No. 768,955. PATENTED AUG. 30, 1904.

W. M. RUSSELL.

PULVERIZER.

APPLICATION FILED JULY 22, 1897. RENEWED OCT. 16, 1900.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.

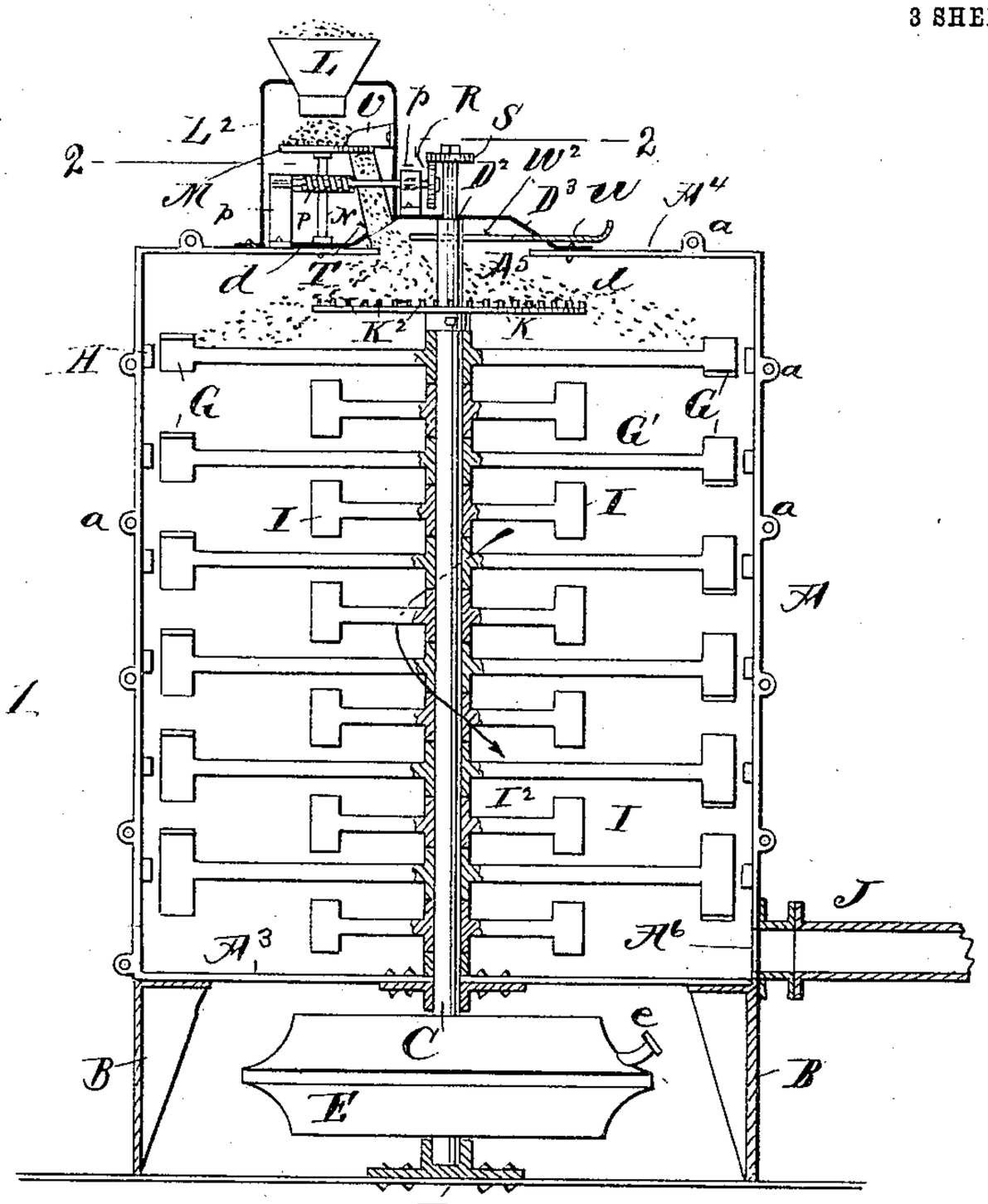


Fig. 2

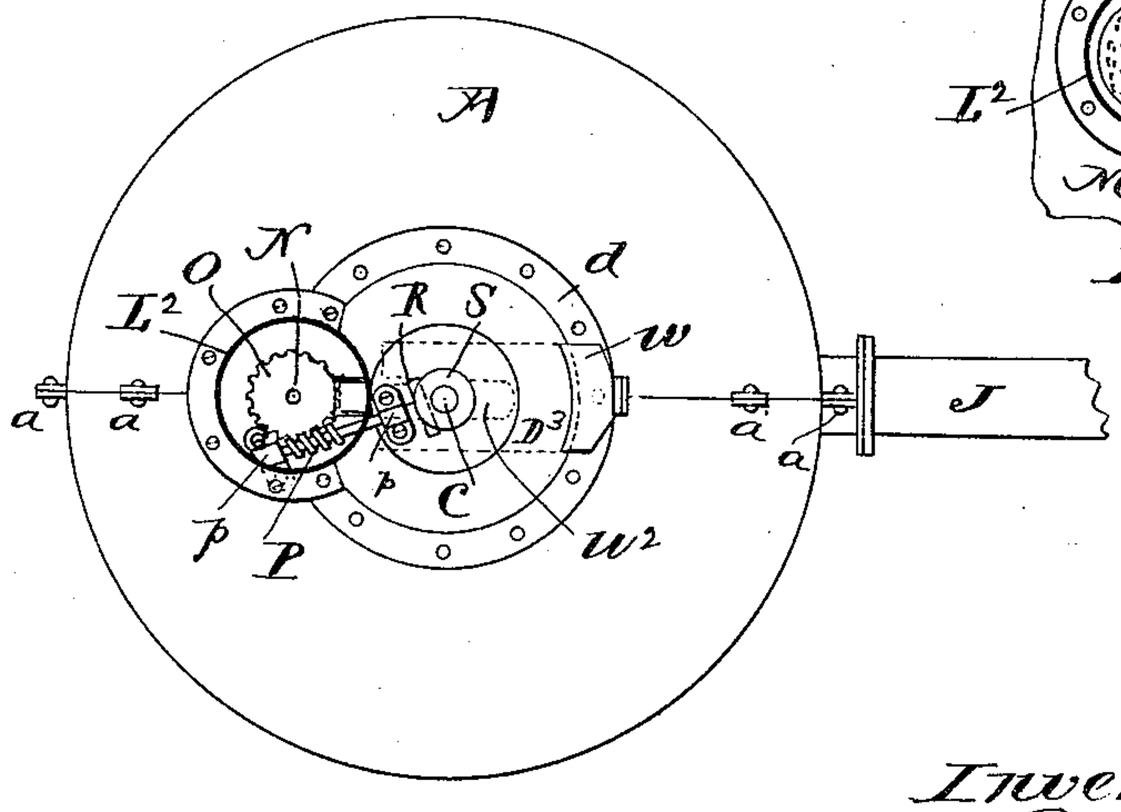
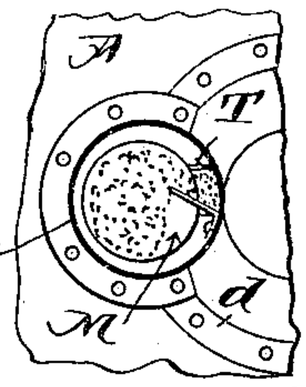


Fig. 3.



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C. F. Benjamin
Thomas E. de Sotolongo

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NO MODEL. 3 SHEETS—SHEET 2.

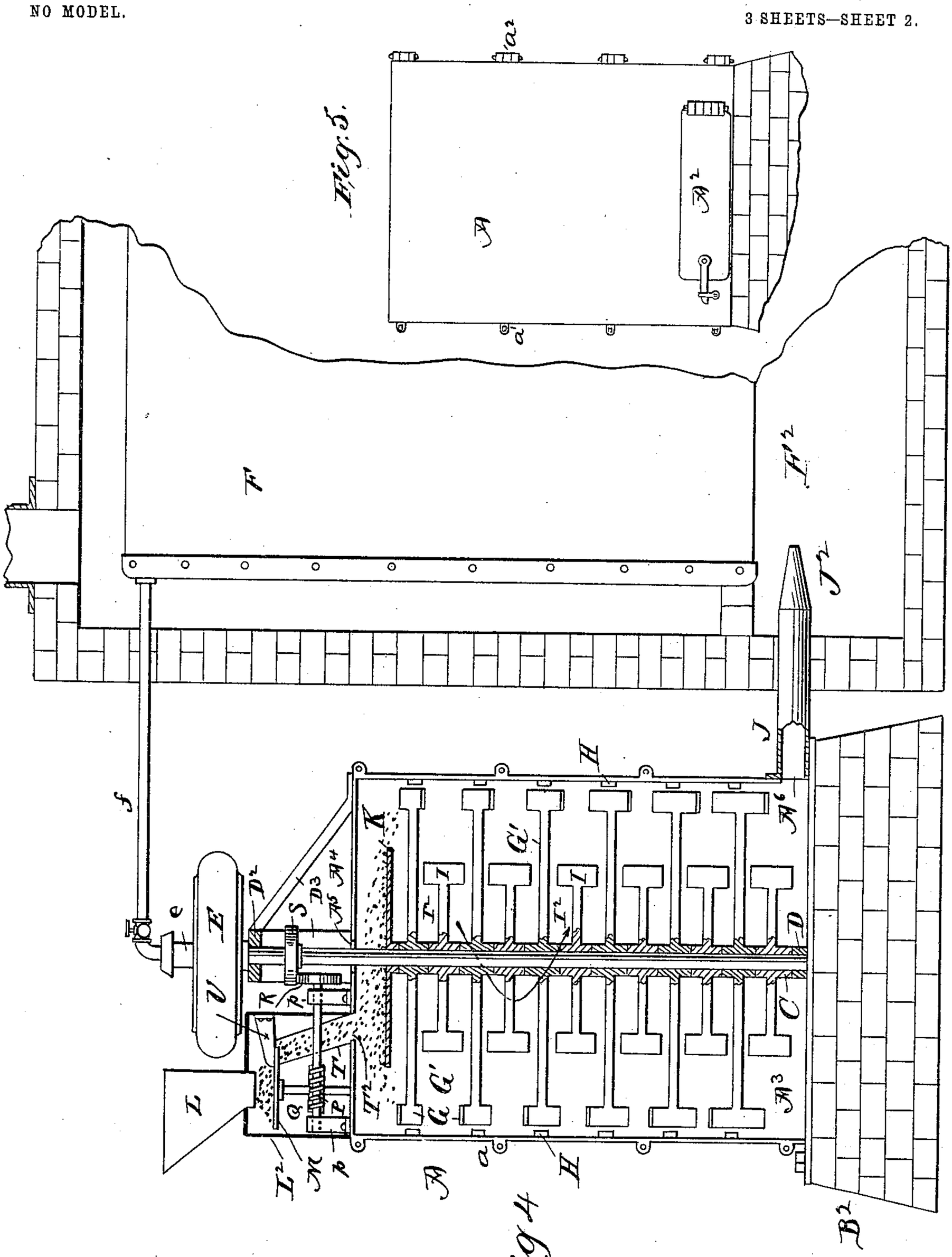

Fig. 5.

Fig. 4.

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NO MODEL. 3 SHEETS—SHEET 3.

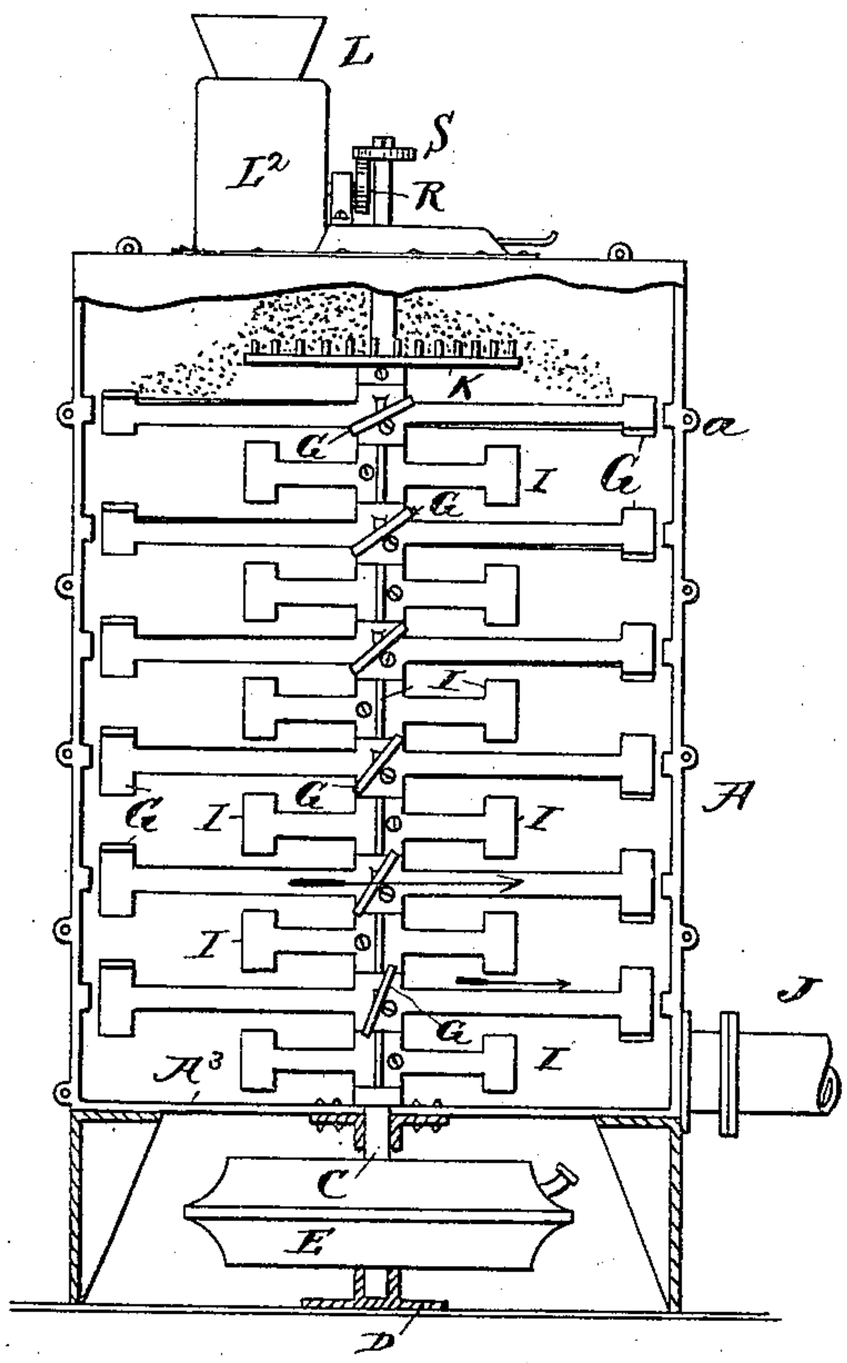

Fig. 6

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No. 768,955. Patented August 30, 1904.

UNITED STATES PATENT OFFICE.

WILLIAM M. RUSSELL, OF NEW YORK, N. Y., ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO TOMAS ASENCIO, WILLIAM M. ERNST, B. F. MONTANYE, AND THE PHOENIX INVESTMENT COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE, AND THEODORE F. BOURNE, OF MONTCLAIR, NEW JERSEY.

PULVERIZER.

SPECIFICATION forming part of Letters Patent No. 768,955, dated August 30, 1904.

Application filed July 22, 1897. Renewed October 16, 1900. Serial No. 33,213. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM M. RUSSELL, a citizen of the United States, residing in New York city, county and State of New York, have invented certain new and useful Improvements in Pulverizers, of which the following is a specification.

My invention relates more particularly to the class of pulverizers in which rotative bats or beaters are carried around within a suitable casing, which bats or beaters by striking the incoming material reduce the same to a finely-divided state and wherein also the attrition of the particles of said material assists in pulverizing the same.

The object of the invention is to provide certain novel and useful improvements in the said class of pulverizers, to the end that the material to be pulverized may be reduced to an exceedingly fine condition before passing from the machine.

The invention consists in a pulverizer comprising a casing or shell having an inlet to admit material to be pulverized and an outlet for the passage of the pulverized material from the casing, a rotative shaft within said casing, which shaft extends in an upward or vertical direction, bats or beaters carried by said shaft, and a rotative disk or plate also carried within said casing and adapted to receive upon it the material that is to be pulverized, whereby as said disk or plate rotates the material that falls upon it will be thrown therefrom by centrifugal action in position to descend among the rotating bats or beaters.

The invention also consists in the novel details of improvement and the combinations of parts that will be more fully hereinafter set forth and then pointed out in the claims.

Reference is to be had to the accompanying drawings, forming part hereof, wherein—

Figure 1 is a vertical longitudinal section of a pulverizer embodying my invention. Fig. 2 is a plan view thereof, partly in section, on the line 2 2 in Fig. 1. Fig. 3 is a detail plan view of part of the hopper. Fig. 4 is a vertical longitudinal section of the pulverizer, showing a modification, and a portion of a boiler and its setting with which the pulverizer is connected. Fig. 5 is a side elevation of a pulverizer-casing on a reduced scale; and Fig. 6 is a side elevation of the pulverizer, part of the casing being removed.

In the accompanying drawings, in which similar letters of reference indicate corresponding parts in the several views, the letter A indicates a casing which may be of suitable shape and construction. The casing illustrated is divided vertically or made in two parts, each part of which may have apertured lugs or flanges *a*, to be bolted or screwed together, Figs. 1, 2, and 4, or the joint along one side of the casing may have hinges a^2, and the other side may have lugs or flanges to be secured together. The casing A may also have a door A^2 to admit access to the interior. Casing A has a bottom A^3 and a top A^4, and it may be provided with legs B, if desired, or it may rest upon a foundation or floor B^2. Within casing A is a shaft C, which extends upwardly or vertically, and it is shown journaled in a step D and bearings D^2. The bearings D^2 may be part of or carried by a bridge or brace D^3, secured upon cover or top A^4, as by a flange or ring *d* and bolts or screws. The shaft C passes through an opening A^5 in top or cover A^4.

Any suitable means may be employed to rotate shaft C. In the drawings I have illustrated in outline a steam-turbine or rotary engine E, connected directly with shaft C, *e* being a steam-inlet for said turbine or motor, which may be connected with a boiler F by a pipe *f*. (See Fig. 4.) In Fig. 1 the steam-turbine or engine E is shown connected with shaft C below bottom A^3 of casing A, and in Fig. 4 the turbine is connected with shaft C above the top A^4. By having the turbine or engine E above the casing dust, coal, &c., are prevented from falling upon the same when the casing is being cleaned out.

The shaft C within casing A carries a number of bats or beaters G, which are shown connected with the shaft by arms G′, that extend radially from the shaft and may be secured thereto by suitable means. The bats or beaters G pass near the inner surface of the vertical walls of casing A, and by preference said surface carries ribs H in line with the bats or beaters G, as shown, but so that the bats can clear said ribs during rotation. The bats or beaters G and their arms G′ are arranged in horizontal series, there being any desired number of such in each series. The bats or beaters G are placed at an oblique angle or inclination to the horizontal or the plane of their rotation, the direction of rotation being indicated by the arrow in Fig. 6, and the bats or beaters of one series are placed at a greater oblique angle to the plane of their rotation than those of the next series above. By preference the bats or beaters of the upper series have a less angle or inclination to the plane or direction of their rotation than the series next below, and so on down throughout the different series of bats, as shown. The advantage of this arrangement is that the material to be pulverized being delivered to the bats or beaters from above will first engage the upper series of bats, which have the least inclination or deviation from the plane or direction of their rotation, and these bats, which rotate rapidly, will act to sustain the material to some degree, and thus prevent it from dropping suddenly to the bottom of the casing and will only allow the material to descend gradually, and so, also, with the other series of bats in accordance with their degree of inclination or deviation from their plane of rotation. These inclined bats also act to force air powerfully downwardly as they rotate. Furthermore, the bats or beaters act upon the material to toss it about within the casing and by striking it and driving it against the sides of the casing and also against the ribs H serve to reduce it to a fine state. The attrition of the particles of material against each other while being tossed about within the casing assists in pulverizing the material.

By having the turbine, engine, or motor connected directly with the shaft C of the pulverizer and blower (it thus being a shaft common to all) they all can be so correlated in capacity and operation that by having a given capacity they will furnish the necessary and uniform amount of fuel elements (powdered coal and air) required for a given furnace. An attachment for steam-boiler and other furnaces is provided which obviates the difficulties experienced in feeding pulverized fuel when a pulverizer, blower, and motor, one or more of them, are set up independently of the other or others.

In addition to the bats or beaters G, I may place another set of bats or beaters I within casing A and nearer to shaft C than bats G. These bats I are connected with shaft C, as by arms I^2, suitably connected therewith, and the bats I are arranged in horizontal series, like bats G, any desired number being in each series. The bats I are preferably placed perpendicular to their plane of rotation, and they aid in setting up the air-current which is to expel the pulverized material from the casing. The bats I also strike material within the casing and drive it back and forth. The combined action of the bats or beaters G and I and of the attrition of the particles of material serves to reduce the latter to a finely-divided state.

At the lower part of the casing A is an outlet A^6, which may be connected with a pipe or duct J to conduct the pulverized material from the casing. In Fig. 4 I have shown the pipe or duct J as leading to the combustion-chamber F^2 of a boiler for supplying a mixture of air and pulverized fuel to said chamber.

The pulverizer described not only pulverizes the fuel, but mixes it intimately with air and expels such mixture through the duct J, and in the combustion-chamber it will burn in the form of a flame. In order to produce proper combustion, the fuel should be reduced to as fine a condition as possible, and if the material could readily pass through the casing it would escape before being reduced to a proper degree of fineness. A very high rotation of the bats or beaters should be given in order to assure the proper pulverization of the fuel. By the described inclinations of the bats or beaters G, coupled with a high speed of rotation, said beaters form a kind of rotating shelf, the capacity of which to resist the descent of the fuel is proportionate to the inclination of the bats or beaters toward their direction of rotation. Thus the upper series of beaters, which extend the least from the horizontal, resist the descent of the material by gravity the most, and thus serve to keep back the larger particles of fuel. When these particles are somewhat reduced, they pass below and are retarded in their descent by the next lower series of beaters, and as they are inclined more toward the vertical than the series above they present less resistance to the descent of the fuel, and so on down through the several series of beaters, each series presenting less resistance to the descent of the fuel than the series next above. This is requisite, because as the particles of fuel become finer it is desired that they should descend, while the lower the particles descend into the casing the bats or beaters that are the more vertical have more surface exposed to strike and pulverize the fuel. Therefore by the time the fuel has reached the lowermost series of beaters it will have been reduced to a very fine state. Thus danger of large particles of fuel passing through the casing is obviated and the reduction of the fuel to a very fine state is assured, which is important, as large

particles passing from the casing will not properly consume in the form of a flame, but will produce smoke and waste. Furthermore, while the fuel is being pulverized it is intimately mixed with air, and a proper mixture of air and fuel can thus be delivered from the casing for the purpose of combustion. Another advantage of having the bats or beaters inclined, as described, is that with a vertical casing gravity acts to cause the fuel to pass toward the outlet in addition to the action of the current of air passing from the casing, and the beaters thus resist the action of gravity, for if gravity and the air-current acted together without such resistance as the inclined beaters give the result would be that particles of fuel would pass from the casing too large to produce proper combustion in the form of a flame. By means of my improvements the fuel is fully consumed, and no appreciable smoke or waste is produced, owing to the extremely fine condition of the fuel expelled from the casing and its intimate admixture with air.

To properly distribute the material to be pulverized to the bats or beaters G, I place a rotative disk or plate K within casing A, preferably above the top series of bats G, upon which disk or plate the material to be pulverized is deposited. Any suitable means may be provided for supporting and rotating the disk or plate K. I have shown the disk or plate K as carried by and secured to shaft C, so as to be rotated by and with said shaft. Thus as the bats or beaters rotate the disk or plate K will rotate in unison therewith and at the same speed. The upper surface of the disk or plate K may be corrugated or ribbed or provided with lugs or pins K^2, as in Fig. 1, which will assist in throwing the material from the disk or plate forcibly, or the upper surface of the disk K may be flat, as in Fig. 4.

Any suitable means may be provided for feeding material to be pulverized into the machine and upon disk or plate K. I have shown for this purpose a hopper L, carried on casing A by supports L^2, and beneath the open end of this hopper is a rotative disk or plate M, upon which the material descends. The disk or plate M is carried by a vertical shaft N, journaled in suitable bearings, and said shaft carries a worm-wheel O, which meshes with a worm-shaft P, journaled in bearings *p*, carried by casing A. Shaft P carries a friction-disk R, that engages a friction-disk S, carried by shaft C, whereby through the parts N, O, P, R, and S rotary motion at a reduced speed is communicated from shaft C to disk or plate M. Beneath disk or plate M is a chute T, that leads to or through opening A^5 in top A^4 of casing A, Fig. 1, or through an opening T^2 therein, either of which openings is above disk or plate K, whereby the material to be pulverized is conducted thereto.

U is a finger or scraper, shown carried by the support L^2 and located above disk M and near one edge thereof, said finger or scraper also being above chute T and in such position that as disk or plate M rotates it will scrape material from said disk or plate to cause it to descend therefrom into chute T.

The opening A^5 in top A^4 of casing A is adapted to allow air to enter said casing to be mixed with fuel or other material therein by bats G and I and to be blown from said casing with said fuel or material. Any suitable damper or the like may be provided to regulate the amount of air to pass through said opening. I have shown a plate W above top A^4 over opening A^5 and which may rest on the top or on ring *d*, said plate having a slot W^2 to receive shaft C to enable said plate to be moved back and forth over said opening.

The arrangement of gearing between shaft C and disk M may be altered, if desired; but the disk or plate M should be rotated much slower than said shaft, but in proportion to the rotation of the latter, so as to feed the proper amount of material into the casing in accordance with the speed of rotation of shaft C.

It will be understood that as disk or plate K rotates it will throw the material therefrom by centrifugal action, which material in its descent will encounter the bats or beaters G, which will act thereon, as before explained.

The use of the feeding devices that are rotated conjointly with and by the shaft C is particularly important in my pulverizer, for the reason that the amount of fuel fed to the bats or beaters should be proportioned to the amount of air to be expelled from the casing, which amount of air is determined by the speed of rotation of the beaters, so that the proper mixture of air and fuel will be assured to produce proper combustion. By my arrangements the amount of fuel fed to the casing and the amount of air expelled therefrom with the pulverized fuel will be proportioned to the speed of rotation of the beaters. Thus if the beaters rotate at one speed a definite amount of air and fuel will be fed to and expelled from the casing in the form of a combustible mixture, and if the speed of the beaters is reduced or increased the amount of fuel to be pulverized and air to be mixed therewith and the mixture to be expelled from the casing will be proportionately decreased or increased. This is very important when it is considered that the air that passes from the casing is combined intimately with the fine fuel to produce a combustible mixture, and such air must be mixed with fine fuel in definite and proper proportions, which should not vary, so as to produce complete and proper combustion.

This machine is a combined pulverizer and blower and is particularly useful in pulverizing coal, mixing it with air, and forcing such mixture into the combustion-chamber of a

boiler or furnace, where it will burn in the form of a flame issuing from a nozzle J^2. (See Fig. 4.) A suitable nozzle for this purpose is shown in the United States Letters Patent issued to me on December 10, 1895, No. 551,098. The machine is also useful for pulverizing other substances—such, for instance, as cement—where the material is to be reduced to a finely-divided state.

Having now described my invention, what I claim is—

1. In a pulverizer and blower the combination of an imperforate casing having an inlet above and an outlet below, a shaft vertically journaled in said casing, and bats or beaters carried by said shaft and arranged in series one above the other, the bats or beaters being inclined at an oblique angle to the horizontal, the bats of one series being inclined less from the horizontal than those of the series next below, and so on down through the several series, whereby the bats or beaters act during their rotation to resist the passage of material by gravity downward through the casing while pulverizing the fuel, mixing it with air and expelling the mixture from the casing, substantially as set forth.

2. An attachment for steam-boiler and other furnaces comprising a rotary motor and a rotary pulverizer and blower arranged to be actuated by the motor, the said motor, pulverizer and blower having a common shaft and being so correlated in capacity and operation that an attachment of a given capacity will furnish the necessary and uniform amount of fuel elements required for any particular furnace.

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