

Feb. 7, 1939.

R. J. C. BOUDRANT
ROTARY MIXING APPARATUS
Filed Sept. 23, 1936

2,146,618

3 Sheets-Sheet 1

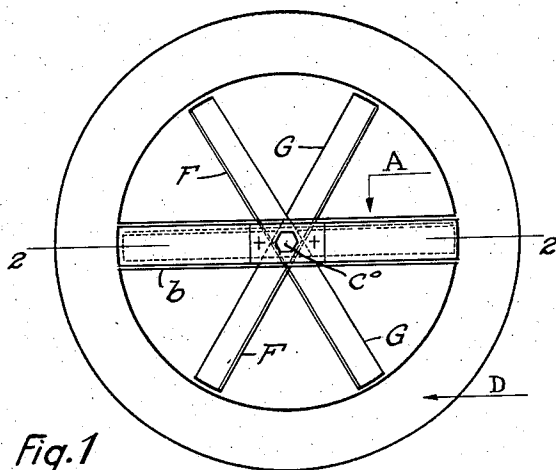


Fig. 1

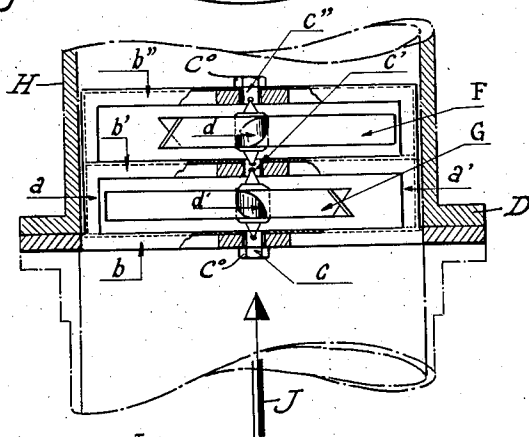


Fig. 2

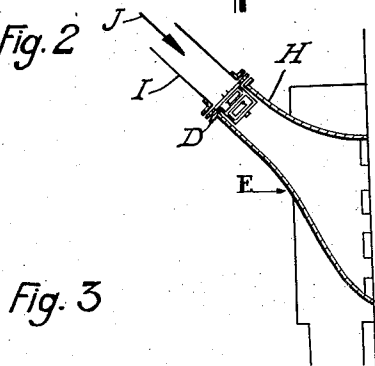


Fig. 3

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3 Sheets-Sheet 2

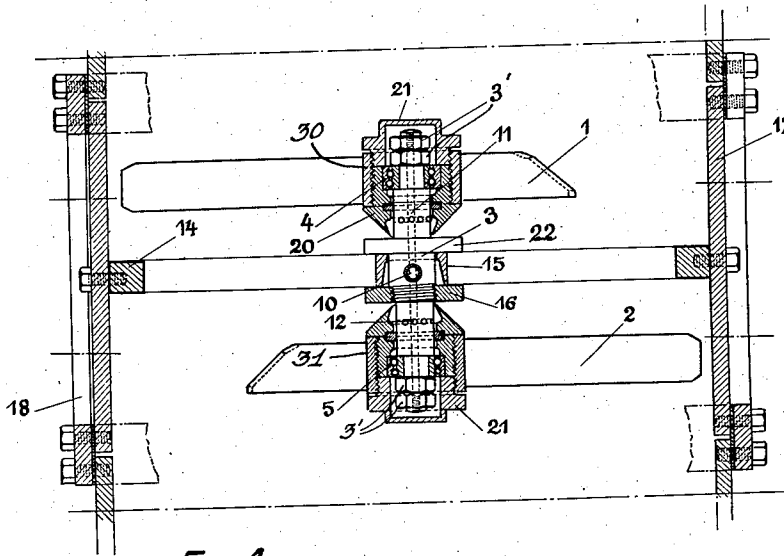


Fig. 4

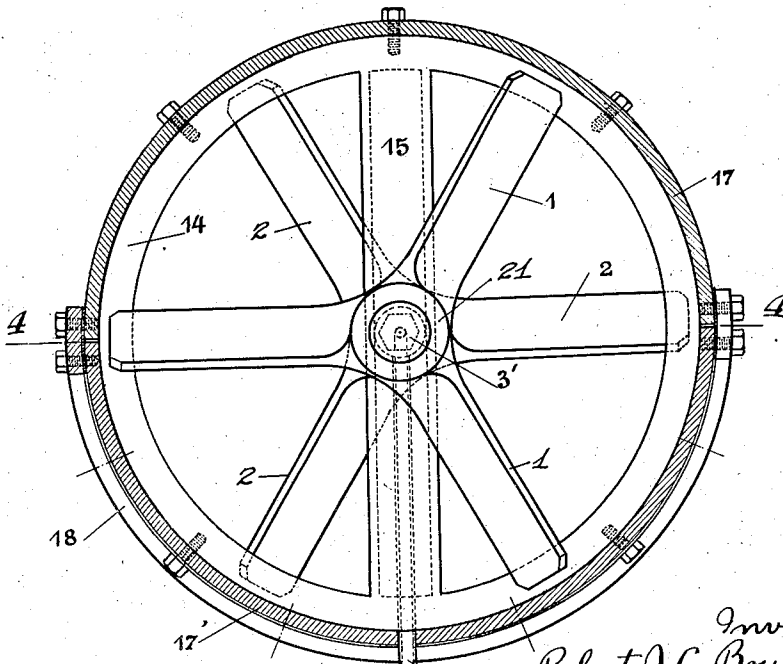


Fig. 5

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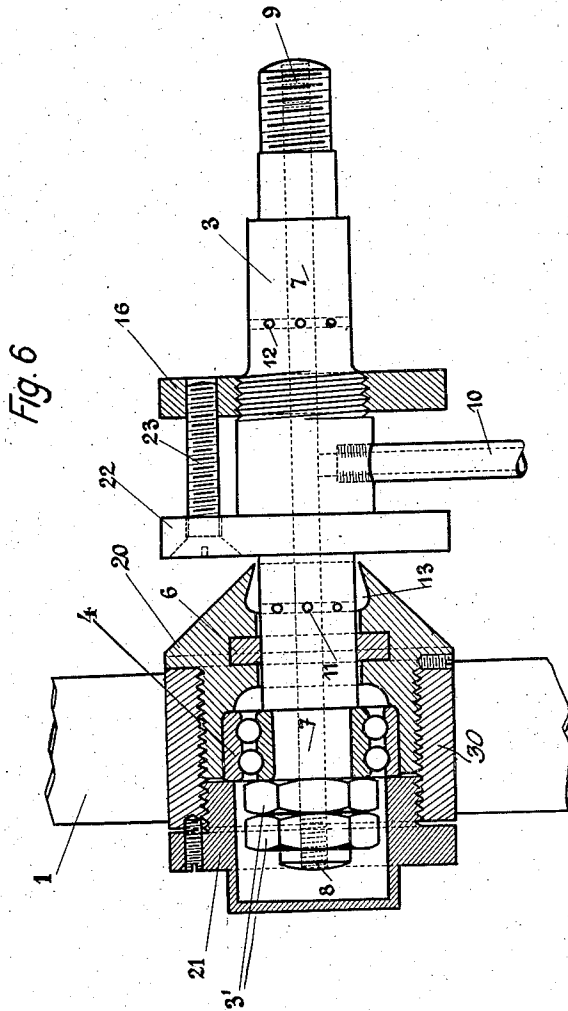
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UNITED STATES PATENT OFFICE

2,146,618

ROTARY MIXING APPARATUS

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Application September 23, 1936, Serial No. 102,215
 In France October 3, 1935

6 Claims. (Cl. 110—104)

This invention relates to rotary means for mixing pulverized coal with air in connection with burners fed with pulverized coal.

It is well known that the rapidity of combustion of pulverized coal depends upon the intimate mixing between the air and the coal. This has led to the construction of burners of the so-called turbulence type.

However, in the majority of these burners, the combustion is far from being perfect, that being due to the lack of homogeneity of the stream or mixture comprising coal dust and primary air.

During the passage of this mixture between the pulverizing mill or storage hopper and the burner, the coal separates out partially in the stream and it is then very difficult to mix the secondary air for combustion in a proper manner with the stream of fluid highly charged with combustible and possessing a considerable momentum.

The object of the present invention is to provide an apparatus which produces a mixture as homogeneous as possible between the air and the fuel immediately in front of the delivery to the burner.

The apparatus is composed essentially of two helically-bladed rotors having two, three or more blades (according to the diameter of the pipe system) inclined upon their axes at angles from 30° to 60° according to the speed of the fluid. The two rotors are of opposite hand to one another and consequently rotate in opposite directions by the effect of the fluid current impinging on the blades.

There results therefrom an energetic mixing up of the fluid in consequence of the eddies thus created.

The apparatus is indeed based upon the difference of velocity existing between the carrier air and the coal carried therein, which produces at the outlet from the first rotor a substantially homogeneous concentration in each concentric layer round the axis of the apparatus. The eddies created at the entry to the second rotor ensure a complete stirring up of the mixture.

With a pulverized-coal burner of the so-called turbulent type, in which the discharge of primary air into the combustion chamber takes place through a vertically elongated opening of considerable height and small width, the unburnt solid particles amount to about 3 percent of the coal consumption.

By adapting the improved rotary mixer according to the present invention, immediately at the entry to the coal and primary air nozzle of the burner, it has been possible to observe a shorten-

ing of the flame, an increase of 100° C. in the mean temperature of this latter, and a considerable reduction of the unburnt particles which have been brought down to about 1 percent of the coal consumption.

Upon the accompanying drawings, to which reference is made in the subsequent description, Figs. 1 to 3 represent a first example of carrying out my invention:

Fig. 1 is a plan view of the mixer;

Fig. 2 is a corresponding vertical section taken along the axis 2—2 of Fig. 1;

Fig. 3 shows the mixer device placed upon a burner;

Figs. 4 to 6 represent another example of carrying out the invention, which obviates the rapid abrasion of the mechanical parts by the pulverized coal;

Fig. 4 is a vertical section taken along the axis 4—4 of Fig. 5;

Fig. 5 is a plan view of the mixer; and

Fig. 6 is a partial view on a larger scale, of a section through the mixer shown in Fig. 5.

Referring to Figs. 1, 2 and 3, a flat ring D inserted at the entry H to the burner E, is cut out to the internal diameter of the pipe I supplying the pulverized coal and primary air; upon this ring, there is fixed a chassis A, composed of two headers *a a'* and three cross bars *b b' b''*, adapted to extend into the burner entry H. Two single cone-centers *c c'* and a double cone center *c'*, mounted in the cross bars, receive the hardened steel pivots of the axes *d, d'* of the two helically bladed rotors F and G. The single cone centers are constituted by the extremities of adjustable screws, secured by lock nuts *c''*.

The helically bladed rotors F and G, of opposite hand, are shown provided with three blades each, these blades being inclined at 45° to the axis.

The arrow J in Figs. 2 and 3 indicates the direction of supply of the pulverized coal and primary air.

In the modification shown in Figs. 4, 5 and 6, the two rotors 30, 31, fitted with helical blades 1, 2, of opposite hand, and composing the rotary mixer, are movable around a common shaft 3, Fig. 4.

The rotors 30, 31 are each screwed upon a hub 20, connected to the shaft 3 by suitable bearings, for example ball bearings 4, 5 (Figs. 4 and 6). These bearings are each fixed to one extremity of the shaft 3 by means of nuts 3', with lock nuts or other devices to prevent unlocking, and protected by a hub cap 21.

On the one hand, a felt washer 6 placed in a

groove formed inside the hub 20, Fig. 6, prevents the loss of lubricant along the shaft 3.

On the other hand, the shaft 3 possesses a central channel 7, closed at its two extremities 8, 9, by any suitable device. This channel is in communication with a compressed air line by a tube 10, Figs. 4, 5 and 6.

The compressed air thus injected into the channel 7 escapes through two series of orifices 11, 12, Figs. 4 and 6, each corresponding to one rotor. These orifices to the number of six to ten for each rotor, and arranged in a ring, blow air under pressure into an annular chamber 13 formed in the hub 20 and thus maintain in that chamber a pressure greater than that existing in the pipe conveying the pulverized coal, thus avoiding any access of dust to the felts and bearing chambers.

In order to obtain absolute protection against the entrance of dust, with a minimum of expenditure of compressed air, the annular clearance between the outlet at the rim of the chamber 13 and the shaft 3 must be as small as possible.

Having regard to this small clearance, it is indispensable that this annular rim shall be cut to a knife edge, as indicated in Figs. 4 and 6, or shall assume any other suitable form, in order to reduce the friction to a minimum in case particles of coal should happen to collect upon the fixed or movable external parts of the apparatus as a result of greasy deposits from the oil which may be carried with the compressed air.

Figs. 4 and 5 show the simple method of mounting the rotary mixer which has just been described, in a pipe conveying air and pulverized coal.

A ring 14 is fixed in the pipe 17; a channel member 15 is formed on one diameter of this ring and is integral with the latter at its two extremities.

The channel member 15 is pierced at its center with a hole into which the shaft 3 can be passed. This shaft 3 is fixed at its center upon the channel member 15 by means of the shoulder 22 integral with the shaft 3, and a nut 16 locked by the screw 23, Fig. 6. The rotors 1, 2, and the tube 10, can then be mounted in place.

A semi-cylindrical piece 17', Fig. 5, of a height slightly greater than that of the mixer, can be cut out of the pipe 17 supplying the pulverized coal and air, this loose piece being then refitted by the aid of a cover plate 18, in order to allow erecting and taking down the apparatus during inspection, without having to dismantle a pipe system of large diameter.

It is naturally permissible, without departing from the scope of the invention, to provide modifications operating practically in the same manner as the examples described above.

The number of blades 1, 2, on the respective rotors 30, 31, and their inclination can vary; they are in fact to be determined according to each particular case.

There can also be provided a larger number of rotors in series, but the increase of turbulence is slight whereas the loss of head rises considerably.

The apparatus is naturally applicable to any type of burner, whether of turbulent or of ordinary type, and can be placed either upon the pipe supplying fuel and primary air, or at a position after the admission of all or part of the secondary air.

What I claim is:—

1. In combination with a pulverized coal burner, a mixer mounted in a pipe conveying the fuel and primary air to the burner, said mixer com-

prising a frame, a pair of helically bladed rotors arranged in series and closely spaced along said pipe, bearings for said rotors carried by said frame, said rotors being rotatable by the current of air and arranged to rotate in opposite directions on said bearings, and means for continuously supplying air under pressure to the interior of said bearings to prevent coal dust from entering said bearings.

2. An apparatus for burning pulverized coal comprising a burner, a mixer through which the powdered coal and primary air travel to said burner, said mixer comprising a frame, a shaft carried by said frame and arranged coaxially of the current of coal-laden primary air, a pair of helically bladed rotors arranged in series, bearings for said rotors carried upon said shaft, said rotors being rotatable by the current of coal-laden air, means for delivering compressed air to the interior of said bearings, and means for discharging said compressed air from said bearings to exclude said coal-laden air from said bearings.

3. In combination with a pulverized coal burner, a rotary mixer having a conduit through which the coal and primary air travel to the burner, a frame mounted in said conduit, a hollow shaft secured to said frame, said shaft being coaxial in relation to said conduit and having its ends projecting in opposite directions from said frame, a pair of rotors mounted in series upon said projecting ends, said rotors comprising helically bladed hubs and being rotated in opposite directions by the current of air in said conduit, means for delivering compressed air to the interior of said shaft adjacent to said frame, said compressed air having access through the projecting ends of said hollow shaft to the interior of said hubs, and means for passing said compressed air between said hubs and said shafts.

4. For use with a pulverized coal burner, a rotary mixer having a conduit through which the coal and primary air travel to the burner, a frame adapted to be mounted in said conduit, a hollow stationary shaft secured to said frame, said shaft being coaxial in relation to said conduit and having its ends projecting in opposite directions from said frame, a pair of rotors mounted upon said projecting ends, helical blades projecting from the hubs of said rotors, said rotors being arranged in series, revoluble in opposite directions around said projecting ends, and driven by the current of air in said conduit impinging on said blades, a hub cap secured to each of said rotors over the respective end of said shaft, an annular chamber in each of said rotors at the end remote from said hub cap, said annular chambers closely surrounding said hollow stationary shaft, said hollow shaft being provided with passages extending from the bore outwards to communicate with said annular chambers, and means for supplying air under pressure to the bore of said hollow shaft in communication with passages and annular chambers.

5. A rotary mixing device for a powdered coal burner, comprising a conduit, a hollow shaft mounted coaxially in said conduit, bearings upon said hollow shaft, a pair of rotors of opposite hand arranged in series in said conduit, each of said rotors including a hub and helical blades projecting therefrom, said rotors being mounted at their hubs on said bearings and adapted to be rotated in opposite directions by the current of coal-charged primary air passing along said conduit and impinging on said blades, annular chambers within said hubs, said chambers having

walls tapering down almost to said shaft, said hollow shaft being provided with channels extending from the bore outwards into said annular chambers, packing washers arranged between
5 said shaft and said hub to the side of said channels remote from said tapered walls, and means for supplying air under pressure to the bore of said hollow shaft in communication with said channels, annular chambers, and the space be-
10 tween said shaft and the tapering walls of said annular chambers.

6. A rotary mixing device for a powdered coal burner, comprising a tubular conduit through which the powdered coal and primary air travel
15 to said burner, a hollow stationary shaft secured in said tubular conduit, bearings upon said shaft, a pair of helically bladed rotors of opposite hand, arranged in series in said tubular conduit and each having a hub with helical blades projecting
20 therefrom, said rotors being mounted at their

hubs on said bearings and being rotated in opposite directions by the coal-charged primary air travelling along said conduit, annular chambers in said hubs, said chambers having walls tapering inwards close to said shaft, said hollow shaft
5 being drilled with small holes to provide a row of communicating channels between the bore and each of said annular chambers, hub caps secured to said hubs, said caps covering the outer ends of said hollow shaft, packing means ar-
10 ranged between said shaft and said hub on the side of said channels remote from the tapering walls of said annular chambers, and means for supplying air under pressure to the bore of said
15 hollow shaft in communication with said channels, annular chambers and the space between said shaft and the tapering wall of each said chamber.

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