

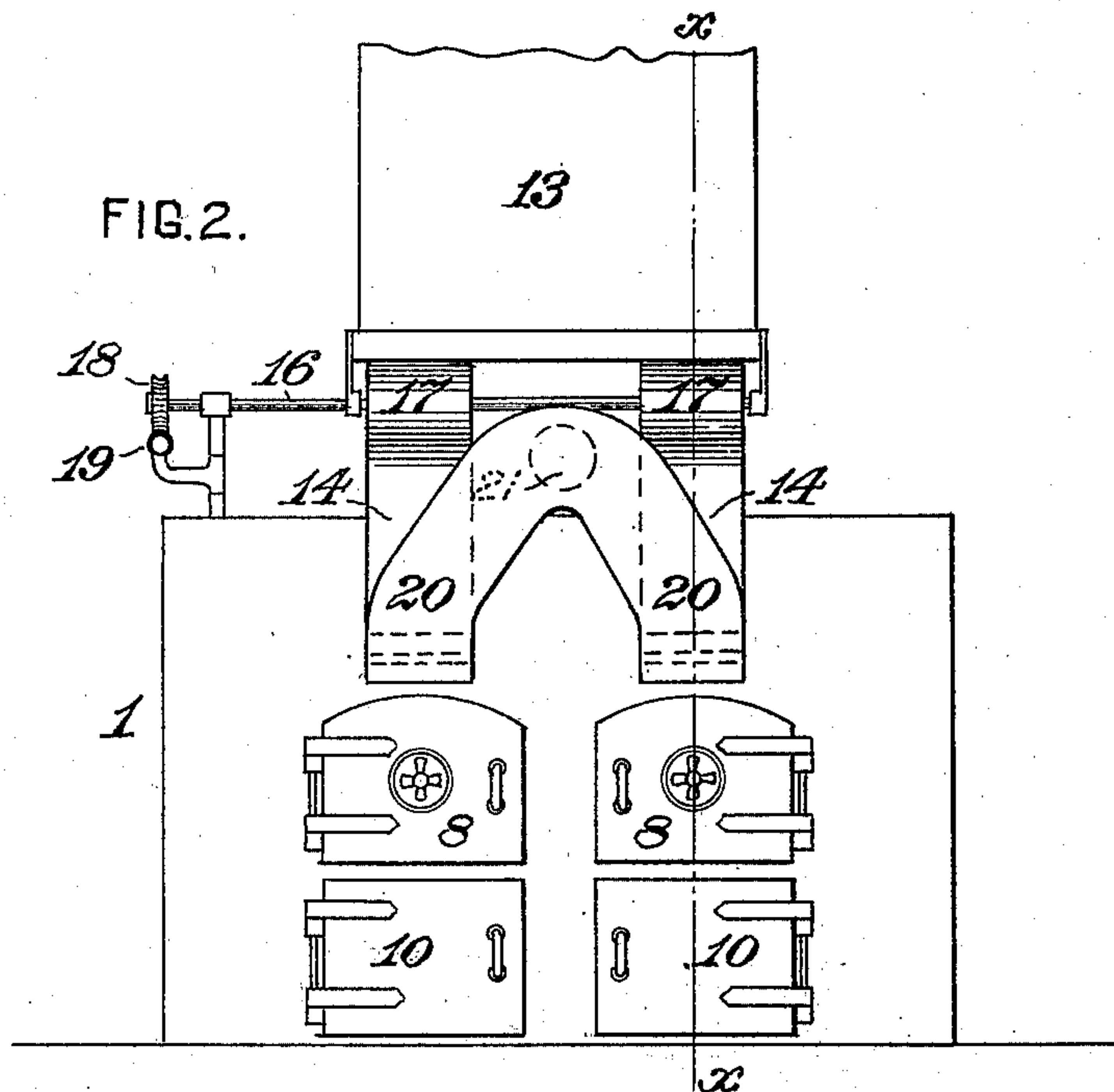
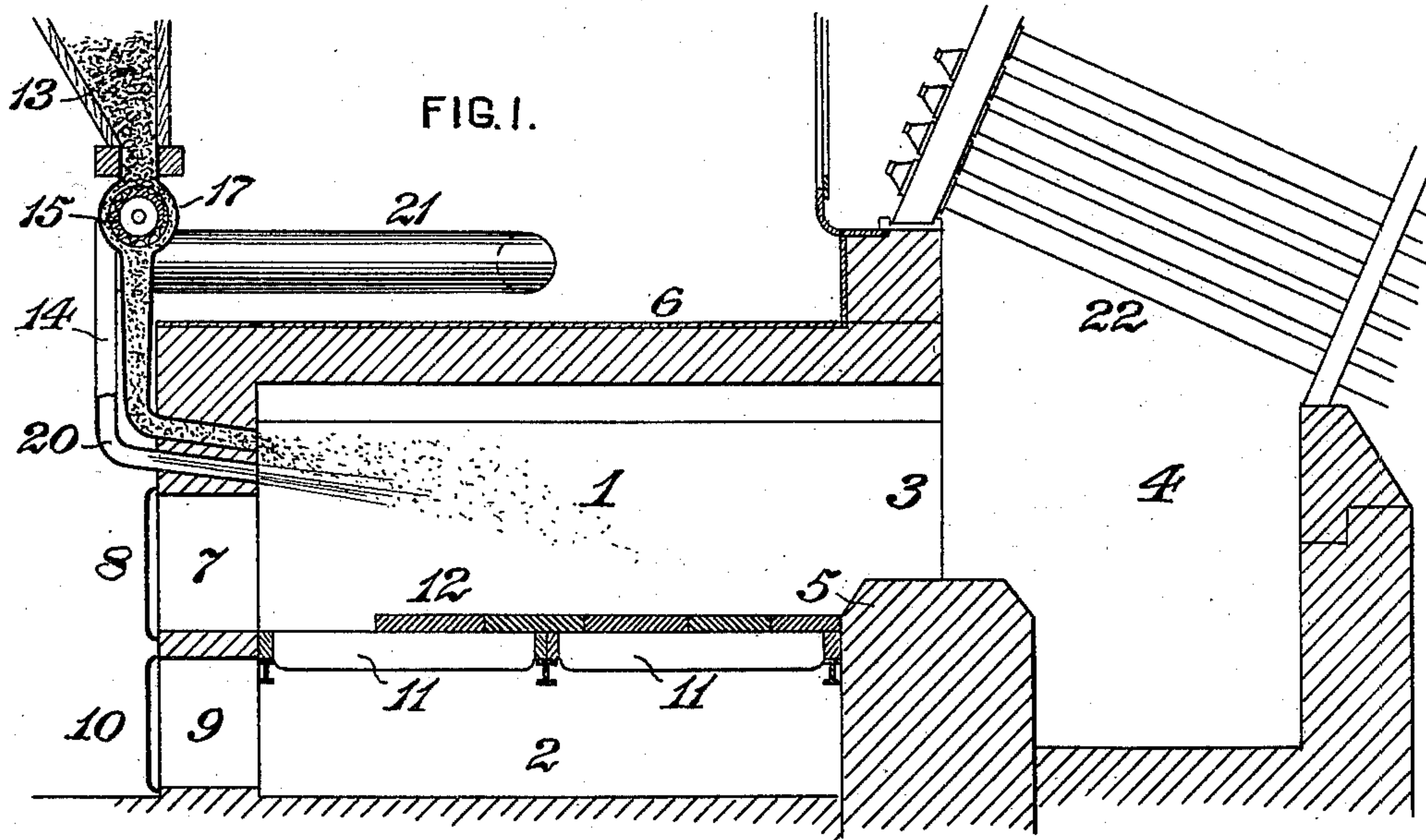
No. 653,206.

Patented July 10, 1900.

J. BOLE & D. R. W. PATTERSON.  
METHOD OF BURNING PULVERIZED FUEL.

(Application filed May 8, 1899.)

(No Model.)



WITNESSES:

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# UNITED STATES PATENT OFFICE.

JOHN BOLE AND DAVID R. W. PATTERSON, OF PITTSBURG, PENNSYLVANIA.

## METHOD OF BURNING PULVERIZED FUEL.

SPECIFICATION forming part of Letters Patent No. 653,206, dated July 10, 1900.

Application filed May 8, 1899. Serial No. 715,914. (No model.)

*To all whom it may concern:*

Be it known that we, JOHN BOLE and DAVID R. W. PATTERSON, citizens of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a certain new and useful Improvement in Methods of Burning Pulverized Fuel, of which improvement the following is a specification.

10 The object of our invention is to enable pulverized or pulverulent combustible materials, including slack and various low grades of coal, to be utilized as fuel in such manner that their thorough and complete combustion  
15 may be effected and the effective and economical application of the heat evolved thereby be attained without the production of smoke.

To this end our invention, generally stated, consists in a novel method of feeding pulverized fuel to a preliminary furnace-chamber, holding the fuel in a wide and thin stream or body in suspension in said chamber and supplying requisite oxygen by the application of an air-blast below and in the same direction  
25 as the incoming body of fuel, burning the fuel while in suspension in said chamber, and delivering the products of combustion to a main or final furnace-chamber.

30 The improvement claimed is hereinafter fully set forth.

Prior to our invention attempts have been made from time to time to utilize fine coal and coal-dust in a raw state as fuel in furnaces of various special constructions; but  
35 so far as our knowledge and information extend none of these has attained such a degree of success in practical operation as to warrant its approval and adoption to any substantial extent. Among the difficulties which  
40 have been encountered and unsurmounted in prior efforts in this branch of the art may be mentioned those of properly and sufficiently supplying oxygen to the fine fuel, of supporting it without waste to an ash-pit in proper  
45 relation to the surface or surfaces to be heated, and of effecting the thorough and economical application of the heat of the products of combustion to such surfaces. Our invention has been fully tested with entirely-satisfactory results in connection with a steam-boiler furnace, and an apparatus in which

it is practiced is now in practical and regular operation in the generation of steam.

In the accompanying drawings, Figure 1 is a vertical longitudinal section through an apparatus adapted to the practice of our invention at the line  $x x$  of Fig. 2, and Fig. 2 a front view in elevation of the same.

In the practice of our invention powdered coal or slack or other pulverized or pulverulent combustible material is fed continuously during operation into a preliminary furnace-chamber, of form and dimensions suitable to admit of the complete combustion of said material therein, in connection with a current of air under pressure, the application of which serves the double purpose of holding the pulverized fuel in suspension and of supplying the volume of oxygen requisite to effect its combustion. The pulverized fuel is ordinarily and preferably fed to the preliminary furnace-chamber by the action of gravity, the feed being regulated and made uniform by a proper mechanical feeding device; but other means of feeding the fuel may be employed, if preferred. The fuel enters the preliminary furnace-chamber through one or more delivery-openings which are comparatively wide and shallow in horizontal and vertical dimensions, respectively, so as to be spread laterally into wide and thin streams or bodies, and the air-blast is delivered through a similarly-formed opening or openings, each of which is located below and adjacent to a fuel-delivery opening, so as to enable the issuing current of air to act directly and fully upon a stream or body of fuel. The fuel is ignited and burned in suspension and its combustion is thoroughly and completely effected in the preliminary furnace-chamber, the incombustible residuum or ash falling by gravity into the lower portion thereof or into a subjacent ash-pit provided to receive it. The products of combustion, which are at a high heat, are delivered from the exit end of the preliminary furnace-chamber to a main or final furnace-chamber, in which their heat is exerted upon a steam-generator or other article or material which is to be heated and after delivering the major portion of their heat thereto are discharged in the ordinary manner through a



suitable exit flue or stack. The application of the air-blast throughout the width of thin streams or bodies of pulverized fuel causes the oxygen of the air to be thoroughly and uniformly distributed to the particles of fuel, and it has been found in practice that a high degree of heat is evolved and the production of smoke is substantially completely prevented.

Referring to the drawings, which illustrate an apparatus that has been found by practical tests to be desirably adapted to the practice of our invention, we provide therefor a preliminary furnace-chamber 1, the lower portion of which forms an ash-pit 2 or which may be located above or adjoining a separate ash-pit, if preferred. The furnace-chamber 1, which is built of brick or masonry and lined with suitable refractory material, is preferably of substantially-rectangular section both longitudinally and transversely, and is closed at top by an arched roof 6. An opening 7, (one or more,) controlled by a door 8, is formed in the outer end wall of the preliminary furnace-chamber for the purpose of affording access thereto, and a lower opening 9 (one or more) is formed in the same wall for the removal of residuum from the ash-pit. Two upper and two lower openings 7 are indicated as provided in the instance shown, and the preliminary furnace-chamber is also shown as provided with grate-bars 11 in order to adapt it for use with lump or solid fuel, if desired, in the event of a temporary failure of supply of pulverized fuel or during renewal or repair of the fuel or air-feeding devices. In the normal operation of the apparatus the major portion of the grate should be covered with a protecting layer of fire-brick or tile 12 to prevent the destruction of the grate-bars by the high heat evolved in the combustion of the fuel.

A bridge-wall 5 may be formed at the inner end of the preliminary furnace-chamber, which communicates by a delivery passage or throat 3 with a main or final furnace-chamber 4, in which the heat of the products of combustion escaping from the preliminary furnace-chamber 1 is exerted for the purpose for which the apparatus is designed. A water-tube steam-generator 22 is in this instance shown as set in the main or final furnace-chamber; but it will be obvious that said furnace-chamber may be employed for any other heating purpose desired without departure from the spirit or essential features of our invention.

A fuel-bin 13 for the reception of a charge of pulverized fuel is supported above the preliminary furnace-chamber 1 adjacent to the outer end thereof, and a fuel-supply conduit 14 (one or more) leads from the fuel-bin into the furnace-chamber 1 above the opening 7 in the front wall thereof. Two fuel-supply conduits are employed in the instance shown, and the number thereof may be more or less

in the discretion of the constructor. The fuel-supply conduits 14 pass through the front wall of the furnace-chamber 1, preferably on a slight incline, as shown, and the delivery-openings of their inner ends are substantially rectangular and are comparatively wide and shallow, so as to discharge the fuel in a stream or body of corresponding transverse section, as indicated by dotted lines in Fig. 2. The fuel is fed by gravity from the fuel-bin to the furnace-chamber 1, and its delivery is regulated and rendered uniform by a suitable mechanical feeding device, consisting in this instance of a pair of peripherally-grooved rollers 15, mounted on and rotating with a shaft 16 in casings 17, which constitute the upper portions of the feed-supply conduits 14. The feed-rollers 15 are rotated at a slow rate of speed through a worm-wheel 18, engaging a worm 19, fixed upon a shaft, to which rotation is imparted from any suitable prime mover.

Air-blast conduits 20 lead from an air-supply pipe 21, communicating with a blast-fan or blower, which may be of any suitable and preferred construction and is not shown, into the preliminary furnace-chamber 1, the delivery-opening of each of the air-blast conduits being substantially similar in form to and located below and adjacent to that of one of the fuel-supply conduits 14, so that the current of air discharged therefrom completely underlies the stream or body of pulverized fuel discharged from the superposed fuel-supply conduit. The volume of air under pressure delivered from the air-blast conduits is regulated as desired by a suitable valve or register in the ordinary manner, and the delivery of fuel is correspondingly regulated in proper proportion by variation of the speed of the feed-rollers 15 or by a valve or gate controlling the discharge from the fuel-bin 13, or both of these well-known expedients may be employed, if deemed advisable.

It will be obvious to those skilled in the art to which our invention relates that the form and proportions of the apparatus above described may be modified in various particulars without departure from the operative principle of our invention, the leading and essential features of which consist in a method of effecting the combustion of pulverized fuel in suspension with an air-blast in a special furnace-chamber and utilizing the heat generated thereby in another furnace-chamber.

The apparatus for the practice of our invention which is herein described and shown is not claimed as of our present invention, but is fully set forth and claimed in a separate application, filed by John Bole September 21, 1899, Serial No. 731,148.

We claim as our invention and desire to secure by Letters Patent—

1. The improvement in the method of burning pulverized fuel which consists in feeding the pulverized fuel into a suitable combus-



tion-chamber, suspending said fuel in said chamber upon an underlying blast of an oxygen-bearing fluid, and burning the fuel while thus suspended.

- 5 2. The improvement in the method of burning pulverized fuel which consists in feeding the pulverized fuel to a combustion-chamber, suspending the fuel in said chamber upon an

underlying air-blast, and burning the fuel while thus suspended.

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