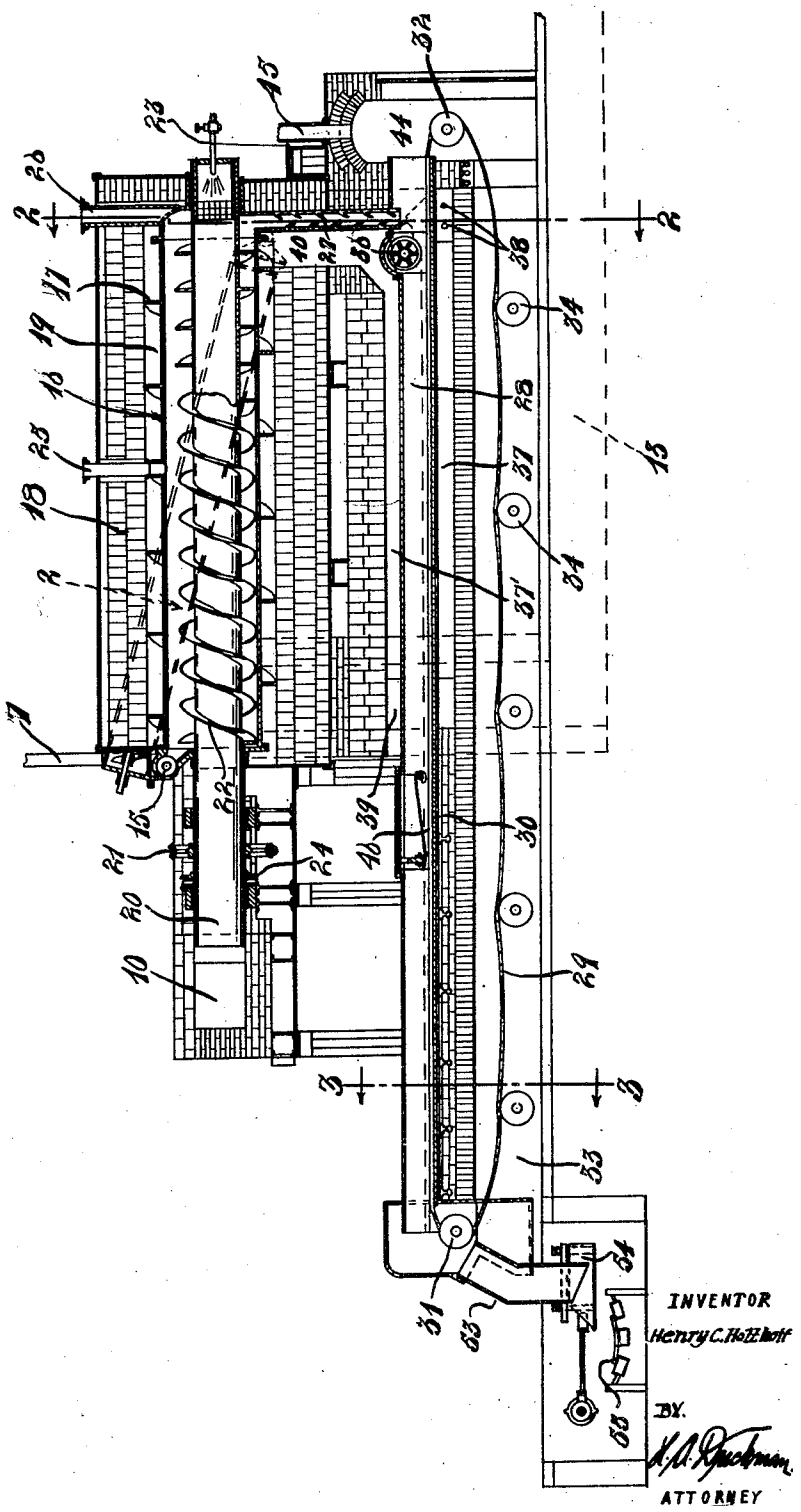
Oct. 13, 1931. H. C. HOLTHOFF 1,827,199

MULTISTAGE LOW TEMPERATURE COKE APPARATUS

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Fig. 1.



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Fig. 2.

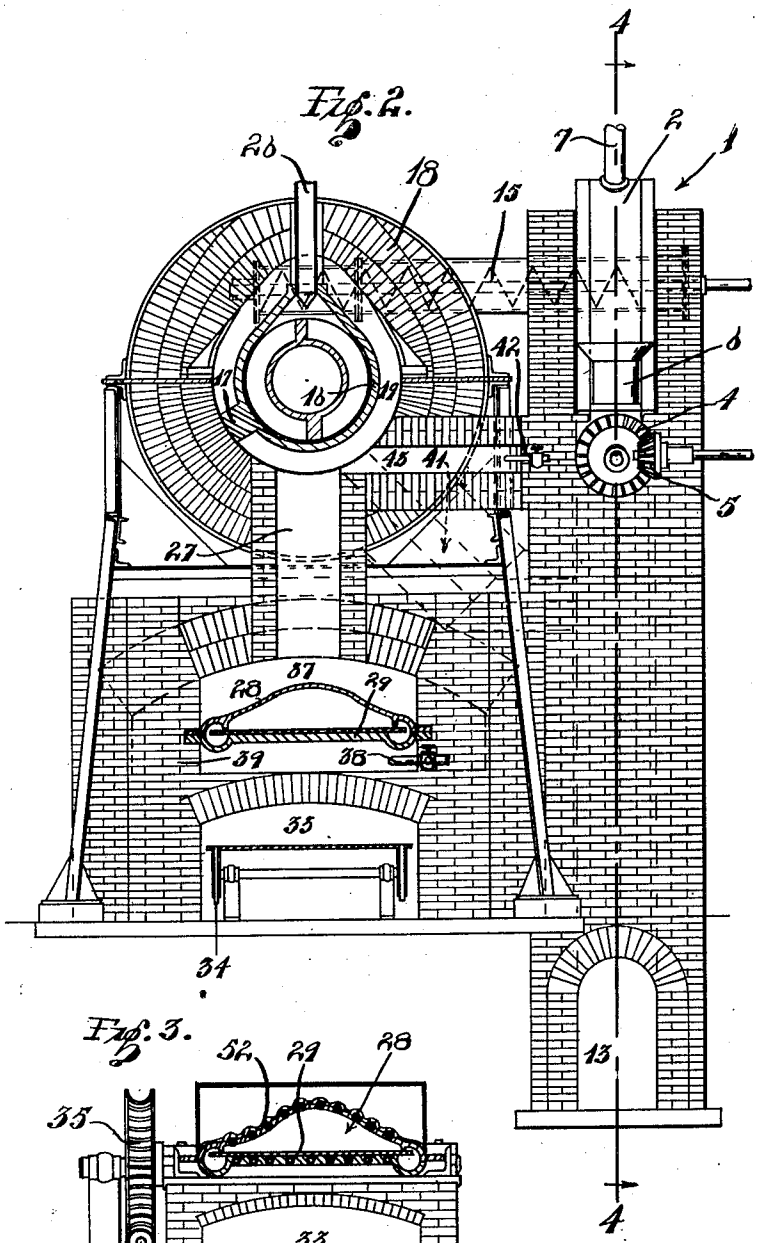


Fig. 3.

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Fig. 4.

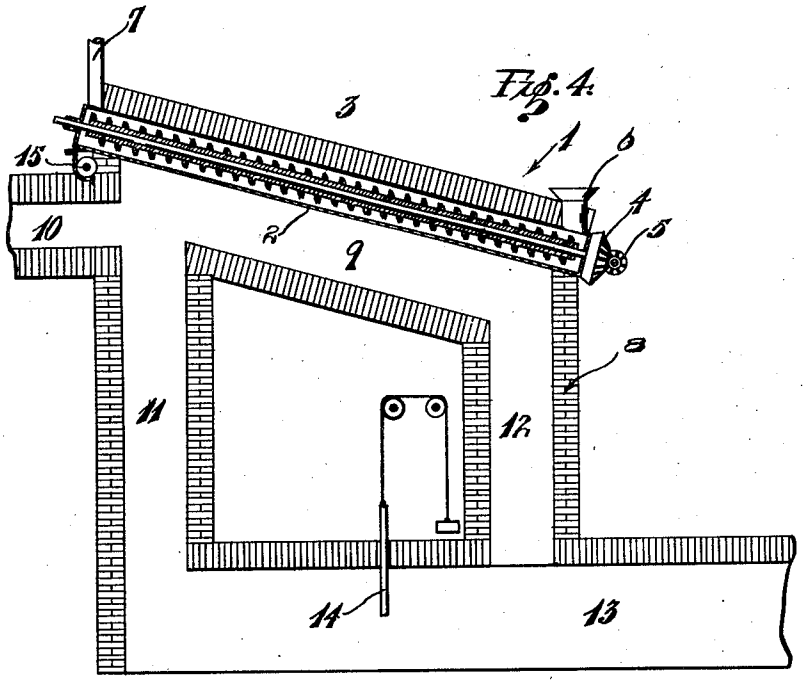
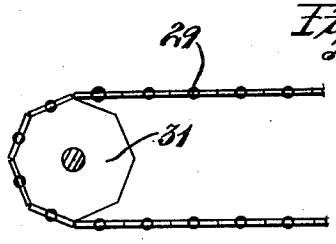


Fig. 5.



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Fig. 6.

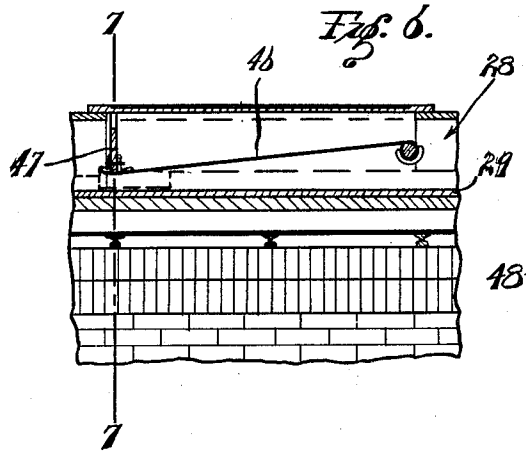


Fig. 7.

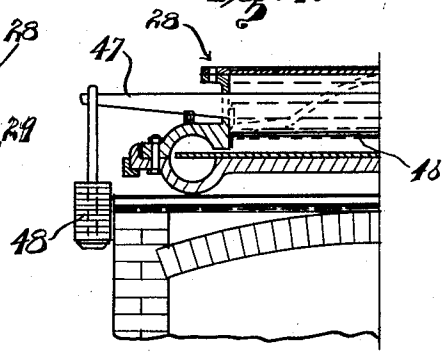


Fig. 8.

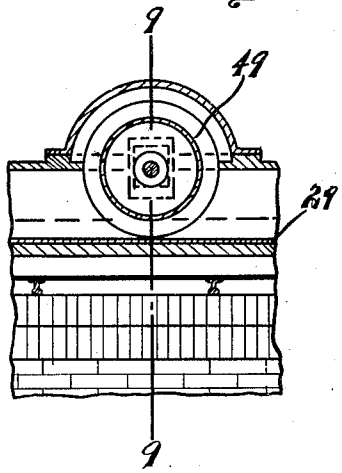
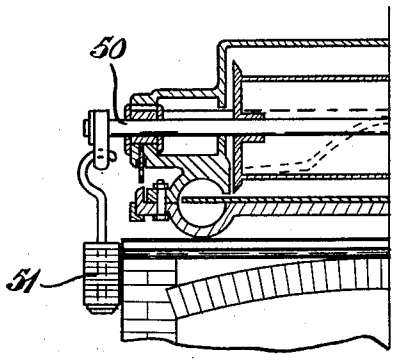


Fig. 9.



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UNITED STATES PATENT OFFICE

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MULTISTAGE LOW TEMPERATURE COKE APPARATUS

Application filed May 23, 1927. Serial No. 193,699.

In the manufacture of low temperature coke the commercial plants heretofore in use were not commercially successful due to certain inherent faults, among which are the following: A lack of large capacity, the exposure of metallic parts to high temperatures, excessive cost of operation and maintenance, and so forth.

An object of my invention is to provide a furnace for the manufacture of low temperature coke which has a large capacity, the metal parts of which are not exposed to high temperatures, and the cost of maintenance and operation being relatively low.

Another object is to provide a multi-stage furnace of the character stated in which the coal is continuously fed from one stage to another without interruption and without loss of heat.

Another object is to provide a furnace in which the coal is transferred to various stages, such transfer being effected prior to a change in the physical characteristics of the coal due to the change in temperatures. That is, at lower temperatures a drying effect is had on the coal, at the next higher temperatures a certain portion of the volatile constituents are released, and at the higher temperatures the coal is in a plastic state. It is obvious that a single stage furnace is not applicable to handling the coal in these various stages in an effective and economical manner.

A still further object is to so handle the coal that the heat transfusion therethrough will be rapid and complete, and also that during the plastic stage the cross-section of the mass will be relatively small, thus insuring a more complete release of the volatile constituents and forming a more compact and commercially useful product.

A still further object is to conduct the coal through a muffle, at the higher temperatures, in a thin layer and without agitation so as to effect a cementing of the coal into a compact mass and to facilitate the evolution of the volatile constituents.

An advantage of my invention is to decrease the time required for the complete carbonization of the coal over the methods heretofore in use.

Another advantage is in the independent regulation as to temperature and heat to which the coal is exposed in the various stages of my furnace.

A further advantage of my furnace resides in the fact that breeze may be fed back at the last stage of the furnace without reducing the output of the furnace.

Other objects, advantages, and features of the invention may appear from the accompanying drawings, the subjoined detailed description, and the appended claims.

In the drawings:

Fig. 1 is a longitudinal vertical sectional view of my furnace.

Fig. 2 is an enlarged vertical sectional view taken on line 2, 2, Fig. 1.

Fig. 3 is an enlarged vertical sectional view taken on line 3, 3, Fig. 1.

Fig. 4 is a vertical sectional view taken on line 4, 4, Fig. 2, to the same scale as Fig. 1.

Fig. 5 is a fragmentary side elevation of the conveyor chain and driving head.

Fig. 6 is a fragmentary vertical sectional view of the muffle showing the compression drag plate.

Fig. 7 is a fragmentary vertical sectional view taken on line 7, 7, Fig. 6.

Fig. 8 is a fragmentary vertical sectional view of the muffle showing a compression roller which may be substituted for the plate shown in Fig. 6.

Fig. 9 is a fragmentary vertical sectional view taken on line 9, 9, Fig. 8.

Referring more particularly to the drawings:

My furnace consists first in a drying and pre-heating unit 1 which comprises an upwardly inclined housing 2 in which a screw

conveyor 3 is mounted. The shaft of the conveyor 3 is provided with a gear 4 on the lower end thereof and a drive gear 5 meshes with the gear 4 and is driven by an independent source of power, not shown. A feed hopper 6 extends into the lower end of the housing 2 through which the coal is fed. A pipe 7 extends from the upper end of the housing 2 to conduct the moisture out of said housing. The housing 2 is mounted on a brick flue wall 8, which flue has a passage 9 extending under the trough 2, and the waste gasses pass from a duct 10 into the passage 9, thus heating the housing 2 and its contents. Down passages 11, 12 extend from either end of the passage 9 to a stack chamber 13. A damper 14 is provided in the chamber 13 to regulate the flow of waste gasses, either through the chamber 9 or directly to the stack chamber 13, as may be desired.

The coal, after being fed into the housing 2 and conveyed there through by the screw conveyor 3, is dried and pre-heated and the moisture is removed therefrom. This operation is effected by the heat of the waste flue gasses, thus economizing on the heat and preparing the coal for the second unit. At the top of the housing 2, I provide a cross-conveyor 15 which dumps the coal into the end of a stationary horizontal retort 16. The retort 16 is preferably constructed of ovoid cross-section and is provided on the exterior thereof with a spiral rib 17. A brick jacket 18 surrounds the retort 16 and is spaced therefrom the depth of the rib 17, thus providing a spiral heating passage 19 the purpose of which will be further described. Within the retort 16 I position a horizontal rotor 20 which is suitably journaled and is rotated through the medium of the gear 21 secured thereto, which gear is actuated from a suitable source of power not shown.

The rotor 20 is provided on its outer surface with a spiral conveyor flight 22, which conveyor is adapted to move the coal from the rear of the retort 16 to the forward end thereof, as will be further described. A burner 23 extends into the forward end of the rotor 20 and supplies heat thereto, and a thrust bearing 24 is provided adjacent the rear end of the rotor 20 so that the expansion of said rotor is forwardly. The passage 10 above referred to extends from the rear end of the rotor 20 to the passage 9, as shown in Figs. 1 and 4.

In the drying and pre-heating unit the temperature of the coal is raised to slightly below the point of distillation, while in the second unit the temperature in the coal is raised to slightly below the point of agglomeration. During the passage of the coal through the second stage, a certain quantity of the volatile constituents thereof will be released and a plurality of outlet vents 25, 26 are provided in the retort 16, which vents are connected to suitable condensers (not shown) for the recovery of the valuable by-products. In order that the heat may rapidly penetrate, or transfuse, entirely through the mass of coal during the second stage, if it is found desirable to stir, or agitate the same, this action may be provided for by an interrupted screw conveyor.

After the coal has traversed the length of the retort 16 it drops through a vertical passage 27 extending downwardly to a muffle 28. In the muffle 28, I provide a conveyor 29 which passes through the muffle on the floor 30, and passes over sprockets 31, 32 at either end of the muffle. The return reach of the conveyor passes under the muffle through a tunnel 33 and rests on a plurality of rollers 34. The shaft of the driving sprocket 31 is rotated through gear means 35 and driven from a source of power, not shown.

As the coal enters the forward end of the muffle 28 i is spread evenly over the conveyor 29 by suitable spreader means, such as the wheel 36. A heating flue 37 surrounds the muffle 28 for approximately one-half the length thereof, and burners 38 extend into said flue to maintain a temperature in the coal (approximately 410 to 450 degrees C.). The burners 38 are located under the muffle 28 adjacent the forward end thereof, and by-passes 39 are provided around the muffle to the return flue 37′ so that the hot gases pass, first along the bottom of the muffle, then around the same to the top, thence along the top to a vertical duct 40 which opens into the heating passage 19 for the heating of the retort 16.

From the heating passage 19 the gases pass through an outlet vent 41 to the heating duct 10, and thence to the first unit, as previously described. If the hot gases from the burners 38 are not sufficient to maintain the proper temperature in the retort 16, I provide an auxiliary burner 42 in a combustion chamber 43 which opens into the forward end of the passage 19, thus I can accurately regulate the temperature in the retort.

The coal enters the muffle 28 prior to its plastic or semi-liquid stage, and during its passage through the heated portion of the muffle becomes plastic. It is essential that during this period the coal should remain in a quiescent state and should not be disturbed or agitated in order that it may cement into a homogeneous mass. During the final stage of the coal in its passage through the muffle, additional gases evolve therefrom, and the forward end of the muffle is open to a chamber 44 from which a vent pipe 45 extends to a suitable condenser, not shown. To compact the carbonized coal on the conveyor while it is in a plastic condition, I provide a hinged drag plate 46 on the rear end of which a cross bar 47 rests. This bar 47 extends through the sides of the muffle and is weighted, as at 48, on the outer ends thereof, thus regulating the pressure of the plate

46 on the surface of the coke. The drag plate serves to break down any froth bubbles on the surface of the coke, as well as to compact the same.

If desired, instead of the drag plate 46 I may provide a roller 49 on the shaft 50, on which I provide weights 51 to force the roller downwardly against the mass of coke, the result being the same as accomplished by a drag plate.

After the conveyor 29 passes from the heated zone of the muffle the coke on the conveyor is cooled rapidly by water cooling pipes 52 inserted in the bottom and top of the muffle. The coke spills off the end of the conveyor 29 into an enclosed chute 53 and a shaker box 54 at the bottom of the chute deposits the coal on a conveyor 55 which carries the same to a storage space.

It will be evident from the foregoing description that the time of treatment of the coal, in any one unit, is variable since the through-put of the various units is under control by reason of the individual regulation of the speeds of the dryer conveyor 3, rotor 20, and conveyor 29. Also, the heat in each of the three units can be readily adjusted for the maintenance of the proper temperature. Furthermore, during the carbonizing stage, the coal is maintained in a quiescent state thereby permitting the coke to cement into a dense mass.

The operation of my invention will be evident from the foregoing description. It will also be evident from the foregoing description that each stage is particularly suited and corresponds to the peculiar physical characteristics of the coal at the particular temperature, and although the coal is separately treated during each stage, my process is continuous and there is no loss of heat during the transfer of the coal from one stage to another.

Having described my invention, I claim:

1. A multi-stage low temperature coke apparatus comprising a furnace, a drying and pre-heating unit, a screw conveyor in said unit, means to drive said screw conveyor, a retort, a conveyor from said drying and pre-heating unit to said retort, conveyor means in said retort, means to actuate said conveyor from the drying and pre-heating unit to said retort, a muffle, said muffle being open to the retort, and means to drive said conveyor means in the retort, said furnace having a heating chamber about said muffle, and a second heating chamber about said retort means to heat said second heating chamber, a duct connecting said above named chambers, means to heat said first named chamber, said furnace having a heating chamber about the drying and pre-heating unit, a duct connecting said last named chamber and the chamber surrounding the retort.

2. A multi-stage low temperature coke apparatus comprising a furnace, drying and pre-heating unit including a housing, a conveyor in said housing, means to drive said conveyor, a retort, heating means whereby the retort is heated, a conveyor extending from said housing to said retort, a rotor in said retort, a screw flight on the rotor, means to heat said rotor internally, means to rotate said rotor, a muffle, a conveyor in said muffle, means to operate said last named conveyor, said muffle being open to said retort at one end thereof whereby the muffle is heated, said furnace having a duct extending from the interior of the rotor to the housing whereby the heat is conducted to the housing to heat the same.

3. A multi-stage low temperature coke apparatus comprising a furnace, a drying and pre-heating unit including a housing, a conveyor in said housing, means to drive said conveyor, a retort, a conveyor extending from said housing to said retort, a rotor in said retort, a screw flight on the rotor, means to heat said rotor internally, means to rotate said rotor, a muffle, a conveyor in said muffle, means to operate said last named conveyor, said muffle being open to said retort at one end thereof, said furnace having a duct extending from the rotor to the housing whereby the heat is conducted to the housing to heat the same, heating means about said muffle, said furnace having a heating chamber about the retort, and a duct extending from said heating means to said chamber, an exhaust port extending from said chamber to said first named duct, and independent heating means for said chamber.

4. A multi-stage low temperature coke apparatus comprising a drying and pre-heating unit which includes a housing, a conveyor in said housing, means to operate said conveyor, a retort, a conveyor extending from said housing to said retort, means to actuate said last named conveyor, a rotor in said retort, means to rotate said rotor, heating means in said rotor, a screw flight on said rotor, a muffle, a conveyor in said muffle whereby the coal is carried there through in a quiescent state, and cooling means at the discharge end ing of said muffle and heat conveying means from the furnace to the drying and pre-heating unit, the retort and the muffle.

5. A multi-stage low temperature coke apparatus comprising a furnace, a drying and pre-heating unit which includes a housing, heat conveying means from the furnace and extending around the housing, a conveyor in said housing, means to operate said conveyor, a retort, a conveyor extending from said housing to said retort, means to actuate said last named conveyor, a rotor in said retort, means to rotate said rotor, heating means in said rotor, a screw flight on said rotor, a muffle, a conveyor in said muffle whereby the cial is carried therethrough in a quiescent

state, and cooling means at the discharge end of said muffle, means adapted to compress the coke in the muffle, heat means about the charging end of said muffle, said furnace having a heating chamber about the retort, a duct extending from the muffle heating means to the chamber, a second duct extending from the rotor to the housing, an outlet port extending from the heating chamber to said last named duct, and independent heating means for heating said chamber about the retort.

6. A multi-stage low temperature coke apparatus comprising a furnace, a housing, heat conduit means from the furnace to the housing, a screw conveyor in said housing, means to rotate said screw conveyor, said housing having a vent therein, a retort, a spiral rib extending from the outer surface of said retort, whereby a spiral heating chamber is formed about the retort, a conveyor extending from said housing to said retort, means to actuate said last named conveyor, a rotor in said retort, means to rotate said rotor, a burner in one end of said rotor, a muffle, a continuous conveyor in said muffle, means to actuate said continuous conveyor, said muffle being open to the retort at one end thereof, heat means surrounding the charging end of said muffle, said furnace having a duct extending from said heating means to said spiral heating chamber about the retort, a drag plate in said muffle adapted to compress the coke on the conveyor, a spreader wheel in said muffle, a vent chamber open to the muffle, and a vent pipe extending from the vent chamber, vent pipes extending from said retort.

7. A multi-stage low temperature coke apparatus comprising a furnace, a housing, heat conduit means from the furnace to the housing, a screw conveyor in said housing, means to rotate said screw conveyor, said housing having a vent therein, a retort, a spiral rib extending from the outer surface of said retort whereby a spiral heating chamber is formed about the retort, a conveyor extending from said housing to said retort, means to actuate said last named conveyor, a rotor in said retort, means to rotate said rotor, a burner in one end of said rotor, a muffle, a continuous conveyor in said muffle, means to actuate said continuous conveyor, said muffle being open to the retort at one end thereof, heat means surrounding the charging end of said muffle, said furnace having a duct extending from said heating means to said spiral heating chamber about the retort, a drag plate in said muffle adapted to compress the coke on the conveyor, a spreader wheel in said muffle, a vent chamber open to the muffle, and a vent pipe extending from the vent chamber, vent pipes extending from said retort, said furnace having a duct extending from the discharge end of said rotor to said housing whereby said housing is heated, and an outlet port extending from said spiral chamber about the retort to said last named duct, independent heating means for said spiral chamber, a chute extending from the discharge end of said muffle, a shaker box on the bottom of said chute, and cooling pipes in the discharge end of said muffle.

In testimony whereof, I affix my signature.

HENRY C. HOLTHOFF.