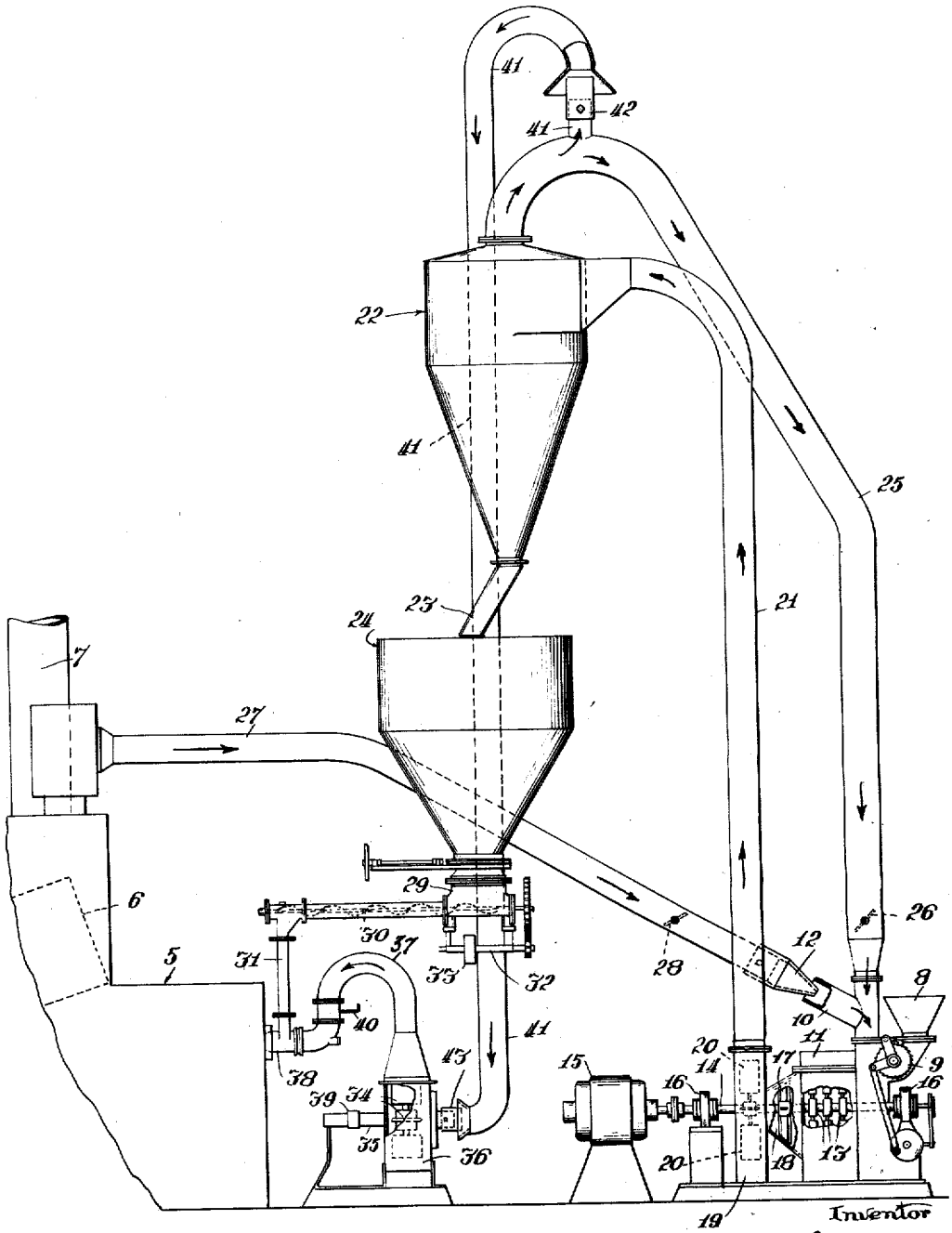
May 10, 1927. 1,627,766

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METHOD OF AND APPARATUS FOR PREPARING, FEEDING, AND BURNING PULVERIZED FUEL

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METHOD OF AND APPARATUS FOR PREPARING, FEEDING, AND BURNING PULVERIZED FUEL.

Application filed April 14, 1924. Serial No. 706,416.

My invention relates to a new and improved method of and apparatus for preparing, feeding and burning pulverized fuel, and it has for its object the improvement of present practices and constructions. Heretofore when coal or other fuel has been pulverized and delivered at substantially atmospheric temperature to a storage bin, it has often happened, by reason of condensation brought about by a cold wind striking the conduit or storage bin or for some other cause, that a sufficient amount of moisture has been gathered at the bottom of the storage bin for giving a small amount of the fuel adjacent to the feed screw such a consistency as to cause it to clog the feeding mechanism and to cause a complete failure of the feeding. This has happened even when the mass of fuel as a body has been comparatively dry, and even when the storage bin has been comparatively small so that the time of storage has been correspondingly short.

It has been the principal object of my invention to prevent the clogging of the feeding mechanism. To this end, it has been one of the particular objects of the invention to dry the fuel more or less before its delivery to the storage bin, and another particular object to prevent condensation at any point such as would cause water to gather at the bottom of the bin or at any other point where it would have the effect of preventing satisfactory operation.

In order to procure the desired results, I have employed a current of hot flue gases, with more or less air as desired, for carrying the pulverized fuel through the pulverizing mill and from the mill to the collector, serving a double purpose. In the first place, the heat from the gases serves to dry the particles of pulverized fuel, the moisture being separated from the particles in the mill but remaining in the stream in the form of vapor, being later diverted from the path of the fuel in the collector. In the second place, the temperature of the fuel is raised very materially, the gases having a temperature ordinarily of about 500 degrees Fahrenheit when leaving the flue; by reason of this rise in the temperature of the fuel, the likelihood of objectionable condensation is very materially lessened.

In carrying out my invention, I have utilized substantially a closed circulating system of conduits between the pulverizing mill and the collector. It has been one of the objects of my invention to provide for taking a portion of the moisture from the stream of air and gases passing through this circulating system so as to prevent the building up of too great a moisture content therein as the drying of the fuel progresses along with the pulverization.

The preferred means by which I have accomplished my objects are illustrated in the drawing and are hereinafter specifically described. That which I believe to be new and desire to cover by this application is set forth in the claims.

The drawing illustrates the preferred form of my improved apparatus, shown more or less diagrammatically, and some of the parts being shown in section. The arrows applied to the several pipes or conduits indicate the direction of flow of the gases or other materials therethrough.

In the drawing, 5 indicates a furnace of any approved type, having a boiler 6 mounted therein in the path of the hot gases from the combustion chamber of the furnace to the flue 7. A pulverizing mill of any suitable type is provided for assisting in the preparation of the fuel to be fed to the furnace, the mill in the construction shown being of the impact or beater type. In the construction of the drawing, 8 indicates the hopper of the mill, to which coal or other fuel to be pulverized is fed from any suitable source, such fuel being fed in the well known manner into the beater chamber by feeding means 9 of any suitable type. An air inlet 10 opens into the mill on the feed side of the beater chamber 11, such air inlet being provided with a damper 12 in the form of a sleeve having a tapered end which is adjustable with respect to the open end of the inlet 10 so as to vary or completely shut off the opening to the atmosphere. Within the beater chamber 11 are mounted a plurality of beaters 13 mounted upon a shaft 14 passing through the beater chamber and driven by the motor 15. In the construction shown, the beaters 13 are mounted upon and supported by the shaft 14, which in turn is supported by bearings 16. In the construction shown, the feeding means 9 is driven by a suitable train of

mechanism from the shaft 14. A beating and regulating device 17 is mounted upon the shaft 14 within a conical extension 18 at one side of the beater chamber 11. At its outer end, the conical extension 18 communicates with a fan chamber 19, within which a fan 20 of any approved type is mounted upon the shaft 14 so as to rotate therewith.

A conduit 21 rises from the fan chamber 19 delivering the pulverized fuel from the mill to a collector 22 of any suitable type, by which the particles of pulverized fuel are separated from the gases comprising the stream by which the fuel is carried, the fuel being delivered by a pipe 23 to a storage bin 24, while the gas separated from the fuel in the collector 22 is returned to the mill through a conduit 25 which is connected at its lower end with the air inlet 10 of the mill, the action of the fan 20 serving to cause a circulation of the air and other gases through the conduits, the collector 22 and the mill. A damper 26 of any suitable type is provided in the conduit 25 for regulating the amount of gas permitted to enter the mill through the conduit 25.

For heating and drying the fuel as it passes through the pulverizing mill and through the conduit 21, I have provided a connection between the pulverizing mill and the flue portion 7 of the furnace, such connection being effected by means of a conduit 27. The lower end of the conduit 27 has communication with the air inlet through the adjustable sleeve 12 above referred to, the sleeve 12 thus serving both as a valve or damper with respect to the inlet 10 and also as a nozzle with respect to the conduit 27. The conduit 27 is provided with a valve or damper 28 of any approved type for regulating the amount of gas passing through the conduit.

In the operation of the mill, with a quantity of hot flue gases being drawn into the mill through the pipe 27, such gases having a temperature ordinarily of about 500 degrees Fahrenheit, the temperature of the fuel itself is raised very materially above that of the surrounding atmosphere, and a very large proportion of the moisture carried by the fuel is removed therefrom. I have found in practice that in some instances the percentage of moisture content of the coal has been reduced from as high as 14 per cent to three or four per cent. This moisture is not removed from the mill at once, but is carried along with the stream of hot gases and fuel passing through the conduit 21 to the collector 22, being carried in the form of a vapor independently of the particles of fuel rather than by such particles. From the collector 22, as is readily understood in connection with devices of this type, the comparatively dried particles of fuel are delivered to the bin 24, while the air, gases and vapor are withdrawn through the conduit 25 for passage again through the mill for feeding and drying the fuel and for carrying the new supply of pulverized fuel to the collector 22. In the operation of the mill, the adjustable sleeve 12 is to be regulated for controlling the admission of atmospheric air to the mill as may be desired. It is, of course, quite possible that under some conditions the sleeve 12 will be adjusted so as completely to close the air inlet at the open end of the pipe adjacent to such sleeve 12.

The means for feeding the pulverized fuel from the bin 24 to the furnace 5 comprises a hopper 29, communicating with the lower end of the bin 24, a screw feeding device 30 of any suitable type for delivering the pulverized fuel from the hopper 29 to the downwardly directed pipe 31, and means for driving the screw 30 from any suitable source of power, such driving means in the construction shown comprising a shaft 32 and a pulley 33. For carrying the fuel from the lower end of the pipe 31 into the fire box of the furnace 5, I have provided a fan 34 of any suitable type, mounted upon a shaft 35 revolubly mounted in a fan chamber 36 for delivering the stream of air or other gas through a pipe 37 to a nozzle 38 into which the lower end of the pipe 31 opens. The shaft 35 is to be driven by a pulley 39 from any suitable source of power. A slide valve 40 of any suitable type is provided for regulating the amount of air or other gas permitted to pass through the conduit or pipe 37.

Inasmuch as the feeding mechanism comprising the screw 30 and the fan 34 forms no part in and of itself of my present invention, it is believed that it is not necessary to describe such parts further herein, it being understood that the screw 30 is designed to feed forward a measured stream of fuel which is driven by the stream of air from the pipe 37 into the combustion chamber of the furnace 5 in the desired manner.

With the pulverizing mill operating for pulverizing and drying the fuel, as above described, there will, of course, be a tendency to build up the moisture content of the circulating stream of air and hot gases passing through the conduits 21 and 25. Moreover, with the conduits 21 and 25, the collector 22, and the mill completely filled with air and other gases, there will be little or no tendency normally for the hot gases to flow through the conduit 27 under the influence of the action of the fan 20. In order to permit the desired flow through the conduit 27 and also for removing a portion of the moisture from the circulating stream of air and gases passing through the conduits 21 and 25, and the mill 11, I have pro-

vided a connection in the form of a conduit 41 leading from the upper end portion of the conduit 25 and opening into the fan chamber 36, the arrangement being such that the fan 34 serves to draw into the chamber 36 a portion of the circulating stream from the conduit 25. An adjustable air inlet valve 42 is provided in the conduit 41 near the upper end, such adjustable inlet comprising a sleeve 42 adjustable longitudinally for varying the amount of air to be admitted. A similar adjustable air inlet comprising a sleeve 43, also adjustable longitudinally, is provided at the lower end portion of the pipe 41. By the use of one or both of the valves or adjustable inlets 42 and 43, the amount of hot gases and air with its high moisture content drawn from the pipe 25 into the fan chamber 36 can be regulated with respect to the amount of air also admitted into the fan chamber 36, as will be readily understood.

As will be appreciated, the hot gases within the mill and within the conduit 21 serve to raise the temperature of the particles of the fuel very materially above that of the surrounding atmosphere, the fuel being delivered to the storage bin 24 while still hot. In view of the fact that the bin 24 is comparatively small for use as a temporary storage place only, it will be understood that the fuel is still hot when it comes into contact with the feed screw 30 in the normal operation of the apparatus. By reason of the fact that a large proportion of the moisture content of the fuel has been removed, and further by reason of the fact that the fuel is still hot when deposited in the bin 24, there is very little if any condensation at any point about the collector 22, the bin 24, or the mechanism by which the fuel is fed from the bin 24 to the furnace 5. The result is that the fuel is delivered to the screw 30 in condition to be handled by the screw efficiently with very little, if any tendency for the fuel to clog the screw so as to prevent its normal operation. So far as I am aware, I am the first in the art to provide a construction of this type comprising a temporary storage bin to which pulverized fuel is delivered while hot and from which it is drawn by the feeding apparatus while still hot for delivery to the furnace, whereby objectionable condensation is prevented and successful operation of the feeding mechanism is assured. My claims are to be construed accordingly.

It will be understood that I prefer to employ the combination of parts as illustrated in the drawing, but I do not desire to limit myself to the use of this particular arrangement and construction, except so far as the same is specifically claimed, since it is evident the changes might well be made in the arrangement and construction without departing from the spirit of my invention.

I claim:

1. The method of preparing, feeding and burning fuel, which comprises pulverizing and drying the fuel by carrying it through a pulverizing apparatus by flotation upon a stream of hot gases circulating through the apparatus, withdrawing from the stream a portion of the gases to keep down the moisture content as the drying of the fuel progresses, and adding hot gases to the stream to replace those withdrawn.

2. The method of preparing, feeding and burning fuel, which comprises pulverizing the fuel, subjecting the fuel to the action of hot flue gases from the furnace during the pulverizing operation for heating and drying the fuel, transporting the pulverized fuel by flotation upon a stream of the hot gases, separating the fuel from the stream and depositing it in a bin, returning a portion of the hot gases to the pulverizing operation, and then feeding the fuel from the bin while still hot, and delivering the fuel to the furnace by flotation upon a stream of mixed air and hot flue gases.

3. The method of preparing, feeding and burning fuel, which comprises pulverizing and drying the fuel by carrying it through a pulverizing apparatus by flotation upon a stream of hot gases circulating through the apparatus, adding hot gases from said furnace to said stream, and withdrawing from the stream a portion of the gases for keeping down the moisture content as the drying of the fuel progresses.

4. The method of preparing, feeding and burning fuel, which comprises pulverizing and drying the fuel by carrying it through a pulverizing apparatus by flotation upon a stream of hot gases circulating through the apparatus, withdrawing from the stream a portion of the gases for keeping down the moisture content as the drying of the fuel progresses, and introducing into the circulating stream fresh hot gases from the furnace drawn in by the force of suction produced by the withdrawal of a portion of the gases therefrom.

5. The method of preparing, feeding and burning fuel, which comprises pulverizing and drying the fuel by carrying it through a pulverizing apparatus by flotation upon a stream of hot gases circulating through the apparatus, withdrawing from the circulating stream a portion of the hot gases and directing such withdrawn gases into the furnace with the pulverized and dried fuel, and introducing into the circulating stream fresh hot gases from the furnace.

6. The method of preparing, feeding and burning fuel, which comprises pulverizing and drying the fuel by carrying it through a pulverizing apparatus by flotation upon a stream of hot gases circulating through the apparatus, separating the fuel from the

stream of gases and moisture, withdrawing from the stream a portion of the hot gases and moisture and directing such withdrawn gases and moisture into the furnace with the pulverized and dried fuel, and introducing into the circulating stream fresh hot gases from the furnace.

7. The method of preparing, feeding and burning fuel, which comprises pulverizing and drying the fuel by carrying it through a pulverizing apparatus by flotation upon a stream of hot gases circulating through the apparatus, withdrawing from the circulating stream a portion of the gases for keeping down the moisture content as the drying progresses, and introducing into the circulating stream a fresh supply of hot gases from the flue of the furnace.

8. An apparatus for preparing, feeding and burning fuel, comprising a furnace, a bin, a pulverizing mill, means for causing a current of hot gases to flow through said mill for carrying the fuel through and from the mill, means for separating the fuel from the current of hot gases and depositing it in a bin, means for returning a portion of the heated gases to the mill, and means for withdrawing the fuel from the bin and delivering same by flotation to the furnace while the fuel is still hot, said means utilizing a portion of the said current of hot gases.

9. An apparatus for preparing, feeding and burning fuel, comprising a furnace, a bin, a pulverizing mill, means for causing a current of hot flue gases to flow from the furnace to and through the mill for carrying the fuel through and from the mill, means for separating the fuel from the current of hot gases and depositing it in a bin, means for returning a portion of these heated gases to the mill and means for withdrawing the fuel from the bin and delivering same by flotation to the furnace while the fuel is still hot, said means utilizing a portion of the current of hot flue gases.

10. An apparatus for preparing, feeding and burning fuel, comprising a furnace, a bin, a pulverizing mill, means for causing a current of hot gases to flow through said mill for carrying fuel through and from the mill, means for separating the fuel from the hot gases and delivering it into a bin, means for returning a portion of these heated gases to the mill, and means for delivering the fuel and the remainder of the heated gases from the bin to the furnace while the fuel is still hot.

11. An apparatus for preparing, feeding and burning fuel, comprising a furnace, a pulverizing mill, a collector, means for circulating a stream of gaseous medium through the mill and said collector and back to the mill for carrying the pulverized fuel to the collector, means for introducing into the circulating stream a quantity of hot gases serving to dry and heat the fuel and means for delivering fuel from the collector to the furnace.

12. An apparatus for preparing, feeding and burning fuel, comprising a furnace having a flue, a pulverizing mill, a collector, means for circulating a stream of gaseous medium through the mill and said collector and back to the mill for carrying the pulverized fuel to the collector, means for delivering fuel from the collector and back to the mill to the furnace, and means for introducing into the circulating steam a quantity of hot gases from the flue for drying and heating the fuel during its movement through the pulverizing mill.

13. An apparatus for preparing, feeding and burning fuel, comprising a furnace having a flue, a pulverizing mill, a collector, means for circulating a stream of gaseous medium through the mill and said collector and back to the mill for carrying the pulverizing fuel to the collector, means for delivering fuel from the collector and back to the mill to the furnace, and connections between the inlet side of the mill and the flue through which hot flue gases are admitted to said circulating stream.

14. An apparatus for preparing, feeding and burning fuel, comprising a furnace having a flue, a pulverizing mill, a collector, means for circulating a stream of gaseous medium through the mill and said collector for carrying the pulverized fuel to the collector, means for delivering fuel from the collector and back to the mill to the furnace, connections between the mill and the flue through which hot flue gases are admitted to said circulating stream, and means for withdrawing from the stream a portion of the gases serving to permit a flow of fresh hot gases from the flue to the stream.

15. An apparatus for preparing, feeding and burning fuel, comprising a furnace, a pulverizing mill, a collector, means for circulating a stream of gaseous medium through the mill and said collector for carrying the pulverized fuel to the collector, means for delivering fuel from the collector and back to the mill to the furnace, connections between said mill and a source of hot gases, and means for withdrawing from the stream a portion of the gases serving to permit a flow of fresh hot gases into the circulating stream.

16. An apparatus for preparing, feeding and burning fuel, comprising a furnace, a pulverizing mill, a collector, means for circulating a stream of gaseous medium through the mill and said collector for carrying the pulverized fuel to the collector, a bin to which the fuel is delivered from the collector, connections between said mill and a source of hot gases, and means for with-

drawing from the circulating stream a portion of the gases and directing such withdrawn gases into the furnace with the fuel from the bin, serving to permit a flow of fresh hot gases through said connections into the circulating stream.

17. An apparatus for preparing, feeding and burning fuel, comprising a furnace having a flue, a pulverizing mill, a collector, means for circulating a stream of gaseous medium through the mill and said collector for carrying the pulverized fuel to the collector, a bin to which the fuel is delivered from the collector, connections between said mill and the flue and means for withdrawing from the circulating stream a portion of the gases and directing such withdrawn gases into the furnace with the fuel from the bin, serving to permit a flow of fresh hot gases from the flue into the circulating stream.

18. An apparatus for preparing, feeding and burning fuel, comprising a furnace having a flue, a pulverizing mill, a collector, means for circulating a stream of gaseous medium through the mill and said collector for carrying the pulverized fuel to the collector, a bin to which the fuel is delivered from the collector, connections between said mill and the flue, and a fan for withdrawing from the circulating stream a portion of the gases and directing such gases into the furnace with the fuel from the bin, serving to permit a flow of fresh hot gases from the flue into the circulating stream.

19. An apparatus for preparing, feeding and burning fuel, comprising a furnace having a flue, a pulverizing mill, a collector, means for circulating a stream of gaseous medium through the mill and said collector for carrying the pulverized fuel to the collector, a bin to which the fuel is delivered from the collector, connections between said mill and the flue, a fan for withdrawing from the circulating stream a portion of the gases and directing such gases into the furnace with the fuel from the bin, and an air inlet into the fan chamber, the operation of the fan serving to induce a flow of fresh hot gases from the flue into the circulating stream and also to induce a flow of air into the furnace with the fuel.

20. The method of preparing, feeding and burning fuel which comprises pulverizing and drying the fuel by carrying it through a pulverizing apparatus by flotation upon a stream of hot gases circulating through the apparatus, eliminating from the stream a portion of the moisture and adding hot gases to the stream.

21. An apparatus for preparing, feeding and burning fuel comprising a furnace, a pulverizing mill, a collector, means for circulating a stream of gas through the mill and said collector and back to the mill for carrying the pulverized fuel to the collector, means for introducing into the circulating stream a quantity of hot gases serving to dry the fuel, means for eliminating moisture from the circulating stream and means for delivering fuel from the collector to the furnace.

22. An apparatus for preparing, feeding and burning fuel comprising a furnace, a pulverizing mill, a collector means for circulating a stream of gas through the mill and said collector and back to the mill for carrying the pulverized fuel to the collector, means for introducing into the circulating stream a quantity of hot flue gases from the furnace serving to dry the fuel, means for eliminating moisture from the circulating stream and means for delivering fuel from the collector to the furnace.

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drawing from the circulating stream a portion of the gases and directing such withdrawn gases into the furnace with the fuel from the bin, serving to permit a flow of fresh hot gases through said connections into the circulating stream.

17. An apparatus for preparing, feeding and burning fuel, comprising a furnace having a flue, a pulverizing mill, a collector, means for circulating a stream of gaseous medium through the mill and said collector for carrying the pulverized fuel to the collector, a bin to which the fuel is delivered from the collector, connections between said mill and the flue and means for withdrawing from the circulating stream a portion of the gases and directing such withdrawn gases into the furnace with the fuel from the bin, serving to permit a flow of fresh hot gases from the flue into the circulating stream.

18. An apparatus for preparing, feeding and burning fuel, comprising a furnace having a flue, a pulverizing mill, a collector, means for circulating a stream of gaseous medium through the mill and said collector for carrying the pulverized fuel to the collector, a bin to which the fuel is delivered from the collector, connections between said mill and the flue, and a fan for withdrawing from the circulating stream a portion of the gases and directing such gases into the furnace with the fuel from the bin, serving to permit a flow of fresh hot gases from the flue into the circulating stream.

19. An apparatus for preparing, feeding and burning fuel, comprising a furnace having a flue, a pulverizing mill, a collector, means for circulating a stream of gaseous medium through the mill and said collector for carrying the pulverized fuel to the collector, a bin to which the fuel is delivered from the collector, connections between said mill and the flue, a fan for withdrawing from the circulating stream a portion of the gases and directing such gases into the furnace with the fuel from the bin, and an air inlet into the fan chamber, the operation of the fan serving to induce a flow of fresh hot gases from the flue into the circulating stream and also to induce a flow of air into the furnace with the fuel.

20. The method of preparing, feeding and burning fuel which comprises pulverizing and drying the fuel by carrying it through a pulverizing apparatus by flotation upon a stream of hot gases circulating through the apparatus, eliminating from the stream a portion of the moisture and adding hot gases to the stream.

21. An apparatus for preparing, feeding and burning fuel comprising a furnace, a pulverizing mill, a collector, means for circulating a stream of gas through the mill and said collector and back to the mill for carrying the pulverized fuel to the collector, means for introducing into the circulating stream a quantity of hot gases serving to dry the fuel, means for eliminating moisture from the circulating stream and means for delivering fuel from the collector to the furnace.

22. An apparatus for preparing, feeding and burning fuel comprising a furnace, a pulverizing mill, a collector means for circulating a stream of gas through the mill and said collector and back to the mill for carrying the pulverized fuel to the collector, means for introducing into the circulating stream a quantity of hot flue gases from the furnace serving to dry the fuel, means for eliminating moisture from the circulating stream and means for delivering fuel from the collector to the furnace.

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CERTIFICATE OF CORRECTION.

Patent No. 1,627,766. **Granted May 10, 1927, to**

LARS H. BERGMAN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, line 79, claim 12, for the word "steam" read "stream"; same page, lines 77 and 78, 90 and 91, 102, 115 and 116, claims 12, 13, 14 and 15 respectively, strike out the words "and back to the mill"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 31st day of May, A. D. 1927.

Seal.

M. J. Moore,
Acting Commissioner of Patents.

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