Feb. 10, 1948. W. C. GOSS 2,435,825

APPARATUS FOR THE MANUFACTURE OF METALLURGICAL CHARCOAL FROM COMMINUTED WOOD WASTE MATERIAL

Filed March 4, 1944 2 Sheets-Sheet 1

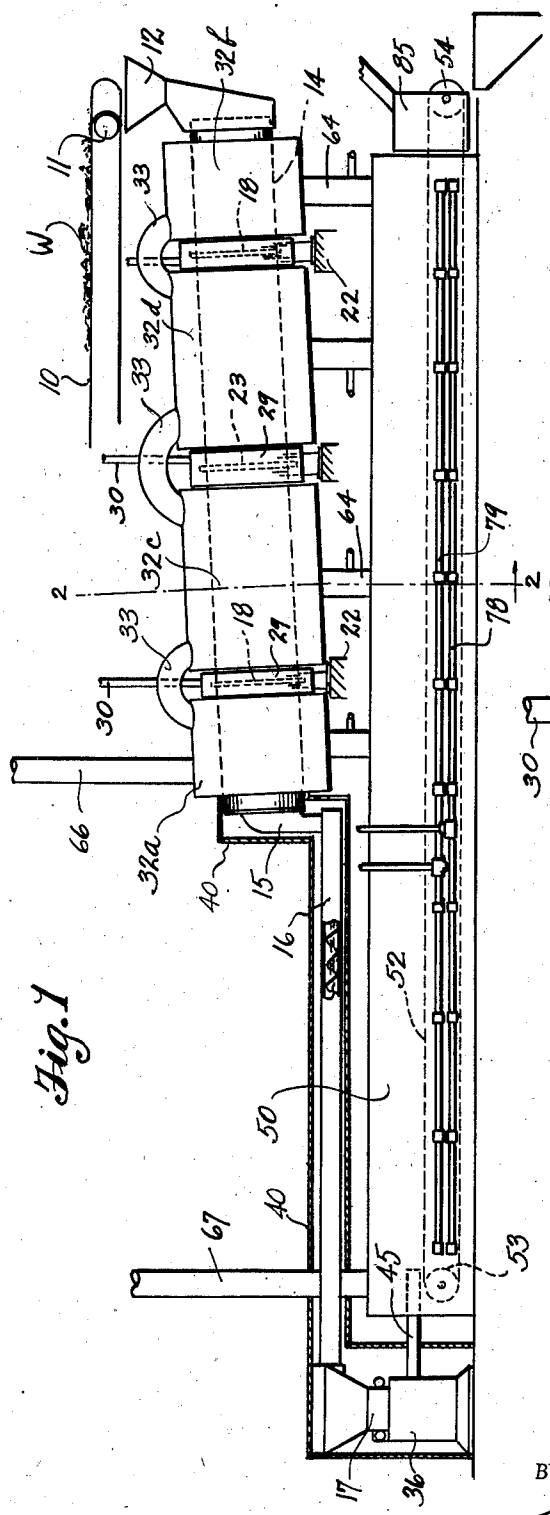


Fig. 1

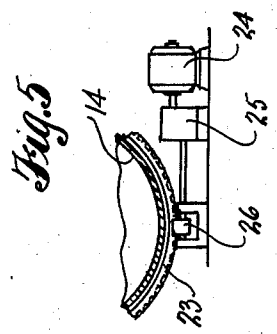


Fig. 5

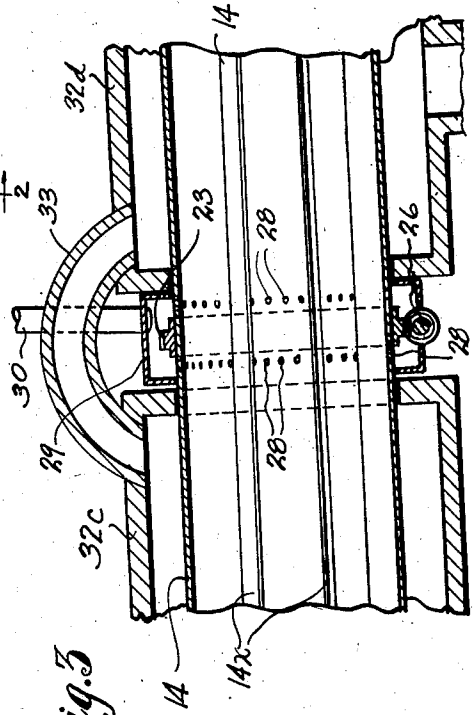


Fig. 3

INVENTOR.
WORTH C. GOSS

BY Cook & Robinson ATTORNEYS

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Fig. 1.

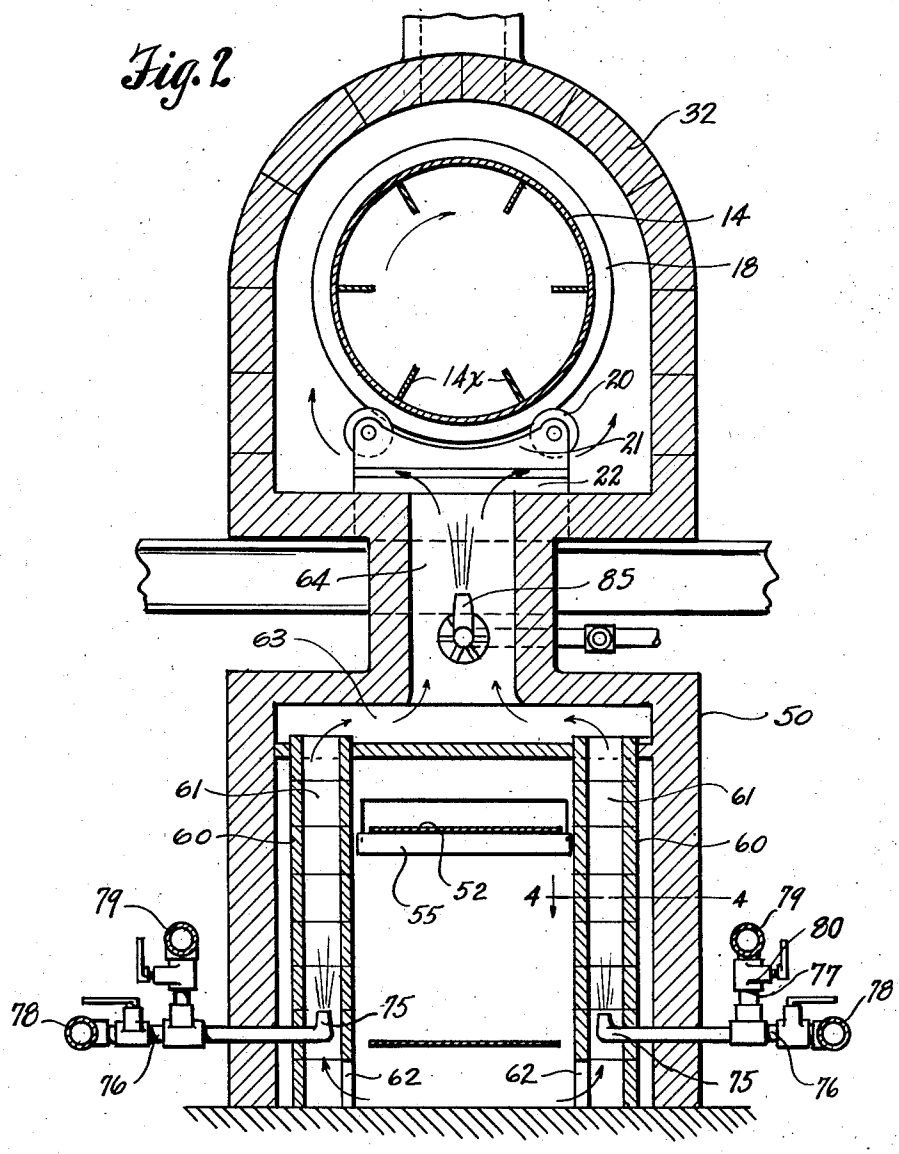
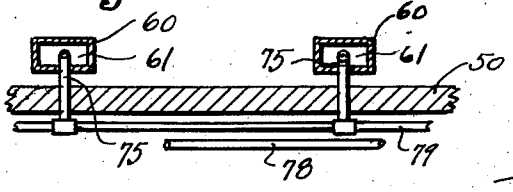


Fig. 4



INVENTOR.
WORTH C GOSS

BY Cook & Robinson ATTORNEYS

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APPARATUS FOR THE MANUFACTURE OF METALLURGICAL CHARCOAL FROM COMMINUTED WOOD WASTE MATERIAL

Worth C. Goss, Seattle, Wash.

Application March 4, 1944, Serial No. 525,117

1 Claim. (Cl. 202—114)

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This invention relates to apparatus for the manufacture of what is known in the art as metallurgical charcoal, and it has reference more particularly to apparatus for the manufacture of metallurgical charcoal from sawmill waste such as sawdust, chips, shavings, and the like, as derived directly from the mill.

For a better understanding of the present invention and its objects, it will here be explained that sawmill waste is quite abundant and in briquetted form is quite suitable for the making of metallurgical charcoal. However, there are difficulties of consequence encountered both in briquetting and in the making of charcoal from briquetted mill waste due to its relatively high moisture content. Mill waste as a general rule, contains from 40% to 60% by weight of water and unless this is entirely eliminated, along with certain light fractions, before it is briquetted and charred, the steam and other gases created by the charring operation will cause the briquettes to expand and crack and to thereby be rendered unsatisfactory as charcoal for the present intended purposes.

A satisfactory charcoal briquette for metallurgical use must have a certain degree of hardness in order that it will not crumble or be crushed under the weight of materials used therewith in the furnace. Furthermore, it must be essentially dust-free and considerably more dense than ordinary wood charcoal in order to present the required electrical characteristics. Briquettes made from moist material, and compressed under high pressures are unsatisfactory due to the fact that the particles do not adhere as required and the briquettes will crumble readily, and cannot be brought up to proper hardness by charring. However, my experience has disclosed that when the waste material is made moisture free and is deaerated prior to briquetting and charring, a very satisfactory product can be obtained, provided that the briquettes are charred under heat of a certain temperature and under proper control through the charring period.

In view of the foregoing and for other reasons, it has been the principal object of this invention to provide an apparatus of a practical, economical and otherwise satisfactory type and character of construction for the commercial, large scale manufacture, or a continuous operation, of metallurgical charcoal from mill waste. Furthermore, to provide an apparatus whereby metallurgical charcoal can be produced from

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briquetted mill waste, that will be entirely satisfactory from the standpoint of hardness, size, quality and electrical characteristics.

More specifically stated, the objects of this invention reside in the provision of an apparatus for the commercial manufacture of metallurgical charcoal, comprising as its principal elements, a rotary drier wherein wet or damp sawmill waste materials may be quickly and effectively dried in an atmosphere of superheated steam to a moisture free and bone dry condition; a grinder, whereby the dried material, deaerated by the superheated steam, may be comminuted to a desired or any required degree of fineness with a certain percentage thereof reduced to dust-like condition found most practical for briquetting purposes; a briquetting machine for pressing the hot, prepared material into hard briquettes of a selected practical size, and a furnace arranged to receive the briquettes for a progressive heating thereof to bring them to the desired charred condition; the apparatus of this invention being characterized by a novel arrangement and relationship of parts by which heat for the drying of the mill waste prior to briquetting it is furnished by the burning of a part of the tars and lighter fractions that are expelled from the briquettes during and incident to the charring operation.

Other objects of the invention are to be found in the details of construction of parts embodied in the apparatus, in their relationship and their mode of operation, as will hereinafter be fully described.

In accomplishing these and other objects of the invention, I have provided the improved details of construction, the preferred forms of which are illustrated in the accompanying drawings, wherein—

Fig. 1 is a side view of an apparatus embodying the present invention, for the manufacture of metallurgical charcoal from sawmill waste.

Fig. 2 is an enlarged, cross-sectional view of the same, taken on the line 2—2 in Fig. 1.

Fig. 3 is a sectional detail of the cylindrical dryer showing provision for steam escapement from the dryer cylinder.

Fig. 4 is a sectional detail of the furnace wall construction, taken on line 4—4 in Fig. 2.

Fig. 5 is a detail of the rotating means for the dryer cylinder.

In a copending application, executed on even date herewith, I have described and claimed a method of manufacturing metallurgical char-

coal that may be carried on by the apparatus of this invention, and have also claimed the charcoal briquette as an article of manufacture.

Referring more in detail to the drawings—

In accordance with the objects of this invention, metallurgical charcoal in blocks of uniform and predetermined size, is manufactured by the proper charring of briquettes made from prepared sawmill waste. This waste material may comprise sawdust, chips, bark and the like as derived directly from the mill, and this would presume that, in most instances, it would be received in a soggy wet condition. The waste material is first dried to a bone dry condition, then the dried material is ground to a predetermined or required fineness, the material briquetted under high pressure, and the briquettes finally charred under designated and controlled temperature. This charring brings about the dissipation of tars and lighter fractions from the briquettes and some of these are burned to produce heat for the charring operation, and some are diverted to the drier and there are burned to furnish heat for the drying operation. These various operations and the equipment to accomplish them will now be described more in detail.

First, it is of importance to bear in mind that the satisfactory briquetting of sawmill waste material of the kind heretofore mentioned, requires the elimination therefrom of all moisture and certain of the lighter fractions. Otherwise there will be a generation of steam and gases that will cause disruption and disintegration of the briquette as soon as it is released from the press. Also, it is to be remembered that charring of the briquette must be done with various objects in mind; that is, to produce a briquette of certain density, electrical characteristics and so treated as to insure against the spontaneous combustion of the charred briquettes in storage prior to use.

In Fig. 1, I have shown the specified waste material W that is to be briquetted, as being brought to the apparatus on a travelling belt conveyor 10 that operates over a supporting and driving roll 11. From the belt conveyor, the material W is discharged into a receiving hopper 12 from which it is evenly admitted into the higher end of an elongated, tubular and rotatably driven drier 14. As indicated in Fig. 1, this dryer is a metallic cylinder of uniform diameter, supported downwardly inclined from its receiving to its discharge end at an angle of approximately 3° relative to a horizontal line. Incident to the cylinder being rotated, the waste material that is received from the hopper 12 thereinto at its higher end, will be progressively advanced in a continuous turn-over operation, from the receiving to the discharge end, from which latter end it is discharged into a receiving tube 15. From the tube 15, the dried material flows to the receiving end of a screw conveyor 16 whereby it is moved and finally delivered into a suitable grinder such as that designated in Fig. 1 in its entirety by reference numeral 17.

To assist in the turnover of material as it is advanced within the drying cylinder 14, the latter is equipped with a plurality of longitudinally extending fins or flanges 14x arranged in spaced relationship about its interior surface, as shown best in Fig. 2.

In order that the drying cylinder 14 may be rotated, the cylinder is equipped at a plurality of locations between its opposite ends, and as

may be required, with encircling bands, or tires 18, and these rest upon transversely spaced supporting and guide rolls 20 mounted in bases 21 that are fixed to foundations 22. Also, fixed to and encircling the cylinder or tube 14, preferably at a medical location, is a ring gear 23. The drier cylinder, as so supported, is rotatably driven by means of a suitable motor 24, here shown as operating through a reduction gear mechanism 25 and a worm gear 26 that meshes with the ring gear 23. The ring gear is here shown as being located centrally of the drier, but might be at any other suitable location therealong.

At spaced intervals along its length, here shown in Fig. 3, as being adjacent the encircling bands 18, the cylinder 14 is formed with encircling rows of perforations 28 provided for the escapement from the drier of steam that is produced in the drying operation, and embracing those perforated sections, or areas of the cylinder, are manifolds 29 which receive the escaping steam. Chimneys, or pipes 30 lead up from the manifolds for the disposal of this steam to atmosphere or to other places of use.

For the purpose of heating the drying cylinder, it is enclosed by housings 32, shown in Fig. 2, as surrounding the drier tube with clearance, and these individual housings extend lengthwise of the cylinder as noted in Fig. 1; there being those housings 32*a* and 32*b* located, respectively, between the supporting tires or bands 18 and its ends, and two housings, 32*c* and 32*d*, extending respectively between the bands 18 and the centrally located ring gear 23. Adjacent housings are connected by the arched ducts 33, seen in Fig. 1, so that hot gases may flow from one to the other.

Each of the housings, 32*a*, 32*b*, 32*c* and 32*d*, receives hot gases direct from the charring furnace, as presently will be fully described, and the gases are burned therein, under control, to produce the temperature required, or desired, to heat the tube to drive off all moisture content from the waste material and to effect drying to a bone dry condition by the time it reaches the discharge end of the drier tube. Preferably, the drying temperature in the cylinder 14 is kept approximately at 500° F., and the steam that is produced in the drying operation becomes superheated and thus completely deaerates the tube and material under treatment. This condition of deaeration is maintained in the dried material, and in the equipment along which it flows until after the briquetting operation.

The dryer cylinder 14 is closed at its ends, except for the provision made for receiving material from the hopper 12 into its upper end, and for the discharge of material from its lower end to the tube 15 and conveyor 16 whereby it is moved to the grinder 17.

The grinder 17, preferably is of the hammer mill type and operates to reduce the dried material to a degree of fineness most practical for briquetting under extremely high pressure. In my experience, I have found that, with the present briquetting machine, the material should be so reduced that about 40% will be of a dust-like character and the remainder of different degrees of fineness.

Material from the grinder and hammer mill 17 is discharged directly into a briquette machine that is herein designated in its entirety by reference numeral 36. This briquette press preferably would be of the type of that shown in United

States Letters Patent No. 2,296,516 issued to me on September 22, 1942, or of any other suitable kind for compressing the dried, ground material into extremely hard briquettes without requiring addition of any binder to the material prior to briquetting.

It is to be understood that the construction of the present drier, conveyor 16, grinder 17 and press 36 is such as to exclude outside air from the dried material. Thus the hot, dry material from the drier passes in a deaerated condition to the grinder, and from the latter to the press, and therefore no difficulty will be experienced in the formation of briquettes by reason of air trapped in the material, and furthermore, the dry material will enter the press at a relatively high degree of heat from the drier, and kept hot by means of suitable steam jacketing, and this degree will be somewhat increased by reason of the extremely high pressure to which the material is subjected in the briquetting operation. Thus, the briquettes, in the present mode of treatment, will be discharged from the press 36 at smoking heat and extremely hard.

In the present instance, I have designated the discharge spout of the press 36 by numeral 45, and this spout extends into one end of an elongated, heat insulated furnace 50 in which the charring of the briquetted material takes place.

It is to be noted, also, that in Fig. 1 I have shown the conveyor 16, the crusher 17, and press 36 encased in a jacket 40 in which super heated steam from the drier or other source is kept in order to keep the material in a deaerated condition until after briquetting.

It will here be mentioned that the briquettes, for most practical use, are made about two inches in diameter and two inches long. During charring, they shrink somewhat in diameter and to about two-thirds their length.

The furnace 50 used for the charring operation in a simple yet practical construction comprises an elongated, housing of rectangular cross sectional shape. A practical construction for commercial production requires a furnace about two hundred feet long. Extending lengthwise within the furnace housing is a continuous belt conveyor 52, carried at its opposite ends over rollers 53 and 54, one or both of which may be driven for the propelling of the belt. The two runs of the belt are carried on suitable roller supports 55, and are spaced apart. The upper run is located near the top wall of the furnace, as seen in Fig. 2. This charring belt may be any one of the conventional forms usually employed for calcining operations.

The rate of travel of the belt 52 is such as to require about four hours time for carrying a briquette through the furnace. This may be increased or decreased as found desirable.

In its present preferred form of construction, the opposite side walls of the furnace are constructed of suitable refractory tile and brick. Within the furnace, at spaced intervals along its side walls, are stacks made up of rectangular hollow tiles 60, laid end to end vertically, thus to form vertical passages 61, as shown best in Fig. 2. These stacks have openings at their lower ends, as at 62, in Fig. 2, into the furnace and open at their upper ends into passages or flues 63 that lead horizontally, in the top wall of the furnace, from the side walls toward the center line, and open into vertical stacks, or ducts 64, that open through the bottom walls of the housings 32 which surround the drying tube. It is

shown in Fig. 1 that the vertical ducts 64 are located at spaced intervals along the dryer, and also, it will be observed that the furnace is here shown as being substantially longer than the dryer, and that the ducts 64 lead upwardly from that part of the furnace that comprises the second half, when considering the briquetting press to be adjacent the end of the first half. The second half, as will later be understood, is the hotter end of the furnace, where final charring of the briquettes is effected.

It is shown in Fig. 1 that one or more of the housings 32 is equipped with an outlet or exhaust stack 66 and this provides for the escape of flue gases and creation of the required draft that will move the hot gases from the furnace wall stacks, through the various passages, and finally through the housings 32 for heating the drying cylinder. Also, the furnace 50 is equipped at its receiving end with a stack 67 for outlet of gases.

The furnace 50 is equipped at spaced intervals therealong, at opposite sides, with burners 75. Each burner has suitable pipe connections 76 and 77 with air and gas supply lines 78 and 79. Valves, as at 80 are applied to these pipes to regulate the flow of gas and air to the burners, thus to control the degree of heat produced.

The burners are arranged to deliver the combustible fuel mixture into the wall stacks or passages wherein it is burned to initially bring the furnace up to its required charring heat. The charring heat of the furnace is progressively increased from the receiving to the discharge end. After the furnace has once been properly heated, and charged with briquettes, the gases and tars driven off from the briquettes will burn in the stacks and these are more than sufficient to produce the charring heat, and their burning may be retarded after gas has been shut off from pipe 77 by closing off the admittance of air through the pipes 76. Thus the charring temperature along the retort may be controlled as is desired to bring about a progressive heating from the receiving to the delivery end of the furnace.

In the present operation, it has been found most practical to extend the charring treatment over a four-hour period and to slowly advance the briquettes through the oven in a starting temperature of 500° F., through which they travel for approximately one-fourth the length of the furnace. Then the temperature is gradually and progressively increased so that as the discharge end of the furnace, it is substantially 900° F. This temperature regulation is accomplished by controlling the admittance of air to the wall stacks 60 allowing only partial burning of the combustible tars and gases that are expelled. Unburned tars and gasses are later burned as needed in the housings 32 to furnish the drying heat, and this heat likewise is regulated by a controlled admission of air to the ducts 64 through valve controlled vents designated at 85.

It might be mentioned here, however, that the charring time would vary in proportion to size of briquettes, and it is not intended to confine the treatment to a four-hour interval.

Having thus described my invention, what I claim as new therein and desire to secure by Letters Patent is:

An apparatus of the character described comprising, in combination, an inclined cylindrical drying chamber, means mounting said chamber for axial rotation, means for delivery of a com-

minuted wood waste material into the chamber at its upper end for continuous turn-over and progressive advancement to the lower end thereof, a grinder, means for delivery of the dried material directly from the drier to the grinder, a press arranged to receive material from the grinder and operable to form it into solid briquettes, an elongated furnace, a conveyor operable to receive the formed briquettes from the press and to convey them slowly through the furnace for charring, means for internally heating the furnace to a charring temperature, a housing enclosing the drier and spaced therefrom, flues connecting the furnace and housing for delivery of hot gases from the furnace to the housing, and means for a controlled admittance of air to said flues to control the heat of combustion.

WORTH C. GOSS.

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