Jan. 27, 1942. J. P. BADENHAUSEN 2,271,157

SYSTEM FOR BURNING BARK

Filed May 10, 1938 3 Sheets-Sheet 1

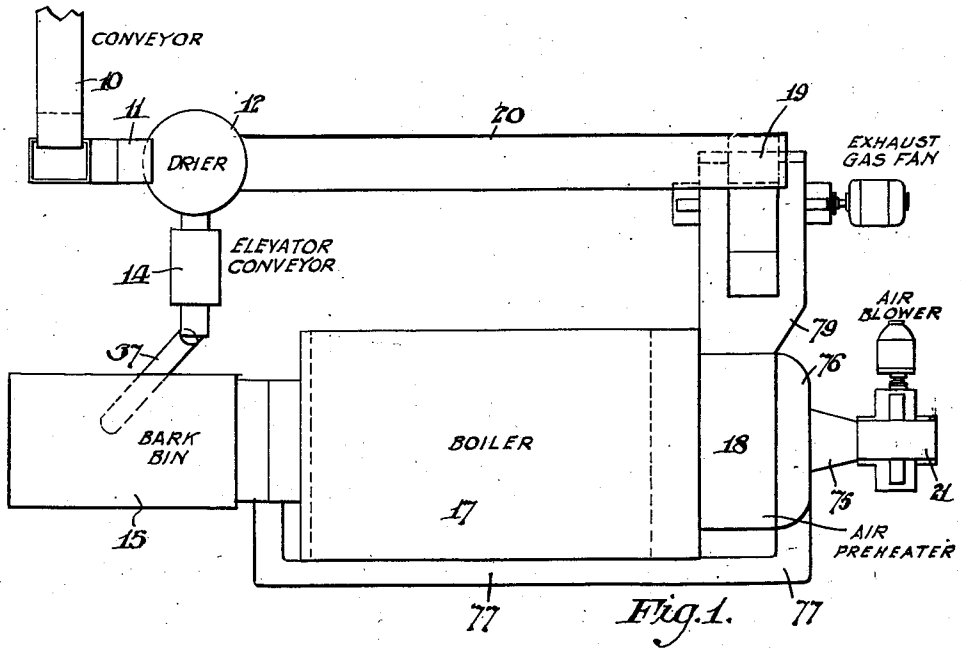


Fig. 1.

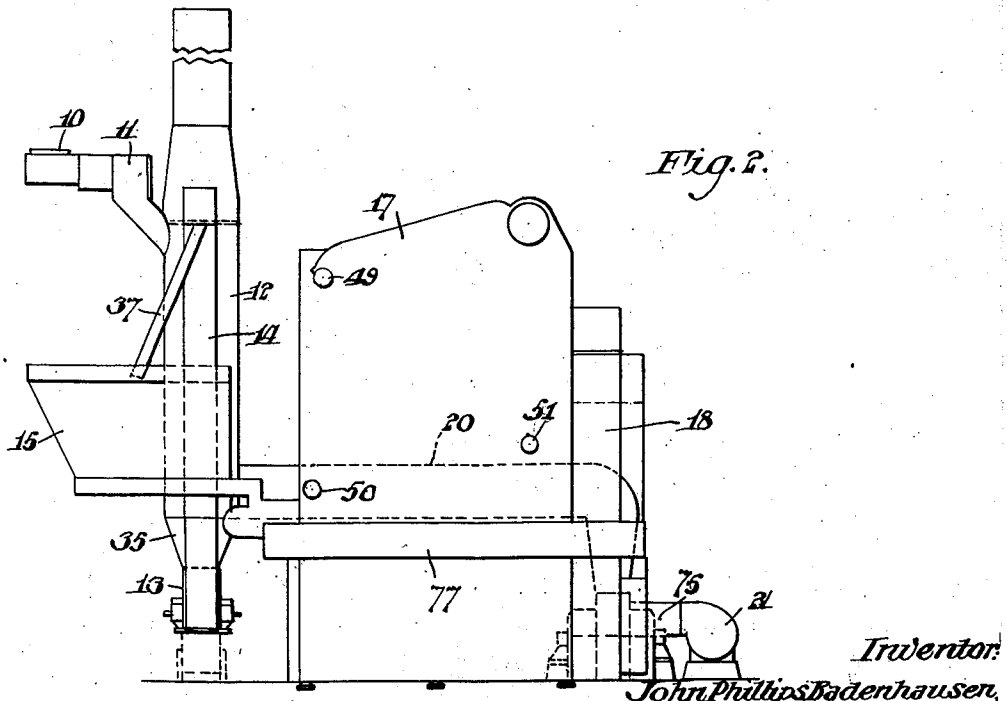


Fig. 2.

Inventor:
John Phillips Badenhausen,
By Z. T. Wolverton 2nd
Attorney.

Jan. 27, 1942. J. P. BADENHAUSEN 2,271,157

SYSTEM FOR BURNING BARK

Filed May 10, 1938 3 Sheets-Sheet 2

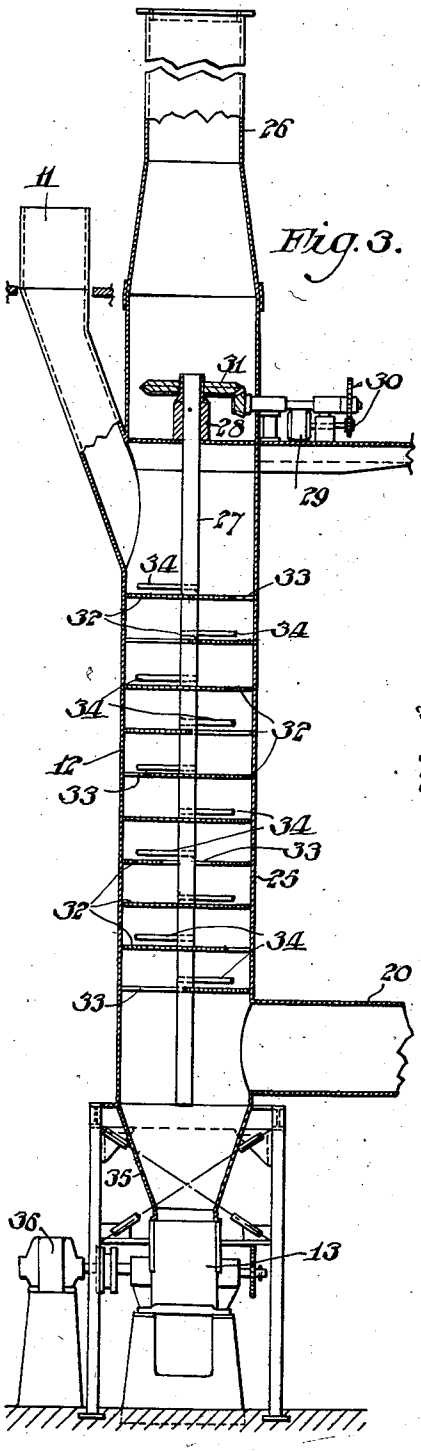


Fig. 3.

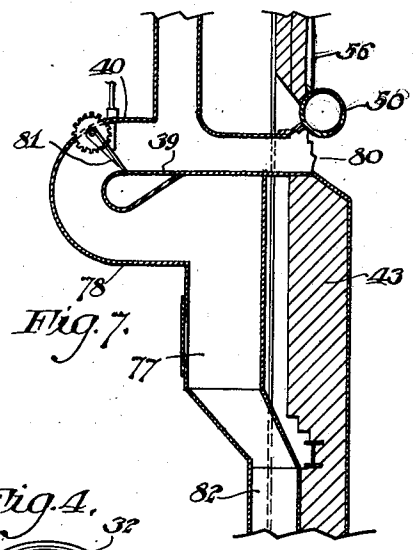


Fig. 7.

Fig. 4.

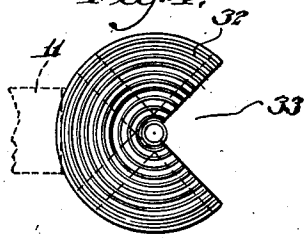
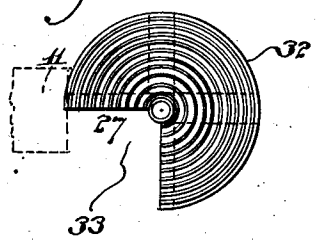


Fig. 5.



Inventor:
John Phillips Badenhausen,
By J. T. Wobensmith 2nd
Attorney.

Jan. 27, 1942. J. P. BADENHAUSEN 2,271,157

SYSTEM FOR BURNING BARK

Filed May 10, 1938 3 Sheets-Sheet 3

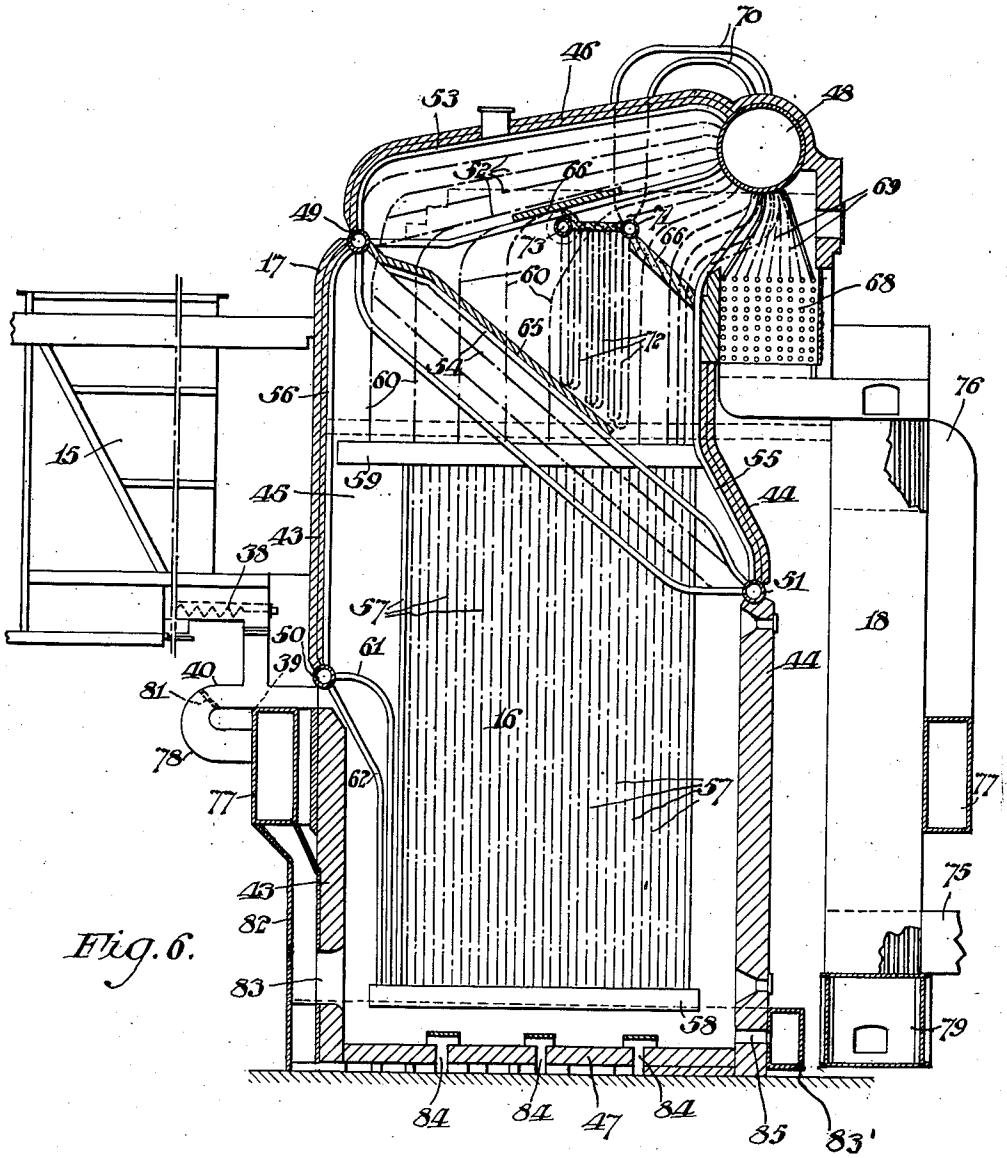


Fig. 6.

Inventor:
John Phillips Badenhausen,
By Z. T. Wolcottsmith 2nd
Attorney.

Patented Jan. 27, 1942 2,271,157

UNITED STATES PATENT OFFICE

2,271,157

SYSTEM FOR BURNING BARK

John Phillips Badenhausen, Philadelphia, Pa., assignor of one-half to Day and Zimmerman, Incorporated, Philadelphia, Pa., a corporation of Maryland

Application May 10, 1938, Serial No. 207,006

7 Claims. (Cl. 110—7)

The present invention relates to a system for burning bark and more particularly to a system for preparing the bark for combustion and for burning in a more effective manner the combustible constituents of the bark.

In the manufacture of pulp and paper the quantities of bark which are obtained are quite large and numerous efforts have heretofore been made to utilize the heat available in the bark.

In the systems heretofore employed the only practical installations which have been available include provisions for pressing the bark to squeeze out the water and thereafter burning the material thus obtained in boilers of the Dutch oven type. In boilers of this type a large fire space and grate area is required, the fuel is usually fed in through the furnace roof and it is necessary to provide suitable bridge walls and arches in order to obtain combustion.

The size of furnace installation required where the Dutch oven type is used is such that the cost of such installations is excessive and the combustion and steam generation are not effected as efficiently as desired.

It is an object of the present invention therefore to provide a system in which the bark may be suitably prepared prior to combustion and burned in a manner which will increase the heat available from the combustion and increase the efficiency of the heat utilization.

It is a further object of the present invention to provide a system in which the bark, which is obtained from the rotary barking drums or log barkers of a pulp or paper manufacturing plant, is suitably prepared for combustion.

It is a further object of the present invention to provide a system in which the preliminary drying of the bark is effected with waste heat derived from the combustion gases.

It is a further object of the invention to provide a system in which the bark is prepared in such manner that a large area thereof is presented for combustion.

It is a further object of the present invention to provide a system in which the bark is prepared so that the same may be burned in a combustion chamber in suspension.

Other objects of the invention will appear from the annexed specification and claims.

The nature and characteristic features of the invention will be more readily understood from the following description, taken in connection with the accompanying drawings forming part hereof, in which:

Figure 1 is a diagrammatic top plan view showing the main features of the present invention;

Fig. 2 is a side elevational view of the structure shown in Fig. 1;

Fig. 3 is a vertical central sectional view of a form of drier suitable for use in connection with the present invention;

Figs. 4 and 5 are plan views of two of the shelves used in the drier shown in Fig. 3;

Fig. 6 is a vertical sectional view showing a form of steam generator suitable for use with the present invention; and

Fig. 7 is a detailed fragmentary sectional view showing the structure for introducing the shredded bark into the steam generator.

It will, of course, be understood that the description and drawings herein contained are illustrative merely, and that various modifications and changes may be made in the structure disclosed without departing from the spirit of the invention.

The system in accordance with the present invention is shown more particularly in Figs. 1 and 2 of the drawings. The bark removed from the logs by the rotary log drums or barkers of the pulp or paper manufacturing plant (not shown) ranges in size from dust to slabs and slashings several feet in length and several inches in width. This material is preferably delivered from the plant to the system by a suitable conveyor shown diagrammatically at 10 to a discharge chute 11 by which it is supplied to a drier 12. In the drier 12 the bark is moved downwardly where it is brought into contact during its downward movement with the waste gases of combustion for reducing the moisture content, as hereinafter more fully referred to, preparatory to further treatment.

After drying in the drier 12 the bark is delivered to a bark shredder 13 wherein the bark is shredded as hereinafter pointed out, and is delivered from the bark shredder 13 by a suitable conveyor 14 to a bark storage bin 15. From the bin 15 the shredded bark is delivered into the combustion space 16 of the boiler 17. Preheated air supplied by an air preheater 18 is utilized in part for introducing the shredded bark into the combustion space 16. The heat released by the combustion is employed for the generation of steam. After the combustion of the combustible constituents in the combustion space 16 in the boiler 17, the hot gases pass through the air preheater 18, an induced draft fan 19 and a duct 20 to the lower portion of the drier 12.

A forced draft air blower 21 is provided for

supplying air to the preheater 18 and from the preheater 18 to the boiler 17 as hereinafter more fully referred to.

The drier 12, as illustrated more particularly in Fig. 3, preferably includes a cylindrical vertically disposed outer shell 25 having a duct 26 at the upper end thereof leading to the stack (not shown). The shell 25 has the intake chute 11 connected to the upper part thereof for the introduction of the bark brought to the system by the conveyor 10. The shell 25 preferably has a vertical shaft 27 centrally located therein which is supported at its upper end by a suitable bearing 28 and is preferably rotated at a relatively low speed. A motor 29 and suitable gearing 30 and 31 are provided for driving the shaft 27 at the desired speed.

A plurality of shelves 32 are mounted within the shell 25, the shaft 27 passing downwardly through the center thereof. These shelves 32 are of the character illustrated in Figs. 4 and 5, respectively, each of the shelves 32 having a cutout portion 33 and the cutout portions being each respectively staggered with respect to the cutout portion of the shelf 32 thereabove as indicated in Figs. 4 and 5. The vertical shaft 27 has mounted thereon suitable sweep arms 34 which move the material depositing respectively on the shelves 32 toward the cutout portions 33 so that it may fall in turn to the shelves below, and in falling and downward movement through the drier 12, pass in contact with the upward flow within the shell 25 of the hot gases derived from the combustion space 16.

In passing from the uppermost shelf 32 to the lowermost shelf 32 by reason of the agitating movement of the sweeper arms 34, the bark which initially and upon introduction into the drier 12 had a moisture content of approximately 50 to 60%, has the moisture content reduced in the drier 12 so that the bark delivered to the throat 35 which connects the drier 12 with the bark shredder 13 has a moisture content of approximately 30 to 35%.

The character of delivery affected by the sweeper arms 34 is such that there is a gradual feed of bark to the throat 35. The bark because of its low moisture content and the character of the delivery does not pack or jam either in the throat 35 or in the bark shredder 13. The bark is shredded by the bark shredder 13 which may be of any desired type to a stringy form such that a large area of each separate shredded piece of bark is presented for combustion. The size of the shredded stringy pieces of bark obtained from the bark shredder 13 is such that the bark may be picked up by the air introduced into the furnace 17 as hereinafter more fully referred to and burned in the furnace 17 in suspension in the air stream. The bark shredder 13 is preferably operated by a suitable motor 36.

The shredded bark from the shredder 13 is directed by suitable conveying mechanism shown diagrammatically at 14 and is passed by a chute 37 into the bark storage bin 15 which is preferably arranged directly in front of the boiler 17. The bark bin 15 is provided so that the shredded bark may be withdrawn for a controlled feed by means of a plurality of screw conveyors 38 into a downward channel so that the bark falls onto a floor 39. The shredded bark is picked up by the preheated air flowing through an inlet duct 40 and carried in suspension in the air stream into the combustion space 16 for combustion therein in suspension, as hereinafter pointed out.

The boiler or steam generator 17 may be of any desired construction, although the form shown in the drawings has proven satisfactory in practice. The steam generator 17 includes front and rear walls 43 and 44, side walls 45, a top wall 46 and a bottom wall 47. An upper steam drum 48 is mounted in the upper rear part of the steam generator 17, an upper front header 49 is preferably mounted at the junction of the front wall 43 and the top wall 46, a middle front header 50 is preferably mounted at a medial location in the front wall 43 and a rear header 51 is preferably mounted at a medial location in the rear wall 44.

Banks of tubes 52 are provided for connecting the upper front header 49 with the steam drum 48 and a group of tubes 53 of the bank 52 may line the top wall 46. Banks of tubes 54 are provided for connecting the rear header 51 with the upper front header 49, and banks of tubes 55 which line portions of the inner upper part of the rear wall 44 are provided between the rear header 51 and the steam drum 48. A bank of tubes 56 is preferably also provided for lining the upper portion of the front wall 43 and extends from the front medial header 50 to the upper front header 49.

The side walls 45 of the combustion chamber 16 may be provided with suitable water tubes as at 57, the tubes 57 on the side walls 45 being connected from a lower side wall header 58 to an upper side wall header 59. The upper side wall header 59 is connected by suitable banks of tubes 60 to the steam drum 48 and the lower side wall header 58 may be connected by suitable banks of tubes 61 and 62 to the medial front header 50.

Suitable baffles are provided within the steam generator 17 for directing the gases within the interior thereof in a plurality of passes in heat exchange relation with the banks of tubes 54 and 52. One of these baffles is shown at 65, along the uppermost group of tubes of the bank of tubes 54 and a baffle at 66 is provided for directing the gases into contact with the bank of tubes 52 between the upper front header 49 and the steam drum 48.

An economizer 68 is preferably provided in the upper rear portion of the casing of the steam generator 17 and is preferably connected by a suitable bank of tubes 69 to the steam drum 48.

The steam drum 48 preferably has steam outlet pipes 70 which lead to a header 71 of a superheater 72, the superheater tubes being disposed in a pass of the boiler 17. The superheater 72 has a superheater header 73 from which superheated steam is supplied for use in the plant.

The air heater 18 is preferably disposed to the rear of the steam generator 17 so that the gases may enter upon their leaving the economizer 68. In the air heater 18 the gases are passed in heat exchange relation with air entering the air heater 18 by a suitable air inlet 75, the air being supplied to the air inlet 75 from the forced draft air blower 21. The heater air outlet 76 of the air preheater 18 is connected by a suitable duct 77 to a duct 78 communicating with the inlet duct 40.

The hot gases discharged through the gas outlet 79 of the air preheater 18 are drawn by an induced draft fan 19 and directed through a hot gas duct 20 to the lower portion of the drier 12 where they pass upwardly in contact with the bark as heretofore indicated, and pass out through the top of the drier 12 to the stack (not shown).

The front wall 43 of the steam generator 17

is preferably provided with an inlet 80 to which heated air at a temperature of approximately 550° F. is supplied from the duct 77. A suitable damper 81 is provided for regulating and controlling the quantity of air introduced through the inlet 80, so that the air is maintained at substantially constant velocity and there is no throttling by the damper 81.

The air passing the damper 81 picks up the shredded bark as the same tends to fall to the floor 39 upon its delivery by the conveyors 38, and carries the shredded bark into the combustion space 16 of the steam generator 17, the velocity of the air current being sufficient to effect the introduction of the shredded bark.

Upon the entry of the shredded bark into the combustion space 16, because of the relatively small size of the pieces of shredded bark, the same is kept in a suspended condition within the combustion space 16 for and during combustion and presents a relatively large area of each individual piece of shredded bark in contact with the combustion supporting air so that the shredded bark is burned rapidly and the combustible constituents thereof substantially completely burned.

Provision is also made for introducing air from the duct 77 through the duct 82 to air inlet openings 83 at the lower portion of the front wall 43 and to suitable tuyéres 84 in the bottom wall 47. Air from the duct 82 may also be supplied by the duct 83' connected to the duct 82 and introduced through air inlets 85 in the rear wall 44.

The hot gases of combustion as heretofore indicated pass in contact with the banks of tubes 54 and 52, a substantial part of the heat of the combustion being absorbed by the tubes lining the walls of the combustion space 16 and a substantial quantity of heat being absorbed by the other steam generating tubes which are provided. A large proportion of the remaining heat available from the combustion and within economic limits, is utilized in the economizer 68, the air preheater 18 and the drier 12.

I claim:

1. The method of preparing and burning bark which includes reducing the moisture content of the bark with a stream of hot gases derived from the burning of the bark, preheating air with the same stream of hot gases, shredding the bark of reduced moisture content to a size such that it may be introduced and burned in suspension, projecting the shredded bark into a combustion space by a portion of the preheated air, supplying other portions of the preheated air to the combustion space at a plurality of locations, and burning the bark in suspension in the combustion space.

2. The method of preparing and burning bark which comprises drying the bark to reduce the moisture content thereof, then shredding the bark and introducing the shredded bark into a combustion space in suspension, burning the shredded bark in the combustion space and utilizing the gases of combustion for the initial drying of the bark.

3. The method of preparing and burning bark which comprises drying the bark to reduce the moisture content thereof, then shredding the dried bark, and thereafter introducing preheated air and the shredded bark together into a combustion space, said shredded bark being in suspension in said preheated air, supplying additional separated streams of preheated combustion supporting air to said combustion space, burning the shredded bark in the combustion space in suspension, and utilizing the gases of combustion for the initial drying of the bark and for the preheating of the air.

4. Apparatus for preparing and burning bark comprising a furnace, a bark shredder connected to said furnace, a bark drier connected to said bark shredder for drying the bark prior to its introduction into said bark shredder, means for introducing hot gases of combustion from said furnace into said drier for drying the bark passing therethrough to said bark shredder, and means for introducing the shredded fuel material into said furnace for combustion in suspension in said furnace.

5. Apparatus for preparing and burning bark comprising a furnace, a bark shredder connected to said furnace, a drier connected to said bark shredder, means for introducing hot gases of combustion from said furnace to said drier for drying the bark passing therethrough to said shredder, and means for projecting the shredded bark into said furnace, said projecting means including a horizontal plate to which bark is supplied and a duct in communication with said plate for supplying a stream of preheated air for carrying the shredded fuel from said plate into said furnace in suspension.

6. Apparatus for preparing and burning bark comprising a furnace, a bark shredder connected to said furnace, a drier connected to said bark shredder, means for introducing hot gases of combustion from said furnace to said drier for drying the bark passing through said drier prior to its delivery to said shredder, and means for delivering said shredded fuel into said furnace for combustion therein in suspended condition, said means including an air preheater for supplying air preheated by the hot gases to said furnace and a conduit to which said preheated air and said shredded fuel are discharged for introduction into said furnace.

7. In apparatus for preparing and burning bark, the combination of a bark drier, a bark shredder to which the bark is delivered from said drier, a furnace, an air preheater to which exhaust gases are supplied from said furnace, means for delivering shredded bark from said shredder to said furnace, said means including a conduit connected to said air preheater, said conduit also being connected to said furnace at a plurality of locations within said furnace for supplying preheated combustion supporting air, and means for delivering hot furnace gases to said drier.

JOHN PHILLIPS BADENHAUSEN.