

(No Model.)

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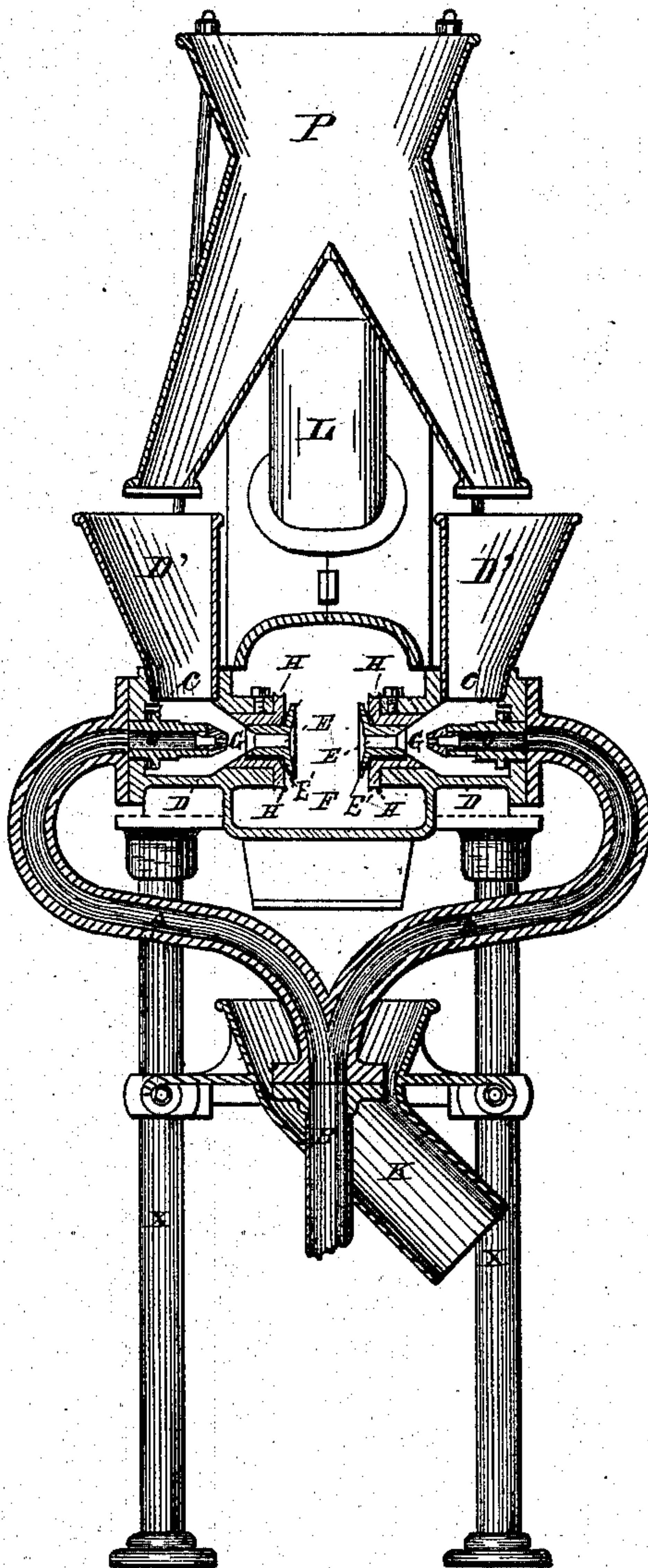
F. A. LUCKENBACH.

APPARATUS FOR PULVERIZING ORES, &c.

No. 291,367.

Patented Jan. 1, 1884.

*Fig 1*



WITNESSES:

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INVENTOR

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(No Model.)

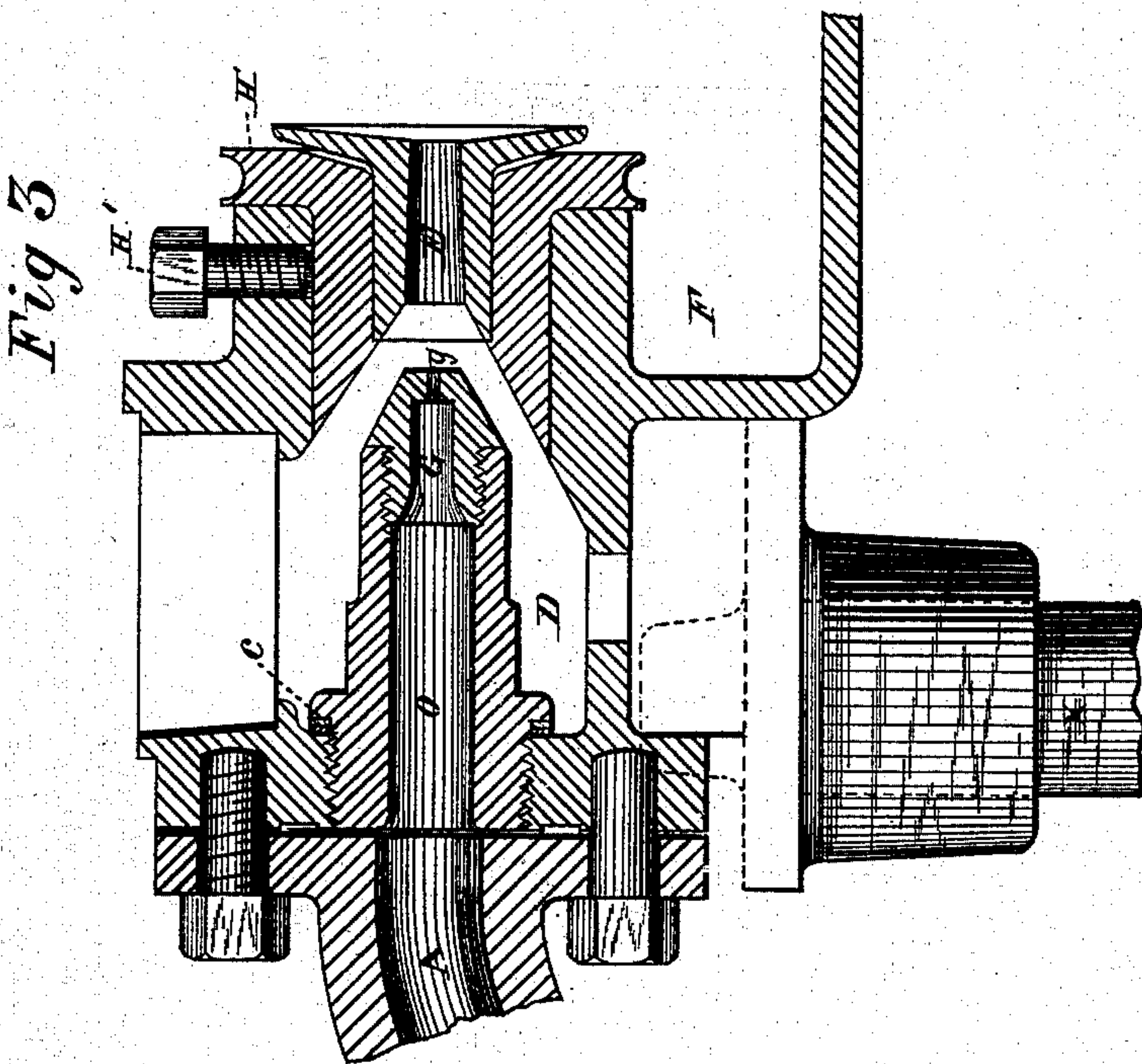
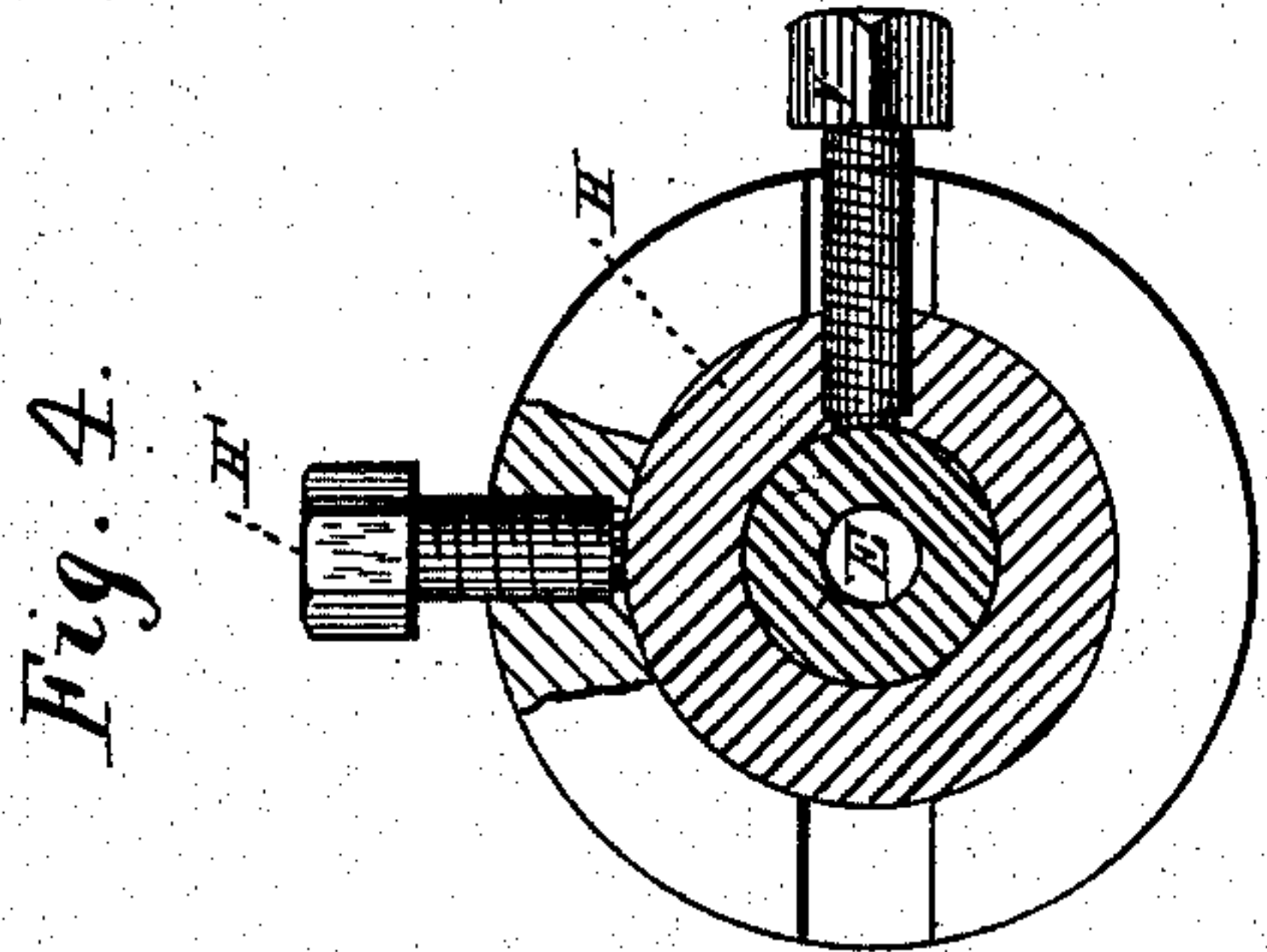
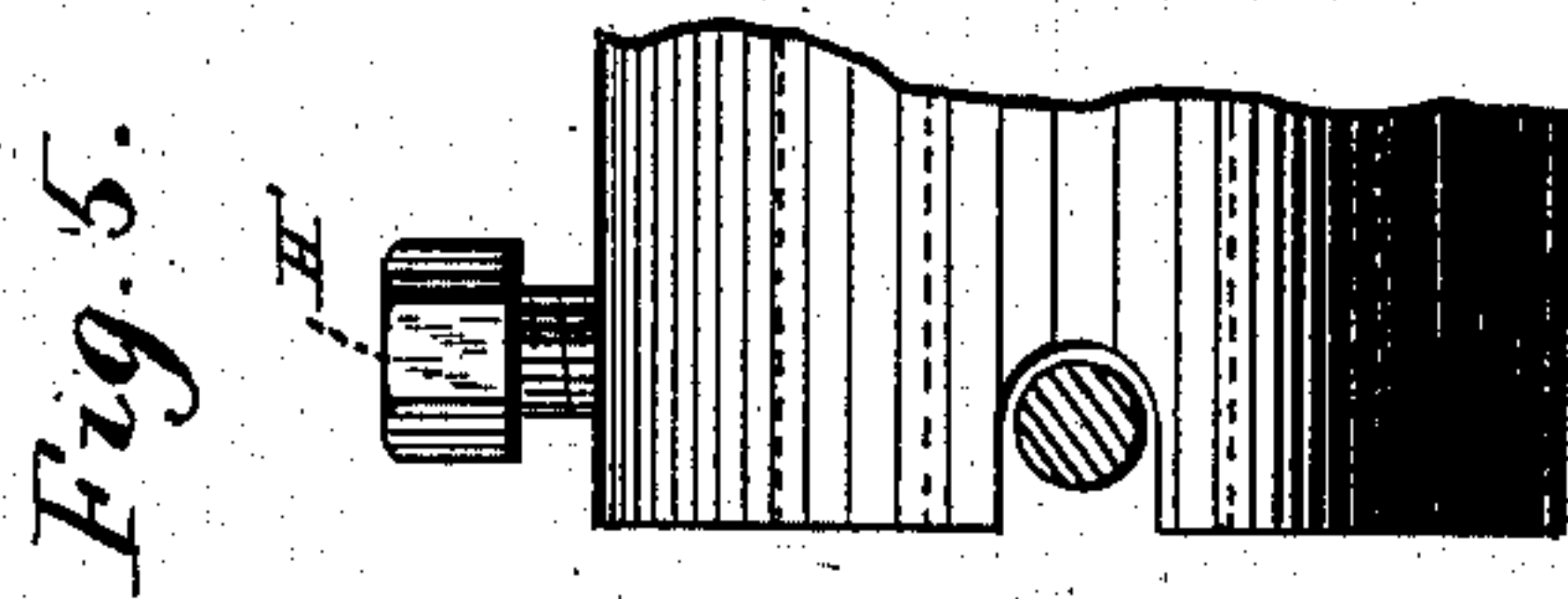
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Inventor:  
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# UNITED STATES PATENT OFFICE.

FREDERIC A. LUCKENBACH, OF NEW YORK, N. Y.

## APPARATUS FOR PULVERIZING ORES, &c.

SPECIFICATION forming part of Letters Patent No. 291,367, dated January 1, 1884.

Application filed June 15, 1883. (No model.)

*To all whom it may concern:*

Be it known that I, FREDERIC A. LUCKENBACH, of the city, county, and State of New York, have invented a new and useful Improvement in Apparatus for Pulverizing Ores and Other Substances, of which the following is a specification.

My invention relates to improvements upon apparatus for pulverizing ores and other substances by concussion or impact of said substances, when carried in a current or opposing currents of superheated steam, compressed air, water, or other aeriform fluids, under suitable pressure, to a focal or central point.

The said invention consists, in the main, of improvements upon a former invention for a similar purpose, shown and described in Letters Patent of the United States granted February 22, 1881, No. 238,044. In the said former invention there were certain tubes through which the ores or other substances to be pulverized were drawn or forced by steam or other fluid; and these tubes were so arranged that the opposing currents of material would be driven against one another, and the tubes through which the steam or fluid passed formed an annular opening around the central supply-tube, through which the material was drawn, the steam from the annular opening drawing the material from the central supply into its current and forcing it into a wearing-tube, from which it was discharged to meet the opposing current. It has been found in practice that these tubes are difficult to adjust, and that when worn out by the abrasion of the ores the expense of replacing them is very great; and it has been found that the distance between the nozzles of these steam or air tubes and the point of impact was too great, thereby weakening the force of the current, and that the passage of the steam or other fluids through annular nozzles weakened the force of the steam by friction, and such annular nozzles were difficult to construct with accuracy; and it was also found that the means employed for discharging the pulverized material and the exhaust-steam, air, or other gases were imperfect.

The objects of this invention are to remedy these defects first, by providing an im-

proved arrangement and form of the tubes and nozzles for discharging the steam and ores, by which their length may be more readily adjusted, and the working made more efficient; second, by providing improved wearing parts for the tubes, which can be easily removed and more cheaply constructed; third, by providing an improved exhaust-extension connected with the pulverizing-chamber. I accomplish these objects by the mechanism shown in the accompanying drawings.

Figure 1 represents a central vertical front section, partly in elevation, of my improved apparatus; Fig. 2, a central vertical side section of the same, with parts in elevation; and Figs. 3, 4, and 5 show enlarged views of details.

Similar letters refer to similar parts throughout the several views.

X X represent the frame-work of the machine; P, the main hopper for the ore or other material to be pulverized, and D' D' the secondary hoppers supplied by the two branches of the main hopper. D D are ore-chambers at the bottoms of said hoppers.

B is the main supply-pipe for the superheated steam or other fluid, having two branches, A A, which should be made with as few angles as possible.

F is the pulverizing-chamber, into which open the wearing conducting-tubes E E, through which the steam or other fluid and the ores or other material to be pulverized are discharged together, as in said former patent.

O O represent adjustable nozzles, having reduced openings G G, screwed into their extremities. These nozzles are attached to the supply-pipes A A, and form their discharging ends and project toward one another through the charging ore-chambers D D, which chambers form the bottoms of the hoppers D' D'. The discharge of steam from the nozzles O O draws the granulated ores from the chambers D D, and chiefly from the upper part of said chambers, and draws them into the pipes E E. These chambers D D, I prefer to have annular and completely surrounding the nozzles O O, so that their lower parts form a sort of pocket below those nozzles, as shown in Fig. 1, in which the heavier particles of the



granulated material (which might close the pipes E E) naturally gravitate and are retained in said pockets, from which they may be drawn in any convenient manner. These chambers D D may, however, be formed so as to surround only the upper portions of the nozzles O O, the bottom pockets being omitted. The nozzles O O, with reduced ends, extend into said charging-chambers D D, and terminate near the inner ends of the tubes E E, which correspond with the tubes A A of said former patent. The exteriors of the nozzles are preferably made tapering toward their exit ends, so that the passage of the granulated substances toward the pipes E E may be facilitated, and at the end of each of these nozzles O O is a reduced cylindrical passage, *g*, forming a small aperture for the passage of the jet of steam or other fluid. Instead of being tapering throughout their length and formed of one piece of metal, the parts O O may be formed of a straight piece of pipe, with a small nozzle having a reduced opening screwed to their ends. The size and form of the inner construction of the apertures at the ends of the nozzles O may be varied to suit special requirements, so long as it constitutes, essentially, a pipe of reduced size; but the size which has proved the most effectual for general purposes is a cylindrical opening five-sixteenths of an inch long by five thirty-seconds of an inch in diameter. The form of nozzle shown in the drawings, and herein described, gives greater force to the current, with much more economy of the power employed, together with simplicity of construction and ease of adjustment. The interior of the nozzle may be formed tapering up to the small aperture at the extremity; but when working with superheated steam or compressed air under a pressure of one hundred and fifty or two hundred pounds to the square inch, the inside end of the tubes forming the nozzles O O should preferably be made as shown in the drawings, as there is less friction produced with this construction. The nozzles O O are adjustable in their length by one or more loose rings, *cc*, that may be packed behind them at the points where they are screwed into the backs of the chambers D, the nozzles themselves being formed to be turned by a wrench within the chambers D D by removing the hoppers D' D'. By this means they may be brought nearer to or farther from the pipes E E, as the case may require.

The pipes E E are composed of hard metal, preferably cast upon a chill, and are preferably joined to the charging-chambers D D by the bushings H H, in which they are suitably secured by the screws V, and they open into said chambers D D with conical or flaring mouths, into which the ore and steam easily pass. The inner diameter of these tubes is such that whether steam or air is discharged from the nozzles C O the force and expansion of the currents are sufficient to displace the

atmospheric pressure within the tubes E E, which causes a partial vacuum within the charging-chambers D D, and draws the ores or granulated substances into the tubes E E. I prefer to use the bushings H H to hold the tubes E E, because those tubes are the only parts subjected to wear; and by making them separate from the bushings they may be removed, when worn out, without throwing away any great amount of material. The bushings H H are made to taper at the ends toward the nozzles G G, as shown in the drawing, Fig. 1, so that their inner ends form parts of the sides of the conical chambers D D, and thus suitable space is left around the nozzles O O for the passage of the granulated substances into the conducting-tubes E E. The bushings H H are removable, and are held in place by screws H' H', passing through projections cast upon the sides of the pulverizing-chamber F, as shown. This feature of the removable bushings and pipes E E is of great advantage, as it allows the wearing parts of the apparatus to be made of much less weight. The bushings H H may, however, be dispensed with, though with less economy, by making the tubes E E much thicker, and attaching them directly to the sides of the pulverizing-chamber F by the screws H'. The tubes E E are provided with flanges E' at the discharging ends, which overlap the bushings H H and prevent their abrasion by stray particles. I have found the best distance from the discharging ends of the tubes E E to the point of impact to be about an inch and a half, and that the best distance from the nozzles O O to the point of impact is about from four to five inches, though I do not confine myself to any particular distances.

In the patent issued, as above stated, the means employed for discharging the pulverized material and the exhaust-steam, air, or other gases from the pulverizing-chamber F were imperfect. The present improved apparatus renders this important part simple and effectual. It consists of an exhaust-extension part, F', at the top of the chamber F, with a steam or air jet exhauster, I, consisting of a suitable chamber, F<sup>2</sup>, connected with the chamber F by a pipe or in any other suitable manner, in which chamber F<sup>2</sup> is a jet-pipe, I', provided with a small nozzle, I<sup>2</sup>, which pipe, being supplied with a suitable fluid under pressure, draws up or exhausts from the apparatus the finely-pulverized substances, together with the exhaust-steam, air, or other gases employed, depositing the finely-pulverized material into a suitable chamber, T, provided with screen U, outlet S, and suitable discharge-hopper valves. When superheated steam or other dry fluid is used, the jet-exhauster I should also be supplied with the same fluid. An opening, J, under the pulverizing-chamber allows the coarser pulverized substances to fall or pass through into a conducting-spout, K, leading to suitable receptacles for bolting and sizing the materials.



A steam-escape pipe, L, is provided to allow wet steam to pass through when required, as occurs by condensation when starting the apparatus. A damper, M, provides for opening or closing escape-pipe L and exhaust-extension part F', when required. The pulverizing-chamber F is provided with a suitable opening for obtaining easy access to the wearing and removable parts of the apparatus, which is provided with a cover, N, a discharge-regulator, R, Fig. 2, suitably arranged in opening J, and made adjustable by a set-screw provided for a free discharge of material, and prevents an excess of air being drawn into the pulverizing-chamber F.

The improved apparatus, having two opposing current pipes or nozzles, O O, and charging-chambers D D, can easily and quickly be changed into an apparatus having but one current pipe or nozzle O and charging-chamber D; or special apparatus may be constructed having several current-pipes with nozzles O O and charging-chambers D D in position parallel with each other, and one or all arranged to discharge their currents against a solid substance, instead of against an opposing current. This can be accomplished in the opposing-current apparatus by removing one nozzle O and inserting in its place a tight-fitting plug to close the steam or air current from discharging on that side, and by dispensing with one bushing H and tube E and inserting in their place a solid plug or bushing for the one current to be discharged against. This arrangement of currents and impact may be adopted for pulverizing soft or easily-frangible substances having no hard or gritty character that will abrade or wear the solid bushing or impact base; but it is not adapted nor economical for ores or other hard minerals, on account of the great wear and destruction of the impact base.

In the practical working of the improved apparatus, it is very essential that the steam or other compressed gases employed should be introduced into the apparatus in a thoroughly dry condition, in order to prevent any moisture upon the substances during the time of their passage through the process of pulverization and sizing. This important requirement is accomplished successfully and economically by employing suitably constructed superheating apparatus, which is suitably arranged in connection with the improved apparatus and a steam-generator. The superheating apparatus may be placed directly within a suitable part of the steam-generator, or it may be constructed and arranged separately with suitable connections by pipes and valves between the generator and the pulverizing apparatus. The temperature of the superheated steam may be varied according to the requirements. For simply pulverizing purposes, 600° to 700° Fahrenheit is sufficient to render the pulverized substances dry when discharged from the apparatus. A

much higher temperature is required when it is desired to effect or partially volatilize and eliminate sulphur, arsenic, antimony, &c. Suitable non-conducting coverings should be provided for the supply-pipes B and A A to retain the heat.

The operation of my said invention is as follows: The hopper P, and from it the secondary hoppers D' D' and the chambers D D, being filled with the ore or other material to be pulverized, suitably granulated to allow its passage through the apparatus, and the supply-pipe B being connected with the source from which is obtained the superheated steam or compressed air or other fluid, the steam or fluid will then pass through the branch pipes A A, and be discharged through the nozzles O O into and through the chambers D D, and directly into and through the pipes E E, creating a partial vacuum in the said chambers D D, and drawing into the current of fluid in the pipes E E the granulated material from the said chambers D D. The said material is then discharged by the force of the steam into the said chamber F, and is pulverized by the impact and attrition of the two opposing currents. The heavier particles of the pulverized material will fall into the opening J, and thence into the conducting-spout K, leading to suitable receptacles, while the lighter particles will be carried into the exhaust-extension F', and thence through the jet-exhauster I into suitable receptacles. The coarser particles can, if desired, be passed through the apparatus more than once, in order still further to pulverize them.

That which I claim as my invention, and desire to secure by Letters Patent, is—

1. The combination, in a pulverizer, of the chamber D, nozzle O, and wearing-pipe E, having flange E', constructed and arranged substantially as described.

2. The combination, in a pulverizer, of the chamber D, nozzle O, wearing-pipe E, and bushing H, substantially as described.

3. The combination, in a pulverizer, of the chamber F, chambers D, nozzles O, wearing-pipes E E, and bushings H H, substantially as described.

4. The combination, in a pulverizer, of the chamber F, wearing-pipes E E, having flanges E', and chambers D D, substantially as described.

5. The combination, in a pulverizer, of the chamber F, wearing-tubes E E, chambers D D, and adjustable steam-nozzles O O, substantially as described.

6. The combination, in a pulverizer, of the chambers D and F, communicating with each other, and an adjustable steam-nozzle, O, substantially as described.

7. The combination, in a pulverizer, of the steam-nozzle O, with removable reduced opening G, the tapering chamber D, and pulverizing-chamber F, substantially as described.

8. The combination, in a pulverizer, of the



chamber D, steam - pipe A, and adjustable steam-nozzle O, substantially as described.

9. In a pulverizer, and in combination with the pulverizing-chamber F, the chamber D,  
5 the steam-nozzle O, and the jet-exhaust apparatus constructed and arranged to draw the pulverized material, exhaust-steam, &c., from said chamber, substantially as described.

10. The combination, in a pulverizer, of the removable bushings H H and wearing-pipes to E E, substantially as described.

FREDERIC A. LUCKENBACH.

In presence of—

C. WYLLYS BETTS,  
JOSEPH H. MARVIN.