(No Model.) 8 Sheets—Sheet 1.

E. D. LEAVITT, Jr.

STEAM STAMP FOR CRUSHING ORE.

No. 275,224. Patented Apr. 3, 1883.

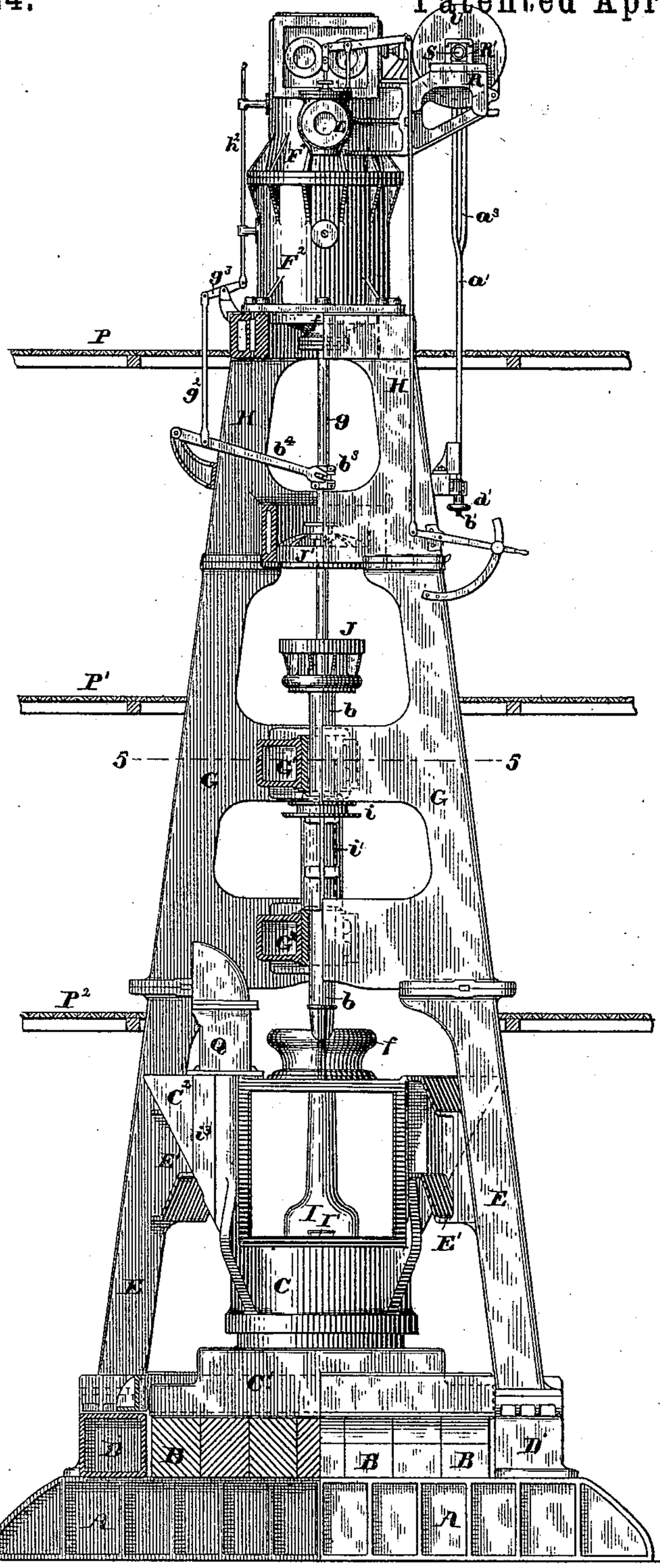

Fig. 1.

Witnesses:
Walter E. Lombard
E. A. Himmenway.

Inventor:
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by N. E. Lombard
Attorney.

(No Model.) 8 Sheets—Sheet 2.

E. D. LEAVITT, Jr.

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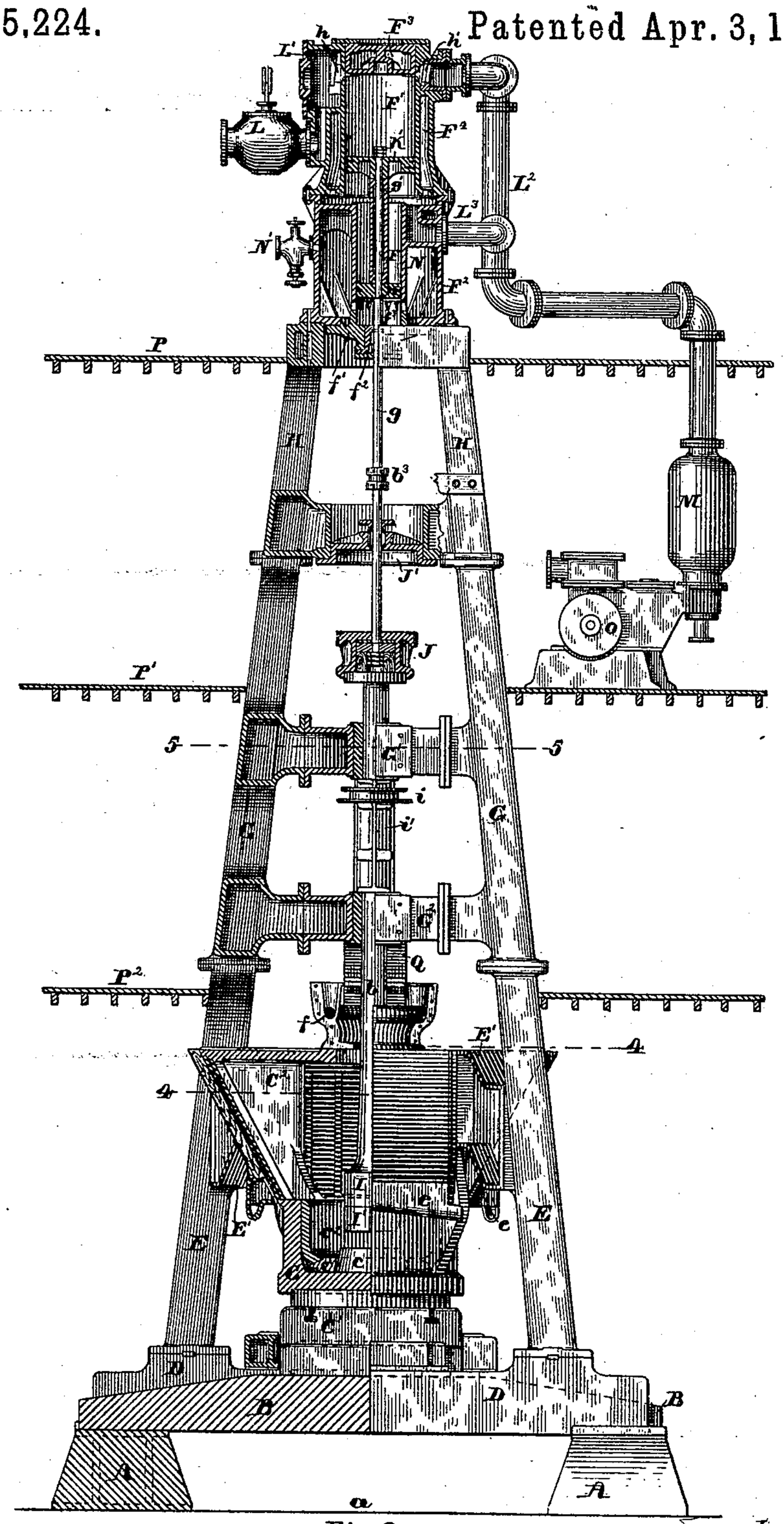

Fig. 2.

Witnesses:
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Inventor:
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(No Model.) 8 Sheets—Sheet 3.

E. D. LEAVITT, Jr.

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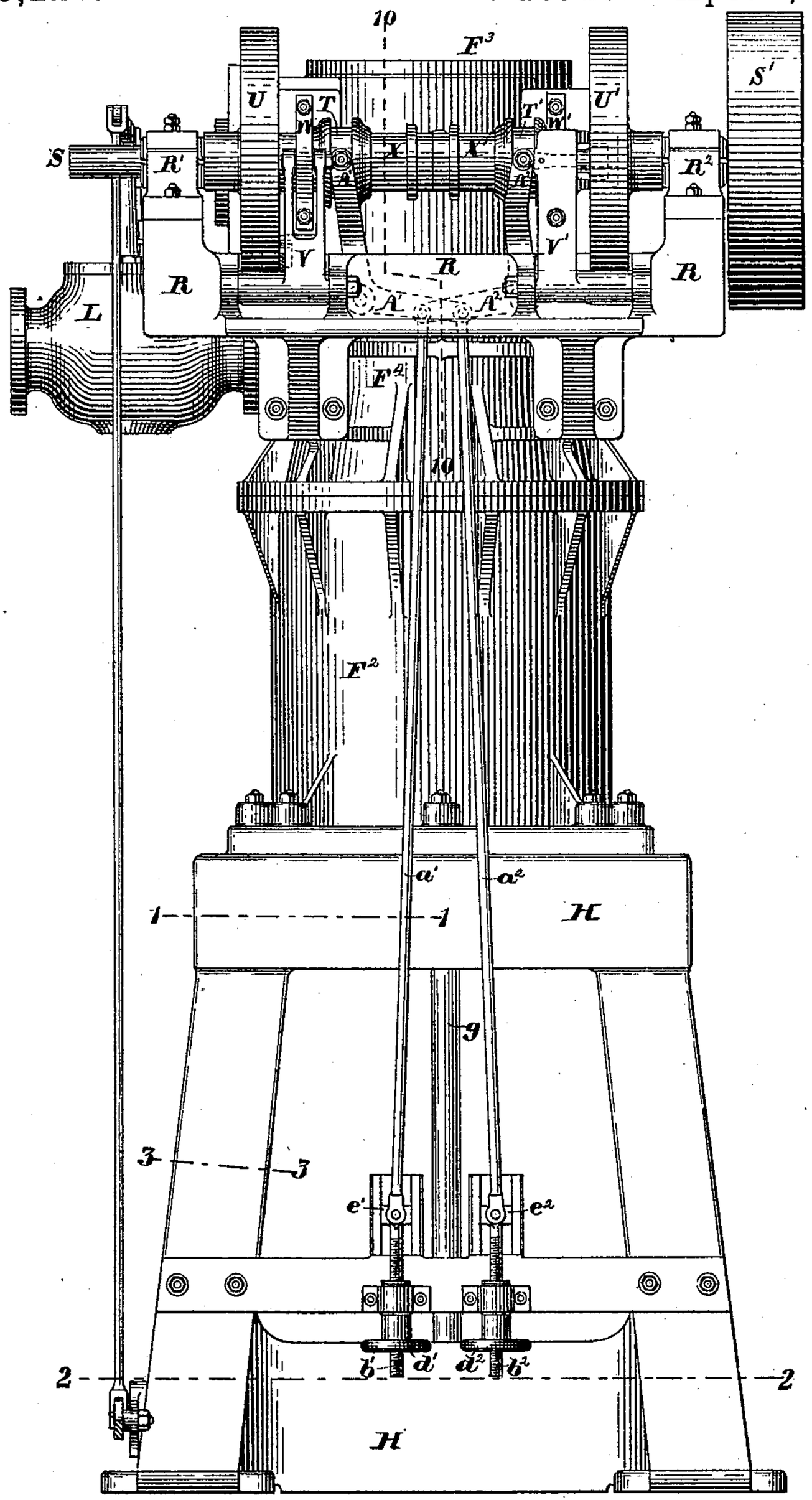

Fig. 3.

Witnesses:
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(No Model.) 8 Sheets—Sheet 4.

E. D. LEAVITT, Jr.

STEAM STAMP FOR CRUSHING ORE.

No. 275,224. Patented Apr. 3, 1883.

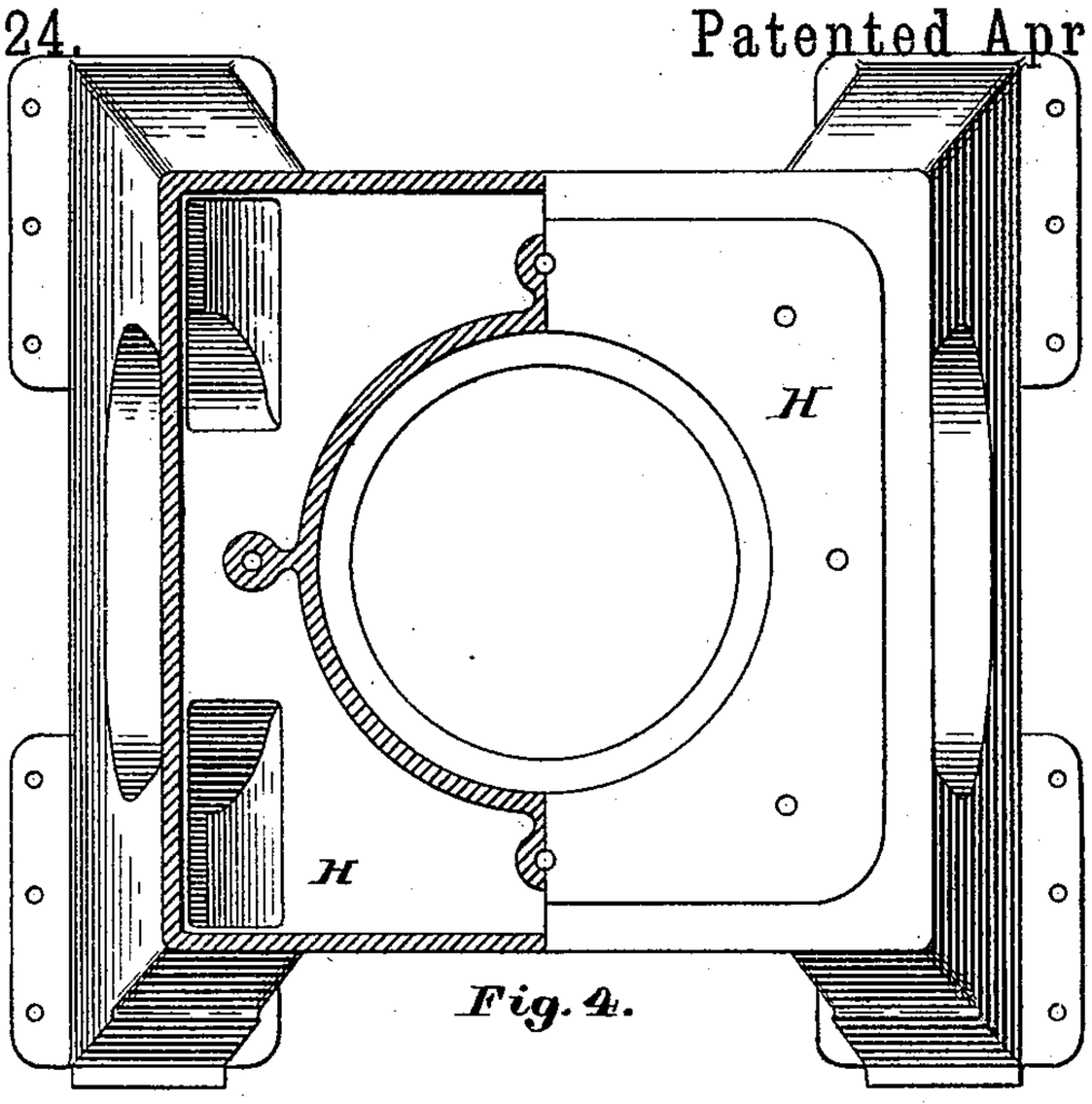

Fig. 4.

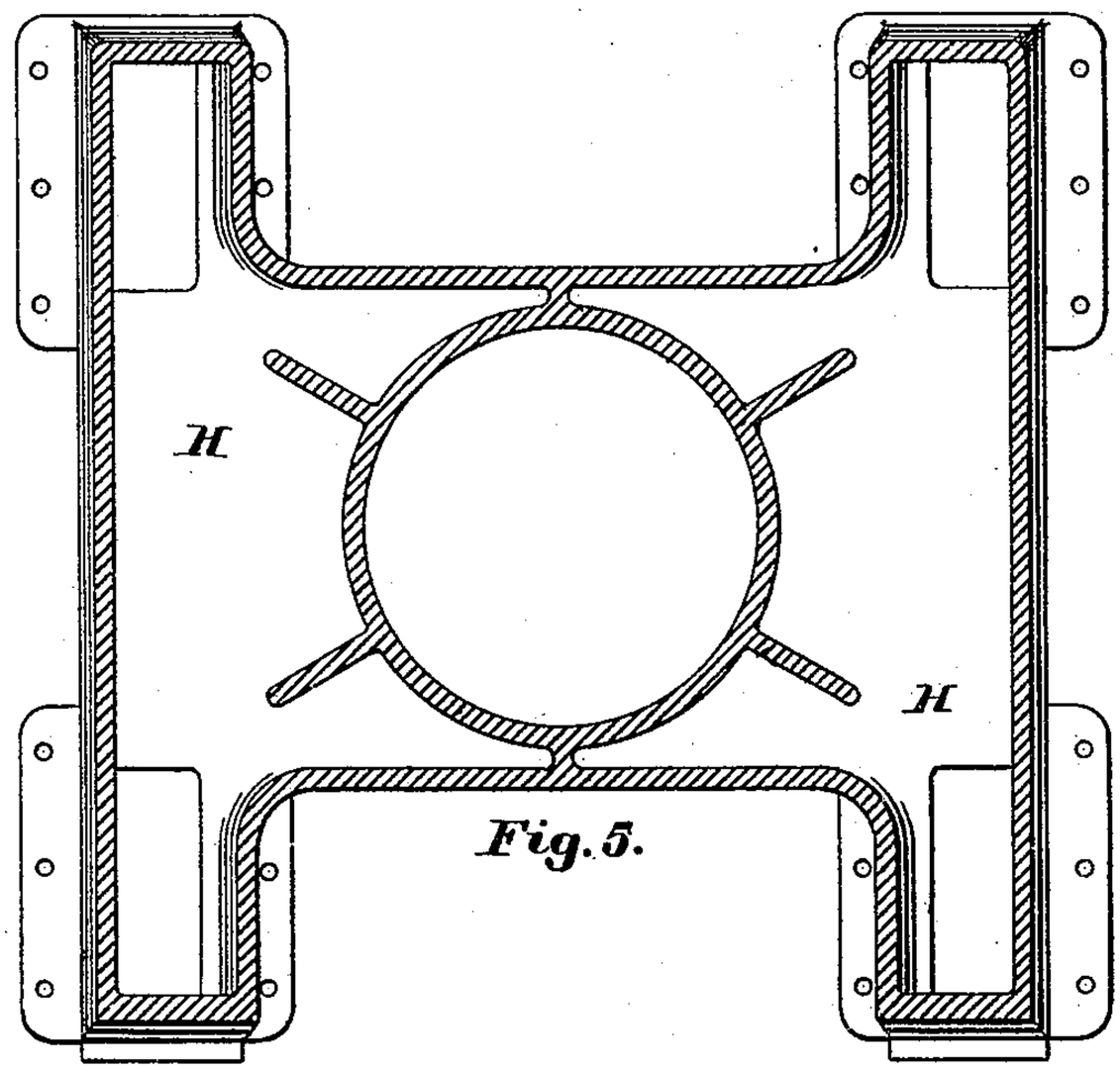

Fig. 5.

Fig. 6.

Witnesses:

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Inventor:

Erasmus D. Leavitt Jr

by N. W. Lombard

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(No Model.) 8 Sheets—Sheet 5.

E. D. LEAVITT, Jr.

STEAM STAMP FOR CRUSHING ORE.

No. 275,224. Patented Apr. 3, 1883.

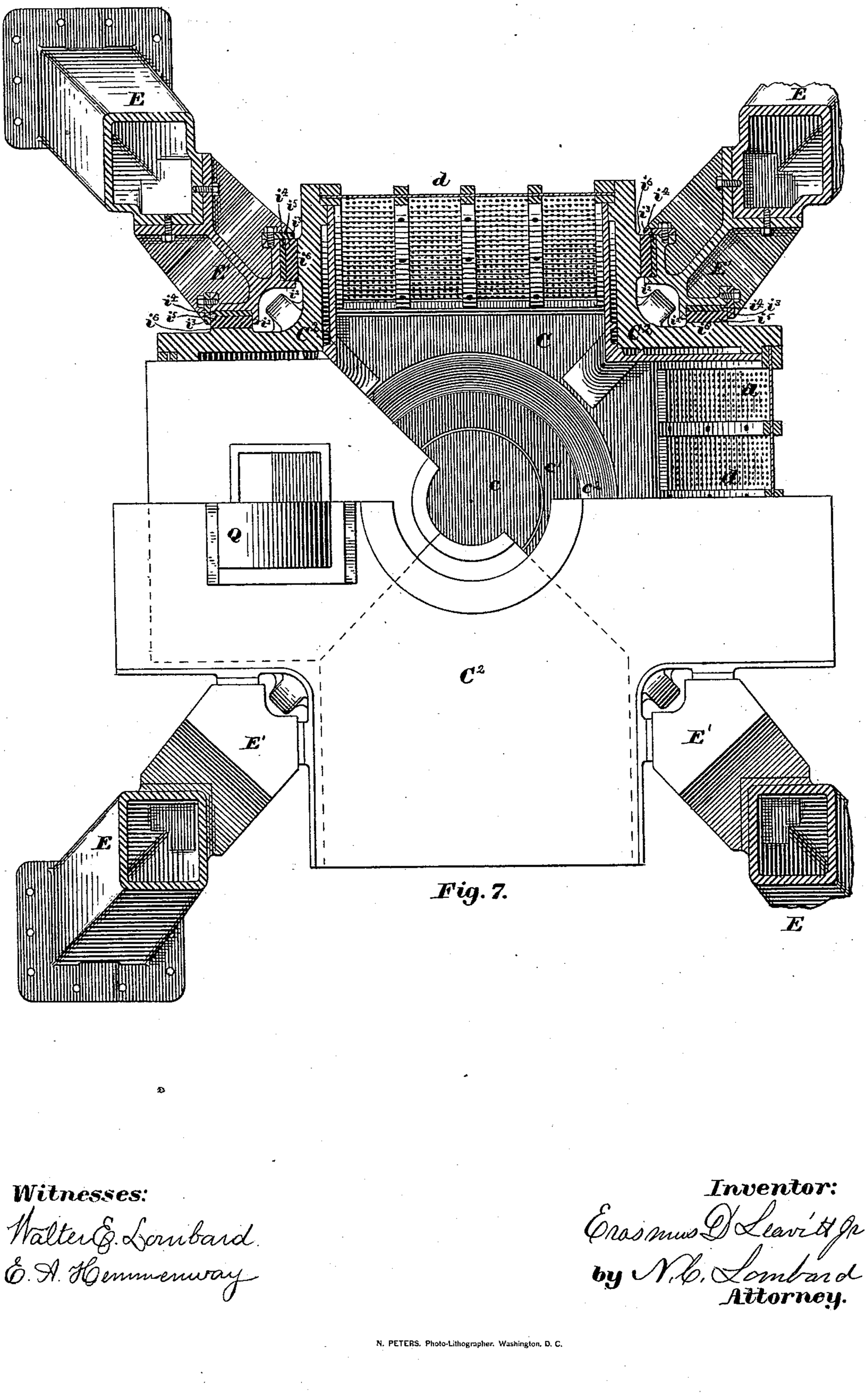

Fig. 7.

Witnesses:
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(No Model.) 8 Sheets—Sheet 6.

E. D. LEAVITT, Jr.

STEAM STAMP FOR CRUSHING ORE.

No. 275,224. Patented Apr. 3, 1883.

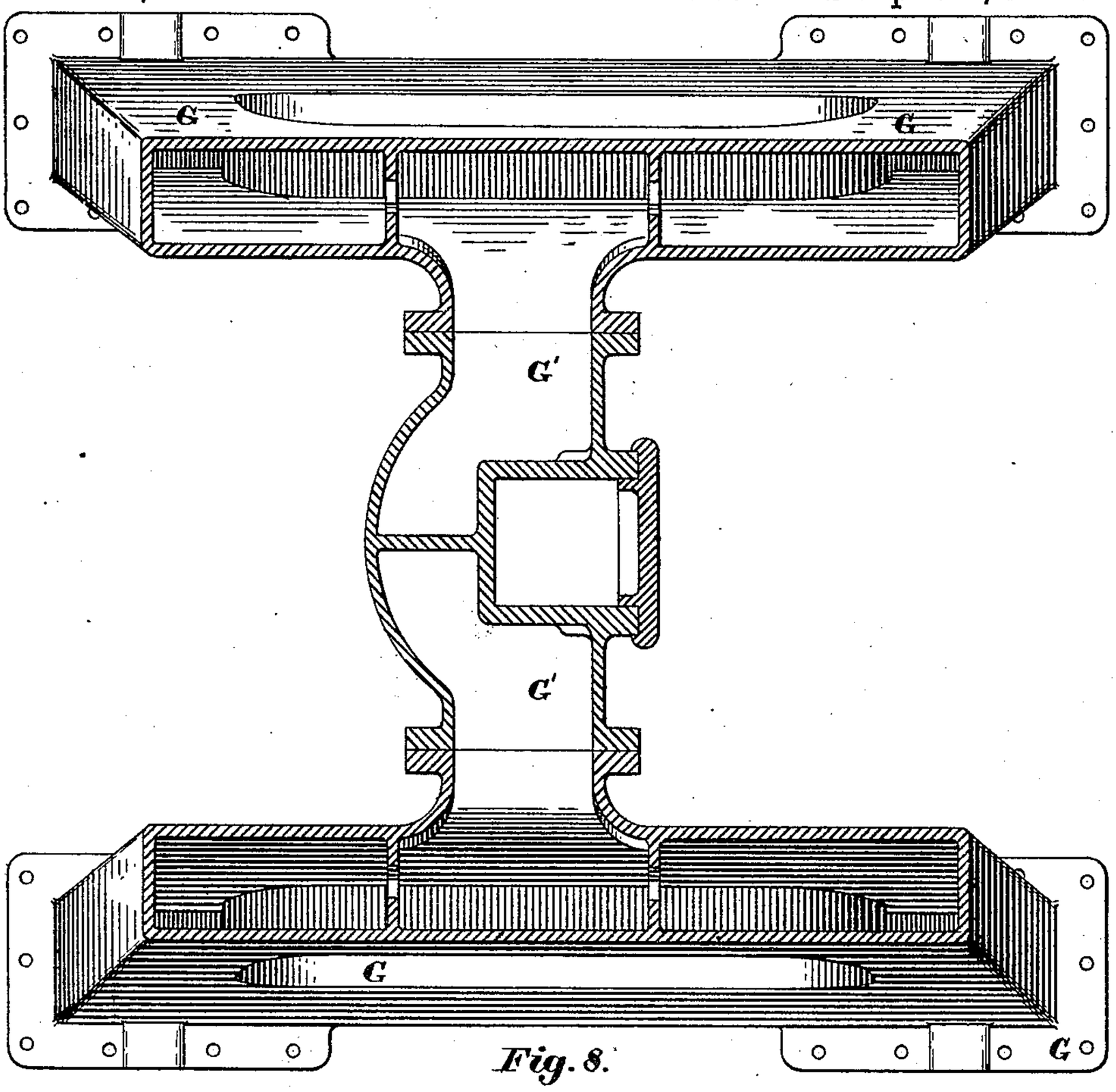

Fig. 8.

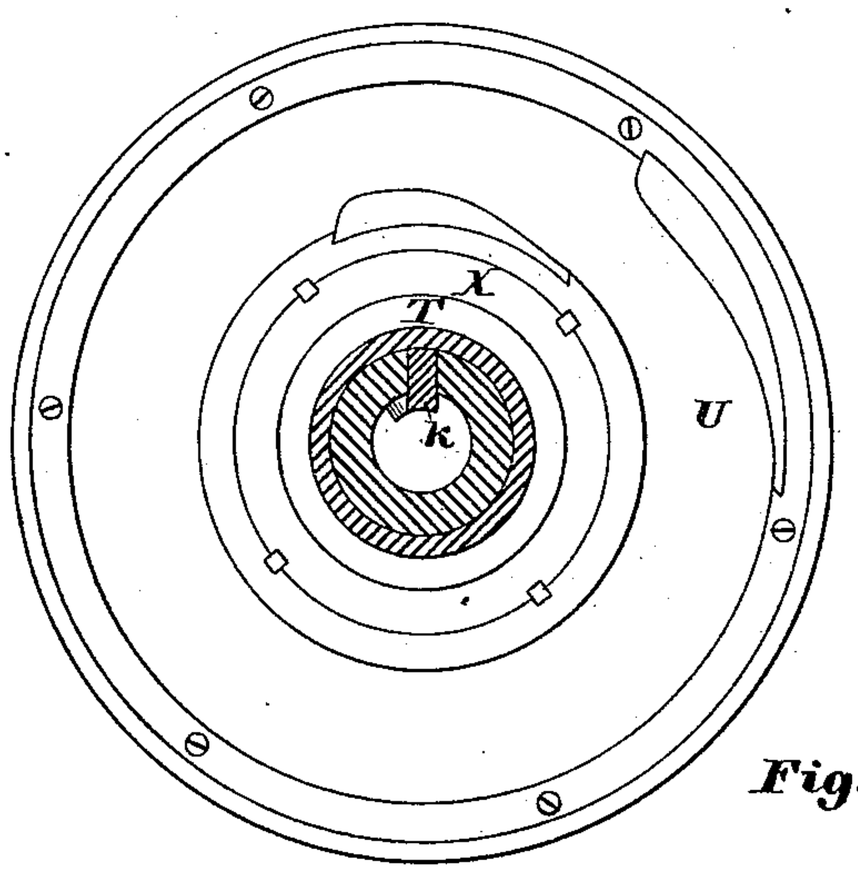

Fig. 19.

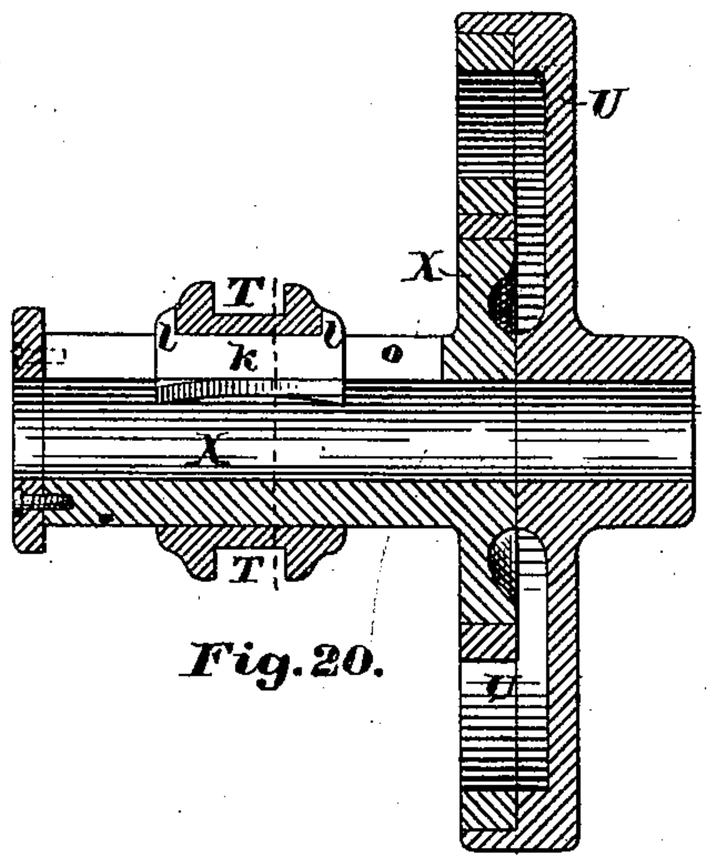

Fig. 20.

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(No Model.) 8 Sheets—Sheet 7.

E. D. LEAVITT, Jr.

STEAM STAMP FOR CRUSHING ORE.

No. 275,224. Patented Apr. 3, 1883.

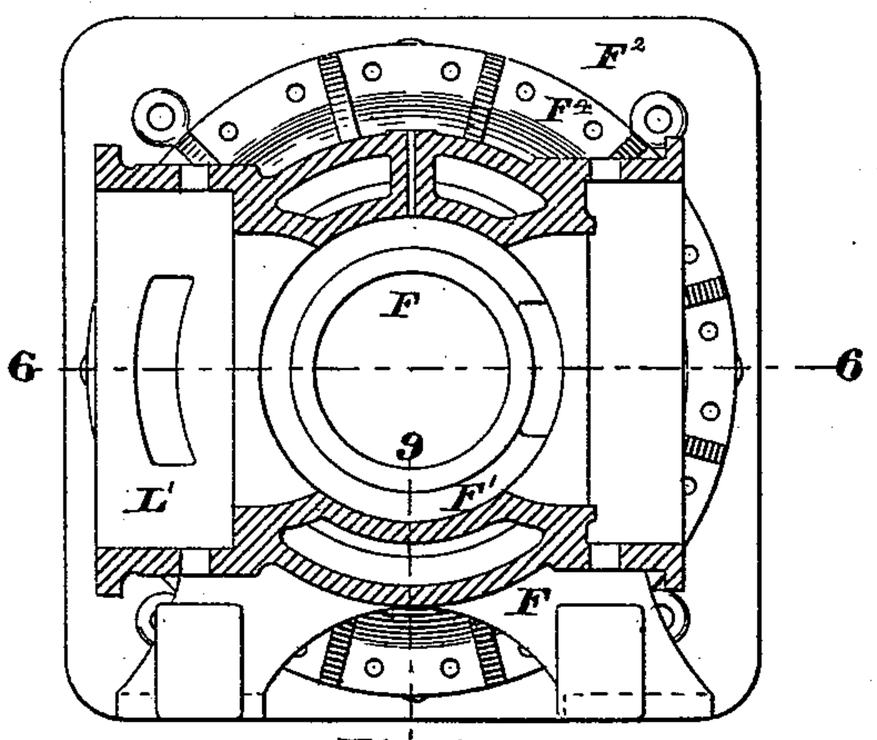

Fig. 10.

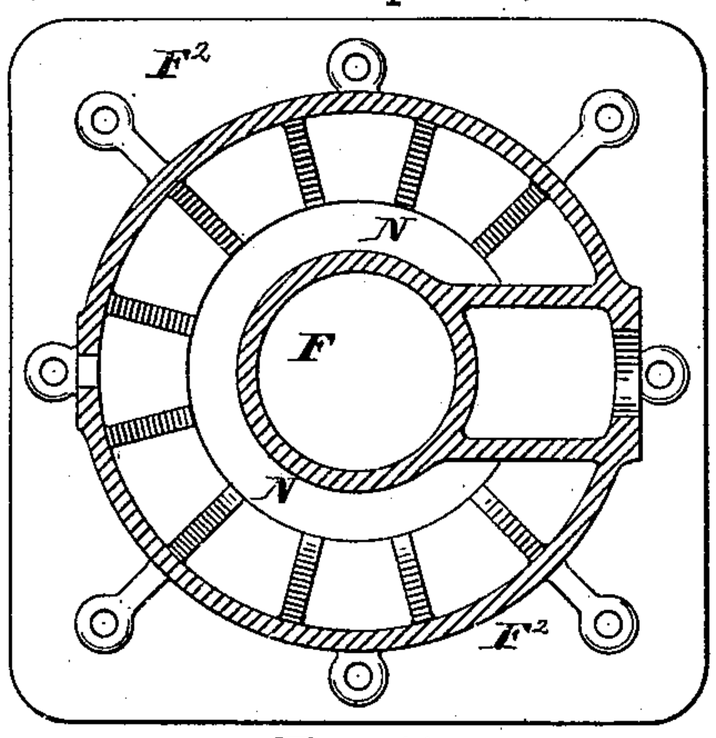

Fig. 11.

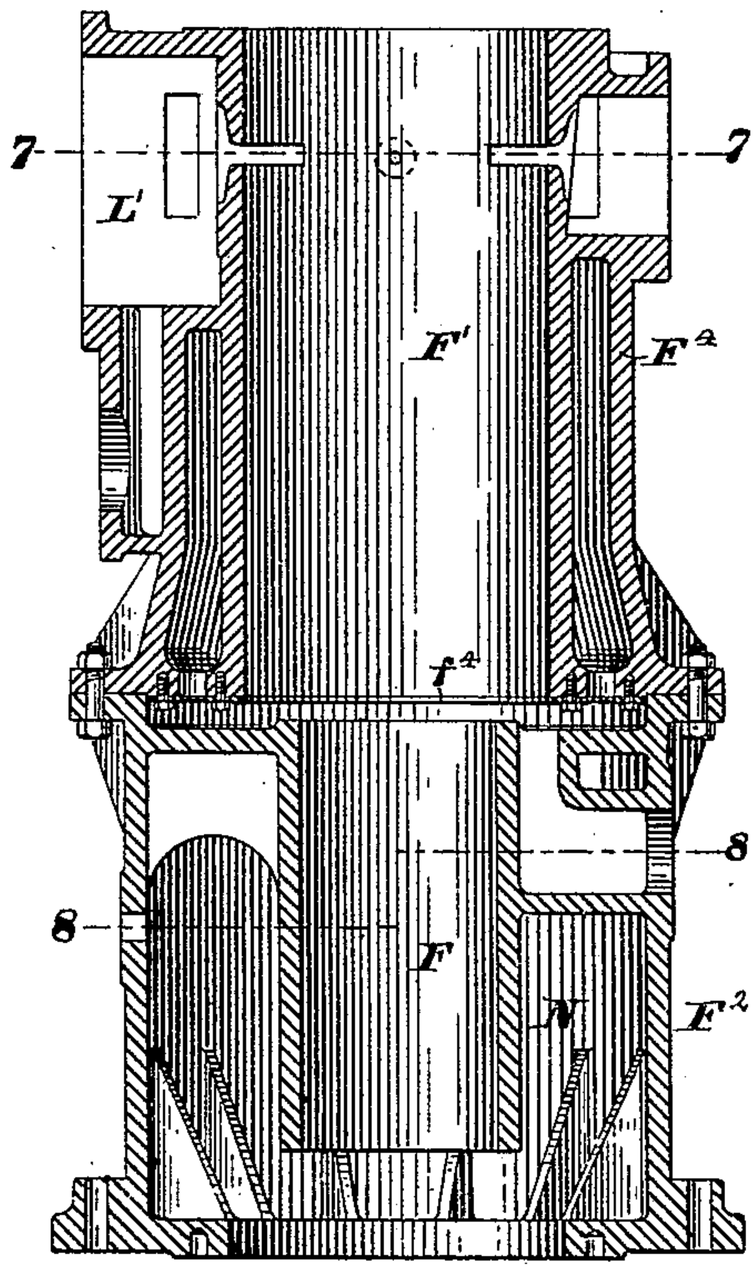

Fig. 9.

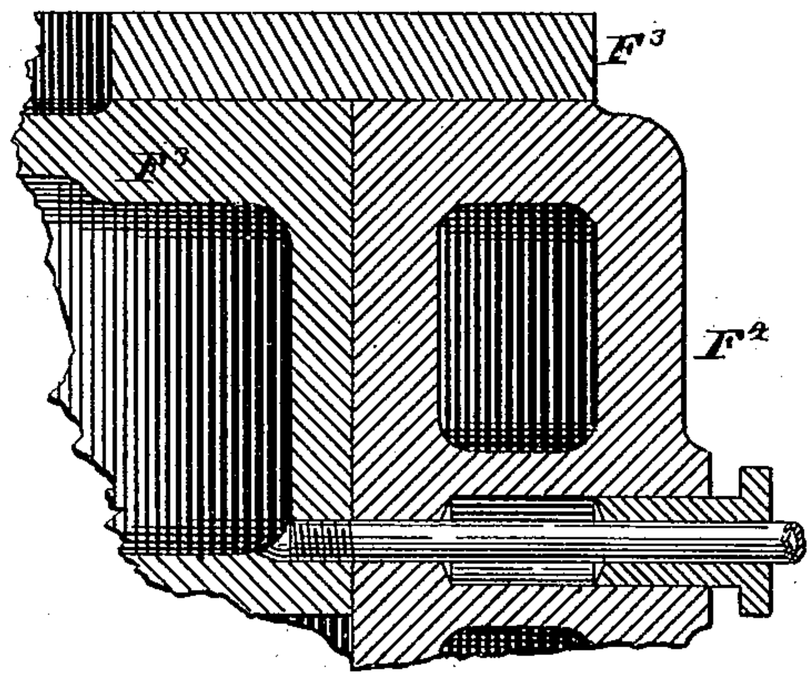

Fig. 12.

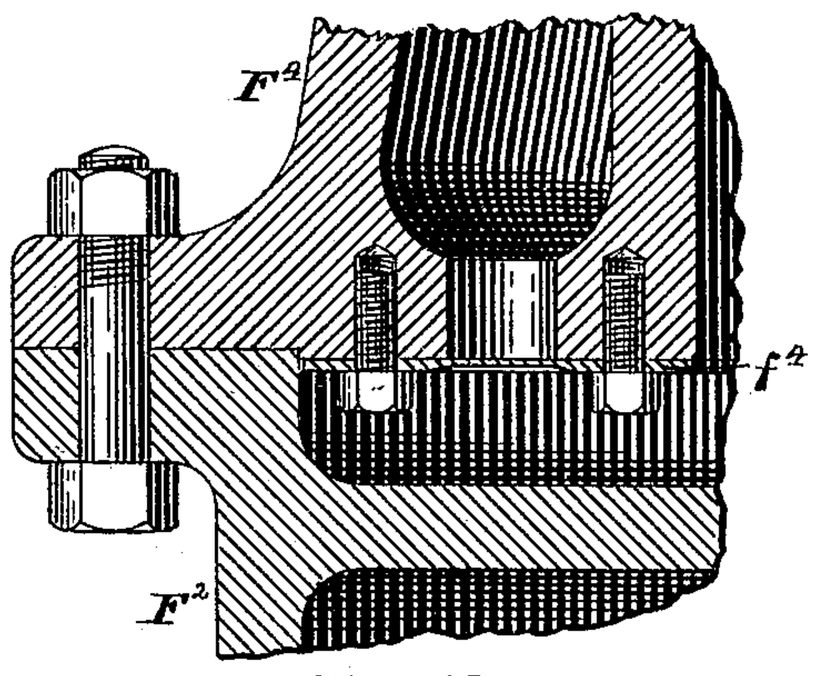

Fig. 13.

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(No Model.) 8 Sheets—Sheet 8.

E. D. LEAVITT, Jr.

STEAM STAMP FOR CRUSHING ORE.

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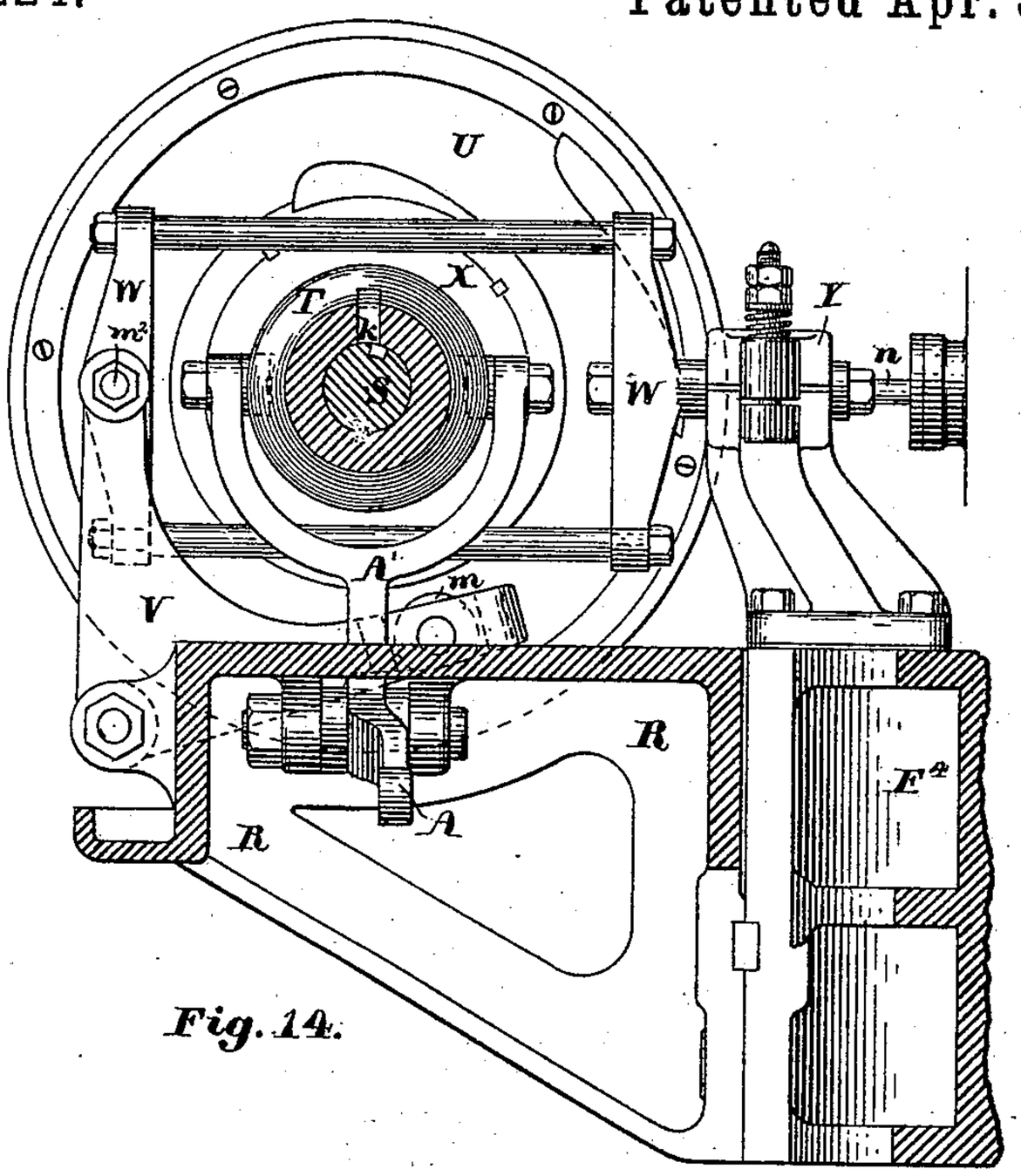

Fig. 14.

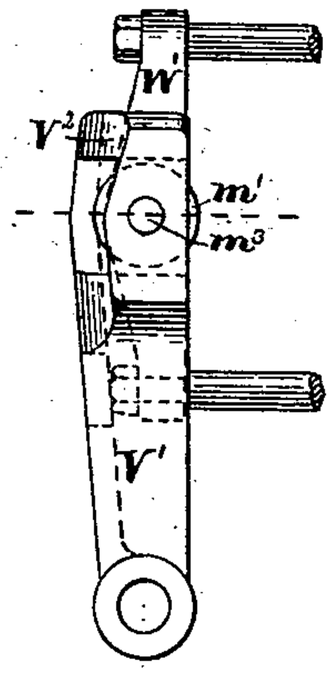

Fig. 15.

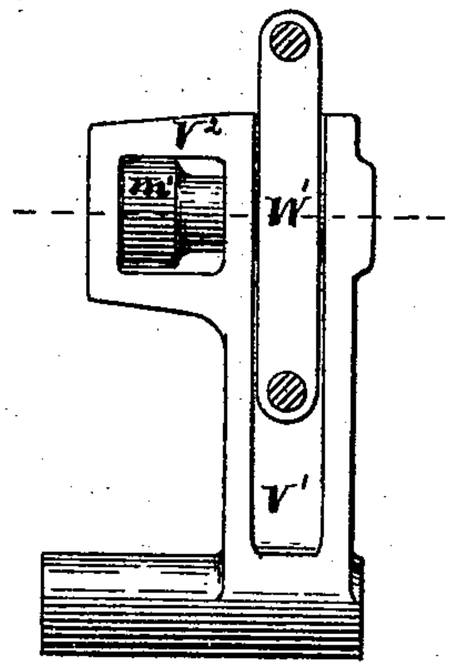

Fig. 16.

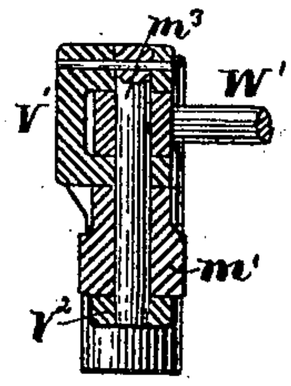

Fig. 17.

Fig. 18.

Witnesses:

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E. A. Hemmenway.

Inventor:

Erasmus D. Leavitt Jr.
by N. C. Lombard
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UNITED STATES PATENT OFFICE.

ERASMUS D. LEAVITT, JR., OF CAMBRIDGEPORT, MASSACHUSETTS.

STEAM-STAMP FOR CRUSHING ORE.

SPECIFICATION forming part of Letters Patent No. 275,224, dated April 3, 1883.

Application filed July 12, 1882. (No model.)

To all whom it may concern:

Be it known that I, ERASMUS D. LEAVITT, Jr., of Cambridgeport, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Steam-Stamps for Crushing Ores, of which the following, taken in connection with the accompanying drawings, is a specification.

My invention relates to that class of ore-stamps in which the stamp or hammer is operated by the direct application of steam to the hammer-rod, or a piston or pistons secured thereto, and is an improvement upon the well-known Ball stamp; and it consists, first, in the employment, as a means of operating the stamp or hammer, of differential steam-cylinders and pistons arranged in axial line with each other, in combination with means of maintaining the maximum pressure beneath the smaller piston at a uniform standard, and means of intermittently admitting steam to and exhausting it from the chamber above the larger piston, as will be more fully described hereinafter.

It further consists in the combination of the smaller cylinder, a receiver having free communication with said cylinder, and an automatically-operating valve arranged to control the admission of steam to said receiver, and thus maintain the maximum pressure therein at a uniform standard.

It further consists in a novel construction of the valve-gear, whereby the time of opening and closing the valves may be varied at will while the machine is in operation.

It further consists in the combination, with the differential cylinders and pistons, of a dash-pot located beneath and adapted to receive one of said pistons, and cushion it at the lower end of its downward movement, as will be described.

It further consists in the combination, with the stamp-rod and means of reciprocating it, of a dash-pot as a means of limiting its upward movement and a dash-pot for limiting its downward movement.

It further consists in the combination, with a vertically-reciprocating stamp or hammer, a mortar or stamping-chamber, and a steam-cylinder and piston adapted to operate said stamp or hammer, of a frame-work for supporting the steam-cylinder, made pyramidal in form and divided horizontally into three sections or stories, and having its upper section cast in one piece and its lower section made in two or more pieces, the whole being so united as to be self-supporting and independent of the structure of the building in which it is placed, and so that one portion of the lower section may be removed to permit the removal of the mortar without endangering the rest of the structure.

It further consists in the employment of a frictional clamping device applied to the valve-stem to prevent any undue movement of the valve.

It further consists in the combination of the large steam-cylinder provided with a jacket-casing cast therewith, but separated therefrom at one end, an annular expansion ring or plate connecting said jacket with the cylinder proper, and a smaller cylinder cast separate from and bolted to said larger cylinder in axial line therewith.

It further consists in a novel construction of the head of the lower or smaller cylinder, whereby said head is made to serve the purpose of a dash-pot to limit the downward movement of the piston of said cylinder.

It further consists in the combination of differential cylinders and pistons with means of maintaining a vacuum between said pistons, as will be more fully described.

It further consists in certain details of construction and arrangement of the parts, which will be readily understood by reference to the description of the drawings, and to the claims to be hereinafter given.

Figure 1 of the drawings is a side elevation of my improved stamp with a portion of the framing in section. Fig. 2 is a sectional front elevation of the same. Fig. 3 is a front elevation of the steam-cylinders and the upper section of the frame, with the valve-gear mounted thereon, drawn to an enlarged scale. Fig. 4 is a sectional plan of the upper section of the frame, the cutting-plane being on line 1 1 on Fig. 3. Fig. 5 is a horizontal section on line 2 2 on Fig. 3. Fig. 6 is a section of one corner of said upper section of the frame on line 3 3 on Fig. 3. Fig. 7 is a section on line 4 4 on Fig. 2. Fig. 8 is a horizontal section of

the framing on line 5 5 on Figs. 1 and 2. Fig. 9 is a central vertical section of the steam-cylinders on line 6 6 on Fig. 10. Fig. 10 is a horizontal section on line 7 7 on Fig. 9. Fig. 11 is a horizontal section on line 8 8 on Fig. 9. Fig. 12 is a partial vertical section on line 9 9 on Fig. 10, drawn to a still larger scale. Fig. 13 is a partial vertical section of the steam-cylinders, showing the manner of applying the expansion ring or plate, drawn to the same scale as Fig. 12. Fig. 14 is a vertical section of the valve-gear on line 10 10 on Fig. 3. Figs. 15, 16, 17, 18, 19, and 20 are detail views of parts of the valve-gear, to be hereinafter referred to.

A A are two metal bed-sills resting upon and secured to a suitable foundation, of which the line *a* indicates the upper surface, and B B are a series of timbers resting at their ends upon said bed-sills, and together forming a table or platform to receive the metallic bed C′ of the mortar C.

D D are two hollow metallic beams, arranged one upon each side of the wooden platform B B, and resting by their ends upon the bed-sills A A and firmly secured thereto by bolts or rivets. (Not shown.) Four hollow metallic columns, E E, are erected upon and secured to the upper surface of the beams D D in inclined positions, so that each column forms one corner of the lower section of a pyramidal structure composed of three divisions or sections placed one above the other, and supporting at its top the steam-cylinders F and F′, as shown.

The middle or central section of the pyramidal frame is composed of two side frames, G G, connected together by the tie-girts G′ and G², in which are formed the bearings for the stamp-shaft *b*, and provided at each end with flanges, by means of which and corresponding flanges upon the other sections, its lower end is firmly secured to the tops of the columns E, and its upper end is in like manner secured to the lower end of the upper section, H, which is cast entire in one piece, as shown in Figs. 3, 4, and 5.

The mortar proper, C, is made circular in plan, and the die *c*, ring *c′*, and lining *c²* are all constructed and arranged substantially as in the Ball stamp; but the upper part of the mortar or the screen-chamber C² is made cruciform in plan, instead of rectangular, as is the Ball screen-chamber, the outer wall of each arm of the cruciform chamber being inclined, and provided with a perforated screen-plate *d*, through which the pulp or crushed ore is discharged into the hopper or trough *e*, one of which is applied to each of said inclined sides of the screen-chamber, as shown in Fig. 2.

I is the stamp or hammer, secured to the stamp-shaft *b*, and having secured thereto the shoe I′ in a well-known manner.

Upon the top of the screen-chamber and surrounding the stamp-shaft *b* is an annular pipe, *f*, provided upon its inner periphery with a series of orifices and upon its upper side with two cone-like or funnel-shaped nozzles, through which water may be introduced into the mortar through suitable pipes. (Not shown.)

The stamp-shaft *b* has its bearings in the tie-girts G′ and G², and has secured to its upper end the piston J, which, near the upper end of its upward stroke, enters the inverted dash-pot J′, secured to the under side of the upper section of the pyramidal frame, by means of which the upward stroke of the stamp and its stem is limited without serious shock to the machinery.

F is a cylinder, open at both ends, and connected at or near its upper end by an annular flange or head with the inclosing-casing F², which in turn is bolted at its lower end to the upper surface of the upper section of the pyramidal frame, and also has secured to its lower end the head *f′*, provided with the stuffing-box *f²* and with the short upwardly-projecting cylinder *f³*, corresponding in interior diameter to the cylinder F, and having its upper end open and serrated, as shown in Fig. 2. F′ is another steam-cylinder, open at its lower end, having its upper end closed by the head F³, and having cast in one piece therewith and connected thereto, near its upper end, the casing F⁴, which is bolted by its lower end to the casing F², and connected by the annular expansion-plate *f⁴* to the lower end of the cylinder F′, as shown in Figs. 2, 9, and 13.

K and K′ are two pistons of different diameters, both mounted upon the piston-rod *g*, and fitted to and arranged to reciprocate in the cylinders F and F′, respectively, said pistons being maintained at the proper distance apart by the sleeve *g′*, interposed between them and surrounding the rod *g*, as shown in Fig. 2.

L is a steam-gate through which steam is admitted to the steam-chest L′ of the cylinder F′, and *h* is the steam-valve by which the admission of steam to the cylinder F′, above the piston K′, is controlled. When the steam above the piston K′ has accomplished its work of forcing the pistons K and K′, the piston-rod *g*, the stamp-shaft *b*, and stamp I downward to give the desired blow, the steam escapes through the exhaust-port and the valve *h′* into the pipe L², through which it passes to the condenser M. The pipe L² is connected by the pipe L³ with the chamber between the two pistons K and K′, for the purpose of maintaining a vacuum in said chamber. The chamber N, between the cylinder F and the outer casing, F², and the chamber beneath the piston K, are supplied with steam at a constant pressure by means of an automatic valve, N′. (Shown in Fig. 2.)

The valve N′, not being of my invention, is not shown in detail in the drawings, and need not be described here further than to say that the valve which I have successfully used in this connection is shown and described in Letters Patent No. 240,060, granted to Joseph E. Watts, April 12, 1881, which operates to maintain a uniform maximum pressure beneath the piston K; or, in other words, the valve N′

so regulates the admission of steam to the chamber N and the space beneath the piston K that the maximum pressure therein is uniform, regardless of what may be the fluctuations of pressure above the piston K′.

O is an air-pump for discharging the air and water from the condenser M.

The rod *g* is connected to the stamp-shaft *b* by a swivel-connection, so that the stem *b* and stamp I may be revolved by means of a flanged pulley, *i*, mounted upon the sleeve *i′* and a suitable belt leading therefrom to any suitable driving-pulley. The sleeve *i′* surrounds the stem *b* between the tie-girts G and G′, and is connected to said stem by means of suitable keys and keyways, so that as said sleeve is revolved the stamp-shaft *b* and the stamp I must revolve therewith, while at the same time it is free to be moved endwise through said sleeve as the stamp rises and falls.

The short serrated section of cylinder f^3, upon the head *f′*, serves as a dash-pot to limit the downward movement of the piston K, the steam contained therein serving as an elastic cushion to receive the blow, the serrations formed in the upper end of said short cylinder serving as ports for the admission of steam to the cylinder F, and by virtue of their peculiar shape to gradually check the downward movement of the piston and prevent undue shock to the cylinder.

P, P′, and P^2 are the several floors of the building through which the pyramidal frame extends, as shown.

Q is the hopper or chute through which the ore is supplied to the mortar in a well-known manner.

R is a frame or bracket secured to the front side of the cylinder F′, and supporting thereon the pillow-blocks R′ and R^2, in which is mounted the shaft S, upon one end of which is firmly secured the pulley S′, by means of which and a suitable belt leading therefrom to a driving-shaft (not shown) said shaft S may be revolved.

The shaft S has formed in its periphery two keyways or spline-grooves, *j* and *j′*, extending spirally partially around said shaft in opposite directions, as shown in Fig. 18, in each of which is fitted a curved key, *k*, which is provided with an outwardly-projecting lip, the sides of which are parallel with the axis of said shaft, and the outer edge of which is provided with the lugs *l l* to embrace the grooved collar T or T′, as shown in Figs. 19 and 20. The shaft S has firmly secured thereon, so as to revolve therewith, the two annular or inside face-cams, U and U′, arranged respectively to open the steam-valve *h* and to close the exhaust-valve *h′* through the medium, in the one case, of the truck *m*, lever V, yoke W, and valve-rod *n*, and, in the other, of the truck *m′*, lever V′, yoke W′, and valve-rod *n′*. Within these annular cams U and U′ are two face-cams, each provided with a long hub, X or X′, and mounted upon the shaft S, and connected thereto, so as to revolve therewith, by means of the keys *k*, the outer portions of which project through slots *o* and *o′*, respectively, which are cut longitudinally of said hubs, as shown in Figs. 19 and 20, so that said cams and their hubs X and X′ may be moved to a limited extent around said shaft, while said shaft is in motion, for the purpose of varying the time of closing the steam and opening the exhaust valves, respectively, which is done by said face-cams acting upon the opposite sides of the same trucks, *m* and *m′*, that are acted upon by the annular cams U and U′ to open the steam and close the exhaust valves.

The lever V for operating the steam-valve *h* is a two-armed bent or elbow lever, the upright arm of which is forked so as to embrace the outer bar of the yoke W, and is pivoted thereto at m^2, and the movable end of the other arm has mounted upon a suitable journal set therein the truck *m*, all as shown in Figs. 3 and 14.

The lever V′, which operates the yoke W′, and through it the exhaust-valve *h′*, is a single-armed lever slotted upon its inner face so as to embrace the outer bar of the yoke W′, and provided with the slotted projection V^2, in which is mounted the roll *m′* upon the pin m^3, which also serves as the pivotal connection between the lever V′ and the yoke W′, as shown in Figs. 15, 16, and 17.

A′ and A^2 are forked elbow-levers provided at their forked ends with trucks or studs to engage with the peripheral grooves in the collars T and T′, respectively, and having pivoted to their opposite ends the links a' and a^2, respectively, the lower ends of which are in turn pivoted to the screw-rods b' and b^2, fitted to the hand-nuts d' and d^2, and guided at the their upper ends in the slides e' and e^2, respectively, as shown in Fig. 3. By turning the hand-nut d' the collar T will be moved along the hub X, carrying with it the key *k*, which, moving in the spiral groove *j* in the shaft S, will cause the hub X and its cam to be moved around the shaft S, so as to vary the angular distance between the throw of said cam, which closes the valve *h*, and the throw of the cam U, which opens said valve. By turning the hand-nut d^2 a precisely similar result is produced upon the hub X′ and its cam as a means of varying the movements of the exhaust-valve *h′*.

A grooved collar, b^3, is firmly secured upon the rod *g*, and engages with the forked lever b^4 to vibrate it as the rod *g* moves up and down.

The lever b^4 is connected by the link g^2 to the lever g^3, the opposite end of which is pivoted to the rod h^2, arranged to slide vertically in bearings, and provided at its upper end with means of connection with a cord for operating a steam-indicator. (Not shown.)

The valves *h* and *h′* are prevented from being thrown too far by their operating cams by mounting their stems or the connecting portions of the yokes W and W′ in the friction-bearings Y, as shown in Fig. 14.

Upon the inner corner of each of the col-

umns E of the lower section of the pyramidal frame-work is securely bolted a bracket, E′, having at its inner edge two faces at right angles to each other, which, with the fixed lips i^2 i^2 and the detachable lips i^3 i^3, form vertical grooves, into each of which are fitted two pieces of wood, i^4 and i^5, against the latter of which the planed surfaces i^6 i^6, formed upon the sides of the mortar, bear to hold said mortar in position and at the same time permit it to move vertically as the blow of the descending stamp is received upon the die *c*.

By constructing the pyramidal frame in sections, as described, and the lower section of the four columns E and brackets E′, the mortar or screen chamber may be removed for repairs by removing three of the brackets E′ and one of the columns E without disturbing the remainder of the structure, which is a great advantage, and another advantage of constructing the frame in the pyramidal form is that the machine is entirely self-supporting, and the jar and tremble of the machine do not disturb its alignment.

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

1. The combination, in a steam-operated stamp, of a pair of differential steam-cylinders in axial line with each other, means of maintaining a constant pressure beneath the piston of the smaller cylinder, means of intermittently admitting steam to and exhausting it from above the piston of the larger cylinder, and a stamp-shaft carrying at its lower end a stamp, die, or hammer, substantially as described.

2. The cylinder F, the casing F^4, surrounding said cylinder and inclosing an annular chamber, openings or ports connecting said annular chamber with the interior of said cylinder, and an automatic valve adapted to control the admission of steam to said chamber and cylinder and maintain the maximum pressure therein at a uniform standard, substantially as described.

3. The cam-shaft S, provided with the spiral groove *j′*, in combination with cam U, fixed thereon, the slotted hub X and its cam, the key *k*, the collar T, and means of moving said collar along said hub X, substantially as and for the purposes described.

4. The combination of the shaft S, provided with the spiral groove *j*, the cam U, slotted hub and cam X, key *k*, collar T, forked elbow-lever A′, link *a′*, screw-rod *b′*, and hand-nut *d′*, all arranged and adapted to operate substantially as and for the purposes described.

5. The combination of the differential cylinders F and F′, the pistons K and K′, and the dash-pot f^3, all constructed, arranged, and adapted to operate substantially as and for the purposes described.

6. In a steam-operated ore-stamp, the combination, with the stamp-shaft and a steam-piston for operating it, of a dash-pot adapted to receive said piston and limit its downward stroke by a cushion of steam, and a second and inverted dash-pot surrounding said stamp-shaft, but removed from the steam-cylinder and adapted to limit the upward movement of said shaft by means of a cushion of air, substantially as and for the purposes described.

7. In combination with a vertically-reciprocating stamp or hammer, a mortar or stamping-chamber, and a steam-cylinder and piston for operating said stamp or hammer, an iron frame-work for supporting said cylinder and the other operative parts of the machine, made pyramidal in form and divided horizontally into three sections or stories, the upper section being cast in one piece and the lower section in two or more pieces, the whole being so united as to be self-supporting and independent of the building in which it is placed, substantially as described.

8. In a steam-stamp, a pyramidal frame divided horizontally into two or more sections or stories, the upper section or story of which is cast in one piece and the lower section in two or more pieces, one of which may be removed to permit the removal of the mortar, in combination with brackets or guides secured to said lower section and adapted to support or guide the mortar in its slight vertical movements, substantially as described.

9. The combination of the cams U and X, lever V, yoke W, valve *h* and its rod, and the friction-bearing Y, all arranged and adapted to operate substantially as described.

10. The combination of the differential cylinders F and F′, the annular casing F^4, cast in one piece with the cylinder F, and the annular expansion-plate f^4, all constructed, united, and adapted to operate substantially as and for the purposes described.

11. In combination with the cylinder F, open at its bottom and provided with the annular casing F^2, the head *f′*, provided with the short cylinder f^3, open at its upper end, and suitable openings for the passage of steam between the contiguous ends of said cylinders F and f^3, substantially as described.

12. The combination of two differential cylinders arranged in axial line with each other, two differential pistons mounted upon a common piston-rod, and means of maintaining a vacuum between said pistons, substantially as described.

13. The combination of the screen-chamber C^2, provided with the surfaces i^6, the brackets E′, provided with the guideways i^2, and the columns E, all arranged and adapted to operate substantially as described.

14. The dash-pot f^3, provided with a series of V-shaped notches in its upper edge, substantially as described.

ERASMUS D. LEAVITT, JR.

Witnesses:
DECOURCY MAY,
G. E. WHITNEY.