April 16, 1963 H. G. TUFTY 3,085,947

METHOD AND APPARATUS FOR PRODUCING FURNACE CHARGING MIXTURES INCLUDING CARBONACEOUS FUEL

Original Filed Feb. 24, 1955 2 Sheets-Sheet 1

FIG. 1.

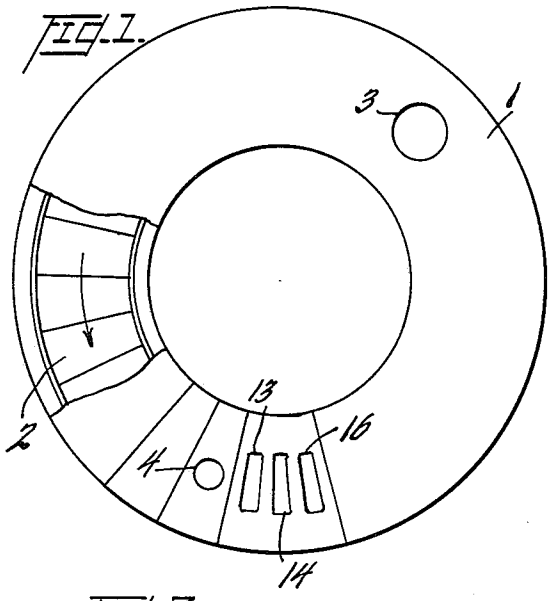


FIG. 2.

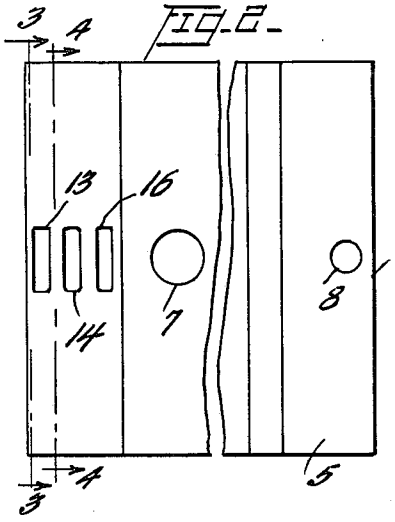


FIG. 3.

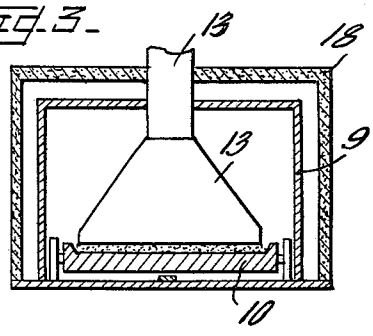


FIG. 4.

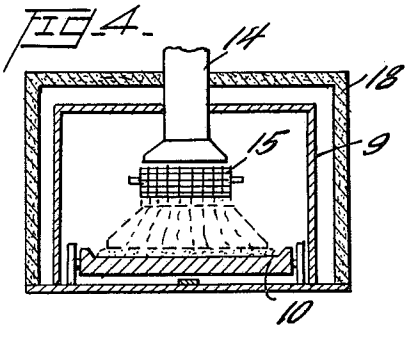


FIG. 5.

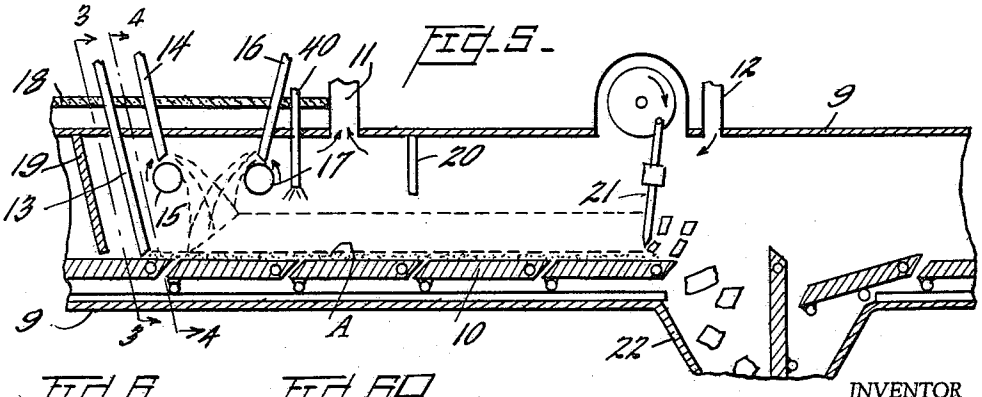


FIG. 6.

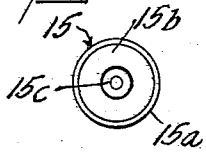
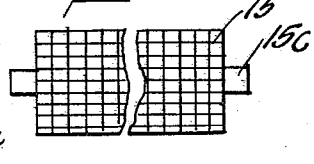


FIG. 6A.



INVENTOR

Harold G. Tufty,

BY Watson, Cole, Grindle & Watson

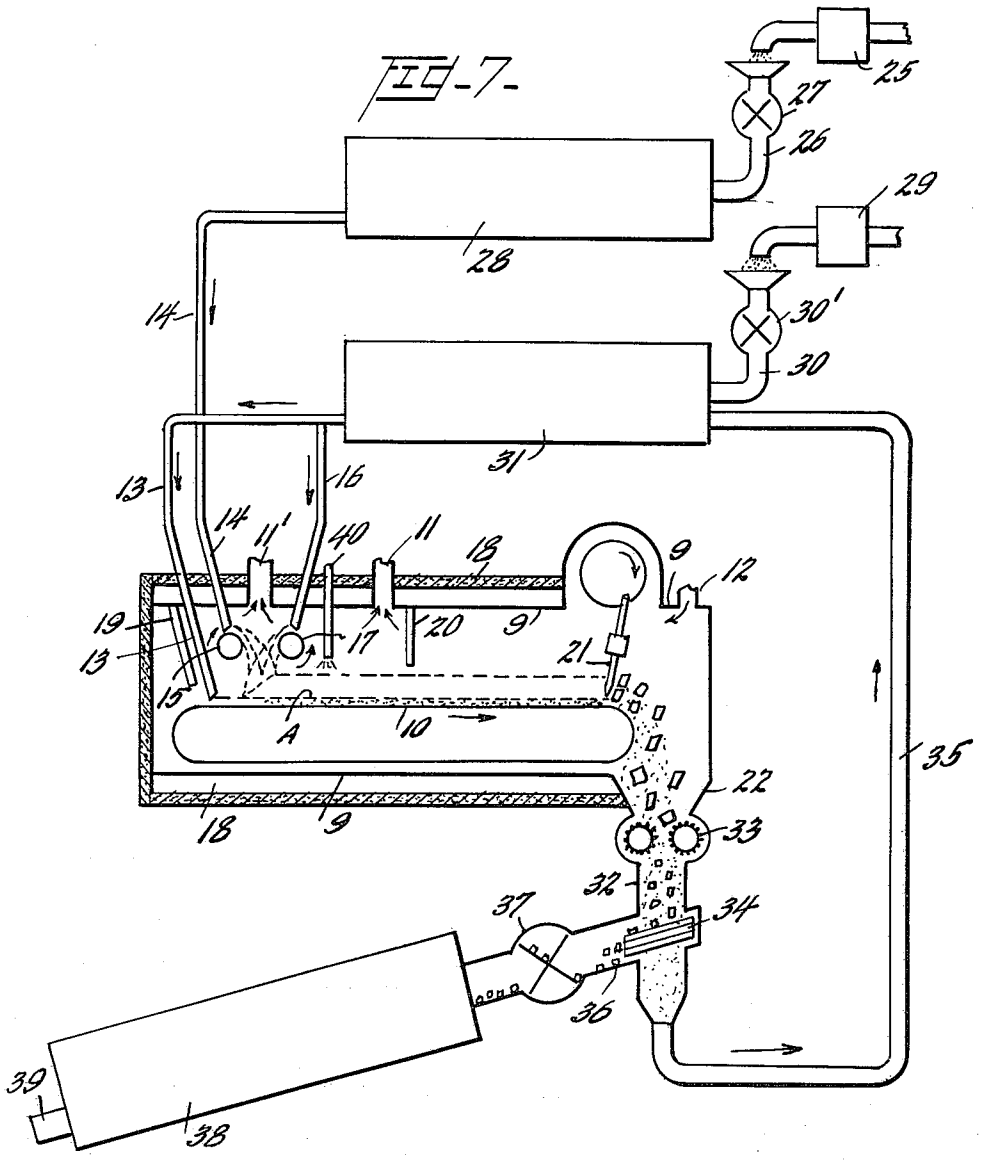
ATTORNEYS

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FIG-7-



INVENTOR

Harold G. Tufty,

BY Watson, Cole, Grindle + Watson

ATTORNEYS

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3,085,947
METHOD AND APPARATUS FOR PRODUCING FURNACE CHARGING MIXTURES INCLUDING CARBONACEOUS FUEL

Harold G. Tufty, 6221 Massachusetts Ave. NW., Washington 16, D.C.

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4 Claims. (Cl. 202—9)

The present invention relates to a method and apparatus for producing furnace charging mixture of carbonaceous fuel with mineral materials as well as the low temperature carbonization or coking of finely divided carbonaceous material.

In metallurgical and similar operations, process carbon and other material have been individually measured and fed into furnaces, as for example in the production of calcium carbide and metallic zinc. The process carbon must be first prepared as by treating coal and during the heating of the coal for this purpose its plastic or agglutinating characteristics create considerable difficulty in handling the same while the coal is going through its plastic stage prior to coking and yielding of the volatiles it contains. Known low temperature carbonization procedures, attempting to overcome these difficulties by preoxidation of the coal or heating and holding the same before the plastic point is reached, have proved to be time consuming or reduced the commercial value of by-products derived therefrom.

The principal object of the present invention is to provide means whereby furnace charging mixtures of process carbon and other desired material may be admixed in an efficient and continuous manner while carbonizing the carbonaceous material, collecting the volatiles therefrom and providing a sponge of carbon and admixed material ready for further processing or for introduction into a furnace.

A further and equally important object of the invention is to provide a low cost and efficient means for the continuous preparation of coke or semi-coke by low temperature carbonization of coal by admixture with coke breeze or the like without utilizing additional heating media during the process.

A still further and important object of the invention is the carbonizing of agglutinating coals upon an endless belt without the coal adhering to the belt and without utilizing additional heating means for the carbonizing process while at the same time forming an agglomeration of semi-coke which can be readily broken into pieces suitable for subsequent handling.

Further objects of the invention will be in part obvious and in part pointed out in the following detailed description of the methods employed and the accompanying drawings of apparatus suitable for carrying out such methods.

In the drawings:

FIG. 1 is a top view of a circular retort which can be used to carry out the present invention.

FIG. 2 is a top view of a straight line retort for the present purpose.

FIG. 3 is a cross-sectional view taken on line 3—3 of FIG. 5.

FIG. 4 is a cross-sectional view taken on line 4—4 of FIG. 5.

FIG. 5 is a schematic side view of a portion of the retort of FIG. 1 with a side wall removed showing the apparatus for carrying out the present invention.

FIG. 6 is an enlarged end view of a roller forming part of the retort.

FIG. 6A is a side view of said roller, and,

FIG. 7 is a schematic side view of an apparatus incorporating the retort of FIG. 2 which retort likewise is shown with its side wall removed.

Referring now more particularly to the accompanying drawings in which like and corresponding parts are indicated by similar reference characters, numeral 1 indicates a circular casing through the bore of which runs an endless conveyor 2 for supporting the material to be treated. Outlet pipe 3 is for the removal of by-product gases from the interior of said casing while pipe 4 indicates an inert cooling gas admission duct.

FIG. 2 discloses a similar retort having casing 5, outlet pipe 7 and inlet pipe 8, but with said casing extending in a straight line.

The interior of either of said retorts is similar to the retort shown in FIG. 5 which has casing 9, endless conveyor 10, outlet pipe 11 and inlet pipe 12. Also shown is duct 13 leading through the top of said casing and ending just above said belt. A duct 14 which may be suitably insulated and jacketed also extends through said casing and is directed to a serrated roller 15 above said belt. Said roller has a peripheral metallic shell 15*a* and a heat insulating core 15*b* of porcelain or the like and a hollow shaft 15*c* through which a cooling liquid can be passed. A third duct 16 likewise extends through said casing and is directed towards a serrated roller 17 similar to and extending substantially parallel to roller 15.

Casing 9 is surrounded by an insulated air jacket 18 adjacent to said ducts and terminating at outlet pipe 11. Baffles 19 and 20 extend within said casing towards said belt controlling the movement of the atmosphere in said retort. A driven chopper 21 is mounted within said casing just prior to the outlet 22.

As shown in FIG. 7 an automatic weighing feeder 25 is connected by pipe 26 having a rotary air lock 27, to an end of a preheater 28. Said duct 14 is connected to the opposite end of said preheater.

A second automatic weighing feeder 29 is connected by pipe 30 having a rotary air lock 30', to an end of a superheater 31 with ducts 13 and 16 connected to the opposite end thereof.

Casing outlet 22 is connected to passage 32 having breaker rollers 33 therein and a vibrating screen 34. Said passage continues as pipe 35 to superheater 31. A side passage 36 including a rotary air lock 37 connects passage 32 with a calciner and cooler 38 having outlet 39.

In the manufacture of calcium carbide the charge to the furnace generally consists of 100 parts of limestone to 65 parts of the carbon content of the coke, by weight. To prepare this charging mixture from raw coal and limestone dust each in the proper proportions, coal with relatively high plastic characteristics is introduced to weighing feeder 25 and passed to preheater 28 where the coal is heated to below its plastic forming point of approximately 640° F. At the same time limestone is introduced to weighing feeder 29 and passed to superheater 31 where it is heated to 1000° F. Feeders 25 and 29 are adjusted to feed the ingredients in the proportions required.

The superheated limestone then passes through duct 13 onto conveyor 10 forming a thin but covering layer A thereon. Further, superheated limestone goes from duct 16 to roller 17 and is thrown in the air into mixture with the heated coal also thrown in the air from duct 14 by striking roller 15. This mixture falls onto the layer A of limestone on the conveyor. The temperature of superheated limestone is selected so as to give the desired average temperature to the mixture laid on layer A. It is the purpose of the air jacket 18 to maintain this average during the carbonization period by preventing flow of heat from the mixing chamber out through the casing 9. This is done by maintaining a jacket temperature the same as the average temperature

of the mixture. Flow of heat through the walls is, therefore, substantially zero. By this mixing method the coal is very rapidly brought through its plastic state and up to the distillation temperature of the mixture or 800° F. and held there by means of said hot air jacket.

The atmosphere in casing **9** contains only inert gas so as to prevent the combustion of the coal. The volatiles given off are collected through outlet **11**, and partly used to heat the preheater **28** and superheater **31** and also to provide chemical by-products. The coal which has rapidly been brought through its plastic state adheres to the adjacent limestone layer A, but not to said belt. Chopper **21** breaks up the agglutinated sponge containing semi-coke and limestone after it is sufficiently cooled by the introduction of an inert cooling gas by pipe **12**. The sponge then passes through breakers **33** to screen **34** and to calciner for complete devolatilization, if desired, and cooler **38** where semi-coke limestone sponge emerges from outlet **39**. Limestone separated by screen **34** passes through pipe **35** back to the superheater **31** for reuse.

Heavy tar or pitch condensate either from other sources or from the volatiles passing from pipe **11** can be introduced through pipe **40** and sprayed on the mixture upon the conveyor and be redistilled by the heat from said mixture.

The foregoing procedure can be carried out utilizing coal and other mineral substances besides limestone such as metallic oxides, namely the oxides of tin, zinc, cadmium, lead, iron, chromium, calcium, copper, and manganese. The proportions of coal to mineral substance is determined by the ratio of process carbon to metallic oxide required. The temperature of the oxide is determined by the resultant temperature of the mixture desired.

Agglutinating coals can be carbonized much in the same manner utilizing the present apparatus. For this purpose coke breeze or recycled semi-coke is introduced in superheater **31** and passes after heating to ducts **13** and **16**. The coal to be treated is preheated in preheater **28** and passes to duct **14** thereafter. The superheated coke breeze or semi-coke forms layer A on conveyor **10** while the preheated coal fines and additional superheated semi-coke or coke breeze are intermixed in air after striking rollers **15** and **17** respectively. The proportion of coal to coke is governed by setting the weighing feeders **25** and **29** to intorduce sufficient coke to meet the heat requirements of the particular coal used. The superheated coke supplies all the heat necessary to raise the temperature of the coal to its plastic stage whereupon some of the volatiles are driven from the coal and pass upwardly through outlet pipe **11** while the individual pieces of plastic coal adhere to the adjacent coke breeze or semi-coke forming a semi-coke sponge. The resultant semi-coke sponge upon reaching the chopper **21** is broken up cooled by the incoming inert gas from pipe **12** and goes through outlet **22**, past breakers **33**, over screen **34** whereupon a part thereof can pass through pipe **35** back into superheater **31** forming part of the superheated semi-coke for carbonizing further supplies of coal while the balance goes to outlet **39** and its ultimate use.

While rollers **15** and **17** are shown for throwing the carbonaceous and inorganic materials together it is to be appreciated that other forms of apparatus can be employed for this purpose for example vibrating feeders can be used in lieu of said rollers and also the material can be dropped from ducts **14** and **16** onto driven horizontally rotating disc spreaders positioned within the retorts for this purpose. Care of course must be taken to guide the material by use of shields or the like onto layer A.

The retorts of FIGS. 5 and 7 are presented on the drawings as in a straight line, but can equally as well be employed as circular retorts such as disclosed in my copending application for patent, Serial No. 406,944, now abandoned utilizing the circular casing **1** of FIG. 1 and an endless conveyor **2** moving around therein with ducts **13**, **14** and **16** directed towards said conveyor while volatiles pass out pipe **4** and inert cooling gases enter by pipe **3**.

The apparatus shown and described herein is capable of considerable modification and such changes thereto as come within the scope of the appended claims is deemed to be a part of the present invention.

What I claim is:

1. Method of producing furnace charging mixtures including carbonaceous fuel consisting essentially of preheating the carbonaceous fuel, superheating material suitable for furnace charging purposes to a temperature sufficient for heating said fuel to a plastic state upon contact therewith, forming said superheated material as a moving layer, mixing said fuel and an additional amount of said superheated material in space and dropping said mixture onto said moving layer while in an atmosphere preventing the combustion of said fuel to form a combined semi-coke and furnace charging material sponge.

2. Method of producing furnace charging mixtures including a carbonaceous fuel consisting essentially of forming a moving layer of superheated non-agglutinating inorganic granular material, mixing a carbonaceous fuel with an additional quantity of said superheated inorganic granular material and dropping said mixture onto said moving layer, maintaining an atmosphere preventing combustion of said fuel around said mixture and layer and at generally the temperature of said mixture and thereafter separating said mixture from the non-adhereing inorganic material.

3. Method of producing furnace charging mixtures consisting essentially of preheating coal, superheating an inorganic mineral to a temperature sufficient for the low temperature partial carbonization of said coal upon contact therewith, forming a portion of said mineral as a moving layer, mixing the remainder of said mineral and said coal above said layer, dropping the resulting mixture onto said layer, maintaining an atmosphere preventing combustion of said fuel at said mixing and above said layer, withdrawing the volatiles given off by said coal, cooling said mixture with an inert cool gas after said coal has reached its plastic state and adhered to part of said mineral forming a sponge thereof and separating the unattached mineral from said coal and mineral sponge.

4. Method for the low temperature carbonization of carbonaceous material consisting essentially of superheating semi-coke to a temperature sufficient for rendering carbonaceous material plastic upon contact therewith and driving off at least some of the volatiles thereof, forming a moving layer of said superheated semi-coke, mixing said carbonaceous material with an additional amount of said superheated semi-coke and comingling the resulting mixture in space above said moving layer and maintaining an atmosphere preventing combustion of said fuel around said mixture and said layer.

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