No. 821,421. PATENTED MAY 22, 1906.

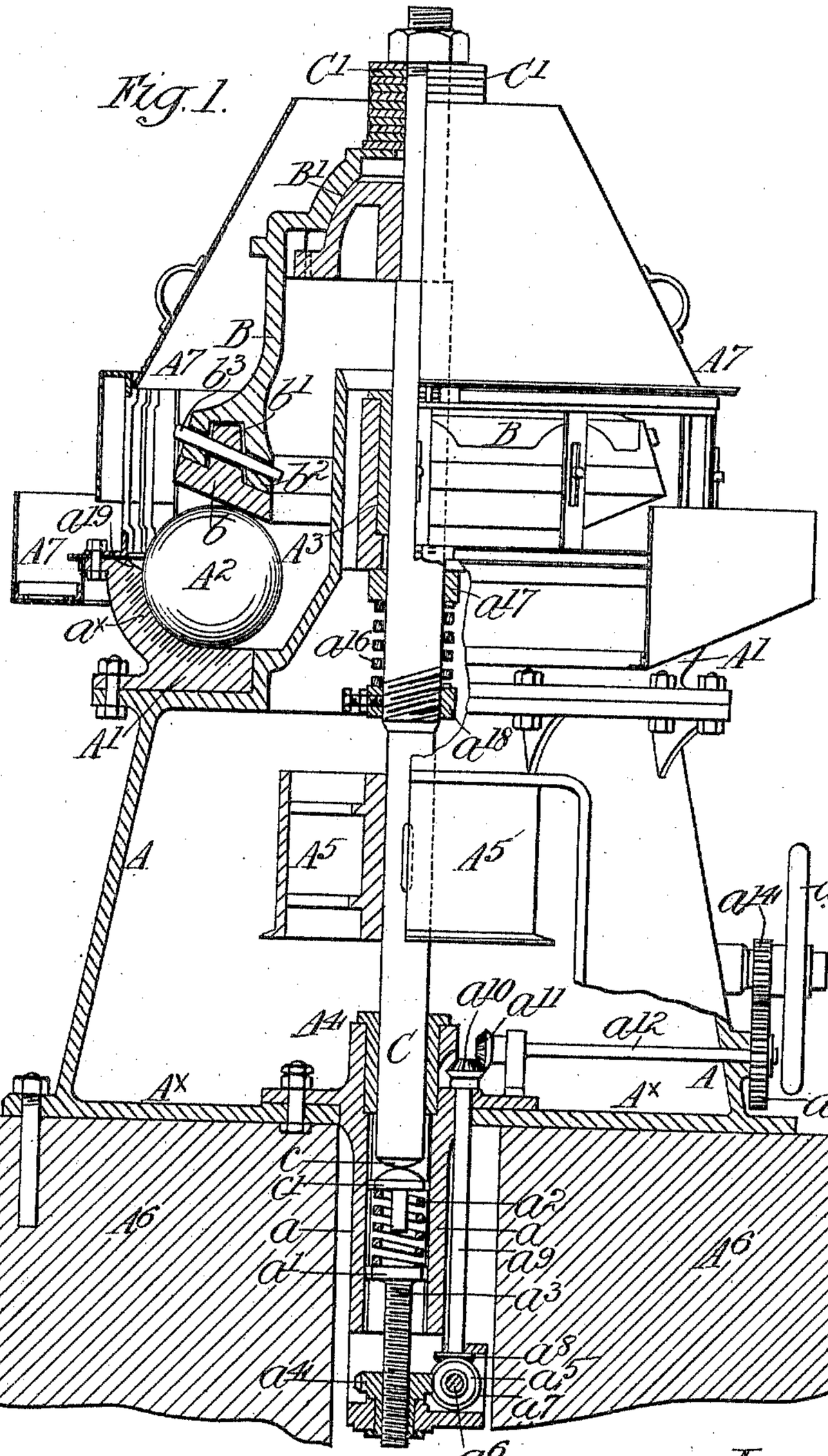
W. KITTO.

CRUSHING OR PULVERIZING APPARATUS.

APPLICATION FILED JAN. 6, 1905.

2 SHEETS—SHEET 1.

Fig. 1.



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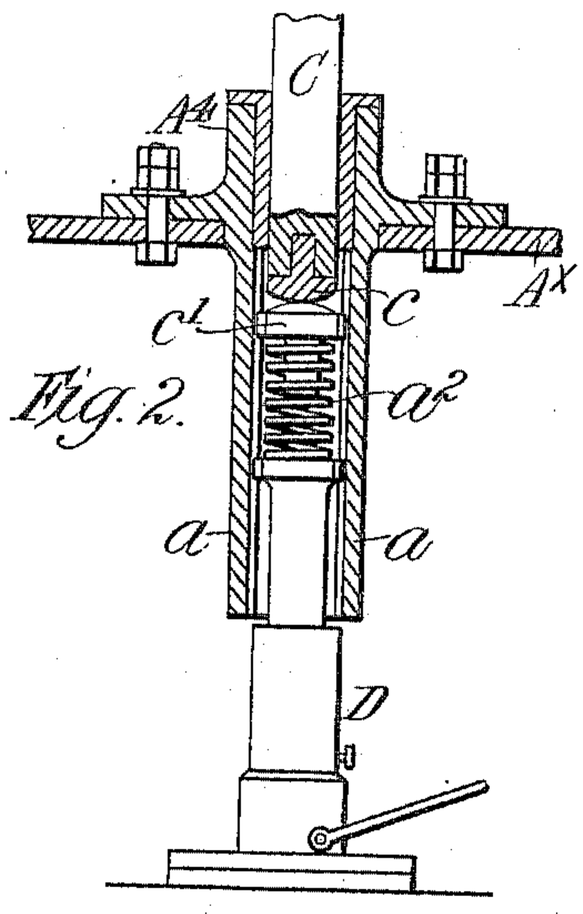


Fig. 2.

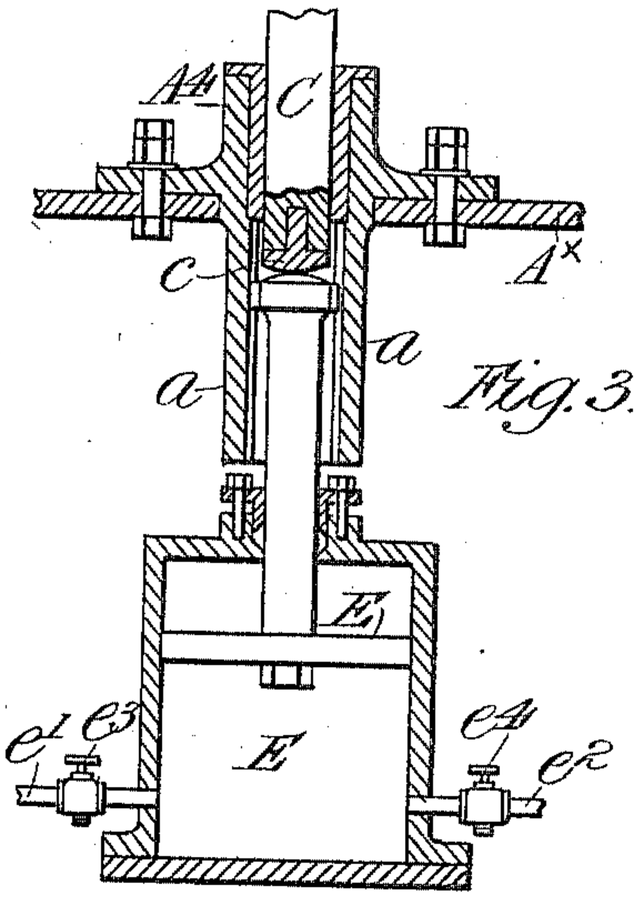
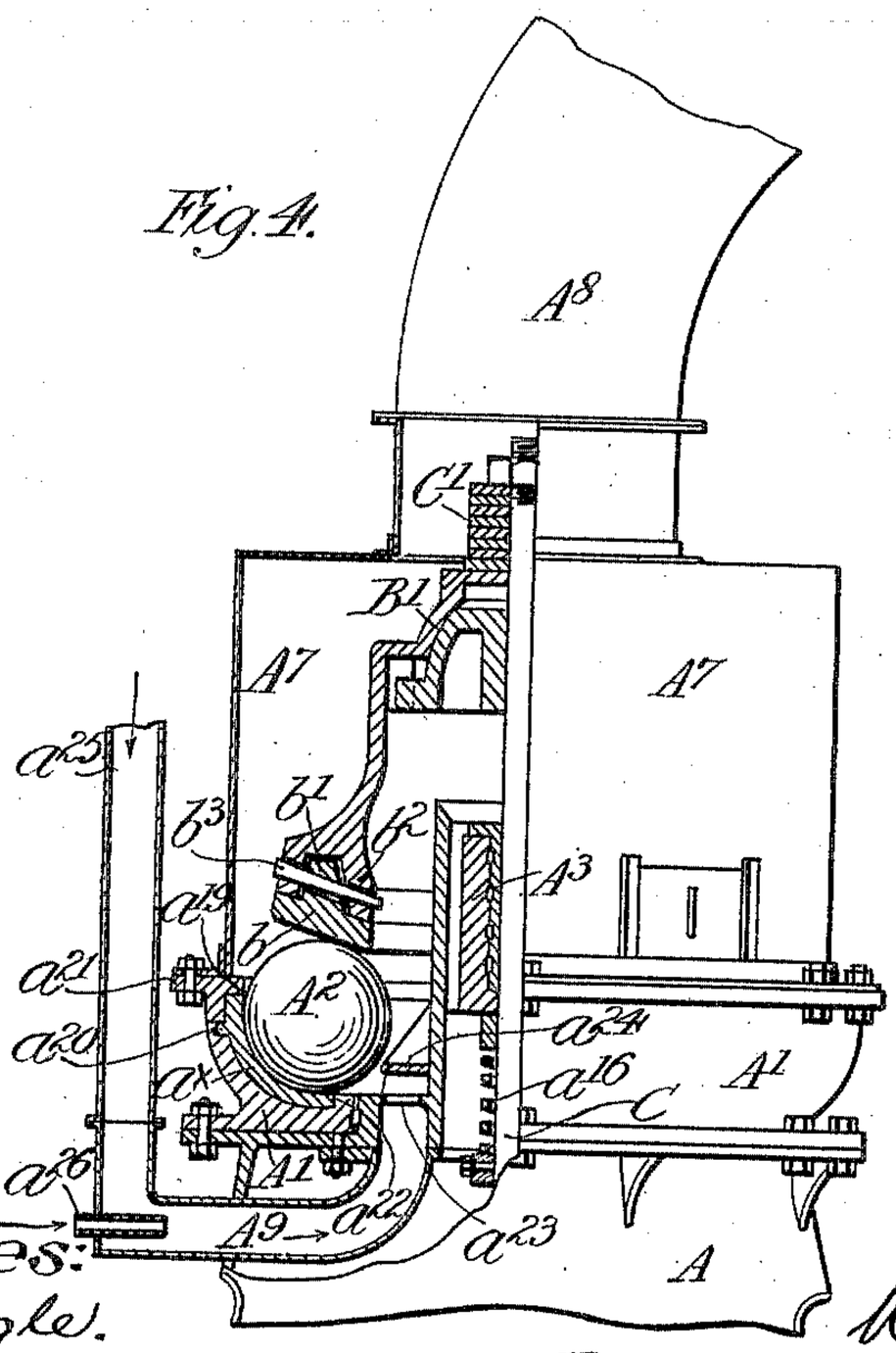


Fig. 3.

Fig. 4.



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UNITED STATES PATENT OFFICE.

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CRUSHING OR PULVERIZING APPARATUS.

No. 821,421. Specification of Letters Patent. Patented May 22, 1906.

Application filed January 6, 1905. Serial No. 239,837.

To all whom it may concern:

Be it known that I, WALTER KITTO, engineer, a subject of the King of Great Britain, residing at 14 Lonsdale road, Barnes, in the county of London, England, have invented certain new and useful Improvements in Crushing or Pulverizing Apparatus, of which the following is a specification.

This invention has reference to crushing or pulverizing apparatus of the kind already designed by me, in which there is a casing or under frame having at its upper part an annular crushing-path upon which a sphere or spheres are adapted to roll or travel during the crushing operation, motion being imparted to said spheres by the frictional contact therewith of a superposed rotary bell-shaped or other suitably-formed device or propeller driven by a central upright shaft through a ball-and-socket arrangement, said propeller having a certain amount of resiliency or freedom of vertical movement on the shaft against the resistance of a spring or springs situated near the upper part thereof.

According to my present invention I provide below the lower end of the aforesaid upright shaft an adjustable spring-controlled support or footstep, and at a suitable point on the said upright shaft I provide an adjustable buffer-spring. By appropriately adjusting these springs I can very efficiently regulate the pressure of the bell-shaped propeller on the sphere or spheres and also the degree of longitudinal movement of the said propeller during the grinding operation, so that the working of the apparatus is rendered smooth and free from unnecessary jarring. In some cases the adjustment of the said spring-controlled footstep may be effected by hydraulic or pneumatic pressure, and in the latter case the spring would be unnecessary.

The crushing path or surface upon which the sphere or spheres work may be made of chilled steel or other appropriate metal, as in my previously-constructed apparatus; but instead of making said surface to extend laterally over the entire working surface I leave a portion of the said surface near the upper edge unhardened—that is to say, of ordinary cast-iron, of which the said casing of the apparatus is composed—thus preventing the sphere or spheres from unevenly wearing away the crushing-path. This chilled or hardened surface may either be made integral with the casing or may be made separately and secured in place by any suitable means. The lower or active edge of the said bell-shaped propeller may be made detachable by providing said edge with lugs, which are adapted to enter corresponding openings in the propeller and which are held in place by keys or cotters driven through holes in the lugs and the propeller.

When the apparatus is intended for use in grinding or crushing dry material, such as cement, I provide for the circulation of a draft or current of air in the apparatus, as hereinafter described, and at a suitable part of the air-supply pipe or conduit I may provide an opening or tube through which the surrounding air of the atmosphere may be induced to flow by the current of air passing through said air-supply pipe or conduit, thus assisting in keeping the said circulating current of air cool.

In order that my said invention may be clearly understood and readily carried into effect, I will describe the same more fully with reference to the accompanying drawings, in which—

Figure 1 is a sectional elevation of the improved crushing apparatus. Figs. 2 and 3 are sectional elevations showing modified forms of the spring-controlled footstep. Fig. 4 is a detail sectional view of the apparatus, showing how the air is supplied thereto when said apparatus is used for dry grinding. In this figure is also shown the chilled or hardened surface of the crushing-path and the detachable connection of the lower or active edge of the bell-shaped propeller to the body portion thereof.

In all the figures like letters of reference indicate similar parts.

A is the under frame or casing of the apparatus, supporting the crushing-path A′. A^2 is the sphere, which is adapted to roll on said path during the crushing operation, and B is the rotary bell-shaped propeller for driving said sphere. Any suitable number of the said spheres may be employed. The said propeller is supported by a ball-and-socket device B′, one member of which is keyed to the vertical shaft C and the other member (forming part of the propeller) engages therewith by suitable projections and recesses, as is well understood in connection with crushing apparatus of this kind. C′ C′ are disks of india-rubber or other suitable resilient material arranged around the upper end of the shaft C above the propeller and adapted to permit of a certain amount of vertical and lateral move-

ment of the propeller during the grinding operation. A^3 A^4 are bearings for the vertical shaft C, and A^5 is a pulley mounted on said shaft for enabling it to be driven by a belt from any suitable prime mover. The said under frame A is firmly secured to a foundation A^6 of masonry, and the part of the apparatus in proximity to the crushing-path is inclosed in a suitable hood or covering A^7. When the apparatus is intended to deal with dry material, the said hood or covering is connected, by means of an exit conduit or conduits A^8, Fig. 4, to a collecting-chamber of the ordinary kind. (Not shown in the drawings.)

A^9 is the conduit or conduits for supplying air to the crushing-path, as hereinafter described, suitable fans or blowers being provided for drawing or forcing the air-currents through the said conduits.

I will first describe the portion of my invention relating to the adjustable footstep, for which purpose reference will be had to Figs. 1, 2, and 3, The lower bearing A^4 is mounted in a surrounding casing which is bolted to the sole-plate $A^\times$ of the under frame A and is provided with a downward elongation a for the reception of a movable platform or piston a', upon which the spring a^2 of said support or footstep bears. The lower end of the shaft C is curved at c, and there is interposed between the upper end of the spring a^2 and the said curved end of the shaft a mushroom headed plunger c', which bears against the said curved end of the shaft. The platform or piston a' is guided in said casing, so as to be incapable of turning therein, although free to move rectilinearly, and it has in Fig. 1 a screw-threaded stem a^3, passing through a nut a^4, situated at the lower end of the casing and capable of revolving without otherwise moving on said stem. The periphery of this nut is formed with worm-teeth to gear with a worm a^5, mounted on a spindle a^6. This spindle is furnished with a bevel-pinion a^7, gearing with a corresponding bevel-pinion a^8 on another spindle a^9, terminating at its upper end in a bevel-pinion a^{10}. This pinion a^{10} gears with a bevel-pinion a^{11} on a horizontal spindle a^{12}, which is capable of being turned by means of a hand-wheel a^{13} through gearwheels a^{14} a^{15}. By revolving this hand-wheel the aforesaid platform or piston a' can be caused to rise or fall in the casing a to the desired extent for adjusting the spring-controlled footstep. This mode of supporting and controlling the said shaft also permits of its being lifted sufficiently to remove the propeller from contact with the spheres, if desired.

a^{16} is the spring-buffer, which is provided on the said shaft C at a point in proximity to the lower end of the bearing A^3 and which operates to prevent the shaft from unduly rising during the working of the apparatus. The said shaft has two collars a^{17} a^{18}, between which the spring a^{16} lies, the lower one of these collars being screw-threaded to engage with corresponding threads on the shaft. The upper collar a^{17} is loose and lies in contact with the lower end of the bearing A^3. In the event of the shaft C unduly rising the spring a^{16} will be compressed and will thereby serve as a buffer to limit the extent of such movement. By turning the lower nut a^{18} in one or other direction the degree of resistance of the spring can be thereby regulated. It will be seen that this spring a^{16} exerts a pressure on the shaft C in a direction opposed to that of the spring a^2, so that said shaft is very efficiently supported in a resilient manner. Instead of adjusting the spring a^2 of the footstep-bearing by toothed gearing, as above described, I may adjust the same by means of a hydraulic jack D, as shown in Fig. 2.

In some cases I employ at the footstep-bearing a pneumatic piston E, as shown in Fig. 3, in which case the resiliency of the air within the cylinder E′ of said piston will serve the purpose of the spring a^2, which can then be dispensed with. Suitable inlet and outlet pipes e' e^2 for compressed air may be provided on the cylinder E′ and may be controlled by appropriate valves e^3 e^4 for regulating the degree of pressure within the said cylinder.

Referring now more particularly to Fig. 4, $a^\times$ indicates the chilled or hardened surface of the crushing-path A′, and A^{19} indicates the part thereof near the upper edge which is left unhardened. In Fig. 4 the said surface is supposed to be made separate from the crushing-path and applied to the latter in the process of erecting the apparatus. For this purpose the said surface is made with a flange or projection a^{20} to fit a corresponding recess in the crushing-path A′ and is held in place by means of semicircular rings a^{21}, bolted together at their meeting ends. The inner edge a^{22} of the surface $a^\times$ is beveled to engage with a corresponding beveled surface in the crushing-path. In Fig. 1 the aforesaid chilled or hardened surface is integral with the crushing-path. The lower or active edge b of the propeller B has on its upper surface lugs b', which engage with corresponding recesses in the adjacent edge b^2 of the body of the propeller. Apertures are formed transversely through the edge b^2 and the detachable edge b for the reception of taper keys or cotters b^3, which retain the two edges firmly together, but in such a manner as to permit of the edge b being conveniently removed from the body of the propeller when worn and required to be replaced by a fresh one.

When it is required to adapt my improved apparatus for grinding dry material, such as cement, I form a series of openings a^{23} adjacent to the crushing-path A′, which open-

ings communicate with the air-inlet conduit or conduits A^9. Above the said openings I provide a baffle or deflector a^{24} for directing the air toward the sphere or spheres A^2. The hood or covering A^7 communicates, by means of the conduit or conduits A^8, with the aforesaid collecting-chamber, and from this chamber the air after depositing its suspended particles of crushed material in said collecting-chamber in the well-known manner may return to the aforesaid openings a^{23} through a pipe or pipes a^{25}. At the point or points where the said pipe or pipes a^{25} meet the conduit or conduits A^9, I provide an inlet-tube a^{26}, which is open to the atmosphere at its outer end, so that the current of air drawn or forced through the pipes and conduits a^{25} A^9 will induce a current of external air to enter through said tube or tubes a^{26} and have a cooling effect upon the air traveling in the apparatus. For drawing or forcing the air through the apparatus I may employ an exhaust-fan connected with the conduit A^8 or a blower connected with the conduit A^9.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. In a ball crushing-mill, the combination with a ball-raceway, a vertical driving-shaft extending through said raceway, and a bell-shaped ball-propeller driven by said shaft; of a resilient footstep for said shaft, a piston or platform vertically adjustable in said footstep and on which the lower end of said shaft directly rests, a spring interposed between said shaft and said piston, an adjustable buffer and means for adjusting the piston for the purpose specified.

2. In a ball crushing-mill, the combination with a ball-raceway, a vertical driving-shaft extending through said raceway, and a bell-shaped ball-propeller driven by said shaft; of a resilient footstep for said shaft, a piston or platform vertically adjustable in said footstep, a convex-headed piece adapted to bear against the convex end of the shaft, a spring interposed between said convex-headed piece and the piston, and means for adjusting the piston for the purpose specified.

3. In a ball crushing-mill, the combination with a ball-raceway, a driving-shaft extending through said raceway, and a bell-shaped ball-propeller driven by said shaft; or a resilient footstep for said shaft, a piston or platform vertically adjustable in said footstep, a convex-headed piece adapted to bear against the convex end of the shaft, a spring interposed between said convex-headed piece and the piston, a screw-threaded extension on said piston, a nut engaging with said screw-threaded extension, and means for revolving said nut substantially as and for the purpose specified.

4. In a ball crushing-mill, the combination with a ball-raceway, a vertical driving-shaft extending through said raceway, and a bell-shaped ball-propeller driven by said shaft; of an adjustable resilient footstep for said shaft and on the piston of which the end of said shaft directly rests, and a buffer-spring opposed to the resilient footstep substantially as and for the purpose specified.

5. In a ball crushing-mill, the combination with a ball-raceway, a vertical driving-shaft extending through said raceway, and a bell-shaped ball-propeller driven by said shaft; of an adjustable resilient footstep for said shaft and on the piston of which the end of said shaft directly rests, a spring situated around said shaft and adapted to abut at one end against a stationary part of the mill, a collar on said shaft against which the other end of said spring abuts, and means for adjusting said collar substantially as and for the purpose specified.

6. In a ball crushing-mill, the combination with a ball-raceway, a vertical driving-shaft extending through said raceway, and a bell-shaped ball-propeller driven by said shaft; of an adjustable resilient footstep for said shaft and on the piston of which the end of said shaft directly rests, a spring situated around said shaft and adapted to bear at its upper end against a stationary part of the mill, a screw-threaded collar situated beneath the inner end of said adjustable spring and adjustable on corresponding threads on said shaft, and means for locking said collar in its adjusted position substantially as and for the purpose specified.

7. In a ball crushing-mill, the combination with a ball-raceway, a vertical driving-shaft extending through said raceway, and a bell-shaped ball-propeller driven by said shaft; of an active surface for said raceway composed of chilled metal except at the portion near the upper edge thereof which is of unhardened metal a ball-and-socket support at the upper end of said propeller and a yielding support for the lower end of said shaft, substantially as and for the purpose specified.

8. In a ball crushing-mill, the combination with a ball-raceway, a driving-shaft extending through said raceway, and a bell-shaped ball-propeller driven by said shaft; a ball-and-socket support at the upper end of said propeller, and a yielding support for the lower end of said shaft of a separable active edge for said ball-propeller, and means for detachably connecting said edge to said propeller and a detachable surface for the raceway having its upper edge unhardened substantially as and for the purpose specified.

9. In a ball crushing-mill, the combination with a ball-raceway, a driving-shaft extending through said raceway, and a bell-shaped ball-propeller driven by said shaft and a resilient footstep for said shaft and on the piston of which the end of said shaft directly rests; of a crushing-path in said raceway having vertical air-inlet openings below the

active surface of said raceway therein, and a baffle or deflector situated above said openings substantially as and for the purpose specified.

10. In a ball crushing-mill, the combination with a ball-raceway, a driving-shaft extending through said raceway, and a bell-shaped ball-propeller driven by said shaft and a resilient footstep for said shaft and on the piston of which the end of said shaft directly rests; of a crushing-path in said raceway having vertical air-inlet openings therein, a baffle or deflector situated above said openings, an air-circulating conduit connected with said openings, and a tube of restricted area situated in said conduit and open to the atmosphere substantially as and for the purpose specified.

In testimony whereof I have hereunto set my hand, in presence of two subscribing witnesses, this 14th day of November, 1904.

WALTER KITTO.

Witnesses:
T. SELBY WARDLE,
WALTER J. SKERTEN.