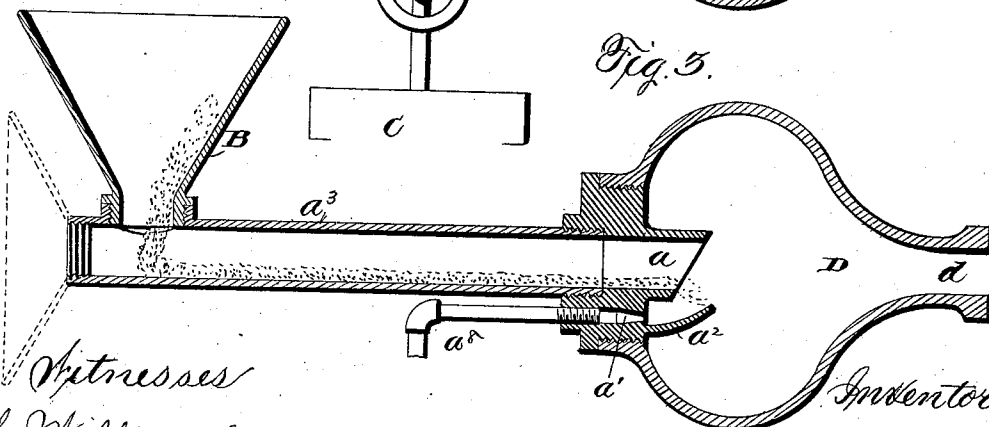
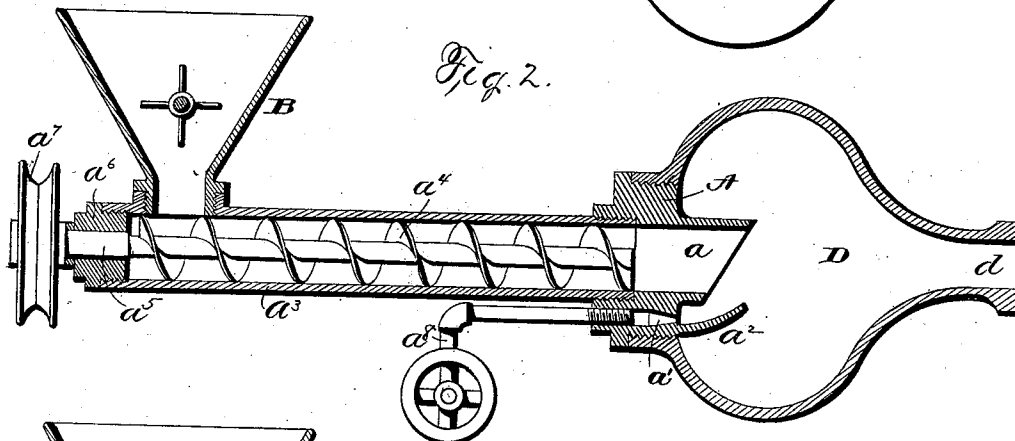
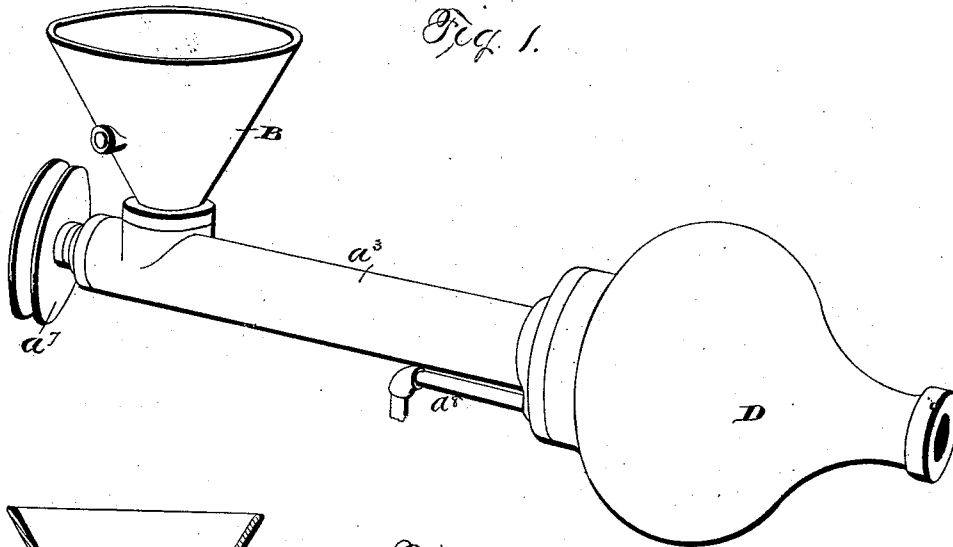


(No Model.)

C. W. CLAYBOURNE.
APPARATUS FOR BURNING GRANULAR FUEL.

No. 531,160.

Patented Dec. 18, 1894.



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UNITED STATES PATENT OFFICE.

COLIN W. CLAYBOURNE, OF INDIANAPOLIS, INDIANA.

APPARATUS FOR BURNING GRANULAR FUEL.

SPECIFICATION forming part of Letters Patent No. 531,160, dated December 18, 1894.

Application filed November 6, 1893. Serial No. 490,152. (No model.)

To all whom it may concern:

Be it known that I, COLIN W. CLAYBOURNE, a citizen of the United States, residing at Indianapolis, in the county of Marion, and in the State of Indiana, have invented certain new and useful Improvements in Processes of and Apparatus for Burning Pulverized or Granular Fuel; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which—

Figure 1 shows a perspective view of my apparatus, with positive fuel feed device; Fig. 2, a view of a longitudinal vertical section of the same, and Fig. 3, a view of a longitudinal vertical section of my apparatus, as arranged for use without the feed screw.

Letters of like name and kind refer to like parts in each of the figures.

The object of my invention is to provide improved means for and process of burning coal-dust, or other granulated or powdered fuel, and to this end my invention consists in the apparatus and in the process as hereinafter specified.

In the means, as heretofore used for burning coal-dust and the like, the pulverized or granular fuel has been fed into the fire-box, to be there met by an air-blast, to blow it forward and supply the oxygen for its combustion.

In my present apparatus, and by the process as covered by the present case, I make certain of the thorough separation of the particles of fuel, and their intimate mixture with a gaseous fluid containing oxygen, before they reach the fire-box or combustion-chamber; so that they will flash into flame and be completely ignited, immediately upon entering the fire-box or combustion-chamber, and will produce a very hot, clear, smokeless flame, capable of being directed or guided, by any suitable draft-devices, so that it will apply its heat uniformly and evenly over any surfaces to be heated, without any blast or blow-pipe action, which, as is known, is destructive to the sheets or tubes of boilers, on account of the flame necessarily striking more directly and forcibly on one part, than on another of the surface to be heated.

In the drawings, A designates a body, which, in general outline, is cylindrical, but can be

of any other shape, as desired. Through such body passes the large central passage *a*, for the admission of the coal-dust, or other pulverized or granulated fuel, and the passage *a'*, for the steam, air, or other gaseous fluid, below the fuel passage, and having its discharge mouth much smaller, than that of the latter. On the body, below the lower passage, is the deflector *a²*, extending forward and upward at an angle to the line of a jet issuing from the passage *a'*. As shown in the drawings, this deflector is preferably, though not necessarily, curved or concave, instead of being straight. Connected with the rear or outer end of passage *a*, is the feed-tube *a³*, communicating at its outer end with the hopper B, or other source of supply of coal-dust, saw-dust, or other granular or pulverized fuel, to be burned. As shown in the drawings, the discharge end of passage *a*, is continued out beyond the front face of body A within a projecting tubular boss, so that its mouth is a short distance forward of the end of the passage *a'*, and at its front end such boss is cut away on a plane extending downward and rearward.

In the form of apparatus shown in Figs. 1 and 2, there is within tube *a³*, the revolving conveyer screw *a⁴*, which, receiving the fuel from hopper B, carries the same forward toward the mouth of passage *a*, at a rate depending upon the speed of rotation of the screw. At its rear end, the screw-shaft *a⁵*, passes out through a suitable bearing in the plug *a⁶*, screwed into the outer end of the tube, and is provided beyond such plug with a pulley or wheel *a⁷*, which is to be connected with and driven from any desired motor or source of power by means of a belt or other suitable connecting gearing. This screw form of feed is only shown and described as one form of a number of conveying devices which might be used for the same purpose, and I do not limit myself to the use of it in my apparatus. The coal-dust, saw-dust, or other pulverized or granular fuel might be fed by gravity, or in any other way instead, without departure from my invention. Where the fuel feed passage is continued out beyond the mouth of passage *a'*, as shown in the drawings, I have found that the pulverized or granular fuel will, when dry, be drawn freely and rapidly

enough from the hopper, along the tube a^3 , without the use of the conveyer screw, by the action of steam admitted into the bulb to be described, through passage a' , as herein-
 5 after set forth. When the fuel is to be thus drawn in, without the use of a positive feed device, I employ the construction of apparatus shown in Fig. 3, having the feed tube a^3 with its outer or rear end extending beyond
 10 the point where the fuel enters from the hopper B, or other source of supply of fuel, left open. The passage of the fuel into said tube is to be so regulated that the latter will be only partially filled, as indicated in the draw-
 15 ings.

The steam issuing from passage a' , and passing by the projecting tubular boss forming the forward continuation of the feed conduit or passage, will induce a current of air through
 20 tube a^3 , which will draw the pulverized or granular fuel rapidly along the latter, and carry it from the same out of the mouth of the fuel passage in head A, so that the fuel feeding will be continuous as long as the tube
 25 a^3 is kept supplied from the hopper, or other source of supply. If desired, the outer or rear end of the fuel tube a^3 can be supplied with an air receiving and directing funnel, as indicated in dotted lines in Fig. 3. The
 30 same feeding of the granular or pulverized fuel, without the intervention of a feed screw, or other positive feed device, could be secured if the outer end of tube a^3 , beyond the hopper B, were closed and the fuel were fed
 35 into the hopper so as not to entirely close up the passage from it into said tube. The induced current, caused by the action of the steam, and acting to convey the fuel, could then pass down through the hopper itself,
 40 drawing the fuel therefrom. Passage a is, through valved pipe a^2 , to be connected with any suitable source of supply of steam, air, or other gaseous fluid under pressure. Such source of supply, which can be of any desired
 45 form, is indicated in a conventional way only, at C.

The bulb D, hereinbefore referred to, which is attached to body A, preferably, but not necessarily, by being screwed thereon, as shown,
 50 has an interior chamber which expands abruptly forward from around the space into which passages a and a' discharge, and then contracts again to the discharge neck d , having an orifice or mouth preferably, several
 55 times the size of passage a' . The general shape of the bulb is that of an oblate spheroid, or a sphere somewhat flattened on its front and rear sides, with a conical or taper portion on its outer side running to the neck d .

In practice I have found very good results to be secured with the mouth of fuel passage a one or two inches in diameter, and the largest diameter of the interior of the bulb, seven inches. The mouth of neck d was then about
 65 an inch wide. I do not, however, intend to limit myself to such relative proportions as the sizes of passage a , bulb D, and mouth of

neck d , can be departed from, or varied at will, without departure from my invention.

By practice, it has been found that within
 70 certain limits, the horse power producing capacity of my burner, as used on boilers, can be increased, by increasing the size of the steam opening and discharge mouth of the bulb.

If desired, in order to secure more rapid and easy feed of the fuel, the passage a could be made larger, but if it is, it would be best to enlarge the opening through neck d , correspondingly.

As indicated hereinbefore, I contemplate forcing in through passage a' , either steam or compressed air, or other gaseous fluid under pressure, sufficient to separate the particles of
 85 fuel fed in through passage a , and whirl them about within the bulb, so that they will be not only completely separated, but well and intimately mixed with the steam or gaseous fluid.

Practice has shown steam to be not only
 90 economical, but to secure the best results in the proper separation of the fuel particles, and the production of a large volume of clear flame of the strongest heating power.

Whether steam, air, or other gaseous fluid
 95 is used, the pressure on the same need not be so great as to force the mingled particles of fuel and fluid from the neck d , so as to produce a blow-pipe form of flame, but can be and is best kept low, so that the flame while
 100 an exceedingly hot and smokeless one, of great volume, can be drawn or directed by suitable draft devices to apply its heat uniformly over the surface or surfaces to be heated.

With the apparatus constructed as shown and described, and the coal dust or other pulverized fuel being fed in through passage a , and steam forced in through the smaller passage a' , the steam will, as it issues from the
 110 latter passage and expands suddenly within the large chamber in the bulb, strike the fuel descending toward the deflector a^2 and, being guided upward and forward by the curved inclined face of the latter, will separate the fuel particles from each other, and,
 115 whirling them around with it within the bulb chamber, will be mixed thoroughly and uniformly with them before passing on out through neck d . The result is, that a mixture
 120 is produced which immediately upon issuing from neck d , will take fire instantly and completely with each particle of the pulverized fuel entirely ignited.

When the pulverized or granular fuel is
 125 dry, and the passage a is carried forward of the mouth of steam passage a' , as shown in the drawings, the steam passing forward and upward past the mouth of the former passage, will produce a draft which will as indicated
 130 hereinbefore draw said fuel from the hopper through the feed tube a^3 and passage a , with sufficient rapidity, without any screw or other positive feed device placed in such tube.

The flame produced by my burner upon ignition of the mixture issuing from the mouth of the bulb, is clear and perfectly smokeless, and, because of the oxygen and hydrogen of the steam being consumed in it, is an exceedingly hot one.

With low pressure on the steam, the flame produced is a soft one, easily directed or guided by ordinary draft devices, so that its heat can be applied uniformly over the surfaces to be heated, a most desirable feature where boilers, brick kilns, or lime kilns are to be heated.

Having thus described my invention, what I claim is—

1. In an apparatus for burning coal-dust, or other granular or pulverized fuel, in combination with a conduit and a source of supply of the granular or pulverized fuel feeding into such conduit, an enlarged mixing chamber into which the conduit discharges, having a suitable discharge mouth, a source of supply of steam, and a conduit for the same discharging into the mixing chamber past the mouth of the fuel passage, substantially as and for the purpose specified.

2. In an apparatus for burning coal-dust, or other granular or pulverized fuel, in combination with the enlarged mixing chamber having a suitable discharge mouth, a steam jet entering such chamber, and the feed conduit connected with a source of supply of the fuel, and having its forward end projecting into the chamber, to a point forward of the discharge mouth of the steam passage, substantially as and for the purpose shown and described.

3. In an apparatus for burning coal-dust, or other pulverized or granular fuel, in combination with a conduit, a source of supply of the granular or pulverized fuel, and means for feeding the same through the conduit, an enlarged mixing chamber into which the fuel is discharged, having a suitable discharge mouth, a source of supply of fluid under pressure, and a conduit for the same entering the chamber so that the fluid will come in contact with the fuel entering the chamber and mingle with the same, substantially as and for the purpose specified.

4. In an apparatus for burning coal-dust, or other pulverized or granular fuel, in combination with a conduit, and means for supplying and feeding the pulverized or granular fuel through the same, a second conduit connected with a source of supply of fluid under pressure, an enlarged mixing chamber around the place where the two conduits discharge, having a suitable discharge mouth, and the deflector extending at an angle forward and in-

ward across the path of the jet entering through the fluid conduit and toward a line through the fuel conduit, substantially as and for the purpose shown.

5. In an apparatus for burning coal-dust, or other pulverized or granular fuel, in combination with a conduit and means for supplying and feeding the pulverized or granular fuel through the same, a second conduit connected with a source of supply of fluid, under pressure, a bulb surrounding the place where such conduits discharge, having its interior chamber expanding suddenly forward, and then contracted down to a smaller discharge mouth, and a deflector to direct the fluid entering the chamber forward and inward at an angle to a line through the fuel conduit, substantially as and for the purpose set forth.

6. In an apparatus for burning coal-dust or other pulverized or granular fuel, in combination with a source of supply of such fuel, and means for feeding the latter from the same, a conduit through which the fuel is fed, a second conduit connected with a source of supply of steam, and a bulb having an enlarged chamber into which the fuel and steam conduits discharge, and within which the steam and fuel are mingled together, and a reduced discharge opening, substantially as and for the purpose described.

7. In an apparatus for burning coal dust, or other granular fuel, in combination with the enlarged mixing chamber having a suitable discharge mouth, a passage for steam into said chamber, the fuel conduit extended into the same with its discharge end inclining rearward and downward, and a deflector adjacent to the mouth of the steam passage to guide the steam past the inclined end of the fuel conduit, substantially as and for the purpose shown.

8. The improved process of burning coal-dust or other pulverized or granular fuel, which consists in feeding such fuel into an enlarged chamber with a suitable discharge opening, and bringing into contact with it as it enters such a chamber, an expansible fluid under pressure, to separate the particles of fuel and whirl them around with the fluid within the chamber before they reach and pass from the discharge opening, substantially as and for the purpose specified.

In testimony that I claim the foregoing I have hereunto set my hand this 31st day of October, 1893.

COLIN W. CLAYBOURNE.

Witnesses:

J. S. STEPHENS,
W. H. PALMER.