

No. 610,845.

Patented Sept. 13, 1898.

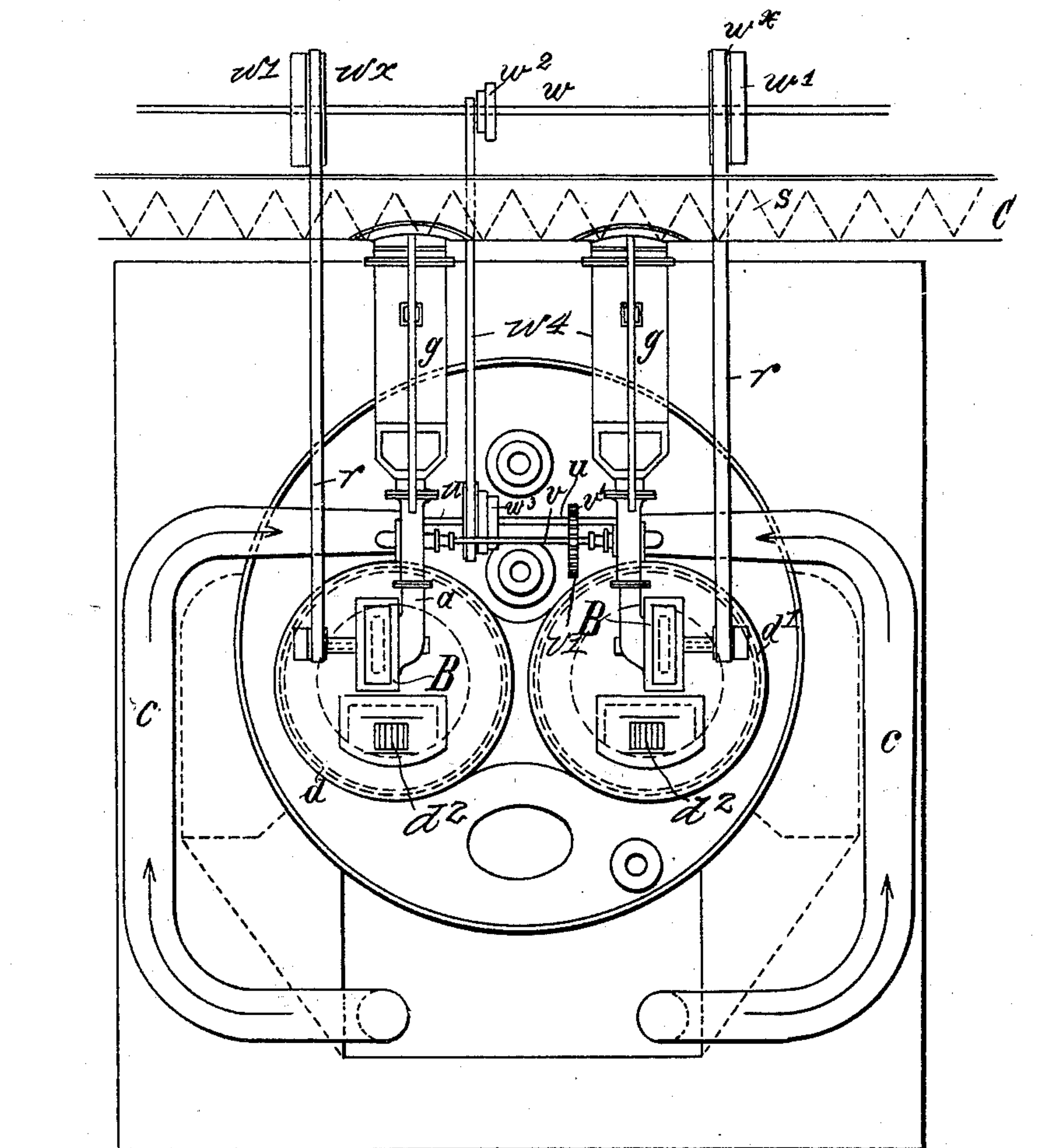
C. A. FREITAG.
APPARATUS FOR BURNING PULVERULENT FUEL.

(Application filed Apr. 17, 1897.)

(No Model.)

4 Sheets—Sheet 1.

Fig 1



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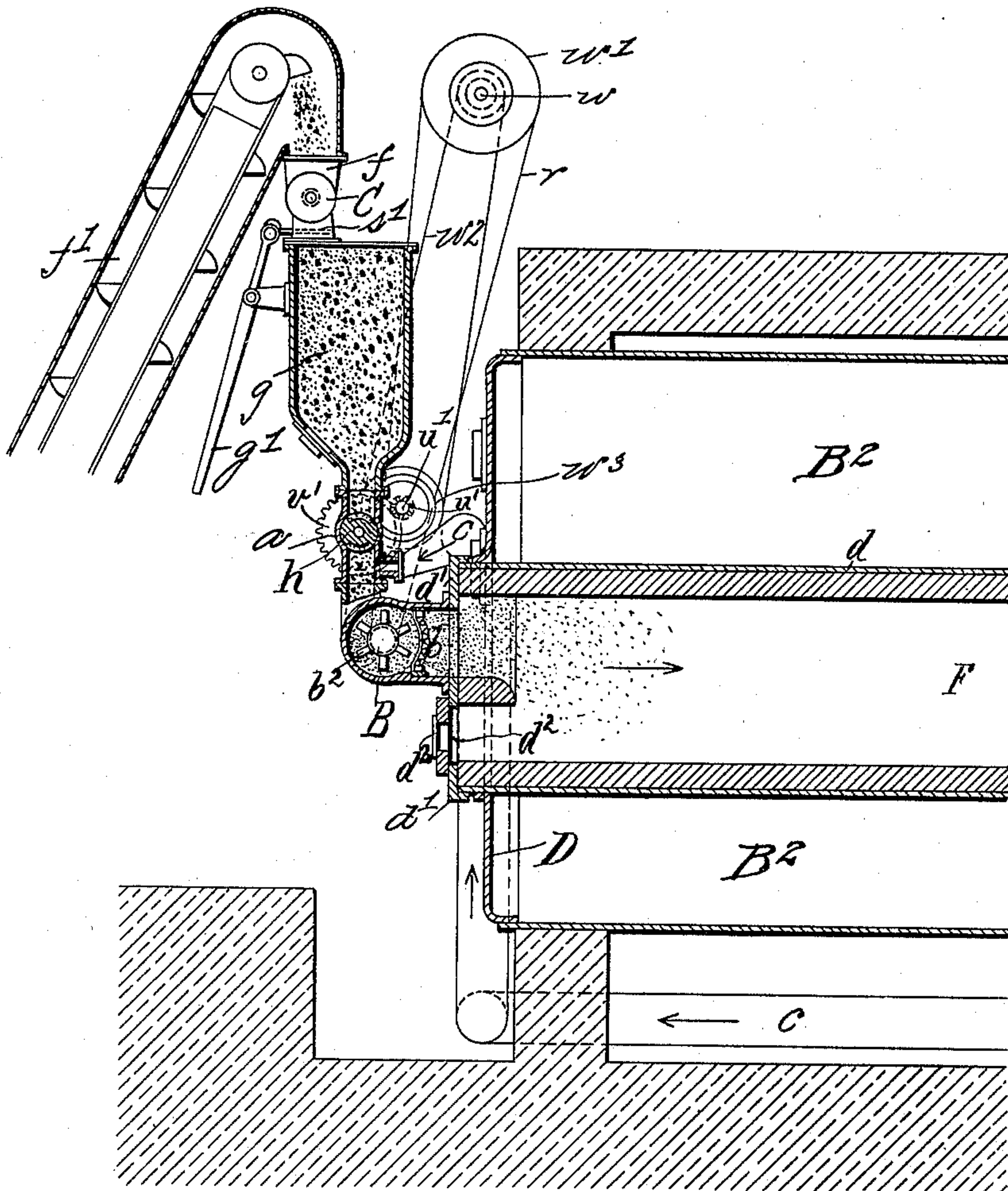
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4 Sheets—Sheet 2.

Fig. 2



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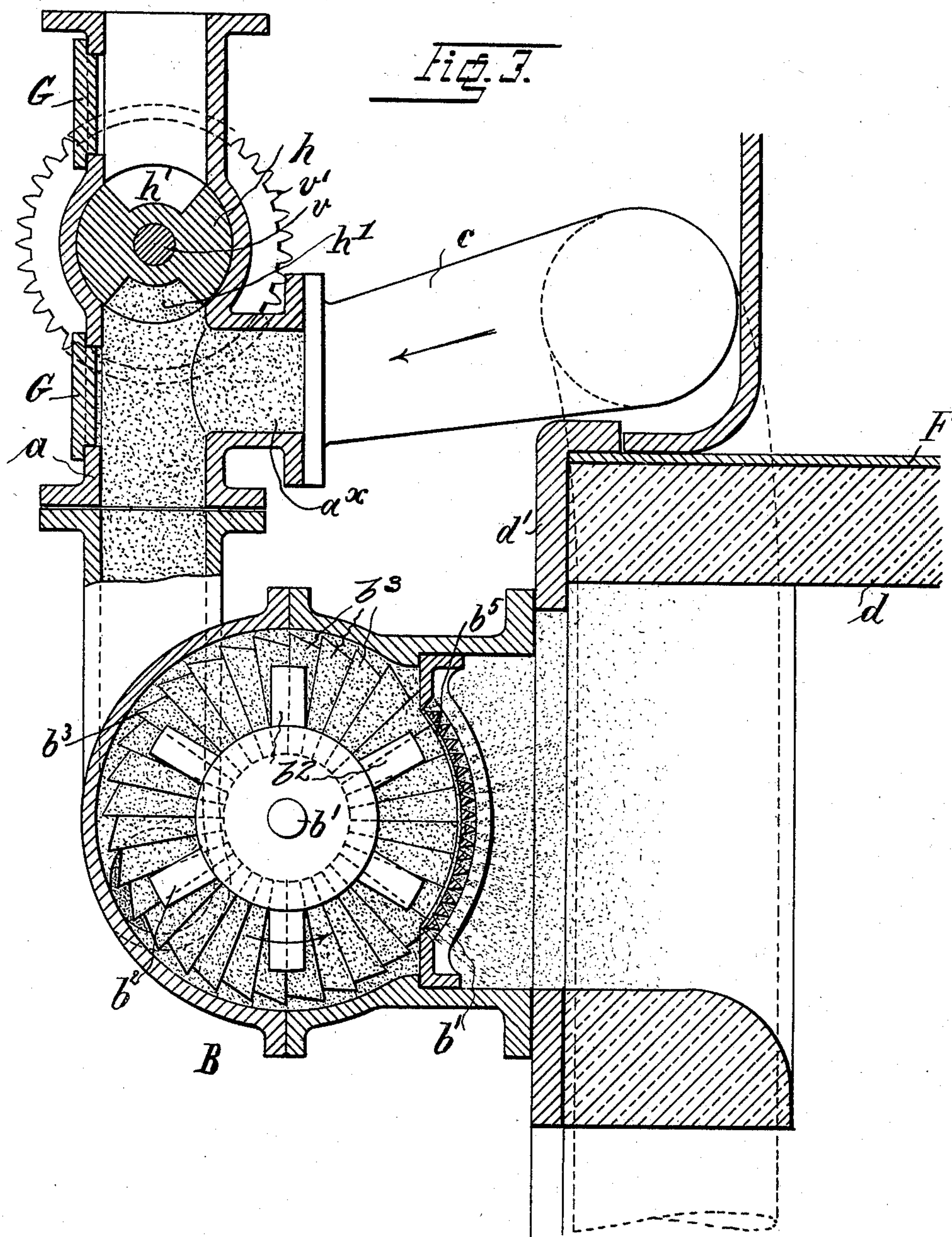
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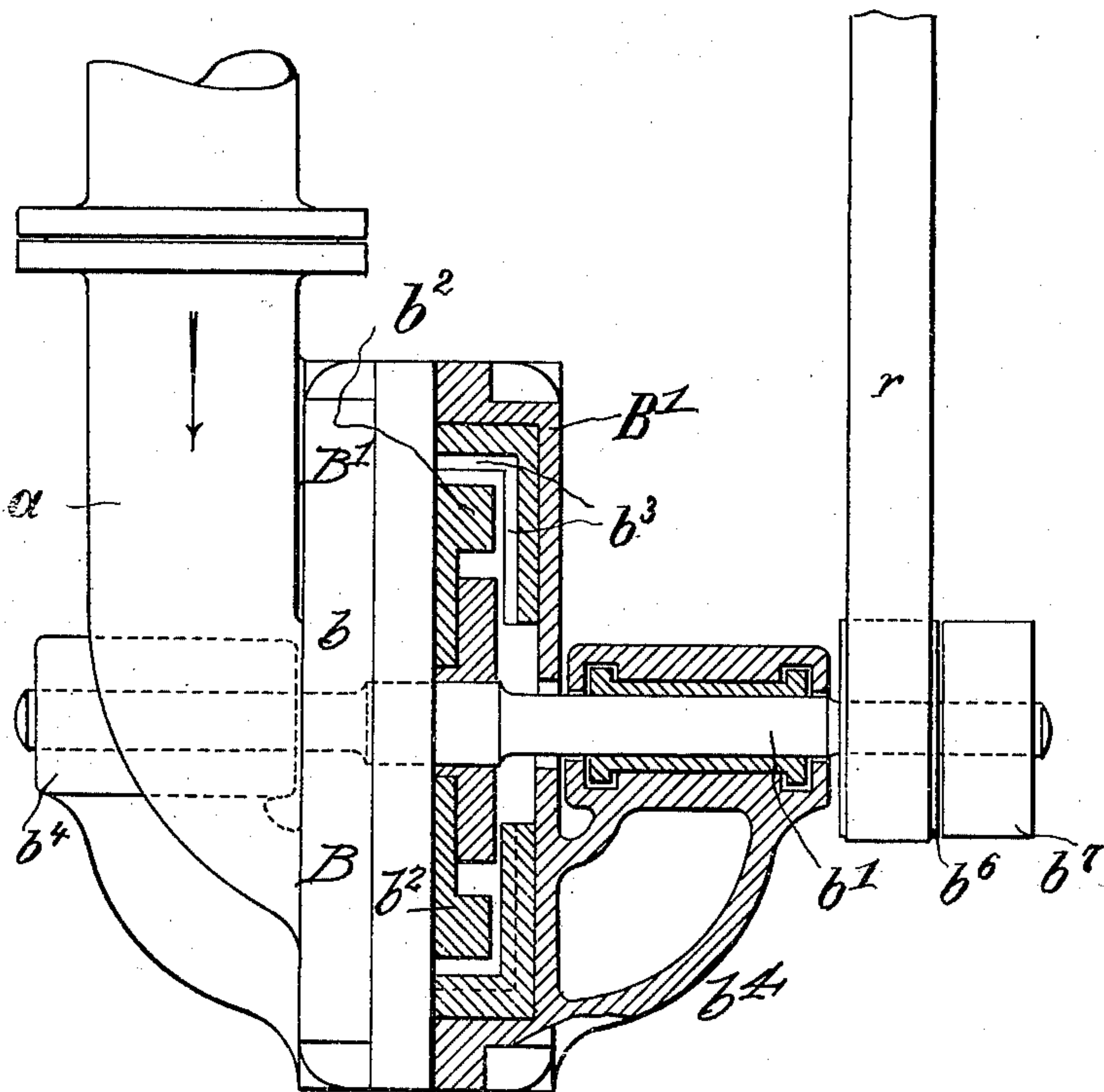
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(No Model.)

4 Sheets—Sheet 4.

Fig. 4.



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UNITED STATES PATENT OFFICE.

CHRISTIAN ANDREAS FREITAG, OF AMSTERDAM, NETHERLANDS.

APPARATUS FOR BURNING PULVERULENT FUEL.

SPECIFICATION forming part of Letters Patent No. 610,845, dated September 13, 1898.

Application filed April 17, 1897. Serial No. 632,592. (No model.) Patented in Germany December 24, 1896, No. 95,375; in France February 5, 1897, No. 263,757; in Belgium February 5, 1897, No. 126,163; in England February 5, 1897, No. 3,129; in Norway February 5, 1897, No. 5,666; in Sweden February 5, 1897, No. 8,760; in Switzerland February 5, 1897, No. 13,958; in Hungary February 5, 1897, No. 9,132; in Austria February 24, 1897, No. 47/573; in Spain March 6, 1897, No. 20,354; in Italy March 31, 1897, XXXII, 43,789, LXXXV, 389; in Canada April 20, 1897, No. 55,660; in Denmark July 29, 1897, No. 1,189, and in Portugal September 4, 1897, No. 2,425.

To all whom it may concern:

Be it known that I, CHRISTIAN ANDREAS FREITAG, a subject of the Queen of the Netherlands, and a resident of Amsterdam, Netherlands, have invented certain new and useful Improvements in and Relating to the Burning of Pulverulent Fuel and to Apparatus Therefor, (for which Letters Patent have been granted in Belgium, dated February 5, 1897, No. 126,163; in Canada, dated April 20, 1897, No. 55,660; in Denmark, dated July 29, 1897, No. 1,189; in Germany, dated December 24, 1896, No. 95,375; in France, dated February 5, 1897, No. 263,757; in Great Britain, dated February 5, 1897, No. 3,129; in Italy, dated March 31, 1897, XXXII, 43,789, LXXXV, 389; in Norway, dated February 5, 1897, No. 5,666; in Austria, dated February 24, 1897, No. 47/573; in Portugal, dated September 4, 1897, No. 2,425; in Sweden, dated February 5, 1897, No. 8,760; in Switzerland, dated February 5, 1897, No. 13,958; in Spain, dated March 6, 1897, No. 20,354, liber 27, folio 38, and in Hungary, dated February 5, 1897, No. 9,132;) 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, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

This invention has relation to the utilization of pulverulent fuel as a means for producing heat, generally and particularly as a heating agent for steam-generators.

The danger of explosion inherent to the use of pulverulent fuel—as coal-dust, for instance—and resulting from the formation of explosive compounds by the admixture of the fuel with air in due proportions, particularly during the operation of feeding, is well known, and many efforts have been made to overcome this difficulty. On the other hand, when the fuel, as a whole or in part, has first to be reduced to a pulverulent condition, and perhaps dried before reduction, the cost of the

plant and the cost of labor or transportation have heretofore not been in such relation to the increased effects or better results derived from the use of pulverulent fuel as to render such use generally practicable.

My invention has for its object to overcome these difficulties, and this object I attain by the provision of means whereby fuel in a raw unprepared state is brought into a finely-divided state, held in suspension in a body of air, and is in this condition continuously fed or supplied to the combustion-chamber under the action of revolving arms in such manner as to avoid all danger of explosion; also, by the provision of means whereby the fuel can be reduced to the required degree of fineness before being fed to the combustion-chamber when solid or partly-solid and partly-pulverulent fuel is used—as, for instance, the so-called “buckwheat” coal and culm; also, in the provision of means for supplying to the finely-divided fuel the required air for combustion and when necessary for the drying of such fuel.

The operation of feeding the fuel to the combustion-chamber consists, essentially, in continuously conveying the fuel-laden air to the combustion-chamber under the action of the revolving beaters or radial arms in suitably-regulated quantities through a finely-perforated plate, thereby avoiding the danger of formation of explosive compounds within the combustion-chamber, means being provided to prevent the ignition of the fuel-laden air before it actually reaches the combustion-chamber.

That my invention may be fully understood I will describe the same in detail, reference being had to the drawings hereto annexed, wherein I have illustrated my said invention in its application to a stationary steam-generator having two combustion chambers or flues.

Figure 1 is a front elevation, Figs. 2 and 3 part longitudinal sectional views, and Fig. 4 a sectional detail end elevation, thereof.

Across the boiler-front, above the combus-

tion-flues F, I arrange a conveyer-trough C, containing a screw conveyer s, (shown in dotted lines in Fig. 1,) and above said conveyer, in suitable bearings, a revoluble shaft w , carrying two sets of fast and loose belt-pulleys $w^x w'$ and a stepped pulley w^2 .

Any suitable driving mechanism may be provided for the elevator f' and conveyer s. Thus, for instance, there may be a belt-pulley on the upper elevator-drum belted to a pulley on the conveyer-shaft, and the latter may carry another pulley belted to one on shaft w , or a separate driving mechanism are not matters of invention, in that they come within the province of the skilled mechanic, I have not deemed it necessary to illustrate the same.

To the outer open end of or entrance to the combustion-flues F, which are preferably lined with a refractory material d , Figs. 2 and 3, I secure an apertured plate d' , to which a crusher-casing B is bolted or otherwise secured, from one of the heads of which extends in an upward direction a feed pipe or duct a , that is surmounted by an enlarged feed hopper or chamber g , which opens into the conveyer-trough C. In the connection between the feed-chamber g and conveyer-trough C, I interpose a cut-off slide or gate s' , pivotally connected to one end of an operating-lever g' , fulcrumed on said chamber, the fuel being fed to the conveyer by a suitable elevator, as the bucket elevator f' , discharging into a hopper f on the conveyer-trough.

As will be readily understood, each of the combustion-chambers has a crusher-casing B connected with the conveyer-trough C, and as both are alike in construction and operated from the shaft w , hereinbefore mentioned, a full understanding of their construction and operation may be had from the description of one of them. The casing B has bearing-brackets b^4 for the crusher-shaft b' , which carries a fast belt-pulley b^7 , belted to a like pulley w^x on shaft w , hereinbefore referred to. The inner and side faces of the heads of said casing B, which is substantially cylindrical, are serrated or provided with cutting edges b^3 , Fig. 3, that coact with beaters or radial crushing-arms b^2 on said crusher-shaft. That portion of the casing B in front of the opening in the head-plates d' for the combustion-flue F is removed and a plate b^5 with fine perforations inserted of the form of a segment of a circle concentric with the circle formed by the inner periphery of the casing. The fine perforations of this plate b^5 increase in diameter outwardly or toward the combustion-flue F for the purpose of avoiding as much as possible the liability to become clogged or choked up.

The object of the beaters or radial arms b^2 revolving with high speed during the operation of crushing is to produce a propelling action, whereby the particles of coal-dust are conducted with air through the fine perfora-

tions in the plate b^5 into the combustion-flue to be there immediately consumed.

In the plates d^2 , below the casings B, I provide a shaft-aperture leading into the combustion-flue F and provided with a draft-regulating slide d^2 for the admission of such additional quantities of air as may be required for the combustion. Generally but little air need be admitted through the draft-apertures, as I propose to supply the air or at least the greater portion of the air necessary to the combustion of the fuel to the latter, and to promote the combustion I preferably heat the air before admitting it to the fuel. To this end I locate two pipes c below the boiler B^2 , Fig. 2, connected to a branch a^x of the feed-tubes a for the crusher, Figs. 2 and 3. The inlet to said pipes may be at a point sufficiently remote from the boiler-front to admit of the preheating of the air before it reaches the feed-duct a . Above the branch a^x of feed-duct a I arrange a cylindrical revoluble feed-valve h , having pockets h' in diametrically opposite faces, the valves for both feed-ducts being secured to a common spindle v , that carries a toothed wheel v' in gear with a like wheel w' on a shaft u , Figs. 1 and 2, that also carries a stepped pulley w^3 , belted to a like pulley w^2 on shaft w and hereinbefore referred to and for well-known purposes.

When the crusher is in operation, the heat transmitted from the flues dries the fuel should it be wet, and the finely-divided fuel is carried along under the propelling action of the beaters through the fine perforations in the plate b^5 into the combustion-flue, where it is immediately consumed, so that a combustible compound liable to explode within the combustion-flues cannot be formed prior to the combustion of the fuel.

The finely-perforated plate b^5 not only performs the function of a feed and distributing plate, but also acts as shield or guard against back flashing or back fire that might result in explosion within the crusher-casing.

By means of the feed-valves h the amount of raw fuel fed to the duct a from the feed-chamber can be regulated according to requirements by varying the speed of rotation thereof through the medium of the stepped pulleys $w^3 w^2$, as will be readily understood.

From the above description the operation of the crushing appliances and the mode of feeding the fuel to the combustion-flues will be readily understood and need therefore not be amplified.

Having thus described my invention, what I claim as new therein, and desire to secure by Letters Patent, is—

1. In combination, a combustion-chamber having its inlet closed by a plate provided with outwardly-tapering openings, and means for forcing fuel-laden air through said openings, for the purpose set forth.

2. In combination, a combustion-chamber

having its inlet closed by a plate provided with outwardly-tapering openings, means for forcing fuel-laden air through said openings, and means for preheating the blast, for the purposes set forth.

3. In combination, a combustion-chamber, a fuel-chamber connected therewith, reducing devices in said chamber for reducing the fuel to powder, a blast apparatus connected with the chamber, and means for breaking up the fuel-laden blast so as to flow into the combustion-chamber in the form of numerous jets or independent streams, for the purpose set forth.

4. In combination, a combustion-chamber, a fuel-chamber connected therewith, reducing devices in said chamber for reducing the fuel to powder, a blast apparatus connected with the chamber, means for preheating the blast, and means for breaking up the fuel-laden blast so as to flow into the combustion-chamber in the form of numerous jets or independent streams, for the purpose set forth.

5. The combination with a combustion-chamber, of a pulverulent-fuel feeder comprising a feed-chamber opening into said combustion-chamber, a finely-perforated plate interposed between the two chambers, a revoluble shaft carrying beaters, or radial arms revolving therewith within the feed-chamber and means for admitting air to the last-named chamber, for the purpose set forth.

6. The combination with a combustion-chamber, of a pulverulent-fuel feeder comprising a feed-chamber opening into said combustion-chamber, a plate interposed between the two chambers and provided with fine perforations of increasing diameter in the direction of the combustion-chamber, a revoluble shaft carrying beaters or radial arms revolving therewith within the feed-chamber, and means for admitting air to the last-named chamber, for the purpose set forth.

7. The combination with a combustion-chamber, of a pulverulent-fuel feeder comprising a feed-chamber opening into said combustion-chamber, a finely-perforated plate interposed between the two chambers, a revoluble shaft carrying beaters or radial arms revolving therewith within the feed-chamber, a feed-duct connected with the last-named chamber, a feed-valve constructed to feed the fuel in predetermined charges to said duct and means for admitting air to the feed-chamber, for the purpose set forth.

8. The combination with a combustion-chamber, of a pulverulent-fuel feeder comprising a feed-chamber opening into said combustion-chamber, a finely-perforated plate interposed between the two chambers, a revoluble shaft carrying beaters, or radial arms revolving therewith within the feed-chamber, a feed-duct connected with the last-named chamber, a feed-hopper on said duct, a revoluble feed-valve between the hopper and duct, means for supplying air to the feed-chamber and mechanism for imparting con-

tinuous rotation to the aforesaid shaft and feed-valve, for the purpose set forth.

9. The combination with a combustion-chamber, of a pulverulent-fuel feeder comprising a cylindrical feed-chamber having a peripheral opening leading to the said combustion-chamber, a perforated plate in the form of a segment of a circle of less diameter than the interior diameter of the feed-chamber inserted in the opening thereof, a revoluble shaft carrying radial arms revolving therewith within said feed-chamber, and means for admitting air to the last-named chamber, for the purpose set forth.

10. The combination with a combustion-chamber, of a pulverulent-fuel feeder comprising a fuel-reducer opening into said chamber, a finely-perforated plate interposed between said chamber and reducer and means for driving the crushed fuel through the perforations of the plate into the combustion-chamber, for the purpose set forth.

11. The combination with a combustion-chamber, of a fuel-crusher, comprising a crushing-chamber having serrated heads, and a revoluble shaft carrying radial crushing-arms coöperating with said heads, said crushing-chamber opening into the combustion-chamber, a finely-perforated plate interposed between the two chambers, and means for admitting air to the crushing-chamber, for the purpose set forth.

12. The combination with a combustion-chamber, of a pulverulent-fuel feeder comprising a fuel-reducer opening into said combustion-chamber, a finely-perforated plate interposed between the two and means for admitting air to the reducing-chamber to carry the pulverized fuel through the perforations of said plate with air under the propelling action of the crushing-arms into the combustion-chamber, substantially as set forth.

13. The combination with a combustion-chamber, of a pulverulent-fuel feeder comprising a fuel-reducer composed of a reducing-chamber having serrated surfaces, and a revoluble shaft carrying radial reducing-arms coöperating with said surfaces, said reducing-chamber opening into the combustion-chamber, a finely-perforated plate interposed between the two chambers, means for admitting air to the reducing-chamber, a feed-duct connected with the last-named chamber, and a valve constructed to feed the fuel in determined charges to said duct, for the purpose set forth.

14. The combination with a combustion-chamber of a pulverulent-fuel feeder, comprising a fuel-reducer composed of a cylindrical casing having a peripheral opening in communication with the combustion-chamber, and interior serrated surfaces and a revoluble shaft carrying radial reducing-arms coöperating with said surfaces, a finely-perforated plate inserted in said opening and having the form of a segment of a circle of less

diameter than that of the interior of the casing, and means for admitting air to said casing, for the purpose set forth.

15. The combination with a combustion-chamber, of a pulverulent-fuel feeder, comprising a fuel-reducing chamber having interior reducing-surfaces and opening into the combustion-chamber, and a revoluble shaft carrying radial reducing-arms coöperating with said surfaces, a finely-perforated plate interposed between the two chambers, a feed-duct connected with the reducing-chamber and terminating in a feed-hopper, a cylindrical revoluble valve in said duct between the hopper and reducing-chamber, said valve having peripheral pockets, means for admitting air to the reducing-chamber and mechanism for imparting continuous rotation to the crusher-shaft and feed-valve, substantially as and for the purpose set forth.

16. The combination with a combustion-chamber, of a pulverulent-fuel feeder, comprising a fuel-reducing chamber having in-

terior reducing-surfaces and opening into the combustion-chamber, and a revoluble shaft 25 carrying radial reducing-arms coöperating with said surfaces, a finely-perforated plate interposed between the two chambers, a feed-duct connected with the reducing-chamber and terminating in a feed-hopper, a cylindrical revoluble valve in said duct between the hopper and reducing-chamber, said valve having peripheral pockets, means for admitting air to the reducing-chamber, and mechanism for imparting continuous rotation to 35 the crusher-shaft and feed-valve and for varying the speed of rotation of said valve, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses. 40

CHRISTIAN ANDREAS FREITAG.

Witnesses:

MARINUS CHRISTIAN PETRUS RASBY,
AUGUST SIGFRIED DOCEN.