A. G. KINYON & A. I. JACOBS.

APPARATUS FOR MIXING FINELY DIVIDED MATERIAL AND AIR.

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1,258,912. Patented Mar. 12, 1918.

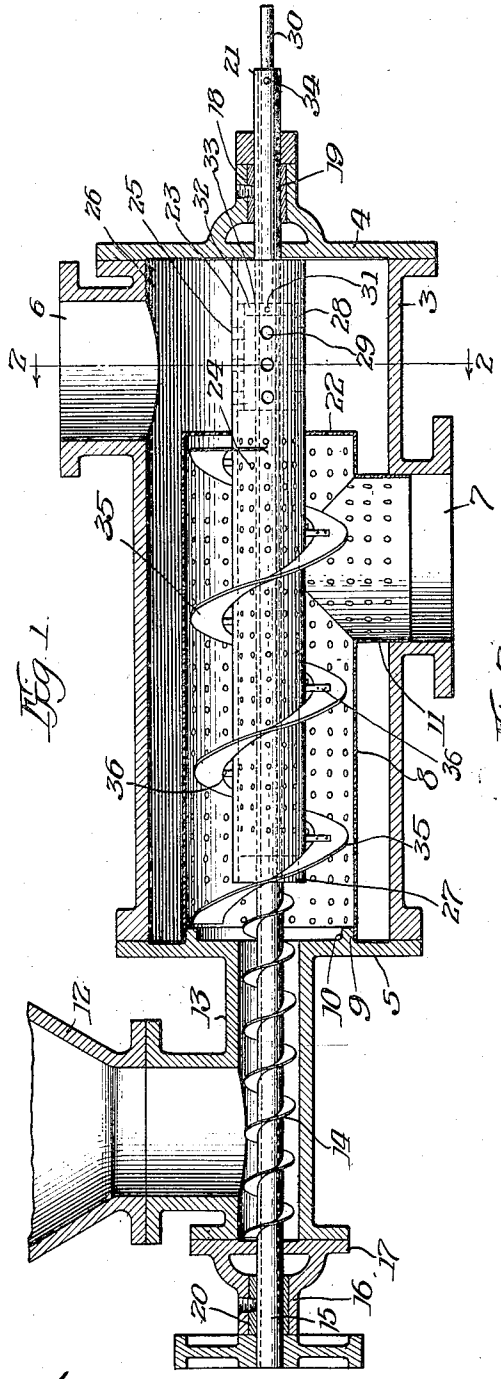


Fig. 1.

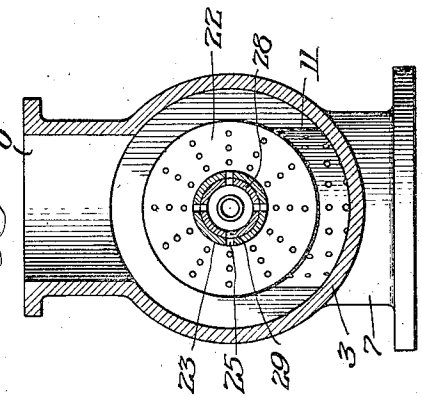


Fig. 2.

Witness:

Inventors

Alonzo G. Kinyon and

Arthur I. Jacobs

By Rector Hibben Davis & Macrae

Attys.

UNITED STATES PATENT OFFICE.

ALONZO G. KINYON AND ARTHUR I. JACOBS, OF CHICAGO, ILLINOIS, ASSIGNORS TO POWDERED COAL ENGINEERING & EQUIPMENT COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

APPARATUS FOR MIXING FINELY-DIVIDED MATERIAL AND AIR.

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To all whom it may concern:

Be it known that we, ALONZO G. KINYON and ARTHUR I. JACOBS, both citizens of the United States, residing in Chicago, county of Cook, and State of Illinois, have invented new and useful Improvements in Apparatus for Mixing Finely-Divided Material and Air, of which the following is a specification.

Our invention relates more particularly to means for mixing powdered fuel with air, though it will be obvious from the following description that it is clearly applicable for mixing other finely divided material with air where the conditions are substantially the same. Powdered fuel has heretofore been employed in furnaces, kilns and the like by feeding it into a jet of air and thereby projecting it into the furnace where additional air is supplied to the fuel sufficient to support combustion. The mixture of the fuel with the air, however, especially with the additional air referred to above, commonly takes place quite slowly and as the fuel is carried rapidly forward by the jet of air provided for the purpose, there is but little combustion until the fuel has been carried some distance from the burner and complete combustion is only effected after a considerable distance has been traversed by the fuel. The result of this is that the flame is a long and slender one composed of rapidly moving air and fuel, the combustion of which begins a considerable distance from the burner and it is impossible to develop the high degree of heat desirable in furnace work adjacent the burner. Such means for burning powdered fuel, is only available where the combustion chamber is of sufficient length to permit the gas and fuel under the conditions mentioned to be completely mixed and burned. Even in such constructions there is but little heat developed adjacent the burner and this part of the heating chamber is therefore for most purposes substantially wasted. On the other hand, if the mixture of fuel and air must follow a tortuous path because of bridge or cross walls or the like, the latter are quickly destroyed by the impingement of the mixture thereon. It is the object of this invention to so thoroughly mix the fuel with the air for supporting combustion thereof prior to feeding the same to the burner, that each particle of fuel is surrounded by an envelop of air sufficient for the combustion thereof and the air is as it were carbureted by the fuel so completely that when it emerges from the burner into the high temperature of the furnace, practically complete combustion takes place close to the burner, the mixture being fed slowly forward and forming what is known as a slow or lazy flame of great volume and little speed within the furnace.

In the accompanying drawings we have shown and in the following specification described in detail the preferred form of our invention. It is to be understood, however, that the specific disclosure is for the purpose of exemplification only, the scope of the invention being defined in the following claims, in which we have endeavored to distinguish it from the prior art so far as known to us without, however, relinquishing or abandoning any portion or feature thereof. In the drawings Figure 1, is a vertical, longitudinal section of our improved apparatus for mixing powdered fuel and air, the parts being shown in elevation, and Fig. 2 is a transverse vertical section thereof on the plane 2—2 of Fig. 1.

The improved apparatus comprises a cylindrical casing 3, inclosing a mixing chamber, which is closed at its respective ends by end plates 4, 5, and provided with an air inlet opening 6 and an outlet opening 7 for the mixture of powdered fuel and air. The mixing chamber proper consists of a perforated cylindrical screen 8 co-axial with the casing 3, secured at one end 9 to an annular flange projecting inwardly from the head 5, and connected to an outlet 7 by a lateral branch or elbow 11. The powdered fuel is fed to the mixing chamber from a hopper 12 through a neck 13 formed integral and co-axial with the head 5 by a screw 14 of small diameter carried by a shaft 15 extending through said neck and beneath the hopper. The shaft 15 extends completely through the neck and the casing, being journaled at one end in a bearing 16 formed on a head 17 connected to said neck and at the other end in a similar bearing 18 formed integral with a head 4. The bearings are shown provided with suitable bushings 19, 20. The shaft 15 is illustrated as a tube, though for the pur-

pose of this invention it need be such only for a short portion thereof between the end 22 of the mixing chamber and end 21 of said shaft. Within the casing and extending substantially the length of the mixing chamber and terminating at the inner wall of the head 4 is an enlarged perforated tube 23 which is concentric with and carried by said shaft 15. Within the mixing chamber the tube 23 is provided with successive annular series of perforations 24 substantially throughout its length, and outside the mixing chamber but within the casing said tube is provided with annuli of larger perforations 25 which are in communication with the air space 26 of said casing. The tube 23 is plugged or closed at the end toward the hopper as at 27.

It will be obvious from the construction as thus far described that the air entering at 6 under pressure flows in through the perforations in the mixing chamber 8 into the interior thereof and also reaches the interior of the mixing chamber through the inner perforated cylinder or pipe 23 which it enters by the openings 25 therein and escapes through the openings 24. The amount of air entering the mixing chamber through the sleeve 23 can be regulated by means of an internal sleeve valve 28 having ports 29 which may be brought more or less into registry with the openings 25 by sliding the sleeve longitudinally. For this purpose a rod 30 extends through the hollow shaft 15, being provided at its inner end 31 with a cross piece 32 extending through slots 33 in the hollow shaft 15, said slots being of a length sufficient to permit the necessary movement of the sleeve 28 to completely open and close the holes 25. The rod 30 may, if desired, be formed at its other end with a handle, and a set screw 34 extends through the hollow shaft 15 and bears upon said rod to secure it in adjusted position. Within the mixing chamber a perforated tube 23 is provided with a spiral blade or ribbon 35, which is mounted upon but spaced from said tube by the posts or supports 36.

The operation of our improved air and fuel mixing device will be apparent from the above description thereof. Means are provided, such for example as the pulley 37 for continuously rotating the shaft 15 and for forcing the required amount of air under pressure through the opening 6. The opening 7 is connected to a combustion chamber for the fuel which may be a furnace, internal combustion engine or other means for utilizing a mixture of fuel and air. The fuel is continuously fed into the mixing chamber by the revolution of the screw 14 and is immediately taken up by the manifold jets of air issuing into the chamber through the openings both in the walls 8 and 22 of said chamber and in the tube 23. It is to be noted that the annular series of openings in the tube 23 are arranged intermediate or alternated with the series of openings in the wall of the chamber 8 so that the jets are not directly opposed, but the jets from the tube 23 are projected intermediate the jets from the openings in the wall 8 producing a great number of small eddy currents, this effect being intensified by the fact that the tube 23 is continuously and rapidly rotated, the jets therefrom being obviously likewise rotated. The revolution of the large spiral blade or ribbon 35 also enhances the mixing effect in the mixing chamber in addition to feeding the mixed air and fuel forwardly to the opening 7.

As a result of these combined agencies, the air and powdered fuel are very intimately mixed so that the fuel floats in the air, each particle thereof being surrounded by an envelop of air sufficient in volume to support the combustion thereof. The quantity or flow of air through the apertures in the tube 23 may be properly proportioned with reference to the air entering through the apertures in the mixing chamber wall by suitably adjusting the sleeve 28, as heretofore described. From the described apparatus the mixture of air and fuel is fed directly to the burner, preferably without the admixture of other quantities of air. It enters the combustion chamber at a relatively low rate of speed, because of the intimate contact of the fuel with the air for supporting combustion, and at once bursts into a flame of high temperature, great volume and slow movement, a so-called lazy flame, which evenly heats the furnace or other combustion chamber throughout.

We claim:

1. A mixing device for commingling air and finely divided matter comprising a mixing chamber, having a perforated wall, a casing surrounding said chamber, means for supplying said casing with air under pressure, a rotary perforated tube within the casing, means for supplying said tube with air and an outlet in the mixing chamber for the mixture of fuel and air.

2. In a device of the class described, a mixing chamber having perforated walls, a casing surrounding the mixing chamber, means for feeding powdered fuel to the mixing chamber, an air inlet to said casing, an outlet from said mixing chamber, a perforated tube within the mixing chamber communicating with the casing outside said mixing chamber whereby the mixing chamber is supplied with air through the walls and through said tube.

3. In a device of the class described, a casing having an air inlet and an outlet, a mixing chamber within the casing, means for supplying the mixing chamber with powdered fuel, a revoluble tube within the

casing and extending for a portion of its length within the mixing chamber, perforations in said tube within the mixing chamber and other perforations in said tube outside said mixing chamber but opening into the casing.

4. In a device of the class described, a casing, a mixing chamber therein having perforated walls, means for feeding powdered material into said mixing chamber, a perforated revoluble tube within the casing extending partially within the mixing chamber, some of the perforations of said tube communicating with the mixing chamber and other of said perforations communicating with the interior of the casing outside said mixing chamber and air inlet to said casing and the outlet from said mixing chamber.

5. In a device of the class described, a casing having an air inlet and an outlet, a mixing chamber within the casing having perforated walls spaced from the walls of said casing, said mixing chamber communicating with the outlet of the casing, a revoluble perforated tube extending partially within the mixing chamber and connecting with the air space in the casing, means for revolving said tube comprising a shaft extending through one end of said casing, a chamber surrounding said shaft and a hopper for feeding powdered material to said chamber.

6. In a device of the class described, a casing, a mixing chamber within the casing and having perforated walls spaced apart from the walls of the casing, an air inlet in said casing, an outlet therefrom, means for feeding powdered fuel to the mixing chamber, a perforated tube in the casing extending partially within the mixing chamber and having perforations communicating therewith and partially extending without the mixing chamber and having perforations communicating with the air space of the casing, a valve for controlling the last said perforations and means for adjusting the valve.

7. In a device of the class described, a casing, a mixing chamber within the casing and having perforated walls spaced apart from the walls of the casing, an air inlet in said casing, an outlet therefrom, means for feeding powdered fuel to the mixing chamber, a perforated tube in the casing extending partially within the mixing chamber and having perforations communicating therewith and partially extending without the mixing chamber and having perforations communicating with the air space of the casing, a valve movable longitudinally of the tube for controlling the last said perforations, and means for adjusting the valve longitudinally of said tube.

8. In a device of the class described, a casing, a perforated mixing chamber in the casing, means for feeding powdered material to the mixing chamber, an outlet from the mixing chamber, a perforated tube communicating with the interior of the casing outside of and within the mixing chamber, means for revolving said tube, a spiral ribbon mounted upon the tube within the chamber, and an inlet to the casing to supply air thereto.

ALONZO G. KINYON.
ARTHUR I. JACOBS.