

E. C. SMITH.
FEEDING PULVERIZED FUEL.

No. 563,987.

Patented July 14, 1896.

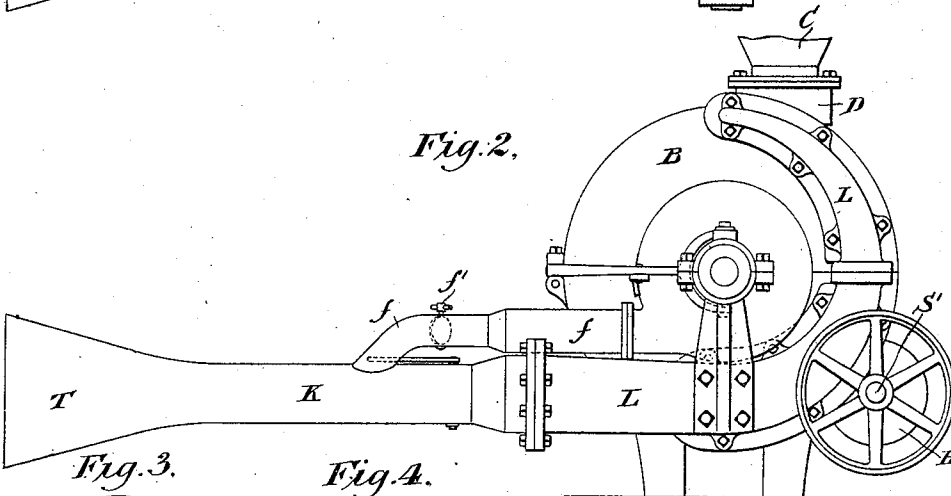
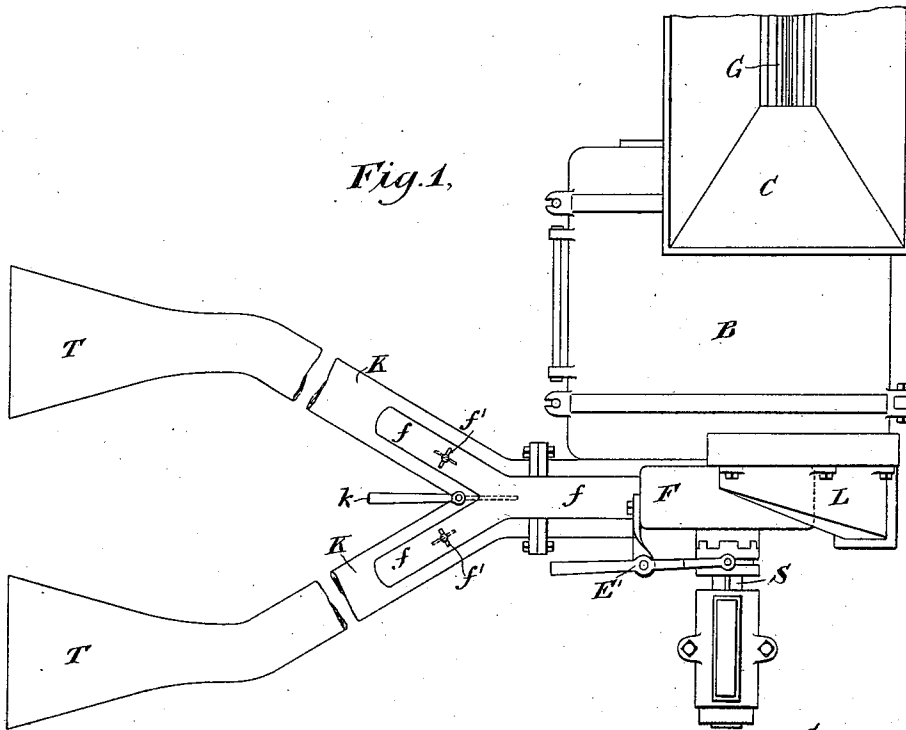


Fig. 3.

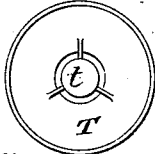


Fig. 4.

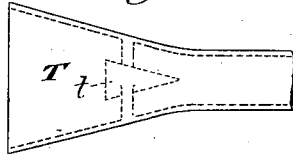


Fig. 5.



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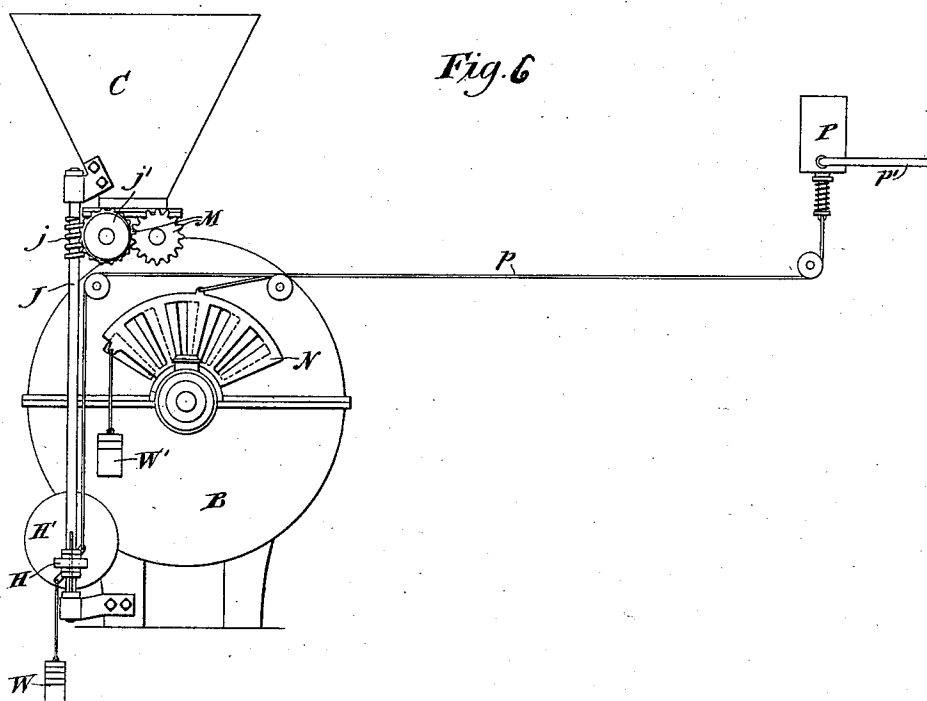
(No Model.)

2 Sheets—Sheet 2.

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UNITED STATES PATENT OFFICE.

EDWARD C. SMITH, OF NEW YORK, N. Y., ASSIGNOR TO JAMES B. KENNEY,
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FEEDING PULVERIZED FUEL.

SPECIFICATION forming part of Letters Patent No. 563,987, dated July 14, 1896.

Application filed August 14, 1894. Serial No. 520,307. (No model.)

To all whom it may concern:

Be it known that I, EDWARD C. SMITH, of New York, N. Y., have invented a new and useful Improvement in Feeding Pulverized Fuel, of which the following is a description, referring to the accompanying drawings, which form a part of this specification.

In an application filed herewith and serially numbered 520,306 I have described means for reducing coal or other fuel to an impalpable powder and commingling the pulverized fuel with air and feeding it to the furnace. The invention which forms the subject of the present patent is of a similar nature, and has for its purposes the more perfect grinding or preliminary reduction of the fuel before it is admitted to the pulverizer, the arrangement of the grinding apparatus in a manner enabling me to employ wet or cohesive fuel, the control and direction of the commingled pulverized fuel and air as it is fed from the pulverizer into one or more discharge-passages, the regulation and control of the admission of fuel and of air into the pulverizer, and the regulation of the flame or jet which issues from the feed-passages into the furnace. In addition to these purposes my invention includes an automatic control or regulation of both air and fuel, so that the apparatus as a whole constitutes an automatic stoker, requiring almost no attention while in use.

To these and certain other incidental uses and purposes which will hereinafter more fully appear, my invention is embodied in the apparatus and its several parts, constructed, arranged, combined, and operated in a manner similar to that hereinafter described, illustrated, and claimed.

My apparatus is particularly designed to burn culm or the waste coal which, being too fine to be commercially valuable, has usually accumulated in great quantities throughout the coal regions. The great economy of combustion which follows the use of my apparatus enables me, however, to use it advantageously with any kind of coal, merely breaking the coal so that it may be fed into the grinder and thence into the pulverizer. When the proper proportion of coal and air are admitted, the impalpable coal-powder carried along with the air-blast may be burned like a gas,

and the combustion is so complete that no smoke whatever passes out of the chimney—the resultant ash in the case of soft coal being an incombustible reddish earth, conclusively demonstrating the completeness of the combustion.

The culm or broken coal is first fed into a hopper and thence into the grinding apparatus, where it is reduced to comparatively fine particles, and then passes into the rotary beater or pulverizer, and is reduced to an impalpable powder by the revolving blades or beaters. Air is fed in at one end of the apparatus, near the shaft, and the commingled air and fuel are discharged through a tangential spiral discharge or feed pipe leading out at the rear end of the pulverizer. The beater-blades acting as fans of a rotary blower draw the air through the pulverizer and force it out through the discharge, carrying with it the comminuted or pulverized fuel in the manner set forth at length in my application above referred to. If desired, an additional air supply may be had by the use of a supplemental blower mounted upon and turning with the shaft of the pulverizer and discharging air into the feed-passages leading to the furnace. These feed-passages terminate in a twyer having a flaring or expanded end, by which the flame or jet of commingled air and fuel is expanded within the furnace and a complete combustion and more efficient heating effect produced.

The grinding apparatus which feeds coal to the pulverizer is driven by an adjustable speed-controller and the speed regulated by a steam-pressure device. The same pressure device is used to admit more or less air to the pulverizer. In this manner when the boiler-pressure rises above the desired amount, the feeding of the coal and air is automatically reduced and the production of steam proportionately checked. When the steam-pressure falls, the feed of the air and the coal is again increased, tending to check the decrease of steam-pressure, and in this manner automatically control the boiler and keep the pressure as nearly constant as possible.

Such, briefly, is a general view of the invention which forms the subject of this patent. The construction and details of the appa-

ratus will more clearly appear from the accompanying drawings, illustrating one embodiment of the invention.

Figure 1 is a plan view showing the complete apparatus for grinding, pulverizing, feeding, and automatically regulating the fuel. Fig. 2 is a rear end view looking along the shaft. Figs. 3, 4, and 5 are details of forms of twyers or mouths for the discharge of commingled air and fuel into the furnace; and Fig. 6 is a front end view of the grinder and pulverizer, showing the automatic attachments and regulation of the air and fuel supply.

Throughout the drawings like letters of reference indicate like parts.

The shell B contains the rotary beaters or blades which pulverize the fuel. The details of these blades are not part of the present invention. They may, however, be substantially similar to those described in the patents to Bordman and Ruddick, numbered, respectively, 416,252 and 388,375.

At C is shown the hopper through which the coal is fed to the grinding-rolls. The rolls turn with shafts and intermeshing gears M, which are driven by a speed-regulating device, as in Fig. 6, and as hereinafter described. From these rolls finely-ground coal-dust is fed directly into the pulverizer. The spiral and tangential discharge-passage L, opening into the feed-pipes K, discharges the fuel from the pulverizer into the furnace. These feed-passages K terminate in flaring or enlarged twyers or mouths T. (Shown in detail in Figs. 3, 4, and 5.) In Figs. 3 and 4 the circular or tunnel shape is shown. This, as well understood in pneumatics, tends to cause a spreading of the gas or other fuel flowing through it. To increase this expanding effect, the small deflecting-core *t* may be employed. Where it is desired to expand the flame more horizontally than vertically, an elliptical or ovoid shape may be employed, as clearly seen in end view in Fig. 5.

Where the feed-pipe K is bifurcated in order to feed two or more twyers, a valve *k* may be used to open or close either at will and direct the supply through the other. I may provide each of these feed-pipes K also with a supplemental air blast or supply from a blower or fan F, which is mounted upon the shaft S of the pulverizer and discharges air through the bifurcated passage *f* into the feed-pipes K. I find that even a small pulverizer may readily be employed to feed coal to several furnaces amounting in all to many hundred horse-power, the principal difficulty being in supplying sufficient air for the purpose, and the use of this supplemental blower F enables me to introduce more air than can properly be drawn in through the pulverizer. Moreover, it allows me to decrease the amount of air passing through the pulverizer and increase that supplied through the fan, and by these means less draft passes through the pulverizer and the fuel may be passed more

slowly through the beaters than in the case where all the air-blast is drawn through the pulverizer. A friction-clutch E, controlled by a handle E', may be employed to connect and disconnect the fan or blower F at will, and dampers or draft-regulators *f'* are placed in the separate passages *f* to control the air-blast to the different furnaces or different twyers. In this way it is clear that I have a separate control of the supplemental air-blast and an entirely independent control of the amount of commingled air and fuel passing through the passage L into the feed-pipes K, and if desired one of the feed-passages may be entirely shut off and the supplemental blast *f* closed.

The grinding-rolls are preferably driven by friction-wheel H and disk H', mounted upon a shaft S', near the base of the pulverizer. A vertical shaft J transmits motion by means of a worm *j* and worm-wheel *j'* to the gears M upon the shafts of grinding-rolls. The friction wheel or roller H is splined to the shaft J, so that it may slide longitudinally upon the shaft and transmit power from the disk H' to the shaft. A steam-pressure regulator P and cord *p*, acting against the counterweight W, adjusts the friction-wheel H upon the shaft J, carrying it toward the center of the disk H', when the steam-pressure rises, and carrying it toward the periphery of the disk when the steam-pressure falls. In this manner the grinding-rolls are driven faster when the steam-pressure falls and more slowly when it rises, so that the feed is automatically controlled by the boiler-pressure. The pipe *p'* connects the pressure-regulator with the boiler and completes the automatic apparatus. Preferably the pressure-regulator is operated by the water rather than the steam, as in this manner useless condensation is avoided and the pressure-regulator may be kept comparatively cold. In the drawings I have indicated a plunger or piston directly drawing upon the cord *p* against the counterweight W, and I have shown the counterweight W consisting of several parts, so that the tension on the cord, and consequently the regulation, may be altered at will. The same pressure-regulator and cord *p* are employed in a substantially similar manner to vary the opening of the damper N, and thereby regulate the air supply.

The counterweight W' tends to open the damper and the pull of cord *p* tends to close the damper, so that, as the boiler-pressure increases, the air supply, like the coal supply, is decreased, and when the boiler-pressure falls the air supply and the coal supply are increased.

I have now set forth one embodiment of my invention and described the manner in which it may be constructed and used. I have purposely omitted the enumeration of the many details and modifications which may be supplied by mere skill in the art and without departing from the principle of the invention,

because to set these forth at length would obscure, rather than make clear, the more essential features; and it must not be understood that my invention is in any way restricted to the details of the pressure-regulator, driving devices, or indeed any of the other parts as shown. On the contrary,

I claim, and desire to secure by these Letters Patent, together with all such modifications and additions as may be made by mere skill in the art, and with only the limitations as expressed or by law implied in view of the state of the related art, the following:

1. In combination in and with a complete apparatus for pulverizing and feeding fine fuel and air to furnaces, a casing, the rotary beater-blades therein, means for admitting fuel and air thereto, a discharge or furnace feed-pipe leading from the said casing, and a supplemental rotary blower separated from but coaxially mounted with the said casing and rotary beaters, and a discharge-pipe leading from the said supplemental blower and discharging a supplemental blast of air into the said furnace feed-pipe, whereby two blasts of air, one containing pulverized fuel, may be simultaneously but separately discharged into the said furnace feed-pipe, substantially as set forth.

2. In combination in a complete apparatus

for pulverizing and feeding fine fuel and air to furnaces, feed-rolls for the said apparatus, adjustable operating connections for the said feed-rolls and a pressure-controlled regulator for the said operating connections, substantially as set forth.

3. In combination in a complete apparatus for pulverizing and feeding fine fuel and air to furnaces, feed-rolls for the said apparatus, adjustable operating connections therefor, an adjustable air admission, and a pressure-controlled regulator for the said operating connections and the said admission, substantially as set forth.

4. In combination with an apparatus for pulverizing and feeding fuel, feed-rolls for the said apparatus, a shaft transmitting power to the said rolls, an adjustable friction-wheel and disk H H' for transmitting power from a driving-shaft to the said shaft, and a pressure-controlled device and connections for automatically adjusting the said friction-wheel, substantially as set forth.

In testimony whereof I have hereunto set my hand, at the city of New York, this 9th day of August, 1894.

EDWARD C. SMITH.

Witnesses:

JAMES B. FINNEY,
HAROLD BINNEY.