Jan. 1, 1929. 1,697,585

W. M. BARKER

COAL DUST FEEDER AND MIXER

Filed Dec. 10, 1926

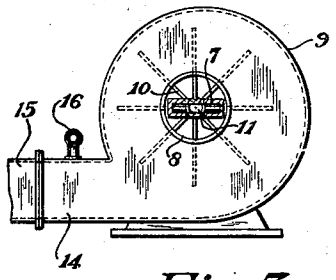


Fig. 3

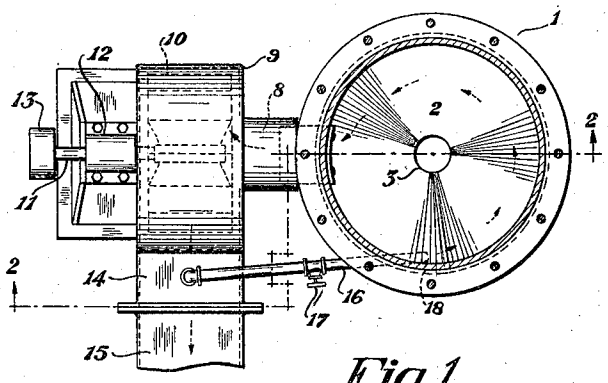


Fig. 1

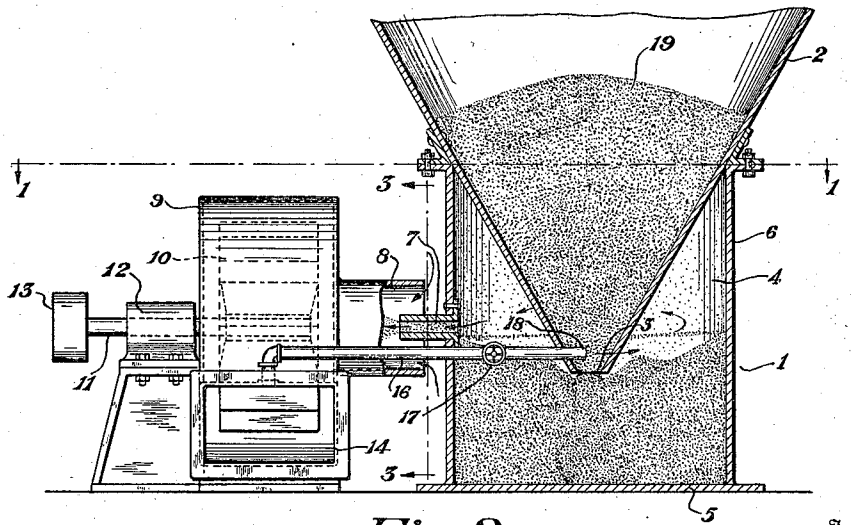


Fig. 2

Inventor

W. M. Barker

By Frease and Bond

Attorneys

Patented Jan. 1, 1929. 1,697,585

UNITED STATES PATENT OFFICE.

WILLIAM M. BARKER, OF CANTON, OHIO.

COAL-DUST FEEDER AND MIXER.

Application filed December 10, 1926. Serial No. 154,023.

My invention relates to methods and apparatus for mixing pulverized fuel, such as coal dust, with the proper quantity of air necessary for continuously constant and complete combustion and for feeding this properly proportioned combustible mixture into a combustion chamber or firebox.

Up to the present time, a number of devices have been used to feed coal dust or powdered coal from the usual storage or feed bins, to the combustion chamber. Innumerable mechanisms including feed screws, air nozzles, or injectors, have been devised to deliver the coal dust from the bins through orifices into ducts where an air stream picks up the coal dust for further mixing and feeding into the combustion chambers.

The various arrangements of these feeding and mixing mechanisms with the bins and fire-boxes, become in some instances very elaborate and complicated, but in spite of this, their continuous action has been uncertain.

Whatever the method used to more thoroughly mix the quantity of coal dust delivered into the air stream by the feed screws, nozzles or injectors, it is first of all necessary that this quantity of fuel delivered into the air stream shall remain continuously constant for any given rate of feeding of a combustible mixture into the fire-box.

The arrangements including feeding mechanisms such as feed screws, air nozzles, or injectors, have been uncertain in their action because the coal dust or powdered coal, being semi-fluid, has been found to be liable at any time to "flush" and run through and around the flights of the feed screws as water would; or on the other hand there has been found a tendency for the coal dust in the bin to arch over and hang above the feed screws and not feed at all. A similar inability to secure a continuously constant rate of feeding of the coal dust into the air stream has been encountered with devices including air nozzles or injectors.

It is obvious that an inability to control the rate of feed of the coal dust into the air stream, renders it impossible to feed into the combustion chamber, regardless of what means may be employed to mix the air and coal dust, a continuously constant combustible mixture having at all times constant proportions of coal dust and air.

It is of course well known in the art of fuel combustion that most efficient combustion of any given powdered or gaseous fuel is obtained by combining the fuel and air in proportions determined by the chemical analysis of the particular fuel, and which proportions may be predetermined for any given fuel, and by intimately mixing these proportions of fuel and air with each other. For any given fuel the proper proportions of fuel and air for the combustible mixture remains constant and unvarying regardless of the rate of feeding the mixture into the combustion chamber or fire-box.

Accordingly the objects of my present improvements are to provide a new and simple method and apparatus for continuously and automatically mixing any desired pulverized or gaseous fuel, such as coal dust with the proper quantity of air necessary for continuously constant and complete combustion, the apparatus simultaneously and continuously delivering the combustible mixture directly through a suitable duct to the desired combustion chamber or fire-box.

Further objects of my improvements are to provide an apparatus for feeding and mixing coal dust and the like, which (1) is positive and automatic in its action; (2) has only one moving mechanical element; (3) may be operated by a central one hand control; (4) feeds at different rates while maintaining the same proportions of air and coal dust in the combustible mixture as determined by the original adjustment of the apparatus; (5) is so compact that the apparatus occupies only a small part of the space required by other feeders, mixers and burners, and at the same time delivers to the fire-box all the coal and air required for complete combustion at all rates of firing without requiring admission of additional secondary air through auxiliary ports.

A preferred embodiment of the apparatus of my invention, and adapted for carrying out the improved method, is illustrated in the accompanying drawing forming part hereof, in which:

Figure 1, is a plan view of the improved apparatus, with portions in horizontal section as on line 1—1, Fig. 2;

Fig. 2, an enlarged front elevation thereof, with portions in offset vertical section as on line 2—2, Fig. 1; and

Fig. 3, an end elevation thereof with portions in section as on line 3—3, Fig. 2.

Similar numerals refer to similar parts throughout the drawing.

The improved coal dust feeder and mixer indicated generally at 1 includes a coal storage bin 2 preferably having sides sloping downward at an angle of 60° with the horizontal and converging to a preferably large round central outlet opening 3, preferably free from obstructions.

This central opening communicates with a relatively large and preferably cylindric closed chamber 4, preferably having a solid bottom 5 beneath the opening and including the cylindric side wall 6 in which is located preferably at a level above the level of the bin outlet opening a relatively low and relatively wide rectangular duct 7 which extends and communicates from the chamber 4 preferably into the central portions of a suction inlet 8 of a fan 9 of any usual or desired construction, and which may include fan blades 10 mounted upon a shaft 11 which is suitably journaled in a bearing block 12, and the shaft 11 being provided with a pulley 13 which may be connected with a motor or other suitable means not shown, for rotating the fan blades.

The suction inlet 8 of the fan is preferably of a substantially greater cross sectional area than the area of the rectangular duct outlet 7 from the closed chamber.

The outlet duct 14 of the fan may communicate through the connecting duct 15 directly to a burner nozzle, not shown, which may be located in a fire-box.

From the top of the outlet duct 14 of the fan a relatively small by-pass pipe 16 preferably having a control valve 17 suitably mounted at a convenient point in its length, communicates from the outlet duct into the closed chamber 4, through a suitable aperture in the cylindric wall thereof, and the outlet end 18 of the pipe 16 is preferably at a level above the level of the central opening 3.

The apparatus constructed as aforesaid, may be operated to carry out the improved method of mixing and feeding coal dust and the like, as follows: The storage or feeding bin 2 may contain any desired quantity of pulverized fuel such as coal dust 19. Due to the relatively steep slope of the sides of the bin, the coal dust falls freely down from the bin through the relatively large central outlet opening 3, striking the bottom plate 5 of the closed chamber after which as the closed chamber fills up, the incoming coal dust naturally spreads and flows outward till it finds its natural angle of repose and the upper surface of the coal dust in the closed chamber will reach substantially the waved level illustrated in Fig. 2, there being a substantial free space above the coal dust in the chamber.

When the fan 9 is started, the rotating blades cause air to flow into the suction inlet 8 thereof and out of the outlet duct 14 thereof at a rate determined by the speed of the fan, part of the outlet air of the fan being by-passed through the pipe 16 into the closed chamber 4.

This by-passed air reaching the closed chamber 4 is of course at a pressure higher than the suction pressure of the suction inlet 8 into which the outlet duct 7 from the closed chamber extends.

The high pressure air delivered in the pipe from the closed chamber sets up a vortex action in the chamber above the coal dust which agitates the coal dust, disturbing its angle of repose, and setting it into air suspension in the free space above its upper surface.

At the same time the low pressure set up in the suction inlet of the fan by the operation thereof, draws the air suspended coal dust into the fan suction inlet where the coal dust mingles with the ingoing free air drawn into the suction inlet about the chamber duct outlet.

In passing through the fan, the coal dust and air are very thoroughly mixed, and this combustible mixture may be driven without there being any opportunity for the coal dust to settle out of the mixture, directly to a burner through the connecting duct 15.

By properly proportioning the relative area of the closed chamber outlet duct 7, the fan inlet 8, the relative proportions of coal dust and air drawn into the fan may be fixed at a ratio equal to the proper ratio for securing constant and complete combustion for the combustible mixture.

The quantity of this unvarying mixture of fuel and air which is delivered into the fire-box depends solely upon the speed of the fan, this speed may be varied by a suitable one hand control of the fan operating motor, and such changes of the fan speed do not affect or change the predetermined ratio of fuel and air in the combustible mixture.

The apparatus once in operation continues automatically as long as a suitable head of coal dust is kept in the bin.

I claim:—

1. A combined feeder and mixer for fuel such as coal dust and the like, including a bin, a closed chamber, and a fan, an unobstructed opening from the bin communicating with the closed chamber, the closed chamber having a broad bottom below the opening and having a large volume as compared with the rate of flow of the dust through the opening, a duct from the closed

chamber communicating with the fan inlet, and a by-pass communicating from the fan outlet to the closed chamber.

2. A combined feeder and mixer for fuel such as coal dust and the like, including a bin, a closed chamber, and a fan, an opening from the bin communicating with the closed chamber, the closed chamber having a broad bottom below the opening and having a large volume as compared with the rate of flow of the dust fuel through the opening, and a duct from the closed chamber communicating with the fan inlet, the area of the fan inlet being different from the area of the duct from the closed chamber.

3. A combined feeder and mixer for fuel such as coal dust and the like, including a bin, a closed chamber, and a fan, an opening from the bin communicating with the closed chamber, the closed chamber having a broad bottom below the opening and having a large volume as compared with the rate of flow of the dust fuel through the opening, and a duct from the closed chamber communicating with the fan inlet, the area of the fan inlet being greater than the area of the duct from the closed chamber.

4. A combined feeder and mixer for fuel such as coal dust and the like, including a bin, a closed chamber, and a fan, an opening from the bin communicating with the closed chamber, a duct from the closed chamber communicating with the fan inlet, and a by-pass communicating from the fan outlet to the closed chamber, the end of the by-pass at the closed chamber being above the opening.

5. A combined feeder and mixer for fuel such as coal dust and the like, including a bin, a closed chamber, and a fan, an opening from the bin communicating with the closed chamber, a duct from the closed chamber communicating with the fan inlet, and a by-pass communicating from the fan outlet to the closed chamber, the duct and the end of the by-pass at the closed chamber being above the opening.

In testimony that I claim the above, I have hereunto subscribed my name.

WILLIAM M. BARKER.