheating the combustion air. In the range of the coking zone, the tubes are then provided with gas passages to the interior of the coking tubes through which indirectly preheated air is directed to supply coking heat by partial combustion of the coke oven gases. Here too, baffle plates can be arranged in the air path to ensure the necessary pressure gradient over the entire length of the coking zone. For autogenous coking, the air ducts extend from the inlet along the furnace tubes to the coking zone or only up to the coking zone cooling location. The coke-oven gases are withdrawn inside the coking tubes at the bottom or the top at the extreme end of the revolving tubular furnace or directly at the upper or lower end of the coking zone.

In accordance with the method of the invention, the coke briquets are discharged from the coking tubes and drop into a discharge unit which is closed at the bottom, for example, by a bucket wheel. The bucket wheel discharges the coke briquets which still have a temperature of 400° C. into a gas-tight collecting vessel from which they are discharged again by a bucketwheel and fed over a conveyor belt to their destination. The sensible heat which still exists in the coke briquets in the collecting vessel is utilized according to the invention for the first preheating of the combustion media. The combustion media is conducted through the collecting vessel and then directed directly to the tubes (autogenous coking) or to the chamber at the lower end from where they are fed to individual ducts between the coking tubes. It is also possible to provide two coke collecting vessels and to charge one of them or both alternately with the hot coke and to preheat in one vessel air and in the other poor gas. With rich gas heating, as well as in autogenous coking, one collecting vessel is sufficient.

An object of the invention is to provide a method for the continuous coking of coal briquets and the production of a molded coke by continuously heating the briquets in a tube as the tube is rotated in a position at which the briquets move along the axis thereof.

A further object of the invention is to provide a method for the continuous coking of coal briquets where the heating of the briquets is effected by indirect heating on the outer walls of tubes through which the briquets are directed.

A further object of the invention is to provide an apparatus for the coking of coal which includes a furnace comprising a plurality of tubes arranged in a bundle with their axis inclined and each tube having a passage defined therethrough for the passage of a coal briquet and with the spaces surrounding the tubes defining a flow path for combustion media, which advantageously is directed over the tubes in a direction different to the advance of the briquets within the tubes.

A further object of the invention is to provide a furnace for the coking of coal which includes a tube bundle arrangement formed by a multiplicity of tubes each having a passage defined therethrough and a spiral groove of a configuration of a final coal briquet defined along the interior and wherein the tubes further include formations on the exterior which define together with additional tubes additional passages around the exterior of the tubes for combustion media.

A further object of the invention is to provide a furnace tube construction for a coking furnace.

A further object of the invention is to provide a furnace construction and a furnace tube construction which is simple in design, rugged in construction, and economical to manufacture.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this application. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descrip-

tive matter in which there are illustrated and described preferred embodiments of the invention.

In the drawings:

FIG. 1 is a partial side elevational and partial longitudinal sectional view of a coking furnace constructed in accordance with the invention;

FIG. 2 is a section taken on the line 2—2 of FIG. 1;

FIG. 3 is an enlarged partial and elevational view of the tube nest for the furnace of FIG. 1;

FIG. 4 is a partial side elevational and partial longitudinal sectional view of an individual tube;

FIG. 5 is an end elevational view of the tube indicated in FIG. 4;

FIG. 6 is a partial and elevational view of a nest of tubes of a nest of another embodiment of tubes; and

FIG. 7 is a section taken on the line 7—7 of one of the tubes indicated in FIG. 6.

Referring to the drawings, in particular, the invention as embodied in FIG. 1 comprises a continuous coking furnace generally designated 50 which includes an elongated hollow tube 1 which is rotatably mounted on a plurality of bearings 2 on foundation pillars 3 for rotation about an inclined axis. The tube 1 is rotated by means of a gear 4 which is secured to the exterior periphery of the tube and which is driven by a gearing 5 from an electric motor 6.

In accordance with the invention, the furnace is operated preferably to maintain a central combustion zone or heating zone *a* with a preheating zone *b* on one end and a cooling zone *c* on the opposite end.

Pre-pressed coal briquets are delivered along a conveyor 23 and directed into an open hopper 52 having a rotary drum seal 24 for the delivery of the briquets downwardly into a vertical feed pipe 8 which is mounted on a fixed support 54. A rotatable feed hopper 7 is connected to sealing elements 9 to the vertical feed pipe 8 and connects at its lower end to the tube 1 of the rotary furnace 50.

In accordance with the invention, the interior of the tubular furnace 1 is lined with an insulating layer 12 (FIG. 2) which may be a refractory material, for example, and a multiplicity of tubes generally designated 13 extend the full length of the interior of the tube 1 at least in the combustion zone *a*, the preheating zone *b* and the cooling zone *c*. In a preferred arrangement, the tubes 13 are arranged to extend with their axes parallel to the tube 1 and are arranged so that the exterior peripheries interengage to form a plurality of passages throughout the tube 1 for the combustion media. In this manner, the coking of pressed spherical coal briquets is provided by indirect heating and it is possible to recover released rich gas.

In the combustion zone *a*, it has been found preferable to arrange the tubes 13 in the manner indicated in detail in FIG. 2. At least for the combustion zone *a*, it is preferable that the tubes 13a be of a ceramic material, as indicated in FIGS. 4 and 5, whereas in the other zones, the preheating zone and the cooling zones *b* and *c*, the tubes may be of a type 13bc in FIGS. 6 and 7 which tubes are made of metal, preferably of heat resistant cast iron. Both the tubes 13a and the tubes 13c have a helical or progressive groove 14 defined therethrough dimensioned to permit passage of coal pellets or briquets 15. The configuration of the grooves 14 is such that the coal pellets 15 can roll along the groove in an axial progression as the tubular furnace 1 is rotated. In the embodiment illustrated, the grooves are indicated to be rounded to accommodate spherical pellets, but, of course, they may be made of a configuration to accommodate cylindrical, ellipsoidal or other shaped pellets in a manner to permit the progression of the pellets through the tubes as the outside tube 1 is rotated.

In accordance with a feature of the invention, the tubes 13 are of a configuration such that their exteriors form separate passageways for the flowing of a separate fluid

media, for example, the combustion media. For this purpose, each of the tubes is provided with three lugs 16 which project outwardly from the surface at equally spaced locations and also with three grooves 17 which are located between the lugs around the exterior surface. The lugs 16 of adjacent tubes fit into the grooves 17 of the other tubes as best indicated in FIGS. 2 and 3 and define, in the embodiment of the furnace illustrated, separate combustion media gas passages G and air passages L. In order to permit the combining of the combustion media gas and the air, slots 18 are provided which extend through the lugs 16 at various intervals in order to permit air to be alternately conducted from the air ducts L into the gas ducts G and inversely the gas from the gas ducts G into the air ducts L. The slots 18 are advantageously distributed over the entire length of the combustion zone *a* indicated in FIG. 1 so that the combustion takes place in steps similar to the well known heat ducts of horizontal chamber coke-ovens having great chamber heights. In this manner, it is possible to ensure uniform heating of the coking tubes over the required length. In order to obtain the necessary pressure gradients between the gas and the air ducts G and L, baffle plates 19 are arranged in the air ducts L immediately behind the slots 18 at the points where the air is to be directed into the gas ducts. In the same manner, baffle plates 19 are also arranged in the gas ducts at the point where the gas is to be introduced into the air ducts.

Each of the tubes 13, as best indicated in FIG. 4, is provided with an annular tongue 21 at one end and an annular recess of corresponding dimensions 20 at the opposite end to permit a plurality of tubes to be assembled together in an axial direction using mortar to make the connection gas tight and permanent. Mortar is also applied in the assembly and the depressions 17 before the lugs 16 of the next adjacent tube are inserted. This results in a stable ceramic structure with ducts for the combustion media separated in a gas tight manner from each other and with gas-tight coking tubes for the movement and pelletization and coking of the coal briquets.

The metallic tubes 13*bc* (FIGS. 6 and 7) are arranged in the part of the furnace where the operating temperature permits the use of a metallic tube part. The interior of these tubes, as indicated in FIGS. 6 and 7, correspond to the tubes 13*a* with the exception that the walls are made thinner because of the change of material. In this embodiment, projections or lugs 16' are made of a different dimension and, in addition, the tubes are provided with ribs 22 to improve the heat transfer between the coal and the interior of the tube and the combustion media and waste heat.

The device operates by feeding the coal briquets from the conveyor 23 into the rotatable hopper 7 which rotates to bring the briquets up to a speed of rotation necessary for entering into the grooves 14 of the tubes 13 and traveling therealong in the preheating zone *b*. They are advanced along the axis of each tube until they finally issue from the tubes at the extreme end after passing through the combustion zone *a* and the cooling zone *c*.

In a preferred arrangement, the coal briquets are first heated in the preheating zone *b* in heat exchange with waste gases and then are delivered to the combustion zone proper *a* where they are heated to the coking temperature. The coked briquets then roll through the cooling zone *c* where they give off some of their heat to the combustion media which is flowing upwardly through the gas tubes G and they leave the tubes 13*c* cooled to a temperature below their ignition temperature. A discharge chute 10 is connected to this end of the furnace tube 1 and is provided with a plurality of baffles 27 which are arranged in a position for directing the discharge briquets past a valve element 28 and into a container 29 through a valve element or gas gate 30 and onto a discharge conveyor 31.

In the construction indicated in FIG. 1, a provision is made for heating with poor gas, which can be obtained, for example, by mixing rich gas obtained in the process with a waste heat gas.

The combustion media gas is advantageously directed through a nipple 32 and defined in a fixed tube 33 and into a tube 34 which is rotatable within the fixed tube and connects from the tube 33 to a chamber 36 which interconnects at this end of the furnace all of the gas ducts G formed around the peripheries of the tubes 13. The tubes 33 and 34 are connected together by means of gas-tight rotary connections 35. The connecting chamber 36 is so designed that the gas ducts G connect into the chamber while the coking tubes 13 and the air ducts L extend through the chamber in a gas-tight manner.

The necessary combustion air is directed into a nipple or fitting 37 and through the preheating chamber 29 where it obtains heat from the coke briquets which are delivered thereto. The air is then directed outwardly through a fitting 38 to a conduit or pipe 39 and into a compartment space 40 formed in the tubular element 33. The space 40 communicates with a tubular element 41 which is rotatably mounted and connects at its other end into an air chamber 42. All of the air ducts 1 connect into the air chamber 42, but the tubes 13 extend through the air chamber in a gas-tight manner. At this location the lugs 16 and the grooves 17 are advantageously eliminated from the tubes 13 where they extend through the connecting chamber 42. The waste heat is eliminated through the connecting chamber 43 which is arranged around the tubes 13 at the heat of the preheat zone at the upper end of the furnace 50. All of the air ducts 1 open into the chamber 43 and the waste gases are directed out through a connection 44. The rich gas which is produced can be withdrawn either through a connection 45 at the upper end of the vertical tube 8, or at a connection 46 at the discharge unit 10.

It should be appreciated that the grooves in the tubes 13 may be of any configuration and, for example, if barrel-shaped briquets are to be formed, then the groove is similarly formed. In some instances, helical guide plates are desirable in the groove formations.

If the heating of the coking in the coking zone *a* is to be effected with gases which cannot be preheated, for example, a rich gas, a residual gas from synthesis, natural gas, liquid gas or similar gas, these are fed approximately at the boundary surface between the cooling zone *c* and the combustion zone *a* through a connecting chamber for the gas ducts G which would be provided at such location. In such an installation, the gas ducts G which are provided in the cooling zone would be employed for preheating the air instead of for gas flow.

The revolving tubular furnace 50 can also be used for the so-called autogenous coking where the production of rich gas is eliminated. In such a case, the preheating zone *b* and the cooling zone *c* can be omitted. The air and gas ducts G and L can also be omitted. The coking tubes are then directly juxtaposed without any interval and the air supply is effected from the filling side and the withdrawal of the waste heat gases from the discharge side.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A furnace for the continuous coking of fuel, comprising a large rotatable tubular furnace, means rotatably supporting said tubular furnace with the axis of rotation of the furnace inclined, a plurality of tubes disposed inside said tubular furnace and extending axially therealong, each of said tubes having a bore with an axially progressing groove of a configuration of the briquet to be coked, means connected to said tubular furnace for directing coal briquets into the tubes, said tubes each having a plurality

of projections and recesses formed at spaced locations around the periphery thereof, the projections and grooves of adjacent tubes being interengaged in a gas-tight manner and defining around the periphery of said tubes a plurality of separate axially extending passages which extend along the length of said tubes on the exteriors thereof for the separate flow of combustion media and air, means for directing combustion media through the gas passages for aiding in the combustion and coking of the briquets, and means for rotating said tubular furnace to advance the briquets through said tubes.

2. A furnace for the continuous coking of fuel, comprising a large rotatable tubular furnace, means rotatably supporting said tubular furnace with the axis of rotation of the furnace inclined, means for rotating said tubular furnace, a plurality of tubes disposed inside said tubular furnace and extending axially therealong, each of said tubes having a bore with an axially progressing spiral groove of a configuration of the briquet to be coked, a rotatable feed hopper connected to the upper end of said tubular furnace for directing coal briquets into the tubes, means for directing briquets into the rotatable feed hopper, said tubes each having a plurality of projections and recesses formed at spaced locations around the periphery thereof, the projections and grooves of adjacent tubes being interengaged in a gas-tight manner and defining around the periphery of said tubes a plurality of separate axially extending gas and air passages which extend along the length of said tubes on the exteriors thereof for the separate flow of combustion media and air, a discharge unit connected to said tubular furnace at the lower end thereof said discharge unit including means defining a discharge chamber for the briquets which have been coked and cooled, and means for directing a combustion media such as poor gas into the discharge chamber for preheating the combustion media from the coked briquets, and for thereafter directing the preheating combustion media through the gas passages for first cooling the coked briquets, then aiding in the combustion of the briquets, and for thereafter preheating the incoming briquets as they pass through said tubes.

3. A furnace for the continuous coking of fuel, comprising a large rotatable tubular furnace, means rotatably supporting said tubular furnace with the axis of rotation of the furnace inclined, means for rotating said tubular furnace, a plurality of tubes disposed inside said tubular furnace and extending axially therealong, each of said tubes having a bore with an axially progressing groove of a configuration of the briquet to be coked, means for directing coal briquets into the tubes, said tubes each having a plurality of projections and recesses formed at spaced locations around the periphery thereof, the projections and grooves of adjacent tubes being interengaged in a gas-tight manner and defining around the periphery of said tubes a plurality of separate axially extending gas and air passages which extend along the length of said tubes on the exteriors thereof for the separate flow of combustion media and air, a discharge unit connected to said tubular furnace at the lower end thereof said discharge unit including means defining a discharge chamber for the briquets which have been coked and cooled, means for directing a combustion media such as poor gas into the discharge chamber for preheating the combustion media from the coked briquets, and for thereafter directing the preheated combustion media through the gas passages for first cooling the coked briquets, then aiding in the combustion of the briquets, and for thereafter preheating the incoming briquets as they pass through said tubes, said means including a separate gas chamber and means for connecting the gas passages defined around some of said tubes to said gas chamber, means for directing air through said discharge chamber for preheating said air and then for directing said air through said air passages defined around said tubes including a separate air chamber defined adjacent the ends of said tubes communicating with the air passages formed around said tubes.

4. A furnace for the continuous coking of fuel, comprising a large rotatable tubular furnace, means rotatably supporting said tubular furnace with the axis of rotation of the furnace inclined, means for rotating said tubular furnace, a plurality of tubes disposed inside said tubular furnace and extending axially therealong, each of said tubes having a bore with an axially progressing spiral groove of a configuration of the briquet to be coked, a rotatable feed hopper connected to the upper end of said tubular furnace for directing coal briquets into the tubes, means for directing briquets into the rotatable feed hopper, said tubes each having a plurality of projections and recesses formed at spaced locations around the periphery thereof, the projections and grooves of adjacent tubes being interengaged in a gas-tight manner and defining around the periphery of said tubes a plurality of separate axially extending gas and air passages which extend along the length of said tubes on the exteriors thereof for the separate flow of combustion media and air, a discharge unit connected to said tubular furnace at the lower end thereof said discharge unit including means defining a discharge chamber for the briquets which have been coked and cooled, means for directing a combustion media through the gas passages for aiding in the combustion of the briquets, and means for directing air through said air passages defined around said tubes.

5. A furnace for the combustion coking of fuel, comprising a large rotatable tubular furnace, means rotatably supporting said tubular furnace with the axis of rotation of the furnace inclined, means for rotating said tubular furnace, a plurality of tubes disposed inside said tubular furnace and extending axially therealong, each of said tubes having a bore with an axially progressing spiral groove of a configuration of the briquet to be coked, said tubes each having a plurality of projections and recesses formed at spaced locations around the periphery thereof, the projections and grooves of adjacent tubes being interengaged in a gas-tight manner and defining around the periphery of said tubes a plurality of separate axially extending gas and air passages which extend along the length of said tubes on the exteriors thereof for the separate flow of combustion media and air, a discharge unit connected to said tubular furnace at the lower end thereof said discharge unit including means defining a discharge chamber for the briquets which have been coked and cooled, means for directing a combustion media through the gas passages for aiding in the combustion of the briquets and for thereafter preheating the incoming briquets as they pass through said tubes, said means including a separate gas chamber and means for connecting the gas passages defined around some of said tubes to said gas chamber.

6. A furnace for the continuous coking of fuel, comprising a large rotatable tubular furnace, means rotatably supporting said tubular furnace with the axis of rotation of the furnace inclined, means for rotating said tubular furnace, a plurality of tubes disposed inside said tubular furnace and extending axially therealong, each of said tubes having a bore with an axially progressing groove of a configuration of the briquet to be coked, said tubes each having a plurality of projections and recesses formed at spaced locations around the periphery thereof, the projections and grooves of adjacent tubes being interengaged in a gas-tight manner and defining around the periphery of said tubes a plurality of separate axially extending gas and air passages which extend along the length of said tubes on the exteriors thereof for the separate flow of combustion media and air, a discharge unit connected to said tubular furnace at the lower end thereof said discharge unit including means defining a discharge chamber for the briquets which have been coked and cooled, means for directing a combustion media through the gas passages for first cooling the coked briquets, then aiding in the combustion of the briquets and for thereafter preheating the incoming briquets as they pass through said tubes, said means including a separate gas chamber and means for

connecting the gas passages defined around some of said tubes to said gas chamber, and means for directing air through said discharge chamber for preheating said air and then for directing said air through said air passages defined around said tubes including a separate air chamber defined adjacent the ends of said tubes communicating with the air passages formed around said tubes.

7. A furnace for the continuous coking of fuel, comprising a large rotatable tubular furnace, means rotatably supporting said tubular furnace with the axis of rotation of the furnace inclined, means for rotating said tubular furnace, a plurality of tubes disposed inside said tubular furnace and extending axially therealong, each of said tubes having a bore with an axially progressing spiral groove of a configuration of the briquet to be coked, a rotatable feed hopper connected to the upper end of said tubular furnace for directing coal briquets into the tubes, means for directing briquets into the rotatable feed hopper, including a conveyor for the coal briquets and a hopper disposed below said conveyor, said tubes each having a plurality of projections and recesses formed at spaced locations around the periphery thereof, the projections and grooves of adjacent tubes being interengaged in a gas-tight manner and defining around the periphery of said tubes a plurality of separate axially extending gas and air passages which extend along the length of said tubes on the exteriors thereof for the separate flow of combustion media and air, a discharge unit connected to said tubular furnace at the lower end thereof said discharge unit including means defining a discharge chamber for the briquets which have been coked and cooled, means for directing a combustion media such as poor gas into the discharge chamber for preheating the combustion media from the coked briquets, and for thereafter directing the preheated combustion media through the gas passages for first cooling the coked briquets, then aiding in the combustion of the briquets, and for thereafter preheating the incoming briquets as they pass through said tubes, said means including a separate gas chamber and means for connecting the gas passages defined around some of said tubes to said gas chambers, means for directing air through said discharge chamber for preheating said air and then for directing said air through said air passages defined around said tubes including a separate air chamber defined adjacent the ends of said tubes communicating with the air passages formed around said tubes.

8. A furnace for the continuous coking of fuel, comprising a large rotatable tubular furnace, means rotatably supporting said tubular furnace with the axis of rotation of the furnace inclined, means for rotating said tubular furnace, a plurality of tubes disposed inside said tubular furnace and extending axially therealong, each of said tubes having a bore with an axially progressing spiral groove of a configuration of the briquet to be coked, a rotatable feed hopper connected to the upper end of said tubular furnace for directing briquets into the rotatable feed hopper, including a conveyor for the coal briquets a hopper disposed below said conveyor and rotary gas-tight valve for delivering said briquets from said hopper into said rotating feed hopper, said tubes each having a plurality of projections and recesses formed at spaced locations around the periphery thereof, the projections and grooves of adjacent tubes being interengaged in a gas-tight manner and defining around the periphery of said tubes a plurality of separate axially extending gas and air passages which extend along the length of said tubes on the exteriors thereof for the separate flow of combustion media and air, a discharge unit connected to said tubular furnace at the lower end thereof said discharge unit including means defining a discharge chamber for the briquets which have been coked and cooled, means for directing a combustion media such as poor gas into the discharge chamber for preheating the combustion media from the coked briquets, and for thereafter directing the preheated combustion media through the gas passages for

first cooling the coked briquets, then aiding in the combustion of the briquets, and for thereafter preheating the incoming briquets as they pass through said tubes, said means including a separate gas chamber and means for connecting the gas passages defined around some of said tubes to said gas chamber, means for directing air through said discharge chamber for preheating said air and then for directing said air through said air passages defined around said tubes including a separate air chamber defined adjacent the ends of said tubes communicating with the air passages formed around said tubes.

9. A furnace for the continuous coking of fuel, comprising a large rotatable tubular furnace, means rotatably supporting said tubular furnace with the axis of rotation of the furnace inclined, means for rotating said tubular furnace, a plurality of tubes disposed inside said tubular furnace and extending axially therealong, each of said tubes having a bore with an axially progressing spiral groove of a configuration of the briquet to be coked, a rotatable feed hopper connected to the upper end of said tubular furnace for directing coal briquets into the tubes, means for directing briquets into the rotatable feed hopper connected to the upper end of said tubular furnace for directing coal briquets into the tubes, means for directing briquets into the rotatable feed hopper, including a conveyor for the coal briquets, a hopper disposed below said conveyor, and rotary gas-tight valve for delivering said briquets from said hopper into said rotating feed hopper, said tubes each having a plurality of projections and recesses formed at spaced locations around the periphery thereof, the projections and grooves of adjacent tubes being interengaged in a gas-tight manner and defining around the periphery of said tubes a plurality of separate axially extending gas and air passages which extend along the length of said tubes on the exteriors thereof for the separate flow of combustion media and air, a discharge unit connected to said tubular furnace at the lower end thereof said discharge unit including means defining a discharge chamber for the briquets which have been coked and cooled, means for directing a combustion media such as poor gas into the discharge chamber for preheating the combustion media from the coked briquets, and for thereafter directing the preheated combustion media through the gas passages for first cooling the coked briquets, then aiding in the combustion of the briquets, and for thereafter preheating the incoming briquets as they pass through said tubes, said means including a separate gas chamber and means for connecting the gas passages defined around some of said tubes to said gas chamber, means for directing air through said discharge chamber for preheating said air and then for directing said air through said air passages defined around said tubes including a separate air chamber defined adjacent the ends of said tubes communicating with the air passages formed around said tubes.

10. A furnace for the continuous coking of fuel, comprising a large rotatable tubular furnace, means rotatably supporting said tubular furnace with the axis of rotation of the furnace inclined, means for rotating said tubular furnace, a plurality of tubes disposed inside said tubular furnace and extending axially therealong, each of said tubes having a bore with an axially progressing spiral groove of a configuration of the briquet to be coked, a rotatable feed hopper connected to the upper end of said tubular furnace for directing coal briquets into the tubes, means for directing briquets into the rotatable feed hopper, including a conveyor for the coal briquets, a hopper disposed below said conveyor, and rotary gas-tight valve for delivering said briquets from said hopper into said rotating feed hopper, said tubes each having a plurality of projections and recesses formed at spaced locations around the periphery thereof, the projections and grooves of adjacent tubes being interengaged in a gas-tight manner and defining around the periphery of said tubes a plurality of separate axially extending gas and air passages which extend along the length of said

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tubes on the exteriors thereof for the separate flow of combustion media and air, a discharge unit connected to said tubular furnace at the lower end thereof said discharge unit including means defining a discharge chamber for the briquets which have been coked and cooled, means for directing a combustion media such as poor gas into the discharge chamber for preheating the combustion media from the coked briquets, and for thereafter directing the preheated combustion media through the gas passages for first cooling the coked briquets, then aiding in the combustion of the briquets, and for thereafter preheating the incoming briquets as they pass through said tubes, said means including a separate gas chamber and means for connecting the gas passages defined around some of said tubes to said gas chamber, means for directing air through said discharge chamber for preheating

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said air and then for directing said air through said air passages defined around said tubes including a separate air chamber defined adjacent the ends of said tubes communicating with the air passages formed around said tubes.

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