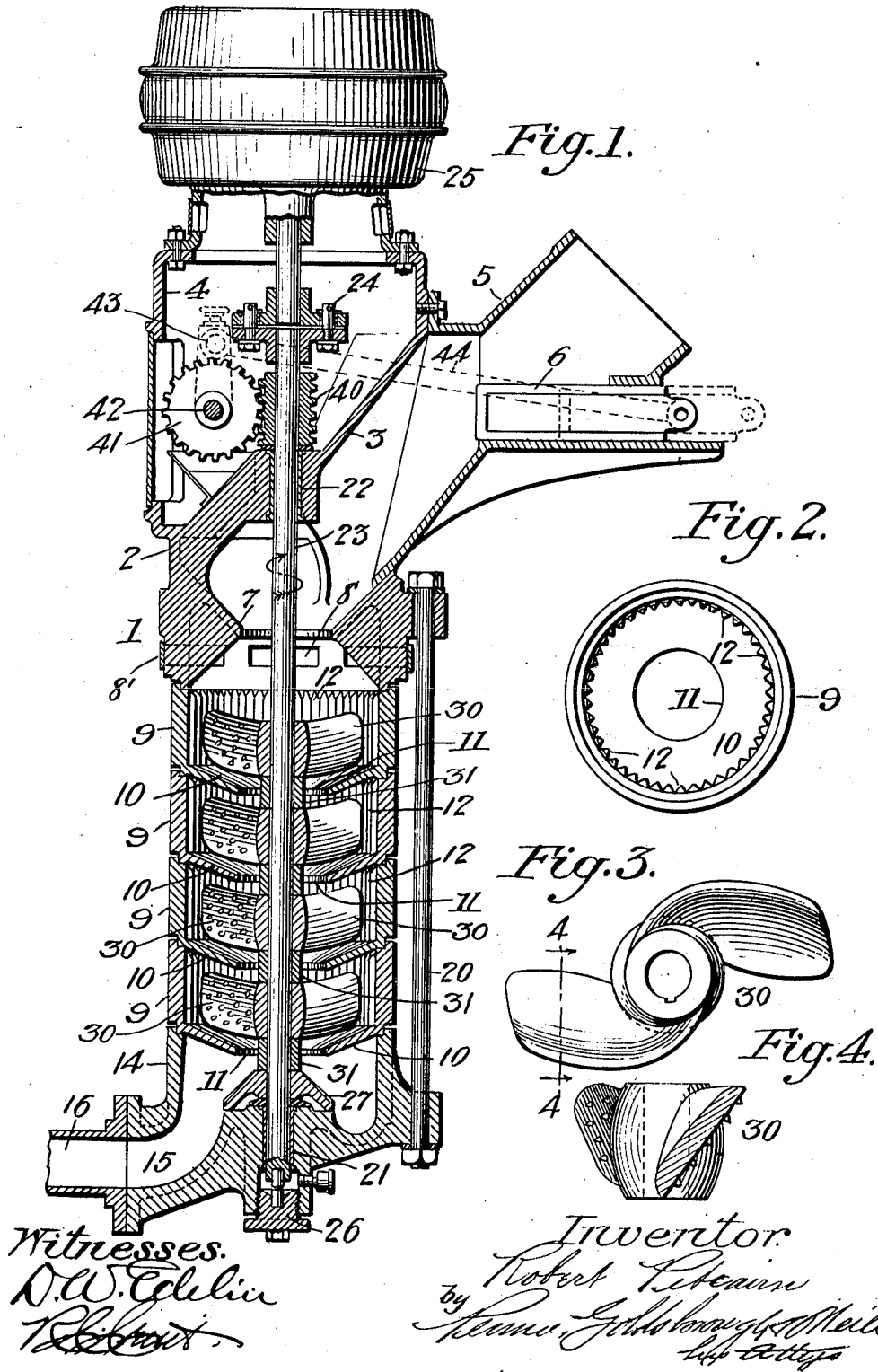


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 APPARATUS FOR PREPARING AND FEEDING FINE FUEL.
 APPLICATION FILED FEB. 19, 1912.

1,048,869.

Patented Dec. 31, 1912.



UNITED STATES PATENT OFFICE.

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APPARATUS FOR PREPARING AND FEEDING FINE FUEL.

1,048,869.

Specification of Letters Patent.

Patented Dec. 31, 1912.

Application filed February 19, 1912. Serial No. 678,542.

To all whom it may concern:

Be it known that I, ROBERT PITCAIRN, a citizen of the United States, residing at Denver, county of Denver, State of Colorado, have invented certain new and useful Improvements in Apparatus for Preparing and Feeding Fine Fuel; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to an apparatus for preparing and feeding fine fuel, such as coal, with appropriate quantities of air to a furnace or other combustion apparatus wherein the admixture of pulverized fuel and air is burned in suspension.

The object of the invention is to provide a simple, durable, compact and efficient apparatus to simultaneously pulverize the fuel and intimately admix the same with the requisite quantities of air and eject the same through the medium of the admixed air into the combustion chamber so that combustion is effected under the most advantageous and economical conditions.

To this end, the invention comprises a casing provided with a longitudinal series of crushing chambers, preferably made up of individual units, each of said chambers having an inclined bottom with a restricted orifice through which the fuel and air is forced, a revoluble shaft in the casing associated with suitable means for driving said shaft, combined air-propelling and fuel crushing blades on said shaft, operating in the respective crushing chambers, together with inlet and outlet orifices for fuel and air in regulable quantities, the whole being associated in a self-contained structure preferably located in vertical position in front of the furnace or other combustion apparatus and adapted to take coal from a hopper or other receptacle, comminute the same to the desired degree of fineness, mix the comminuted fuel intimately with air in the proper proportions, and eject the admixture of fine fuel and air into the combustion space of the heating apparatus. By this apparatus, it is possible to avoid the necessity of storing fine fuel in bulk under conditions highly conducive to disastrous explosions, and to enable the fuel to be pulverized and mixed with the requisite quantities

of air immediately at the time and place where it is required.

A preferred form of the invention is illustrated in the accompanying drawings, in which,

Figure 1 is a vertical longitudinal section through the apparatus. Fig. 2 is a horizontal section through one of the crushing chambers. Fig. 3 is a plan view of one of the combined air propelling and crushing elements. Fig. 4 is an elevation of the crushing elements showing one of the blades in section.

Referring to the drawings, 1 indicates the casing or housing of the apparatus which comprises an upper member 2, divided by a cross partition 3 into two sections or compartments, the top section inclosing the connections between the driving motor and the shaft and also the gearing for operating the cut-off or gate in the coal chute. The coal chute or inlet is preferably formed as a separate casting 5, attached to the upper member 2 of the casing and is provided with a sliding gate or cut-off 6 which is operated by mechanism, to be hereinafter described, to supply the coal or other fuel to be comminuted in appropriate quantities and at desired intervals to the apparatus. Below the chute 5, the member 2 is constricted to a circular outlet 7 which serves to direct the incoming coal toward the longitudinal axis of the apparatus. Below the constricted throat 7, the member 2 of the casing is provided with a series of lateral air inlets 8 co-operating with which is a movable ring-like gate 8' which serves to open and close the openings 8 to any desired extent and thereby to regulate the amount of air supplied to the apparatus. The casing or housing 1 further includes a series of crushing chambers arranged in longitudinal alinement, each of which chambers comprises a ring-like element 9 provided with telescoping joints to connect the several rings and the adjacent casing sections as a substantially air-tight conduit. Each of said ring-like sections 9 is provided with a downwardly inclined bottom 10 which is provided with a central orifice forming a constricted throat 11 through which the material passes and the inner walls of each ring 9 are provided with serrations, ribs, or projections 12, which serve, in conjunction with the rotary

crushing elements hereinafter described, to break up the coal and ultimately reduce the same to a desired degree of fineness. The final element of the casing or housing consists of the cap or closure piece 14 provided with an outlet 15, which is connected by a conduit 16 with the fire box of the furnace or other combustion apparatus. The several elements of the casing or housing 1 are arranged in longitudinal series as shown, and securely connected together by means of tie bolts 20 which pass through suitable lugs on the members 2 and 14 of the casing.

Mounted in bearing 22, carried by the cross partition 3 in the member 2 of the casing, and in a suitable step bearing 21 carried by the member 14 of the casing is a revoluble shaft 23, preferably supported by an adjustable thrust bearing 26, of any appropriate form. The upper end of the shaft is preferably provided with a coupling 24 by means of which the shaft is connected with the stub shaft of a motor 25 secured to the top of the casing or housing 1. In the preferred form of the apparatus, 25 is an electric motor, although it will be understood that said motor may be a turbine or other suitable prime mover, or, in the alternative, it may be replaced by an appropriate form of gearing or other form of transmission for imparting rotary movement to the shaft 23.

Mounted upon the shaft 23 are a series of propeller-like elements 30, one occupying each crushing chamber 9. These elements 30 comprise combined air propelling and fuel crushing blades which are set at an angle to the axis of rotation substantially like the blades of a marine propeller. Each of these air propelling and fuel crushing elements is secured to the shaft by means of a suitable key or spline and the several elements are properly spaced so that they occupy the central space within the respective crushing chambers, by means of blocks 31, mounted on the shaft between the several chambers 30, and between the final elements 30 and the bearing block 27 surrounding the shaft and supported by the bottom of casing member 14. Preferably the forward face of each of the blades of the rotary crushing member is provided with a series of knobs or projections which serve to break up the coal, in conjunction with the ribs or serrations on the interior walls of the crushing chambers 9.

Secured to the shaft 23, within the upper chamber 4 of the housing is a worm 40 which meshes with a worm wheel 41, mounted upon a shaft 42 journaled in the casing. To the outer end of the shaft 42, there is secured a crank 43, which is connected by a pitman 44, with the sliding gate or cut-off 6 in the inlet chute 5, whereby the said cut-off or gate 6 is actuated to open and close

the communication between the apparatus and the fuel supply to regulate the amount of fuel furnished.

The operation of the apparatus as described is substantially as follows: When power is applied to the shaft 23 by means of the motor 25 or other appropriate actuating mechanism, the combined air propelling and crushing elements 30 are rotated with the shaft and the gate or cut-off 6 is operated to admit given quantities of fuel from the storage bins by way of inlet chute 5 to the interior of the casing 1. The incoming coal passes through the restricted throat 7 into the first crushing chamber 9. The rapid rotation of the fan-like beaters 30 draws in air through the openings 8, the quantity of air admitted being accurately regulated to effect complete combustion by adjusting the gate 8' to uncover the openings 8 more or less as desired. The coal upon entering the first crushing chamber 9 is violently impacted by the rotating blades and driven against the serrated walls of the chamber, eventually finding its way through the constricted throat 11 of the chamber into the next chamber where the operation is repeated and so on, until the coal and commingled air escapes from the final crushing chamber 9 into the discharge chamber 15, and thence by way of the education pipe 16 to the combustion chamber. It will be particularly noted that the action of the rotary members in the crushing chambers not only serves to break up the coal, both by direct impact and propulsion against the ribs or serrations on the wall of the casing, as well as a positive grinding action between the blade and the serrated walls, but also serves to draw in the air and force the same with a violent swirling or vertical movement through successive chambers by way of the constricted throats or openings connecting the said chambers. In each chamber the combined air and fuel is allowed to expand until it is forced forward again through the restricted orifice by the fan blade in that chamber. The combined fuel and air is therefore subjected to a successive expansion and contraction which induces an intimate admixture of the fuel and air during the successive stages of comminution of the fuel so that the admixture of comminuted fuel and air is delivered into the combustion chamber, where it is ignited and consumed while in a state of suspension and therefore under the best conditions of efficiency and economy. The provision of the inclined bottoms with the constricted throats in the respective crushing chambers 9 serves the important function of causing the coal and air to move toward the longitudinal axis of the casing as it leaves each chamber and then to be thrown out by the blades toward the peripheral walls of each

chamber so that a thorough and intimate admixture is obtained while the comminution of the fuel is being effected.

By making crushing chambers and propeller elements separable and separate units, it is obvious that should any of the units be broken or damaged, they may be quickly removed and replaced by others, so that should one or more of the elements need replacing this result may be effected without putting the apparatus out of commission for a considerable length of time.

The apparatus as described is substantially automatic and carries out its function of supplying the requisite and regulable quantities of intimately admixed fuel and air to the combustion chambers, as long as the fuel is fed to the device and without the attendant danger of explosion which is characteristic of devices of this general type, in which the fuel is comminuted before it is fed to the apparatus and the latter is employed merely for mixing and feeding the fuel and air. When it is desired to suspend the feeding of fuel to the combustion apparatus, it is only necessary to cut off the fuel supply and run the apparatus until all of the fuel contained therein is expelled, whereby explosion of residual fuel and air is rendered impossible.

What I claim as my invention is:—

1. An apparatus for preparing and feeding fine fuel, comprising a casing having a longitudinal series of crushing chambers, connected by restricted orifices, a revoluble shaft in said casing, combined air propelling and fuel crushing blades on said shaft and operating in the respective crushing chambers, and inlet and outlet orifices for fuel and air in said casing.

2. An apparatus for preparing and feeding fine fuel, comprising a casing having serrated walls and a series of transverse dividing plates with constricted orifices, forming successive crushing and mixing chambers, revoluble air propelling and fuel crush-

ing blades operating in the respective chambers, means for supplying fuel and air to said casing and an outlet for delivering mixed air and fuel from the casing.

3. An apparatus for preparing and feeding fine fuel, comprising a casing provided with a longitudinal series of separate crushing chambers, each having serrated inner walls, and a transverse dividing plate with a constricted orifice, a shaft passing through said chambers, combined air propelling and fuel crushing blades on said shaft and occupying the respective chambers, means for supplying regulable quantities of fuel and air to said casing, and an outlet for delivering mixed air and fuel from the casing.

4. An apparatus for preparing and feeding fine fuel, comprising a casing having inlet and outlet orifices for fuel and air and a series of separable crushing chambers in longitudinal alinement, each having a serrated inner surface and a constricted outlet, a revoluble shaft journaled in the casing, combined air propelling and fuel crushing blades on the shaft and occupying the respective chambers; and a cut off for the fuel inlet operated from the shaft.

5. An apparatus for preparing and feeding fine fuel, comprising a casing provided with intermediate separable crushing chambers, each having serrated inner walls and a constricted central outlet, a feed chamber having regulable fuel and air inlets, a discharge chamber with an outlet for mixed fuel and air, a revoluble shaft journaled in the casing, combined air propelling and fuel crushing blades on said shaft and operating in the respective crushing chambers, a cut off in the feed chamber, and means for operating said cut off from the shaft.

In testimony whereof I affix my signature in presence of two witnesses.

ROBERT PITCAIRN.

Witnesses:

A. B. KENNEDY,
D. J. NEVILL.