No. 711,688. Patented Oct. 21, 1902.

# M. F. WILLIAMS.

## FUEL BLOWER AND PULVERIZER.

(Application filed May 28, 1900.)

(No Model.)

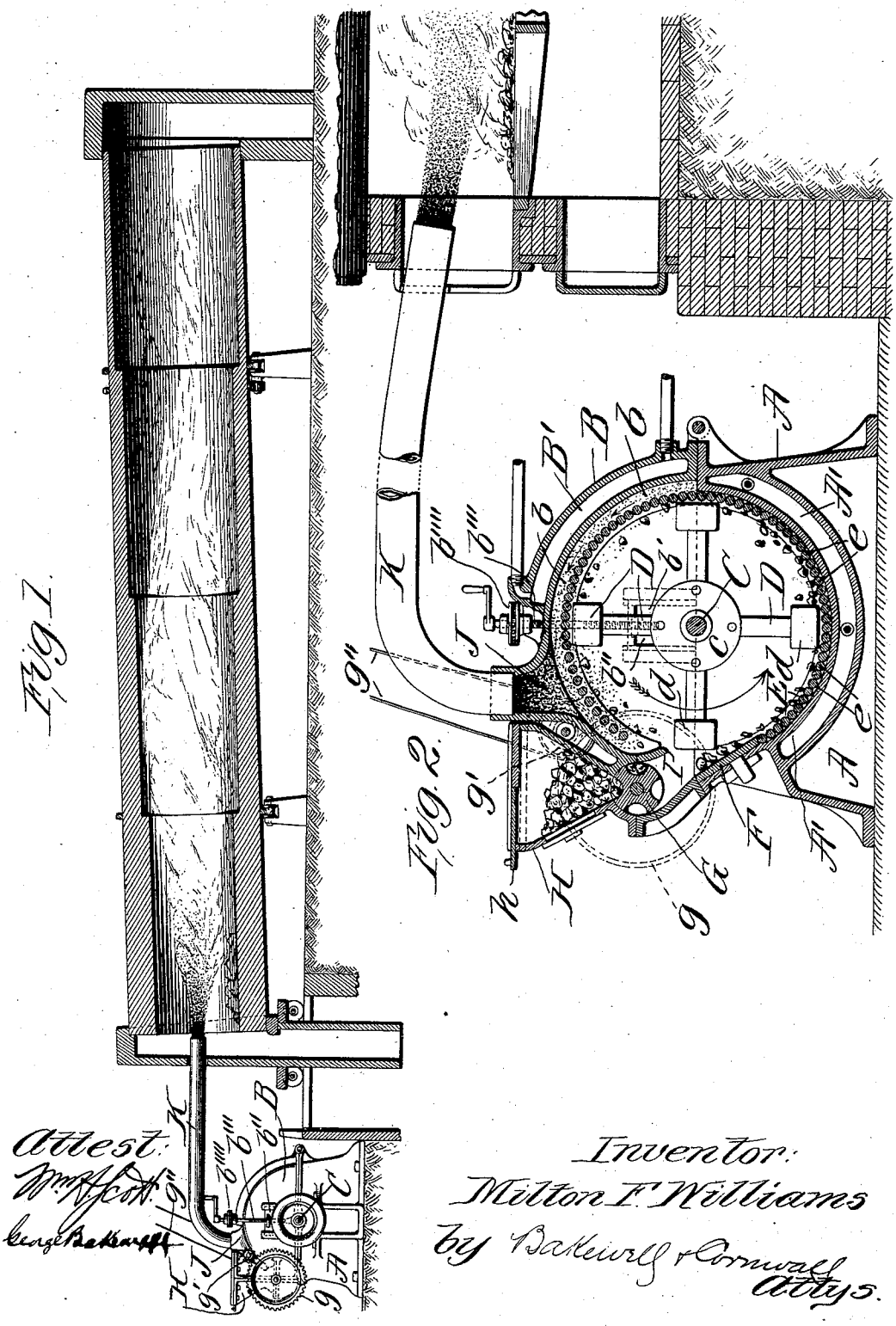


Fig. 1.

Fig. 2.

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# UNITED STATES PATENT OFFICE.

MILTON F. WILLIAMS, OF ST. LOUIS, MISSOURI, ASSIGNOR TO THE WILLIAMS PATENT CRUSHER AND PULVERIZER COMPANY, OF ST. LOUIS, MISSOURI, A CORPORATION OF MISSOURI.

## FUEL BLOWER AND PULVERIZER.

SPECIFICATION forming part of Letters Patent No. 711,688, dated October 21, 1902.

Application filed May 28, 1900. Serial No. 18,243. (No model.)

*To all whom it may concern:*

Be it known that I, MILTON F. WILLIAMS, a citizen of the United States, residing in the city of St. Louis, State of Missouri, have invented a certain new and useful Improvement in Fuel Blowers and Pulverizers, of which the following is a full, clear, and exact description, 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, forming part of this specification, in which—

Figure 1 is an elevational view showing my improved fuel blower and pulverizer operating in connection with a cement-kiln, the kiln being in section; and Fig. 2 is a sectional view through my improved fuel blower and pulverizer, showing the same in operative relation to a boiler-furnace.

This invention relates to a new and useful improvement in a fuel pulverizer and blower, the object being to construct a machine which will disintegrate or pulverize the fuel into a finely-divided state, the pulverizing apparatus also serving as a blast-fan to blow the fuel into the furnace. The blower supplies sufficient oxygen to support complete combustion, and by heating the pulverized fuel and the air which carries it into the furnace part of the moisture in the fuel is evaporated while the fuel is being pulverized, and the finely-divided fuel and air passing into the furnace in a heated condition will burn more quickly and readily.

With these objects in view the invention consists in the construction, arrangement, and combination of the several parts, all as will hereinafter be described and afterward pointed out in the claims.

In the drawings I have shown my improved pulverizer and blower in connection with a rotary kiln for burning cement, Fig. 1, and in Fig. 2 in connection with an ordinary boiler-furnace. This kiln and this furnace are so well understood that I will give no detailed description of the same here; but with respect to the operation of the cement-kiln I will state that the stack is located at the rear and the cement to be burned is introduced at the rear end, the kiln being rotated at an inclination, feeding the cement toward the front end opposite the direction of the draft of the burning fuel through the kiln. A down-spout is arranged at the front end of the kiln, through which the cement clinker falls. In practice where my improved blower and pulverizer is used either with a cement-kiln, boiler-furnace, or any other kind of a furnace a starting-fire is first built, preferably by burning shavings and wood, after which the blast of fuel is introduced thereupon or thereover.

In the drawings, A indicates the casing, and B a suitable cover, which may be hinged or bolted to the casing. C indicates a shaft mounted in the casing, said shaft carrying hammer-supports *c*, in which are pivotally mounted the revolving beaters or hammers D, said hammers preferably having enlarged striking-heads *d*.

E indicates a concentrically-arranged grinding-surface which coöperates with the hammers, said grinding-surface being preferably composed of transversely-arranged bars or rods *e*, which, as shown, are close together throughout the bottom and a portion of the top of the housing, the bars composing the forward upper end of this grinding-surface being spaced a little distance apart.

F indicates a breaker-plate tangentially arranged with respect to the grinding-surface, said breaker-plate being located at the forward end of the machine and by its inclination presenting the material to be acted upon by the hammers in such manner that the material is initially disintegrated or broken while on the breaker-plate and before it is received by the grinding-surace for final comminution.

G indicates a feed-roller arranged above the breaker-plate, the said feed-roller having a gear-wheel *g* conjoined thereto, which gear meshes with a pinion *g'*, driven by a belt *g''*.

H indicates a feed-hopper arranged above the feed-roller, into which may be led a spout from some suitable source of supply, (not shown,) or the material to be reduced may be introduced into said hopper by hand, a sliding cover *h* being provided for this purpose.

The upper portion of the housing, or what I have designated as the "cover" B, is of larger

diameter than the grinding-surface in order to provide a space *b* beyond the grinding-surface, said space continuing forward to an inturned deflecting-lip I, which forms the front wall thereof, and which deflecting-lip tends to direct the current of air and carries particles of material inwardly toward the hammers. Back pressure is thus taken from the feed-roller and, on the contrary, a suction is created which tends to draw the material delivered by the feed-roller toward the action of the hammer.

J indicates a bell-mouth formed on the cover B, from which bell-mouth leads a discharge-pipe K, said discharge-pipe through said bell-mouth being in communication with the space *b*. This pipe K may lead to a separator, where the heavier particles are returned to the machine and the finer particles separated, or it may discharge directly into a storage-bin, whence the finished particles may be delivered to any point desired. As shown in the drawings, pipe K leads directly into a rotary cement-kiln, Fig. 1, and in Fig. 2 into a fire-chamber of a boiler-furnace.

In operation slack-coal or coal reduced in fineness sufficient to be handled by the rotary feeding device is introduced into the hopper H and fed down onto the breaker-plate by the feeding-roll G. The revolving hammers here operate upon the material, initially crushing or breaking it into fine particles, after which it is carried onto the concentric cage or grinding-surface and pulverized. As the pulverulent material is carried around part of it is forced through the cage-bars into the space *b*, those particles which are too large to be forced between the bars being carried onward and reduced. Any large particles which are carried around opposite the large space between the bars at the upper forward end of the grinding-surface will not pass therethrough, because momentum carries the particles across said space and into the current of air directed inwardly by the deflecting-lip. I have found by actual practice that if three or four bars were removed from the forward upper end of the grinding-cage the inturned current of air would be sufficient to carry the larger particles back into the machine, thus preventing their escape into the bell-mouth opening and through the discharge-pipe K. The bars, which are arranged close together to form the space *b*, will, due to inequalities in manufacture, permit finely-divided material to pass therebetween into said space, and of course where the material passes between the bars air will likewise pass through. The bars being spaced widely apart opposite the bell-mouth opening will not only permit the air to pass through said space into the bell-mouth opening, but also the finely-divided material—the heavier particles of material jumping across the spaces between the bars by momentum—and the circulation of air within the housing, as before described. The air and finely-divided particles of material thus passing radially into the bell-mouth opening will induce the air and finely-divided particles of material in space *b* to be drawn into the bell-mouth opening. As the walls of this space, which I have designated the "bell-mouth" opening of the discharge-pipe, converge at their upper ends or present a smaller area at the discharge-point than near the cage-bars, all of the air in the bell-mouth opening cannot escape through the contracted portion, and therefore a back pressure is exerted, which back pressure will escape through the easiest path, which is forwardly and inwardly along the lines defined by the cover and the deflecting-lip. This inturned current of air is utilized to carry the heavier particles back into the machine for further action by the hammers on the grinding-surface at the bottom.

In order to supply air the sides of the cover B next the shaft are provided with openings *b'*, the available area of said openings to be regulated by vertical movable slides *b''*, arranged in suitable guideways and controlled by threaded rods *b'''*. Sprocket-wheels *b''''* are mounted on the upper ends of these sprocket-rods, over which a sprocket-chain passes, whereby the rods may be rotated in unison and a uniform adjustment made with respect to the slides. In this manner more or less air may be admitted to the machine for the purpose of regulating the blast and also for the purpose of regulating the supply of oxygen to support combustion. This regulation of air-supply is increased or diminished, according to the quantity of fuel fed into the machine and the nature of said fuel.

As most bituminous fuel contains moisture, which when the fuel is finely divided causes it to cake, it is necessary to provide means for preventing the machine from choking. I therefore arrange a steam-jacket B' at the back of the cover, whose heat is radiated into the space *b*. The bottom of casing A under the cage-bars is also preferably imperforate and formed with a steam-jacket A' for the purpose of heating the material while it is being ground on the lower cage-bars. The heat thus radiated into the machine serves a double purpose—first, to dry the fuel while it is being ground, driving off the hydroscopic moisture to a great extent, and, secondly, to heat the air in the machine as well as the finely-divided particles of fuel. When the heated fuel is blown into the kiln or furnace through the medium of heated air, combustion takes place much nearer the point of discharge of the pipe K than would be the case were cold air employed. In fact, the temperature of the pulverizer and blower or the pipe K could be raised to such a degree that slow combustion would take place therein, the combustible gases, &c., being discharged into the kiln or furnace in a burning state.

I am aware that minor changes in the construction, arrangement, and combination of the several parts of my device can be made

and substituted for those herein shown and described without in the least departing from the nature and principle of my invention.

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

1. The combination with a casing having an imperforate bottom and a suitable inlet, of a grinding-surface formed by transversely-disposed bars arranged in a concentric series and close together, the bars at the upper portion of the casing being arranged at a short distance away from the top wall of the casing to form a space between said bars and top wall, and a discharge-pipe leading from said space, the bars adjacent to the point of discharge being more widely spaced than the other bars of the grinding-surface, substantially as described.

2. In combination with a casing, of a concentric series of bars forming a grinding-cage, the bars in said cage being arranged close together, and the top wall of the casing above the cage being separated therefrom to form a space outside the bars, a discharge-pipe leading from the forward end of said space, the bars adjacent to said discharge-pipe being widely spaced apart, and an inturned deflecting-lip forming the front wall of said space and extending inwardly beyond the widely-spaced bars, substantially as described.

3. In a machine of the character described, the combination with a casing A and cover B therefor, of pulverizing means in the casing comprising rotary beater-arms, a concentrically-arranged grinding-surface extending around the interior of the cover, said grinding-surface being closed at its bottom and provided with a series of outlet-passages at its top, and being separated from the wall of the cover by a space *b*, and an outlet-pipe J leading from the space *b* through the wall of the cover and to a point exterior thereto, substantially as described.

4. In an apparatus of the character described, the combination with a casing, of a shaft carrying hammers, a concentric grinding-surface which is interrupted at one point, an imperforate plate arranged under the lower portion of the grinding-surface and serving to prevent the escape of the material through the grinding-surface, a cover arranged over the upper portion of the grinding-surface and providing a space or chamber for the finished material, which space communicates with the pulverizing-chamber by means of numerous small openings through the grinding-surface, a discharge-pipe leading from said chamber or space at the top of the machine, a breaker-plate arranged at the point of interruption of the grinding-surface, a hopper above said breaker-plate, and means for feeding material from said hopper onto said breaker-plate; substantially as described.

5. In an apparatus of the character described, the combination with a casing, of a shaft carrying pivoted hammers, of a concentric grinding-surface which is interrupted at one point, a breaker-plate at the point of interruption, an imperforate plate under the lower portion of the grinding-surface and serving to prevent the escape of the material through the grinding-surface, a cover forming a space or chamber exteriorly the upper portion of the grinding-surface which space communicates with the pulverizing-chamber by means of numerous small openings through the grinding-surface, a discharge-pipe leading from said space or chamber for conducting off the finished material, and a deflecting-lip forming the front wall of said space or chamber for directing the air-current and particles of material from the space, back into the machine; substantially as described.

6. In an apparatus of the character described, the combination with a casing, of a shaft carrying hammers, a concentric grinding-surface composed of transversely-disposed bars arranged close together, said bars being interrupted at one point, a breaker-plate at the point of interruption, an imperforate plate arranged under the lower portion of said grinding-surface and serving to prevent the escape of the material through the grinding-surface, and a cover arranged over the upper portion of said grinding-surface and providing a space or chamber for the reception of the finished material which space communicates with the pulverizing-chamber by means of spaces between the adjacent bars, and a discharge-pipe leading from said space or chamber, the bars of which grinding-surface is composed being spaced widely apart opposite said discharge-opening; substantially as described.

7. The combination with a grinding-surface consisting of transversely-disposed bars arranged close together, pivoted revolving hammers coöperating with said bars, a breaker-plate which is tangentially disposed to the bars, and upon which the material to be fed into the machine is placed, a casing in which said grinding-surface and breaker are mounted, said casing forming a space therebetween and the bars at the top of the machine, the discharge-outlet of the machine leading from the space, the bars opposite said discharge-outlet being more widely spaced than the other bars of the grinding-cage, and a deflecting-lip arranged in advance of said discharge-outlet and substantially above the breaker-plate; substantially as described.

8. The combination with a casing, of a concentric series of bars forming a grinding-cage, the bars in said cage being arranged close together, a wall for closing the space between the bars at the bottom of the cage, the casing above the cage forming a space without the bars, a bell-mouth discharge-outlet leading from the forward end of said space, the bars opposite said bell-mouth being widely spaced, and an inturned deflecting-lip forming the front wall of said space and extending in-

wardly beyond the widely-spaced bars; substantially as described.

9. In an apparatus of the character described, the combination with the casing, of a shaft, revolving hammers carried by said shaft, a concentric grinding-surface with which said hammers coöperate, a cover arranged above said grinding-surface so as to provide a space or chamber for the finished material, said space communicating with the pulverizing-chamber by means of numerous small openings through the grinding-surface, a discharge-pipe for conducting off material from said space, and an inturned deflecting-lip which forms the front wall of said space, or chamber, whereby circulating air and material in the front end of said space, which is not drawn off through the discharge-pipe, is directed back into the machine; substantially as described.

10. In an apparatus of the character described, the combination with a casing, of a shaft mounted therein, revolving hammers carried by said shaft, a grinding-surface composed of a concentric series of bars, said grinding-surface being interrupted at one point, a breaker-plate located at the point of interruption, an imperforate plate for closing the spaces between the bars in the lower portion of said grinding-surface, a cover providing a space or chamber outside of the grinding-surface at the top of the machine, a discharge-pipe leading from said space, the bars of the grinding-surface opposite said discharge-pipe being spaced widely apart, an inturned deflecting-lip forming the front wall of said space or chamber and in juxtaposition to said widely-spaced bars, and an opening in the casing near the shaft, for admitting air into the apparatus; substantially as described.

In testimony whereof I hereunto affix my signature, in the presence of two witnesses, this 24th day of May, 1900.

MILTON F. WILLIAMS.

Witnesses:
WM. H. SCOTT,
A. S. GRAY.