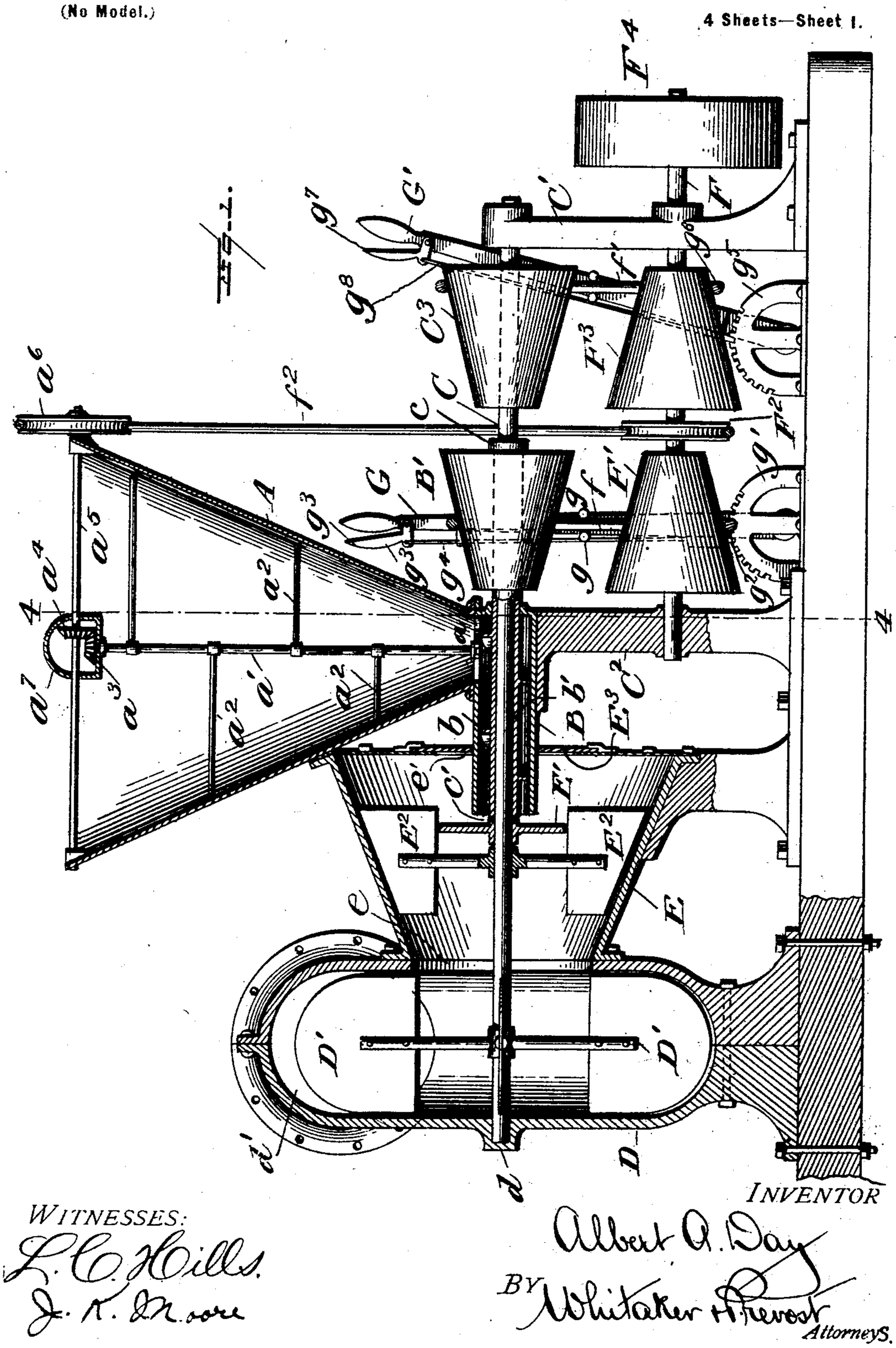
No. 671,161. Patented Apr. 2, 1901.

A. A. DAY.

APPARATUS FOR AERATING AND FEEDING POWDERED COAL.

(Application filed Nov. 7, 1900.)

(No Model.) 4 Sheets—Sheet 1.



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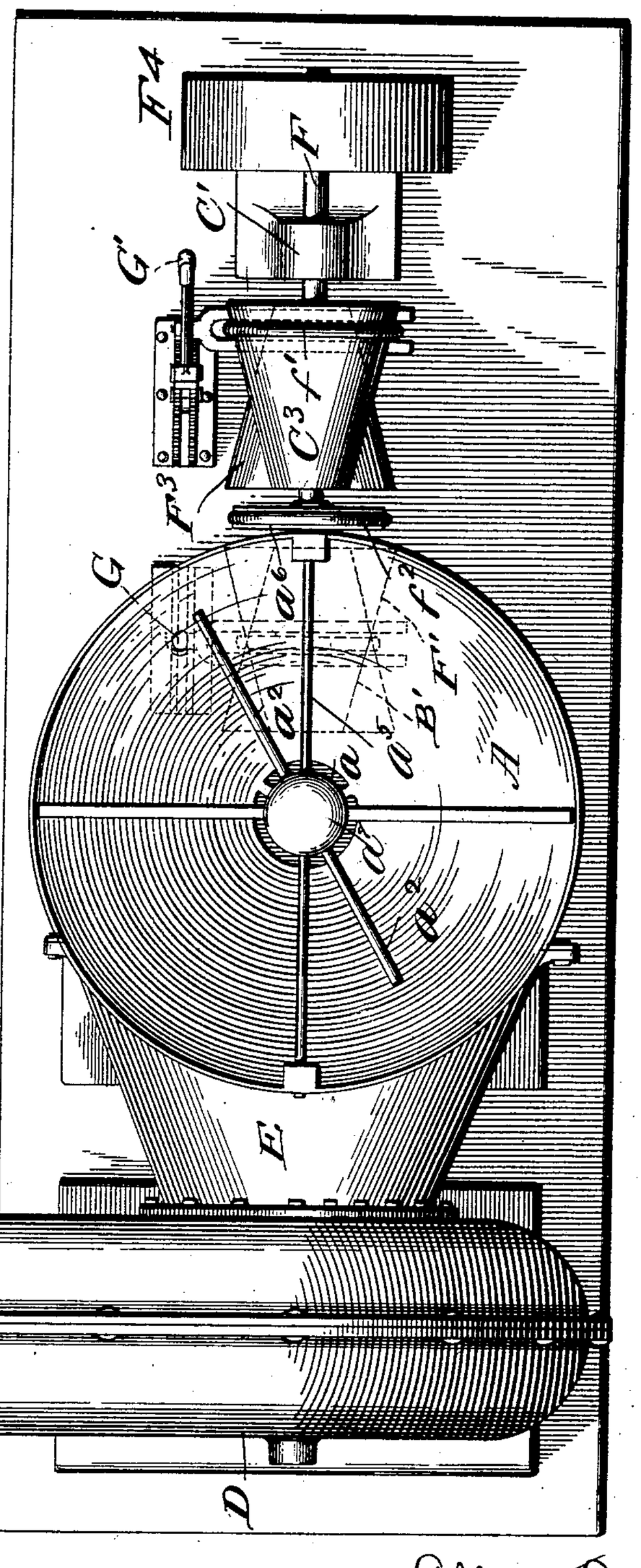
(No Model.) 4 Sheets—Sheet 2.

Fig. 2.



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(No Model.) 4 Sheets—Sheet 3.

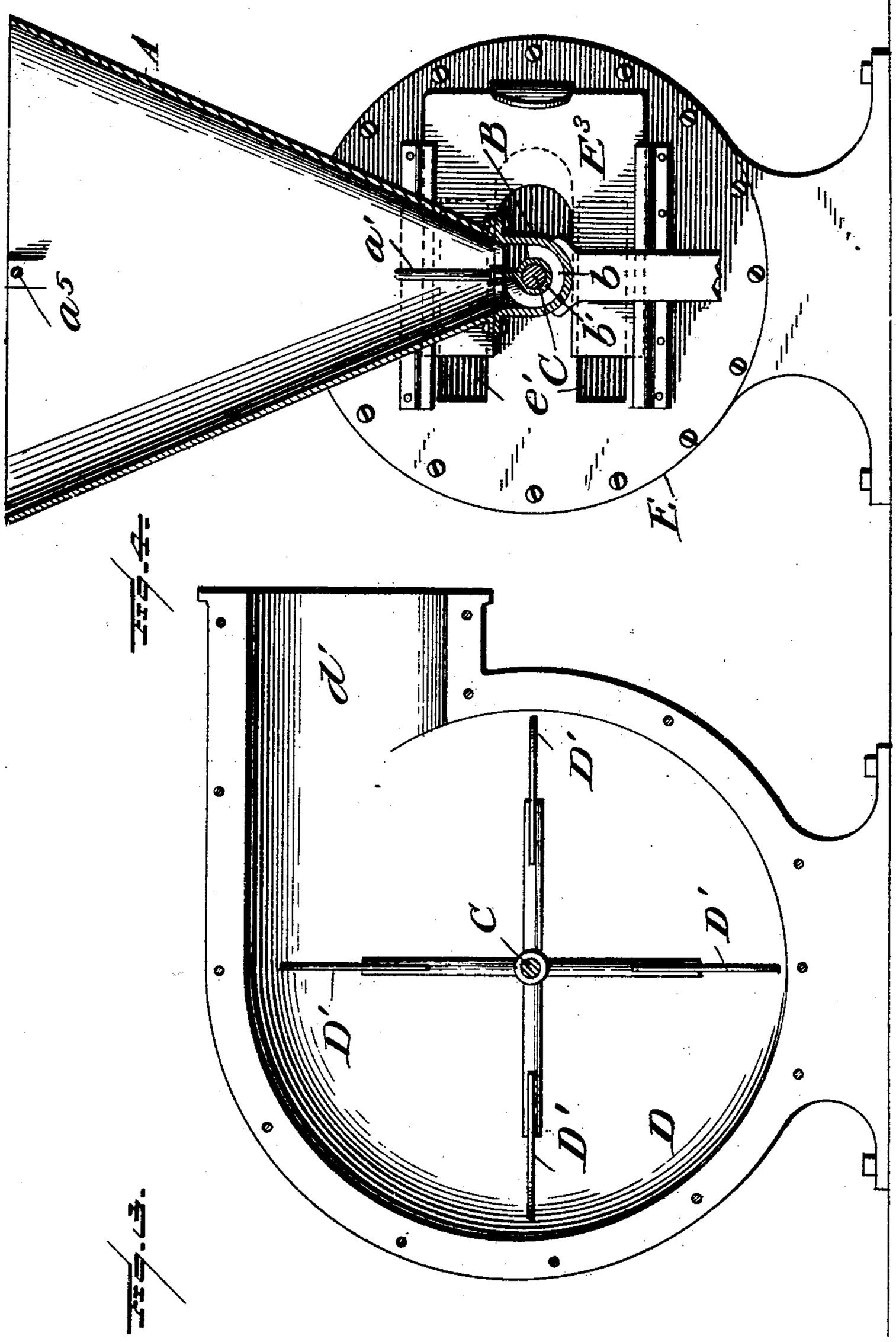

Fig. 4.

Fig. 3.

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Fig. 4.

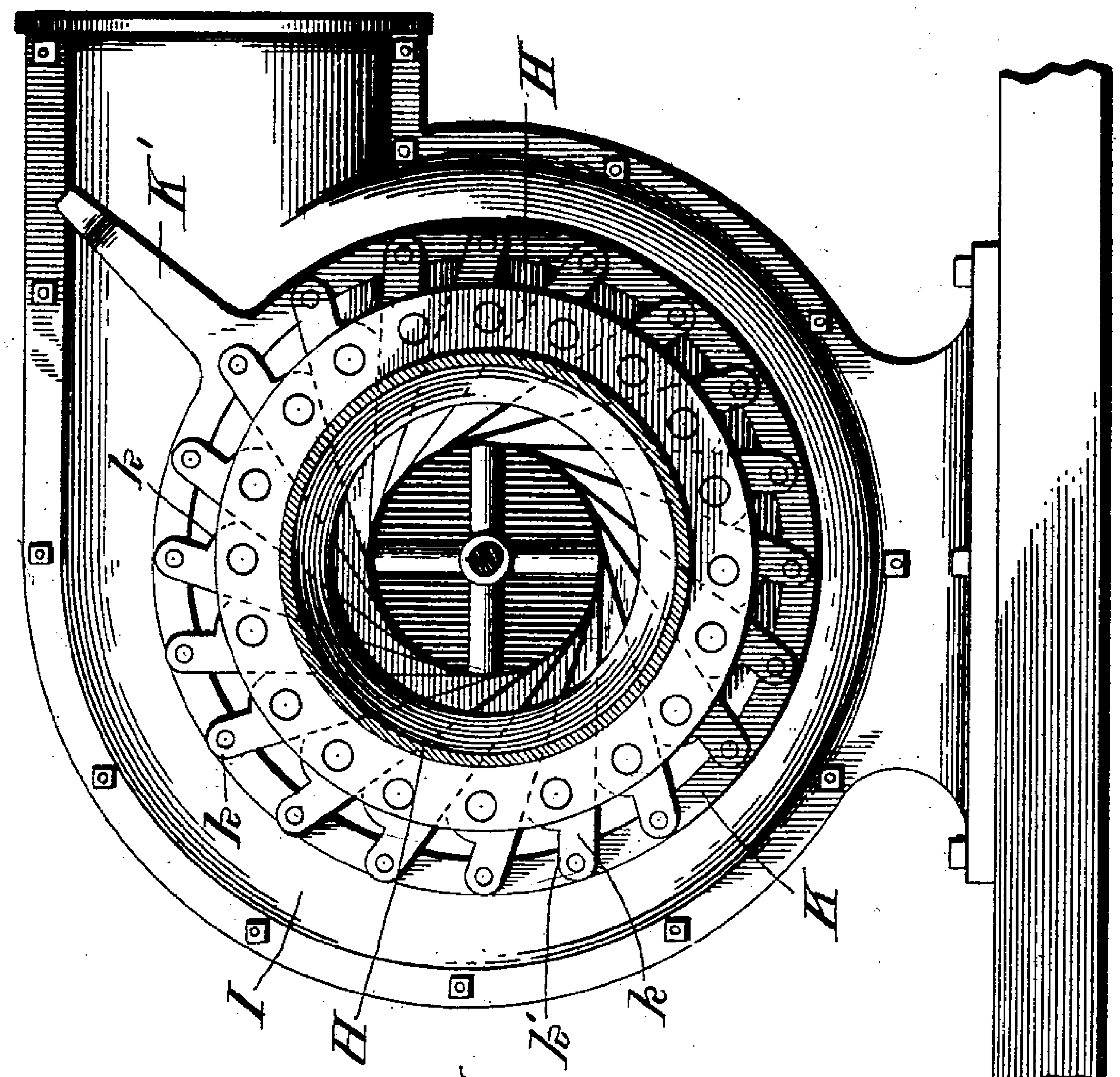
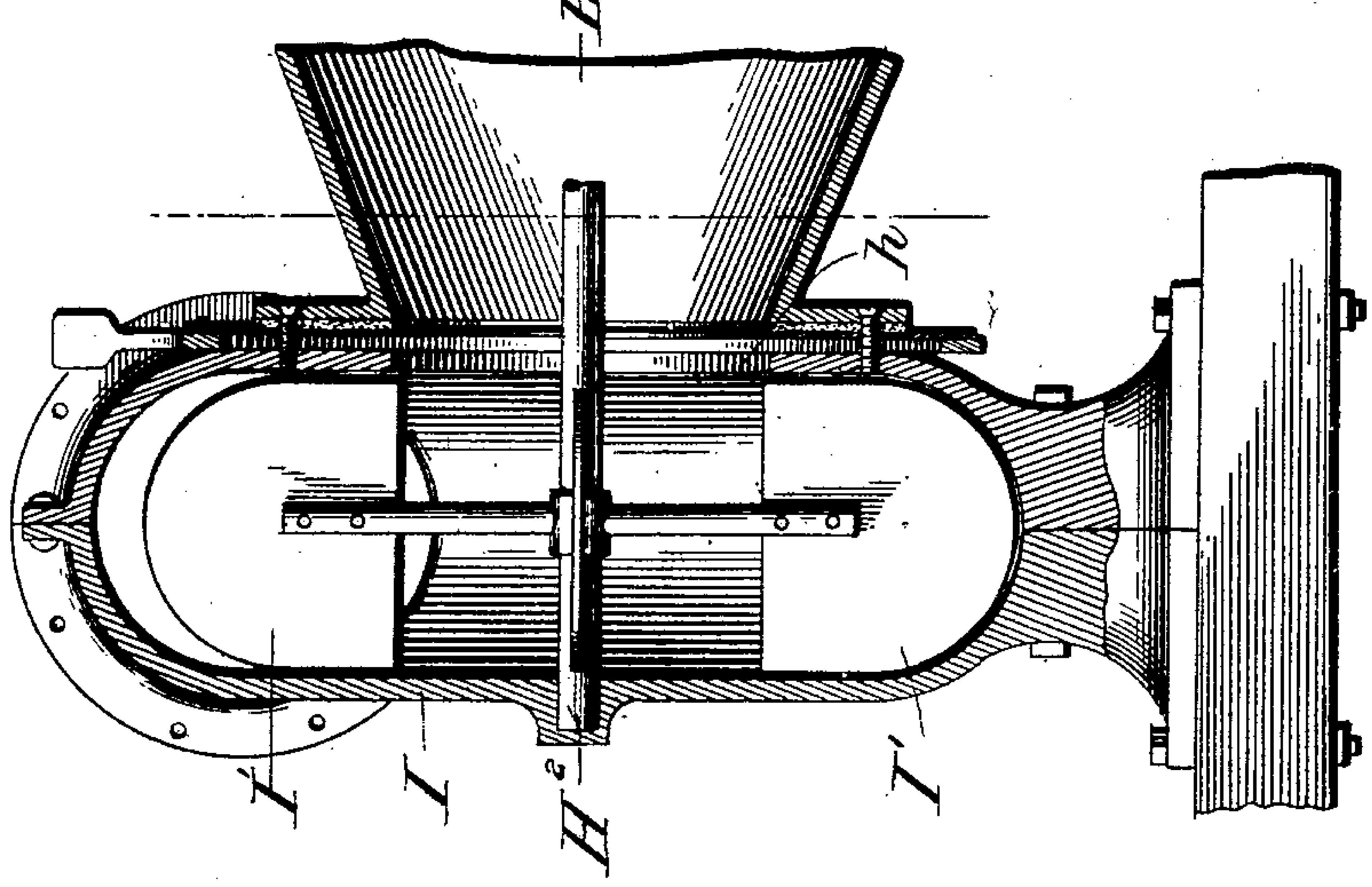


Fig. 5.



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UNITED STATES PATENT OFFICE.

ALBERT A. DAY, OF BROOKLYN, NEW YORK, ASSIGNOR TO THE IDEAL FUEL-FEEDER COMPANY, OF SAME PLACE.

APPARATUS FOR AERATING AND FEEDING POWDERED COAL.

SPECIFICATION forming part of Letters Patent No. 671,161, dated April 2, 1901.

Application filed November 7, 1900. Serial No. 35,741. (No model.)

To all whom it may concern:

Be it known that I, ALBERT A. DAY, a citizen of the United States, residing at Brooklyn, in the city of New York, in the county of Kings and State of New York, have invented certain new and useful Improvements in Apparatus for Aerating and Feeding Powdered Coal; 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.

My invention is an improved apparatus for aerating and feeding coal in pulverulent form; and it consists in the novel features hereinafter described, reference being had to the accompanying drawings, which illustrate one form in which I have contemplated embodying my invention, and said invention is fully disclosed in the following description and claims.

Referring to the said drawings, Figure 1 represents a sectional view of my apparatus. Fig. 2 is a top plan view of the same. Fig. 3 is a sectional view of the ejector or expelling fan. Fig. 4 is a sectional view on line 4 4 of Fig. 1. Fig. 5 is a partial vertical section of a machine embodying a slight modification of my invention. Fig. 6 is a transverse vertical section on line 6 6 of Fig. 5.

My apparatus is adapted to feed coal in a finely-divided or pulverulent condition, in which the particles are of uniform size and about the same condition as fine wheat-flour, so as to form an almost impalpable powder. So far as I am aware I am the first to feed coal in this condition to a furnace.

My apparatus consists, essentially, of a positively operated and controlled feeding mechanism, an aerator for mixing the pulverulent coal thoroughly and intimately with air, and an ejecting mechanism for forcing the air and coal into the furnace, where it is consumed, the use of my apparatus insuring substantially perfect combustion of the fuel, and thereby obviating entirely the formation of smoke.

In the apparatus illustrated in the drawings, A represents a hopper designed to receive the finely-pulverized coal, said hopper being preferably of inverted conical form and provided at its bottom with a discharge-aperture *a*, which communicates with a horizontally-disposed cylindrical trough B. In order to prevent the floury mass of coal in the hopper from packing, I provide a device for stirring or agitating it, consisting in this instance of a vertical shaft a', provided with laterally-extending arms or stirrers a^2, said shaft being mounted in bearings at its upper and lower ends carried by horizontal bars extending across the top of the hopper and across the discharge-aperture *a*. The shaft a' is provided with suitable means for rotating it, and in this instance it is shown as provided with a bevel-pinion a^3, meshing with a similar pinion a^4 on a horizontal shaft a^5, extending across the upper end of the hopper and provided outside the hopper with a driving-pulley a^6. a^7 represents a gear-casing surrounding the gears a^3 and a^4 to protect them from dust and grit.

C represents a shaft which extends centrally and longitudinally through the trough B and has one end supported in a bearing formed in a bearing-standard C′ and its other end supported in a bearing *d*, formed in the casing of the ejector D. Within the trough B is located a worm *b*, formed on or secured to a sleeve b', which is loosely mounted upon the shaft C, so as to turn independently thereof. The sleeve b' extends beyond the outer end of the trough B and is held from endwise movement in that direction by a collar *c*. The projecting part of the sleeve b' is provided, preferably, with a conical driving-pulley B′, by means of which the speed of the worm may be varied, as hereinafter described. The opposite end of the trough B is open and extends within a chamber E, which I term the "aerating-chamber," said chamber being preferably of conical form, as shown, the walls tapering from the side adjacent to trough B toward the opposite side of the chamber. The shaft C is also provided with a collar c' adjacent to the end of the sleeve b' to prevent the longitudinal movement of the sleeve.

E′ represents a spreading device located within the aerating-chamber adjacent to the discharge end of the trough B and consisting in this instance of a circular plate secured to the shaft C and adapted to rotate therewith.

Within the aerating-chamber E are a series of aerating-blades E^2, which are secured to the shaft C and rotate with it.

The aerating-chamber is provided on the side opposite the trough B with an outlet-aperture *e*, which communicates with the ejector-casing D. The side of the aerating-chamber adjacent to the trough B is provided with a central aperture or apertures *e'*, adapted to partially or wholly be closed by a slide E^3. (See Figs. 1 and 4.)

The inner periphery of the ejector-chamber D is constructed eccentric to the shaft C, as shown in Fig. 3, and the casing is provided with a discharge-aperture *d'*, preferably located near the top of the casing. The casing is so constructed that the portion of its inner periphery below the outlet is nearest to the axis of shaft C, and from that point it recedes gradually to a point in line with the top of the discharge-aperture, as shown in Figs. 1 and 3. Within the casing D are a series of radially-disposed ejecting-blades D'.

By reason of the eccentric formation of the interior of the fan-casing it will follow that the outer ends of the blades D' will lie closer to the casing at a point below the discharge-aperture than at any other point. This construction is beneficial in securing a rapid and powerful discharge from the casing.

I provide means for driving the worm *b* and the fans independently and for independently regulating their speeds, which in the present instance consist of the following arrangement of parts: Parallel with the shaft C is a counter-shaft or driving-shaft F, mounted in bearings in the standard C' and a similar standard C^2, which latter also serves to support the trough B and hopper A. Upon this driving-shaft is mounted a cone driving-pulley F', disposed oppositely to and in line with the cone-pulley B' on the sleeve *b'*. The cone-pulleys B' F' are connected by a driving-belt *f*, which is engaged by guides *g g* on a shifting-lever G, pivoted to the base of the machine and provided with a ratchet-segment *g'* and pawl g^2, pawl-operating lever g^3, and link g^4 of ordinary construction, so that the belt can be moved to different positions on said cone-pulleys to regulate the speed of the worm and, therefore the feed of the pulverulent coal. The shaft C is also provided with a cone-pulley C^3, and shaft F is provided with an oppositely-arranged cone-pulley F^3 in line with it and connected thereto by a driving-belt *f'*. I also provide a shifting-lever G' with segment g^5, pawl g^6, lever g^7, and link g^8 similar to lever G and having guides *g g* engaging the belt *f'*, whereby the belt can be shifted to vary the speed of the aerating-blades E^2 and ejector-blades D'.

The shaft F is provided with a pulley F^2, geared by a belt f^2 with the pulley a^6 for operating the stirrer, and said shaft F is also provided with a band-pulley F^4, by means of which it can be driven from a motor, line-shafting, or other source of power.

The coal, which has been previously pulverized to a condition similar to fine flour, is supplied to the hopper A in any desired way and from the hopper it passes to the trough B, where it is fed by means of the worm *b* into the aerating-chamber. As the coal leaves the trough B it is thrown toward the inner periphery of the aerating-chamber by the centrifugal action of the blades E^2, the spreader E' preventing it from passing centrally through the aerating-chamber. The action of the blades E^2 thoroughly mixes the fine powder with air, which is admitted in regulated quantity through the aperture or apertures *e'*, and as the air comes into a state of saturation it passes out into the ejector-casing D, where it is taken up by the ejector-blades and discharged through the outlet *d'*, which is connected by means of a pipe or tube (not shown) with a furnace, where the mixture of air and powder is consumed, producing a white-hot flame without smoke. As before described, the apparatus is perfectly under the control of the operator, as the supply of coal-powder can be accurately regulated independently of the other parts of the apparatus by means of lever G. The speed of the aerator-blades and ejector-blades can be independently increased or diminished by means of lever G', and the admission of air to the aerator is controlled by the slide E^3.

It is to be distinctly understood that no pulverizing or grinding action takes place in any part of the apparatus, as the coal is so finely powdered before being delivered to the hopper that further subdivision of it is not only practically impossible, but undesirable, as I have found by experiment that by the use of this form of fuel in my apparatus the percentage of heat units actually converted into available energy is far in excess of the results produced by the use of coal in ordinary forms—such as lump coal or broken, ground, or so-called "powdered" coal, where the particles are of varying sizes—and I am able to obtain a practically perfect and therefore smokeless combustion.

In the following claims where mention is made of "powdered" coal is to be understood coal which has been brought to the condition of an impalpable powder.

I do not limit myself to the use of an ejector-fan of the specific form shown, as I may employ other forms of ejector-fans in connection with my apparatus, and in other respects I do not wish to be limited to the exact details of construction shown and described, as mechanical variations may be made therein without departing from the spirit of my invention.

In Figs. 5 and 6 I have shown a slight modification of my improved apparatus, in which a device is employed for regulating the size of the aperture between the aerating-chamber and the ejector-casing. In these figures, H represents the aerating-chamber. I represents the ejector-casing, I' the ejector-blades, and *h*

the aperture between the aerating-chamber and ejector-casing. I desire to regulate the size of this aperture and at the same time to maintain said aperture circular and concentric with the shaft H^2, which extends through the aerating-chamber and ejector-casing. I have shown in this connection an adjusting device for the aperture *h*, consisting of what is termed an "iris-diaphragm." This construction comprises a series of overlapping wings and plates *k*, pivoted to the casing I around the aperture *h* and having arms *k'* extending outwardly, all of said arms being pivoted to an adjusting-ring K, provided with a handle K'. The plates *k* are so constructed as to form a circular aperture concentric with the shaft H^2, and by moving the ring K in one direction or the other the diameter of this aperture may be increased or diminished, as will be readily understood.

I do not claim the specific construction of the iris-diaphragm, for it may be substituted by other forms of mechanism for varying the size of aperture *h*. I prefer, however, to employ this device or other suitable device which will adjust the size of the aperture and at the same time maintain it circular and concentric with the shaft.

What I claim, and desire to secure by Letters Patent, is—

1. In an apparatus for aerating and feeding powdered coal the combination with an ejecting-chamber, provided with ejecting mechanism, of a separate aerating-chamber communicating with said ejecting-chamber, a series of revolving aerating-blades, located in the aerating-chamber and a positive feeding mechanism communicating with the said aerating-chamber, substantially as described.

2. In an apparatus for aerating and feeding powdered coal, the combination with an ejecting-chamber provided with ejecting mechanism, of a separate aerating-chamber located at one side of the ejecting-chamber and having a central aperture communicating with the ejecting-chamber, a series of rotary aerating-blades in said aerating-chamber, and a positive feeding mechanism communicating with said aerating-chamber, substantially as described.

3. In apparatus for aerating and feeding powdered coal, the combination with an ejecting-chamber, of a separate aerating-chamber located at one side of said ejecting-chamber, and communicating therewith by a common central aperture, a common shaft extending through said aerating and ejecting chambers, ejecting-blades located in said ejecting-chamber and secured to said shaft, a series of aerating-blades located in said aerating-chamber and secured to said shaft, and a feeding device communicating with said aerating-chamber, substantially as described.

4. In apparatus for aerating and feeding powdered coal, the combination with an ejector-casing, provided with ejecting mechanism, of a separate aerating-chamber, communicating with the ejecting-chamber, a series of aerating-blades located in said aerating-chamber, a positive feeding device communicating with said aerating-chamber, mechanism for positively regulating said feeding mechanism and independent mechanism for positively regulating the speed of the ejecting mechanism, substantially as described.

5. In apparatus for aerating and feeding powdered coal, the combination with an ejecting-chamber, a series of revolving ejecting-blades located therein, a separate aerating-chamber communicating with said ejecting-chamber, a series of revolving aerating-blades located in said aerating-chamber, a positive feeding mechanism communicating with said aerating-chamber, an independent air-supply for said aerating-chamber, devices for regulating said air-supply, mechanism for positively regulating said feeding mechanism, and independent mechanism for regulating the speed of said ejecting-blades, substantially as described.

6. In an apparatus for aerating and feeding powdered coal, the combination with an ejecting-chamber, of a separate aerating-chamber located at one side of said ejecting-chamber and communicating therewith, a shaft extending through said aerating and ejecting chambers, a series of ejecting-blades secured to said shaft within the ejecting-chamber, a series of aerating-blades secured to said shaft within said aerating-chamber, a feeding-trough communicating with said aerating-chamber, a feeding-worm in said trough, mechanism for positively regulating the speed of said worm, and independent mechanism for positively regulating the speed of said shaft, substantially as described.

7. In an apparatus for aerating and feeding powdered coal, the combination with an ejecting-chamber, of an aerating-chamber arranged at one side of said ejecting-chamber and communicating therewith, a feeding-trough communicating with said aerating-chamber, a shaft extending through said ejecting-chamber, aerating-chamber and trough, ejecting-blades secured to said shaft within the ejecting-chamber, aerating-blades secured to said shaft within the aerating-chamber, a worm loosely mounted on said shaft within said feeding-chamber, driving mechanism for said shaft, independent driving mechanism for said worm, means for regulating the speed of said shaft and independent mechanism for regulating the speed of said worm, substantially as described.

8. In an apparatus for aerating and feeding powdered coal, the combination with an ejecting-chamber, and a series of revolving blades located therein, of a separate aerating-chamber communicating with said ejecting-chamber, a series of revolving aerating-blades located therein, feeding devices communicating centrally with said aerating-chamber, and

a deflector located in said aerating-chamber in the path of fuel entering from said feeding device, substantially as described.

9. In apparatus for feeding powdered coal to furnaces, the combination with the aerating-chamber and rotatable aerating-blades located therein, of a trough discharging centrally into said chamber, a feeding-worm in said trough, a deflector in said chamber opposite the discharge end of said trough, an ejector connected with said chamber, a series of rotatable ejector-blades located therein, means for regulating the speed of said worm and independent means for regulating the speed of said aerating and ejecting blades, substantially as described.

10. In apparatus for feeding powdered coal to furnaces, the combination with the aerating-chamber and a trough discharging centrally into said chamber, of a shaft extending through said trough and chamber, a sleeve loose on said shaft, located within said trough, a worm carried by said sleeve, a series of aerating-blades secured to said shaft within the said chamber, an ejector connected with said chamber, means for regulating the speed of said sleeve and independent means for regulating the speed of said shaft, substantially as described.

11. In apparatus for feeding powdered coal to furnaces, the combination with the aerating-chamber, of a trough communicating with said chamber, an ejector-casing communicating with said chamber, a shaft extending through said trough-chamber and ejector-casing, a feeding-worm loosely mounted on said shaft within said trough, means for driving said worm, a series of aerating-blades secured to said shaft within the aerating-chamber, a deflector within said aerating-chamber, adjacent to the discharge end of said trough, a series of ejector-blades secured to said shaft within the ejector-casing, means for driving said shaft, means for regulating the speed of said feeding-worm and independent means for regulating the speed of said shaft, substantially as described.

12. In apparatus for feeding powdered coal to furnaces, the combination with the aerating-chamber, of a trough communicating with said chamber, an ejector-casing communicating with said chamber, a shaft extending through said trough-chamber and ejector-casing, a feeding-worm loosely mounted on said shaft within said trough, means for driving said worm, a series of aerating-blades secured to said shaft within the aerating-chamber, a series of ejector-blades secured to said shaft within the ejector-casing, means for driving said shaft, an air-inlet for said aerating-chamber, a regulating device for said air-inlet, a deflector adjacent to the discharge end of said trough, means for regulating the speed of said worm and independent means for regulating the speed of said shaft, substantially as described.

13. In an apparatus for feeding powdered coal to furnaces, the combination with an ejecting-chamber provided with ejecting mechanism, of a separate aerating-chamber arranged at one side of the ejecting-chamber and communicating by a central aperture therewith, a series of revolving aerating-blades located therein, a feeding device communicating centrally with said aerating-chamber, a deflector located in said aerating-chamber, between the feeding device and the aperture leading to the ejecting-chamber, and means for regulating the size of said aperture, substantially as described.

14. In an apparatus for feeding powdered coal, the combination with the ejecting-chamber and a series of revolving blades located therein, of a separate aerating-chamber located at one side of the ejecting-chamber and communicating therewith by a common central aperture, a feeding device communicating centrally with said aerating-chamber, an air-inlet for said aerating-chamber, means for regulating said air-inlet, a deflector interposed between said feeding device and said common aperture, means for regulating the speed of said feeding device and means for regulating the size of said aperture leading to the ejecting-chamber, substantially as described.

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

ALBERT A. DAY.

Witnesses:
WM. J. SMITH,
W. H. PARRIS.