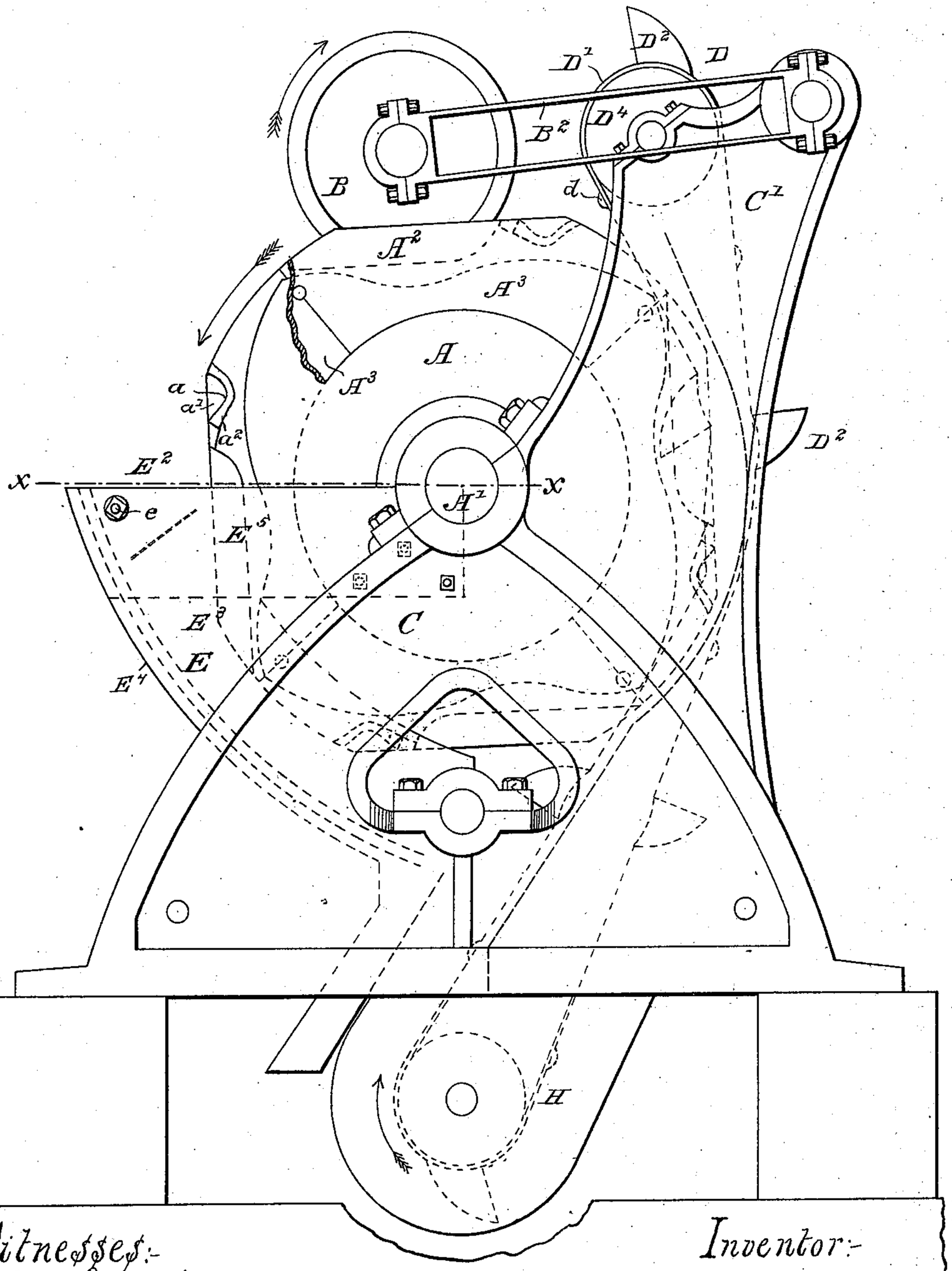
(No Model.) 3 Sheets—Sheet 1.

A. P. GRANGER.

ORE CRUSHER.

No. 376,878. Patented Jan. 24, 1888.

Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

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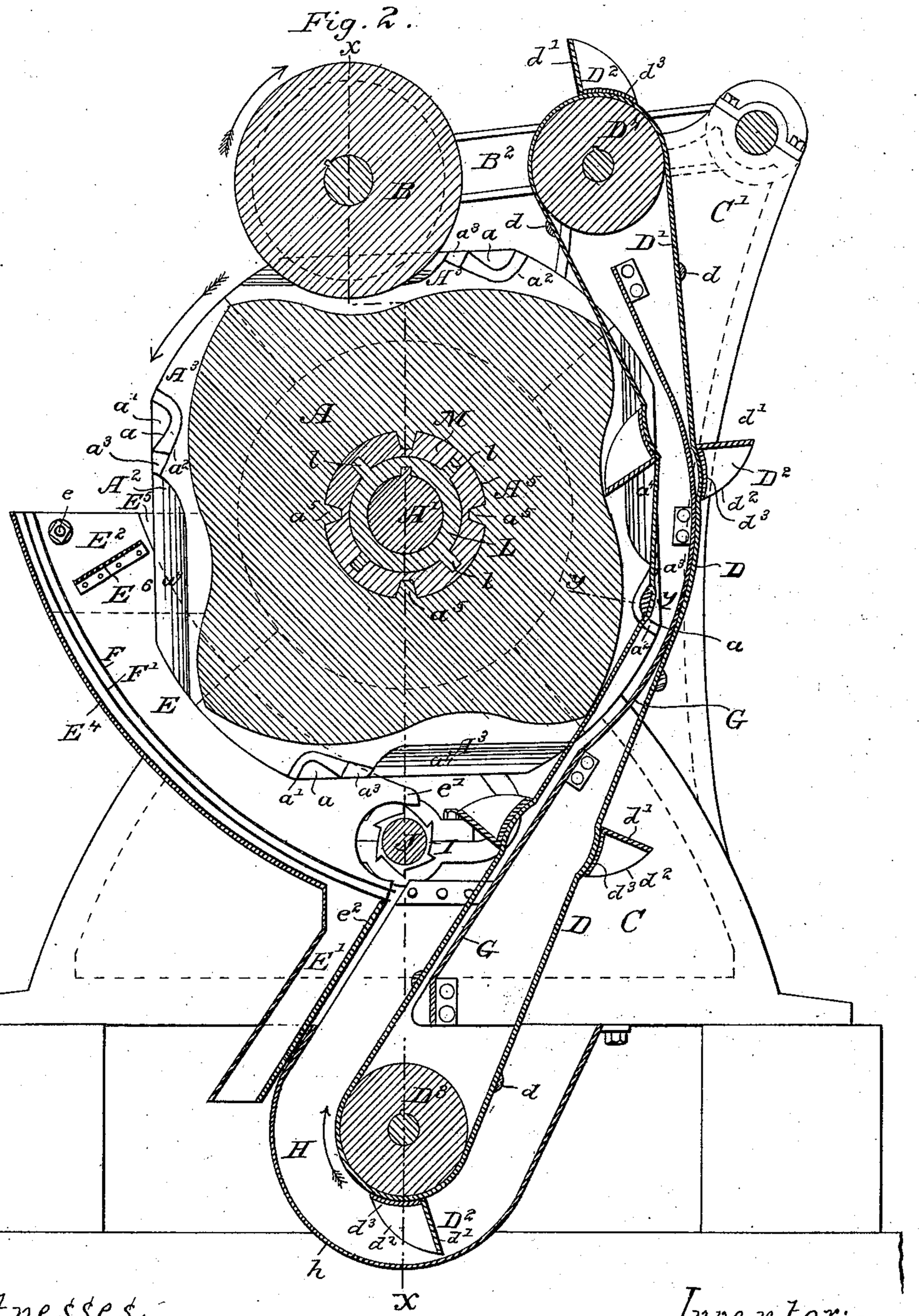
Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

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Fig. 3.

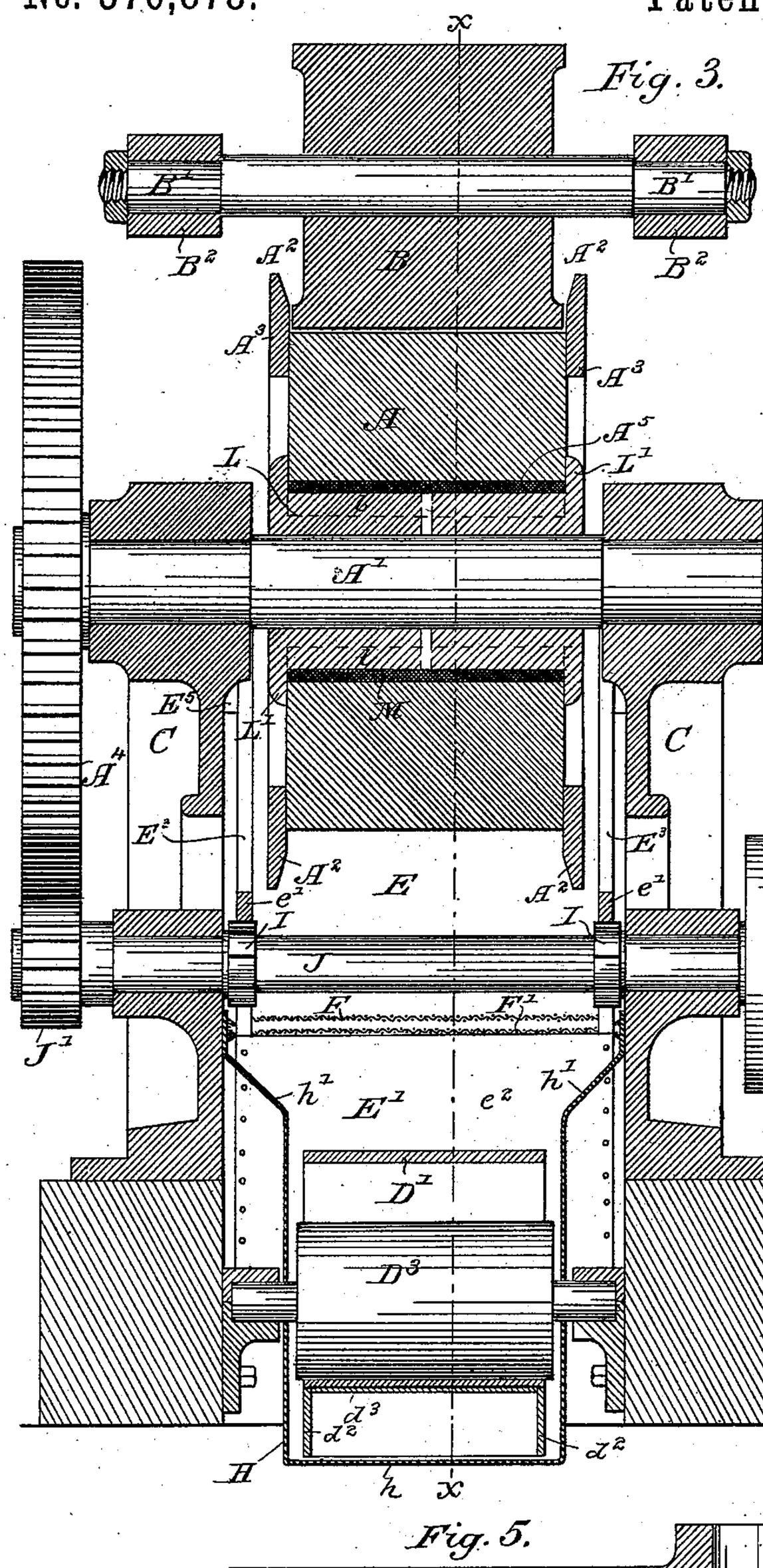


Fig. 6.

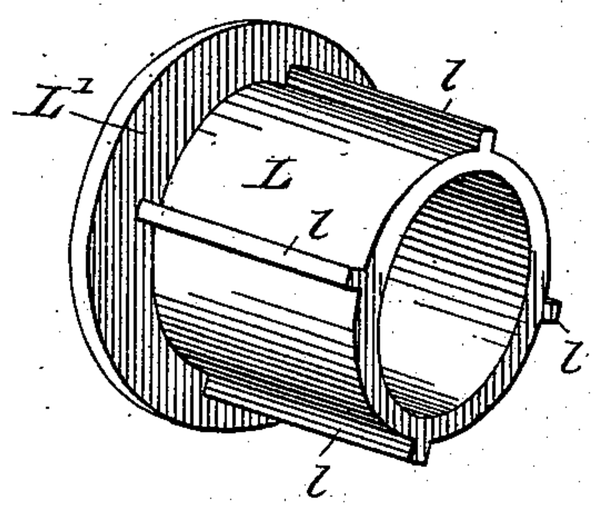


Fig. 4.

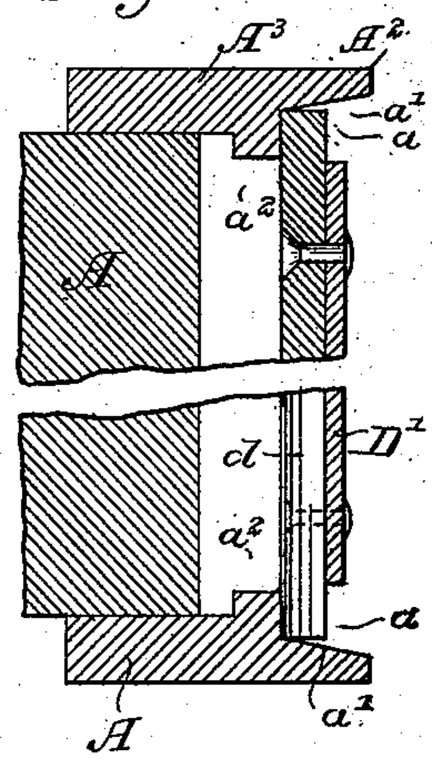
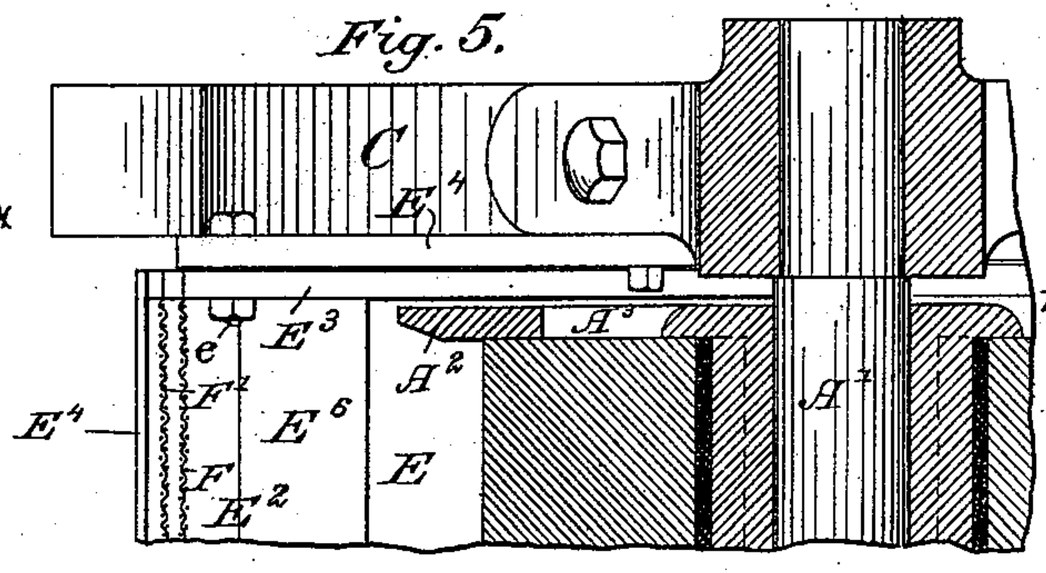


Fig. 5.



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UNITED STATES PATENT OFFICE.

ALVAN P. GRANGER, OF DENVER, COLORADO.

ORE-CRUSHER.

SPECIFICATION forming part of Letters Patent No. 376,878, dated January 24, 1888.

Application filed June 21, 1886. Renewed November 5, 1887. Serial No. 254,442. (No model.)

To all whom it may concern:

Be it known that I, ALVAN P. GRANGER, of Denver, in the county of Arapahoe and State of Colorado, have invented certain new and useful Improvements in Ore-Crushers; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to a novel form of machine for stamping or disintegrating ores, which comprises a revolving wheel mounted upon a horizontal axis and having an undulating peripheral surface and a radially-movable crushing-roller riding upon the wheel as the latter revolves, so as to act upon material placed in the peripheral depressions of said wheel—such, for instance, as is illustrated in a prior application, No. 185,015, filed by me December 7, 1885.

The object of this invention is to improve the construction of machines of the character above described in several particulars, as will hereinafter appear; and it consists in the matters hereinafter described, and pointed out in the appended claims.

In the accompanying drawings, illustrating my invention, Figure 1 is a side elevation of a machine embodying one desirable form of my invention. Fig. 2 is a central vertical section taken through the operative parts of the machine upon line *x x* of Fig. 3. Fig. 3 is a central vertical section taken upon line *x x* of Fig. 2, but showing the several shafts and pulleys in full outline. Fig. 4 is a detail sectional view taken upon line *y y* of Fig. 2. Fig. 5 is a detail sectional plan view taken upon line *x x* of Fig. 1. Fig. 6 is a perspective view of one of the flanged sleeves shown in Figs. 2 and 3 as surrounding the shaft by which the wheel is supported.

As shown in the said drawings, A represents a heavy revolving wheel or casting, denominated herein and in said prior application a "mortar-wheel," and B a crushing-roller which is located over the wheel A and is movably sustained upon the machine-frame in such manner as to rest or ride upon the periphery of the said wheel. The wheel is mounted upon a horizontal shaft, A′, which extends at its ends beyond the sides of the said wheel to form trunnions, which have bearings in the frame C of the machine, and said wheel is provided upon its periphery with a series of transverse depressions and intermediate prominences, giving an undulating form to the peripheral surface thereof.

A^2 A^2 are flanges extending outwardly from the undulating peripheral surface of the wheel at each side of the latter, so as to form a trough or channel of varying depth extending around the wheel, said flanges, as herein shown, being formed by a series of plates, A^3 A^3, applied to the ends of the wheel.

The roller B is made of suitable length to freely enter between the flanges A^2 A^2, and is constructed to rise and fall freely and to roll upon the undulating surface of the mortar-wheel as the latter is rotated, so as to crush the material placed in the hollows or depressions of the wheel, in the manner fully set forth in the prior application hereinbefore referred to. The said roller B may be sustained upon the machine-frame by any suitable devices adapted to permit a free movement of said roller toward and from the mortar-wheel, the devices herein shown for this purpose consisting of two arms or "radius-bars," B^2, which are pivoted at one of their extremities to arms C′ of the frame C, and are provided with bearings for the trunnions B′ B′ of the roller at their opposite and free ends.

D is an endless-belt elevator by which the material is delivered to the upper part of the mortar-wheel. Said elevator comprises a belt, D′, provided with a series of buckets, D^2, and passing at its lower part around a supporting-pulley, D^3, located beneath the mortar-wheel and sustained at its upper part by a pulley, D^4, mounted in the top of the frame above the said mortar-wheel. As far as the operation of the belt elevator alone is concerned, the material may be fed to the lower end of the said elevator in any manner found convenient or desirable.

The machine herein shown is provided with a curved chute, E, extending from a point near the level of the mortar-wheel axis to the lower end of the elevator, and provided with an exit-spout, E′, at its lower end and with screens F F′ above its bottom, said chute being constructed to receive the crushed material from the mortar-wheel, which material is sepa-

rated by the screens, so as to allow the discharge of the pulverized portion thereof through the exit-spout E′, while the larger parts, or those not sufficiently reduced, are discharged from the lower end of the screens to the elevator to be again subjected to the action of the crushing devices. The said chute is also adapted to receive the material fed to the machine, which material passes over the screens, so as to cause the separation of any pulverized or fine particles therefrom, while the coarser parts are delivered to the elevator with the uncrushed material which has previously passed through the crushing devices, the chute being desirably widened or enlarged at its upper end to form a hopper, E^2, for the reception of the material delivered to the chute.

The belt-pulleys D^3 D^4 are so arranged with relation to the mortar-wheel that the elevator-belt D′ is drawn over or rests against the periphery of said wheel at one side of the latter, the buckets D^2 upon the belt being spaced at such distances apart that each bucket will enter one of the hollows or depressions of the wheel as the belt and wheel are moved. As a preferred means of actuating the belt, the latter is provided between the buckets with transverse bars *d*, which project at their ends beyond the side margins of the belt, and are constructed to engage notches or recesses *a*, formed in the flanges A^2 A^2 of the mortar-wheel, so that when the mortar-wheel is rotated the belt will be carried or moved with it, thus rendering any separate actuating devices for the belt unnecessary. The cross-bars *d* and the notches *a* are, furthermore, so disposed relatively to the depressions of the mortar-wheel and the buckets D^2 upon the belt that the buckets come opposite and rest within the said depressions as the belt passes over the said mortar-wheel, the said buckets being made of such size that their outer edges rest or bear against the surface of the said depressions. The buckets D^2 have flat or nearly flat bottoms *d′*, arranged approximately at right angles with the surface of the belt D′, and are provided with side pieces, d^2, extending from the edges of the bottoms *d′* to the side margins of the belt. When the belt is made of leather, rubber, or other flexible material, the buckets are made with stiff back pieces or walls, d^3, curved to correspond with the curvature of the supporting-pulleys D^3 D^4.

The buckets constructed as above described are obviously adapted to receive and hold the material when upon the upwardly-moving part of the belt D′ below the mortar-wheel only, this part of the belt being inclined in such manner that the bottoms *d′* of the buckets slope inwardly or toward the belt, so as to form with the belt a V-shaped receptacle for the material. In the upwardly-moving part of the belt above the mortar-wheel, which is inclined forwardly so as to overhang the wheel, the buckets are obviously held in position to discharge their contents upon the wheel. The buckets are made of such width or size, as above stated, that their outer edges come in contact with or press against the face of the mortar-wheel, and it follows that as each bucket is carried upwardly with its load and comes in contact with the face of the mortar-wheel the material in the buckets will be held in the space between the belt and wheel above the bucket-bottom until the bucket leaves the wheel, when, by reason of the inclined position of the bucket-bottom, the material will slide from the bucket and fall upon the mortar-wheel. Inasmuch as each bucket enters and remains in one of the depressions in the wheel the material will obviously be thrown or deposited in the said depressions by the several buckets. The free or outer edges of the buckets are shown in the drawings as inclined downward by their contact with the mortar-wheel, this position of the buckets obviously favoring the prompt discharge of the material when the buckets reach the top of the wheel. In practice, however, the buckets may remain at right angles with the belt, or may be more or less inclined than shown, according to the form of the mortar-wheel or the relative sizes of the other parts.

To insure that the belt D′ and buckets shall remain in proper position laterally with relation to the mortar-wheel, the notches *a a* of the wheel-flanges A^2 A^2 are formed in the inner faces of the flanges, so as to form end walls or stops, *a′*, engaging the end faces of the cross-bars *d* upon the belt, the inner surfaces of said end walls or stops being preferably made outwardly inclined or flaring, as shown more clearly in Fig. 4, so as to direct or guide the said bars into the proper position as they enter the notches or recesses. In the particular construction shown the notches or recesses *a* are formed partially in the thickness of the flanges A^2 A^2 and partially by ribs a^2 a^2, cast upon the inner faces of the said flanges; but these parts may be made otherwise in practice, as may be found convenient or desirable.

The parts of the inner faces of the flanges A^2 A^2 between the notches *a a* are preferably beveled, as indicated at a^4, to guide the roller B to place in case said roller is lifted upwardly and sidewise by exceptionally large or hard lumps of the material being crushed, the ends of the ribs a^2 which move toward the said roller being beveled or inclined, as indicated at a^3, to prevent the roller striking and catching upon the ends of the said ribs under similar circumstances.

The downwardly-moving part of the elevator-belt, made as above described, may be held free from the upwardly-moving portion thereof by any suitably-arranged guide or guides. As herein shown, a stationary curved guide, G, is employed for this purpose, said guide consisting of a curved plate extending between and attached at its edges to the opposite side pieces of the frame C.

I have herein shown at the lower end of the elevator a casing or shoe, H, surrounding the

pulley D^3 and provided with a cylindric lower wall, *h*, curved concentrically with the axis of said pulley and arranged for the passage of the outer edges of the buckets D^2 in close proximity to it in their movement around the pulley, so that said buckets will scrape or scoop up material delivered to the casing. In the particular construction of the feeding devices shown, in which the material is delivered to the buckets from the lower ends of the screens F F′ as said buckets are moving upwardly from the pulley D^3, the casing H serves to catch any material that may fail to enter or fall from the upwardly-moving buckets, so that such material will be taken up by succeeding buckets. The material to be operated upon may, however, in some cases be fed directly to the shoe or casing H with the same general result, as far as the operation of the elevator is concerned, as when the construction shown is used. A construction in which the material is allowed to fall into or upon the upwardly-moving buckets is preferred, however, inasmuch as a larger quantity of material may be thus deposited upon buckets of the form shown and described than will usually be scooped up by such buckets in passing through the shoe.

The screen-chute E consists, as shown, of a bottom, E^4, made of sheet metal or wood, and side boards, E^3, to which the said bottom and the screens F and F′ are attached. Said chute is pivoted at its upper end to arms E^5, bolted to the frame C by means of pivot-bolts *e*, and rests at its lower ends upon revolving stepped cams I, mounted upon a transverse shaft, J, and engaging, as shown, projecting parts *e′ e′* of the side boards, E^3, said cams operating to shake or jar the chute and screens, so as to facilitate the passage of the material through and over said parts.

In the particular construction illustrated the shaft J is provided at one end outside of the frame with a pinion, J′, intermeshing with a spur-wheel, A^4, upon the mortar-wheel shaft A′, and at its opposite end with a belt-pulley, whereby the said shaft is driven and the several parts of the machine actuated. In the use of other driving devices, however, the cams I may be mounted upon any suitably-located shaft. An important advantage is gained by the use of a pinion intermeshing with a spur-wheel upon the mortar-wheel shaft as a means of actuating the mortar-wheel, inasmuch as a steady motion is thereby given to said wheel, and the latter will be unaffected by the action of the heavy roller B in rolling upon the undulating surface thereof.

To insure delivery of the material passing over the screens to the elevator-buckets, the lower ends of the screens are made to overhang the lower belt-pulley, D^3, the rear wall, e^2, of the spout E′ being inclined rearwardly and upwardly to the rear edges of the screens, as shown, so as to receive and discharge all of the material passing through the screens. I have shown in Fig. 3 the side walls, *h′*, of the shoe or casing H extended upwardly and flared at their upper ends, so as to deflect inwardly to the elevator-buckets all of the material falling from the lower ends of the screens. I have shown in the drawings two screens, F and F′, for the purpose of more perfectly separating the finer and coarser particles of the material being operated upon; but it will of course be understood that one or more than one screen may be used, as preferred or desired.

E^6, Figs. 2 and 5, is an inclined deflector placed in the hopper E^2 for the purpose of throwing toward or delivering to the upper parts of the screens F F′ the material delivered to the said hopper E^2. The said deflector is preferably extended as near as possible to the mortar-wheel, in order that it may deflect outwardly to the upper parts of the screens the material falling from the said wheel.

As an improved construction in the mortar-wheel I make the latter with a central opening, A^5, somewhat larger in diameter than the shaft A′, and provided upon its inner face with several inwardly-extending or radial ribs, a^5, and I provide the said shaft with a series of outwardly-extending radial ribs, *l*, herein shown as cast on sleeves L, keyed to the said shaft A′. In the annular space thus formed between the shaft and the wheel I place a cushion or filling, M, of rubber or other elastic or yielding material, such cushion serving to relieve the frame of the machine and connected parts from the shocks caused by the action thereon of the crushing-roller B or other crushing or stamping device employed. The ribs *l* are made to extend into the spaces between the ribs a^5, so that the wheel is prevented from turning upon the shaft by the presence of the filling M between the said ribs. The sleeves L are, as shown and preferably constructed, provided with outwardly-extending annular flanges L′, for the purpose of covering and holding the cushion or filling M from endwise displacement.

An important and general advantage of the construction described, wherein the elevator-belt is sustained with relation to the undulating periphery of the wheel by the engagement of the cross-bars *d* with the wheel-flanges, the buckets with the depressions, and the belt itself with the prominences of the wheel, as shown more clearly in Fig. 2, is that the part of the belt resting against the mortar-wheel is thereby held in a curve practically circular and concentric with the axis of the wheel, so that the said belt is caused to run smoothly and evenly over the mortar-wheel.

It is to be understood that I consider the belt elevator provided with buckets and operating in connection with the mortar-wheel in the manner described to be broadly new; and I do not wish, therefore, to be restricted to a construction in which the belt is actuated by engagement with the mortar-wheel, as shown, or to the particular details of construction shown in the belt itself or parts connected therewith. A construction in which the belt

is driven from the mortar-wheel has, however, important advantages in point of simplicity of construction and certainty of operation, and a device embracing this feature is therefore made the subject of specific claims herein, as are also certain other details of construction herein illustrated in connection with the said elevator.

A cushion interposed between the mortar-wheel and the machine-frame to prevent the transmission of shock or jar to the latter is also novel, and is herein claimed without restriction to the particular location and arrangement of the cushion herein shown.

It is to be understood, furthermore, that stamping or crushing devices other than the crushing or stamping roller shown may be employed to operate upon material deposited in the depressions of the mortar-wheel, and my invention, as herein claimed, is not therefore limited to a construction embracing said crushing-roller.

I claim as my invention—

1. The combination, with a rotating wheel provided with a series of peripheral depressions and a crushing device acting upon material in the depressions, of an elevating device comprising a belt provided with buckets, and supporting-pulleys for the belt, constructed to sustain the latter with its upwardly-moving part in contact with the said wheel, substantially as described.

2. The combination, with a revolving wheel provided with a series of peripheral depressions and a crushing-stamp, of an elevating device comprising an endless belt provided with buckets arranged at the same distance apart as the said depressions, and supporting-pulleys for the belt, constructed to sustain the latter with its upwardly-moving part in contact with the periphery of the wheel, said belt and the periphery of the wheel being driven at the same speed, whereby the buckets will severally enter the depressions in their upward movement past the wheel, substantially as described.

3. The combination, with a revolving wheel provided with a series of peripheral depressions and a crushing-stamp, of an elevating device comprising an endless belt, supporting-pulleys for the belt located in position to sustain the belt with its upwardly-moving part in contact with the peripheral surface of the wheel, and buckets upon the belt provided with flat bottoms arranged approximately at right angles to the surface of the belt, said buckets being constructed to rest in contact with the peripheral surface of the wheel, whereby the material is retained in the buckets while the latter are moving upwardly past the wheel, substantially as described.

4. The combination, with a revolving wheel provided with a series of peripheral depressions and a crushing stamp, of an elevating device comprising a belt provided with buckets, said belt being engaged with and actuated by the said wheel, substantially as described.

5. The combination, with a revolving wheel provided with a series of depressions about its periphery and with peripheral flanges and a crushing-stamp, of an elevator-belt provided with buckets, and pulleys sustaining said belt with its upwardly-moving part in contact with the wheel, said belt being provided with cross-bars extending at their ends beyond the margins of the belt, and the wheel-flanges being provided with notches or recesses for engagement with said cross-bars, substantially as described.

6. The combination of a revolving wheel provided with peripheral depressions and with flanges having marginal notches or recesses, a crushing-stamp, and an elevator comprising an endless belt provided with cross pieces or bars adapted to engage the notches or recesses of the flanges, said notches or recesses being provided with inclined outer walls engaging the end surfaces of said cross pieces or bars, substantially as described.

7. The combination, with a revolving wheel provided with a series of peripheral depressions and a crushing-stamp, of an elevating device comprising a belt provided with a series of buckets, supporting-pulleys for the belt, sustaining the latter with its upwardly-moving part in contact with the wheel, and a screen chute constructed to receive material from the said wheel and deliver the uncrushed particles thereof to the buckets upon the upwardly-moving part of the elevator-belt, substantially as described.

8. The combination, with a revolving wheel provided with a series of peripheral depressions and a crushing-stamp, of a screen-chute receiving the material from the wheel, said chute being provided with an outwardly and downwardly inclined deflector directing said material against the upper part of the screen therein, substantially as described.

9. The combination, with a revolving wheel provided with a series of peripheral depressions, a crushing-stamp, and a frame supporting the wheel, of a cushion interposed between the wheel and the frame, substantially as and for the purpose set forth.

10. The combination, with a revolving wheel provided with a series of peripheral depressions, a crushing-stamp, and a frame sustaining the wheel, of a shaft, A′, for supporting the wheel, a sleeve, L, attached to the shaft and provided with radial flanges *l*, the said wheel being provided with a central opening larger than the sleeve and with inwardly-extending flanges a^5, and a cushion inserted in and filling the space between the said sleeve and wheel, substantially as described.

In testimony that I claim the foregoing as my invention I affix my signature in presence of two witnesses.

ALVAN P. GRANGER.

Witnesses:
WILLIAM H. SAVAGE,
A. E. WARREN.