(No Model.) 3 Sheets—Sheet 1.

T. L. STURTEVANT.

MILL.

No. 498,037. Patented May 23, 1893.

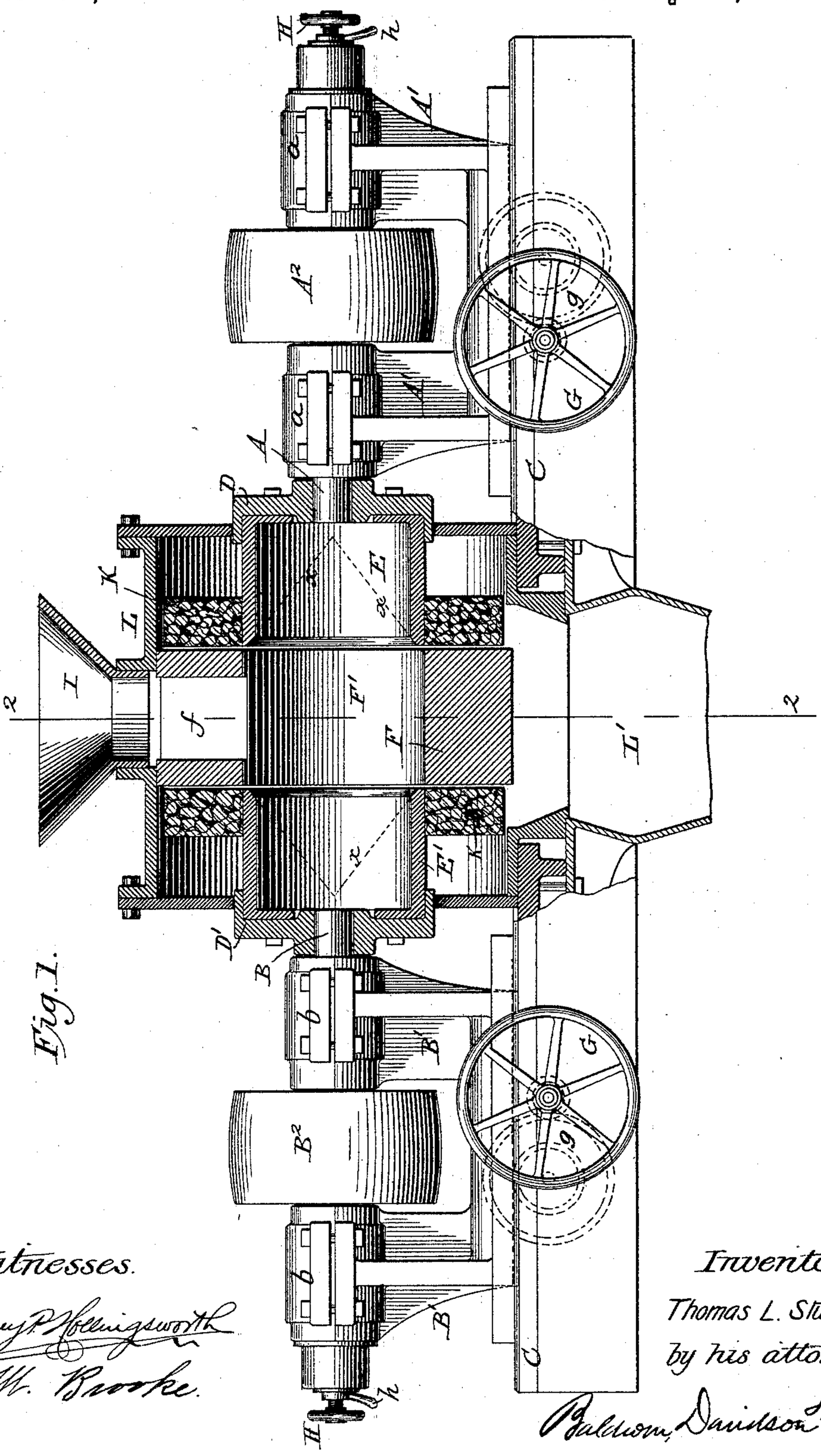


Fig. 1.

Witnesses.

Sidney P. Hollingsworth

C. W. Brooke.

Inventor

Thomas L. Sturtevant

by his attorneys

Baldwin, Davidson & Wright.

(No Model.) 3 Sheets—Sheet 2.

T. L. STURTEVANT.

MILL.

No. 498,037. Patented May 23, 1893.

Fig. 2
ON 2 - 2

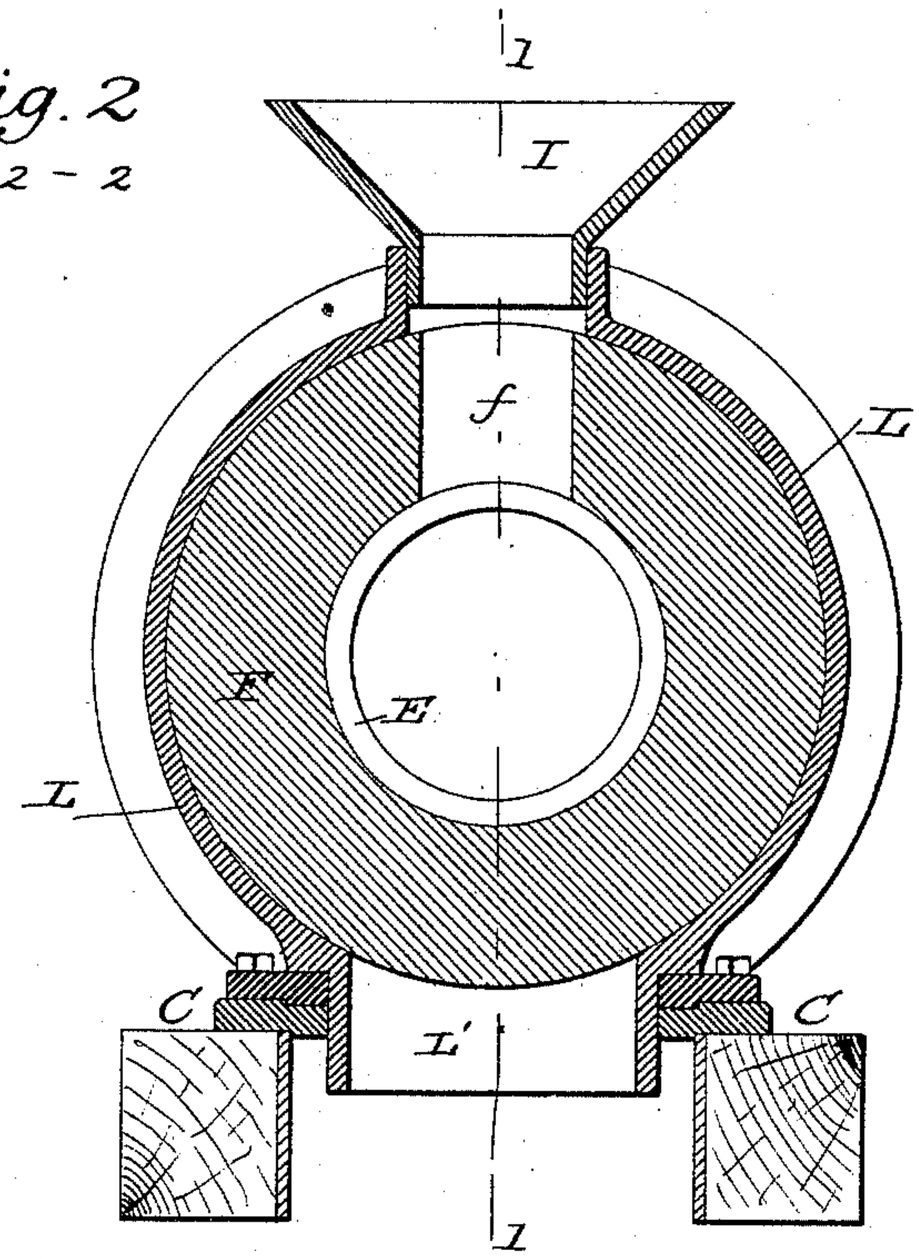


Fig. 3.

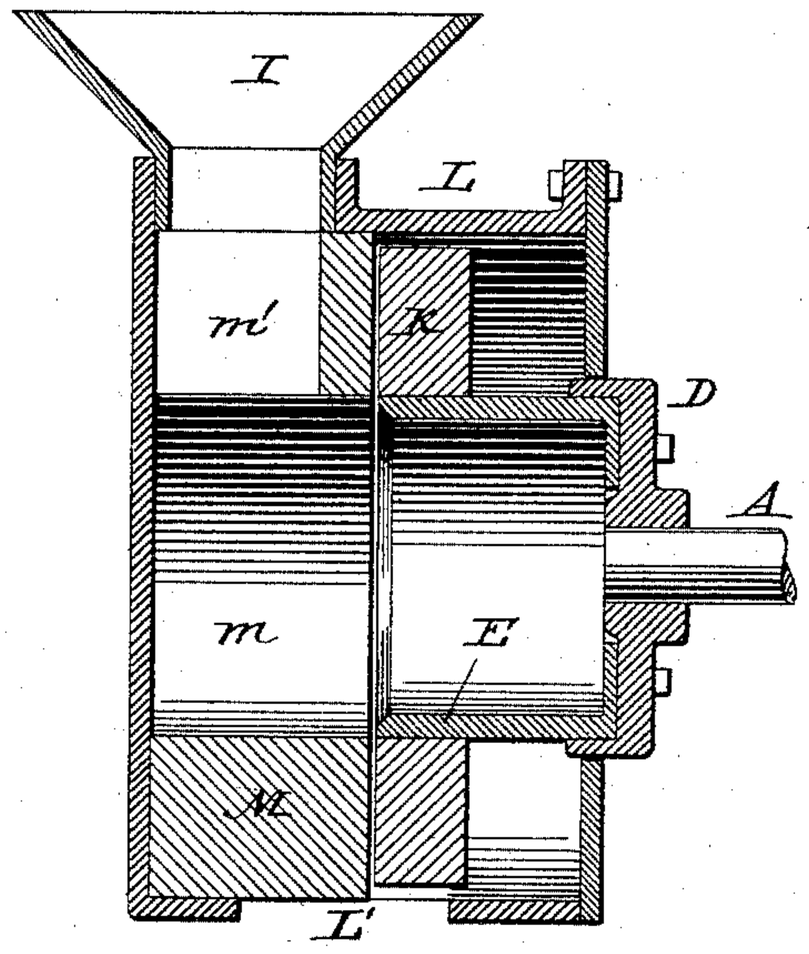
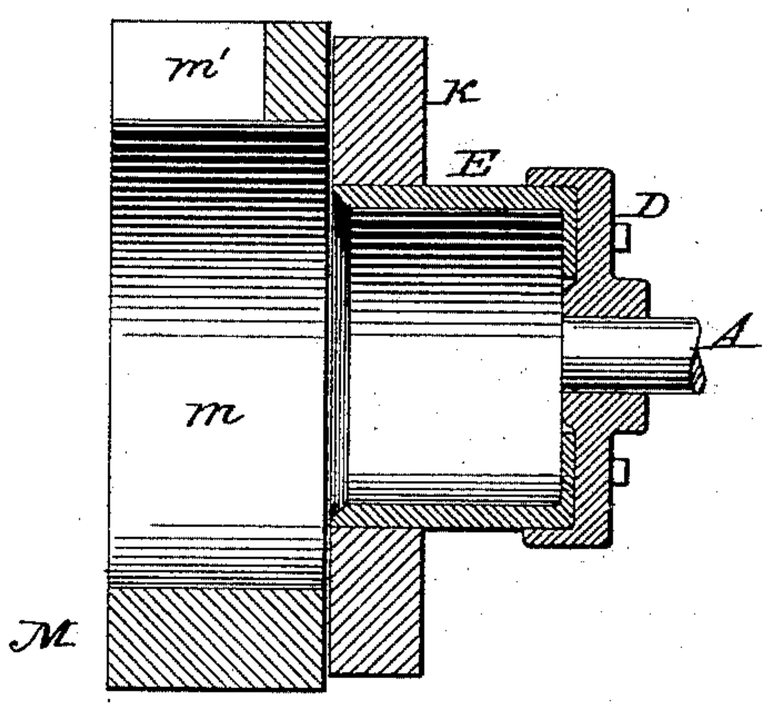


Fig. 4.



Witnesses;
Sidney P. Hollingsworth Jr.
C. W. Brooke.

Inventor;
Thomas L. Sturtevant,
by his attorneys,
Baldwin Davidson & Wright.

(No Model.) 3 Sheets—Sheet 3.

T. L. STURTEVANT.

MILL.

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Fig. 6 on 6-6

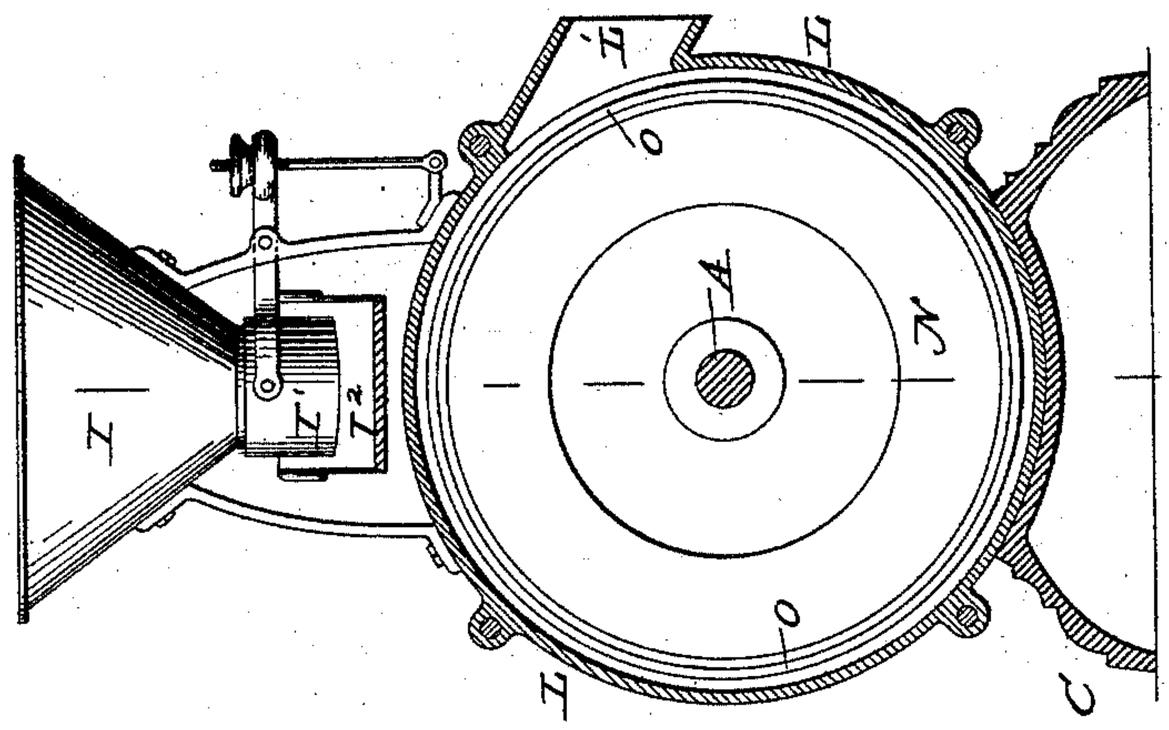


Fig. 7.

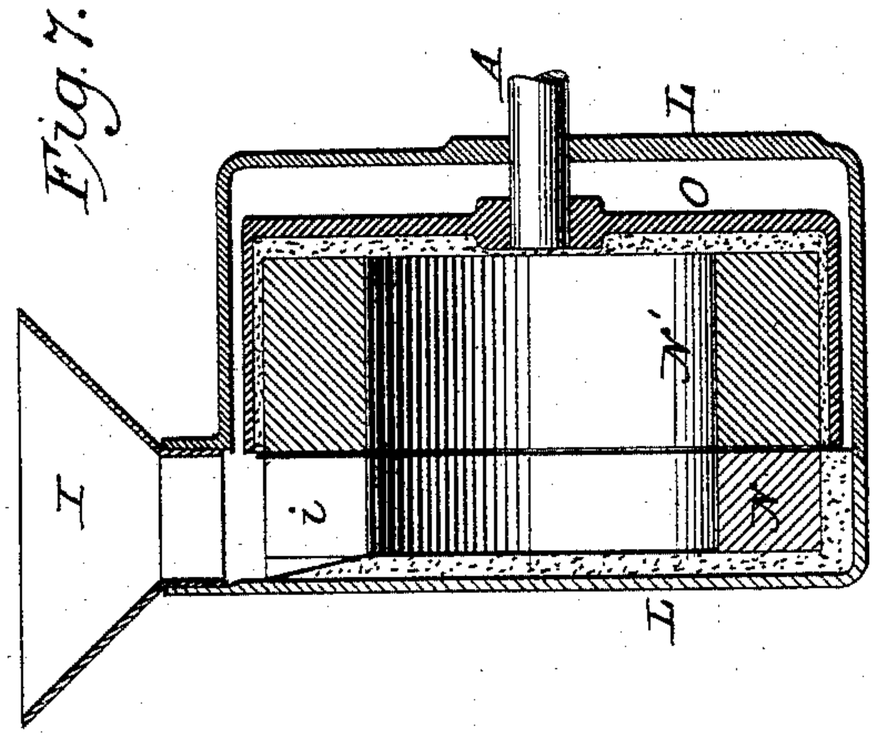
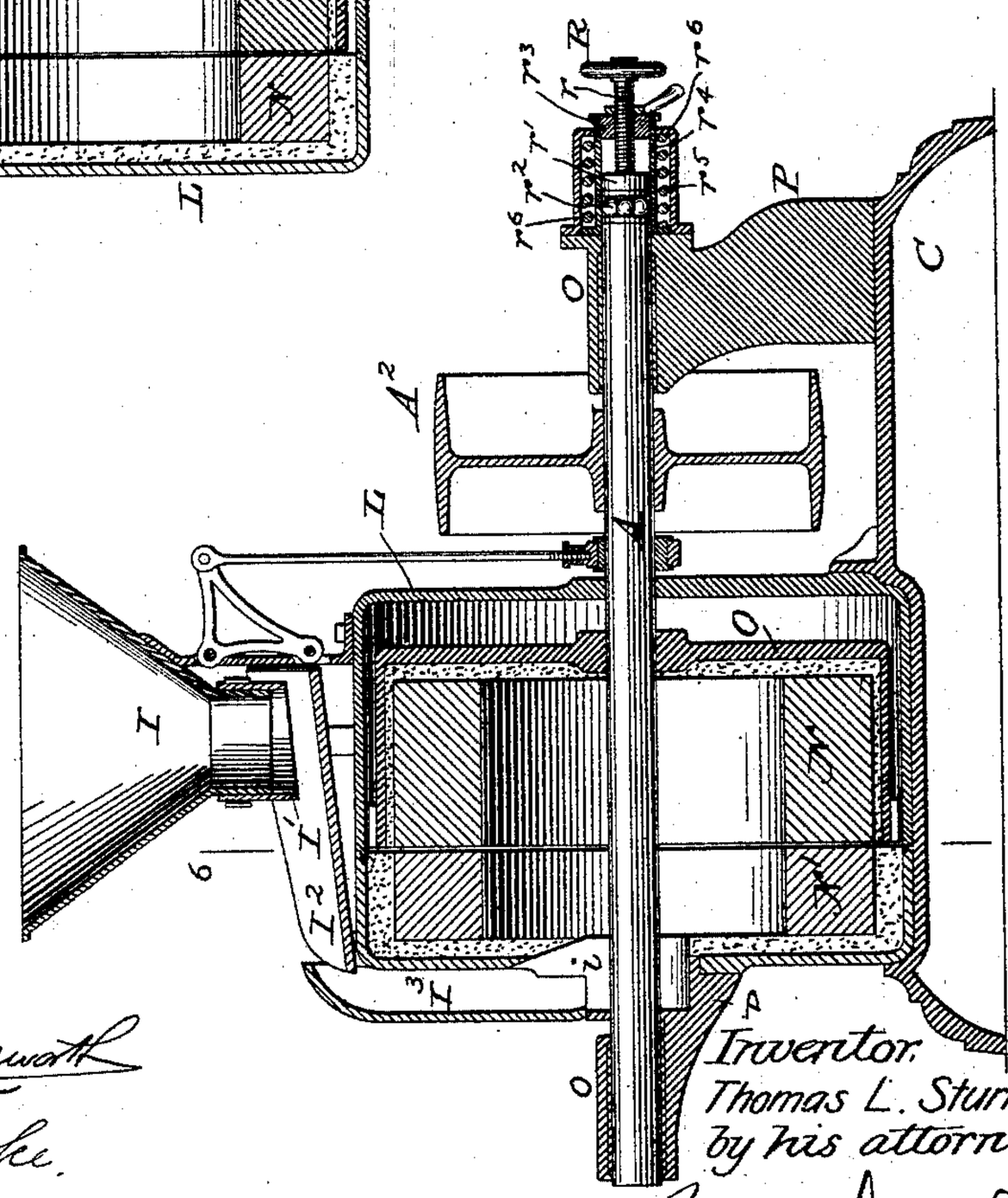


Fig. 5. on 5-5



Witnesses;
Sidney P. Hollingsworth
C. W. Burdett.

Inventor.
Thomas L. Sturtevant,
by his attorneys,
Baldwin Davidson & Wright

UNITED STATES PATENT OFFICE.

THOMAS L. STURTEVANT, OF FRAMINGHAM, ASSIGNOR TO THE STURTEVANT MILL COMPANY, OF BOSTON, MASSACHUSETTS.

MILL.

SPECIFICATION forming part of Letters Patent No. 498,037, dated May 23, 1893.

Application filed August 9, 1892. Serial No. 442,558. (No model.)

To all whom it may concern:

Be it known that I, THOMAS L. STURTEVANT, a citizen of the United States, residing at Framingham, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Mills, of which the following is a specification.

My invention particularly relates to mills for crushing and grinding ores, phosphates, cement and other like hard and refractory materials. It constitutes certain improvements on the attrition mill shown in my patent, No. 255,550, of March 28, 1882. The mill shown in this patent comprises a rotary chambered member, and a chamber connected with a feed hopper. The organization and operation are such that the material in a coarse or rocky condition is caused to act upon itself, to reduce itself into a comparatively fine or granular condition. Such a mill both crushes and grinds the material in a most economical and efficient manner. It is very powerful and there is little wear and tear on the parts and hence it is durable. Heretofore in "running" this mill, all the material has not been reduced to the desired size, and it has been customary to transfer the finer reduced material to buhr stones, or similar millstones, to finish it or reduce it to the desired powdered form. The coarser material has been conveyed by elevator buckets, or similar elevators, to the feed hopper, and has been passed through the mill, where it is re-ground to a fine granular form, suitable for finishing in the mill-stones, as above stated.

The object of my present invention is to improve the mill shown in my patent above referred to in such manner that it shall act more efficiently to crush and grind the material fed to it, and shall also at one operation reduce the material to the desired degree, thus obviating the necessity of re-grinding in buhr stones or of re-conveying the coarser material to the feed hopper. I therefore employ, in addition to the rotary chambered member and the chamber connected to the feed hopper, grinding surfaces operated coincidently or simultaneously with the rotary chambered member, and adapted to act on the reduced material to grind and pulverize it to the desired degree.

In the accompanying drawings,—Figure 1 is a view, partly in longitudinal vertical section, on the line 1—1 of Fig. 2, and partly in elevation, of a mill embodying my improvements. Fig. 2 is a transverse section, on the line 2—2 of Fig. 1. Fig. 3 illustrates a modification in which one of the grinding surfaces is rotary and the other stationary. Fig. 4 illustrates a further modification of the organization shown in Fig. 3. Fig. 5 is a view in longitudinal vertical section, on the line 5—5 of Fig. 6, of a mill in which the feed hopper is connected at the side to the crushing and grinding members. Fig. 6 is a transverse section of the same, on the line 6—6 of Fig. 5, and Fig. 7 is a detail view of a further modification.

In Figs. 1 and 2 I have illustrated a mill embodying two rotary chambered members, in combination with grinding surfaces.

Separate shafts A and B, are mounted in standards A′, B′, supported on a suitable bed-plate C. The shafts have suitable bearings *a*, *b*, and carry driving pulleys A^2, B^2. Each shaft carries at its inner end a flanged head D, D′, to which is secured a cylindrical casing or bushing E, E′, the inner ends of which are arranged a sufficient distance apart to accommodate the stationary central member F. The parts D, E, and D′, E′ each constitute a rotary chambered member and they are adapted to revolve in opposite directions. The standards A′ and B′ are adjustable on the bed-plate by hand-wheels G, and gearing *g*, in order that the distance between the chambered members may be varied, and a finer adjustment may be obtained by the hand wheels H, and the lock-nuts *h*.

Material to be ground is fed from the hopper I, through an opening *f*, in the stationary member F, and, in a coarse rocky condition, passes from the hopper into the chambered members on each side, which throw it inwardly and cause the rocks to act upon themselves forcibly and powerfully so that they are crushed and broken up and more or less powdered. Soon after the crushing operation has commenced, a portion of the finely reduced material adheres to the recessed heads and takes the form indicated by dotted lines at *x*, thus forming a protective lining for the

heads or chambered members, and preventing wear except at the extreme inner beveled edges of the cylinders or bushings E, E′.

In the mill shown in my patent above referred to, the reduced material was discharged through a screen, and this screen was subject to more or less wear, and it was necessary from time to time to renew it. I now omit the screen, and, as shown in Fig. 1, surround each chambered member with a stone or grinder K, which may be of buhr stone, or it may be a composite stone comprising small irregular lumps of emery and a binding material. So far as the scope of my invention extends, however, any suitable grinding material may be employed, but I prefer those specifically mentioned.

The central stationary member F, has an opening F′, extending through it and communicating with the passage *f*, leading to the feed hopper, and the outer sides or edges of the stationary member are in suitable proximity to the grinders K, to reduce the granular material passing from the chambered members to the desired degree. Any suitable exit may be employed for the powdered material.

I have shown the working parts of the mill surrounded by a casing L, and I preferably employ a discharge opening L′, at the bottom thereof. All the reduced material passing out readily from between the grinders, is guided by the casing to the discharge-spout or opening L′, from which it may be delivered to a suitable receptacle.

The grinders K, as above explained, are carried by the rotary members E, E′, which revolve in opposite directions, and the grinding surfaces may be adjusted by means of the hand-wheels G and H, in the manner before explained, to regulate the size or fineness of the material discharged from the machine.

In Fig. 3 I have indicated a slight modification. As there shown, one member may be stationary, while the other rotates. The grinder M, on the left hand side, has a central chamber *m*, which communicates with an opening *m′*, at the top, connected with the feed hopper I. The rotary chambered member E, and the grinder K, are similar in all respects to those indicated at E and K, in Fig. 1. Motion may be imparted to the shaft A in any suitable way. The chambered members and grinders are surrounded by a suitable casing L, and the material is discharged through an opening L′, in the casing.

In Fig. 4 the arrangement is substantially the same except that the chamber *m*, in the stationary member M, is somewhat larger in diameter than the chamber in the rotary member.

The mill shown in Fig. 5 is simpler and less powerful than that shown in Fig. 1. The chambers are formed in the grinders N, N′, and these are surrounded by a suitable casing L. The grinder N′ is stationary, and may be cemented in the casing, as indicated. The grinder N is cemented to a flanged frame O, secured to the shaft A, which has bearings *o*, in suitable standards or brackets P. One end of the shaft is provided with an adjusting hand-wheel R, carried by a screw *r*, having a head *r′*, between which and the shaft are interposed anti-friction balls r^2. The screw passes through a head r^3, in a cylinder r^4, and this cylinder is surrounded by a spiral spring r^5, within a casing r^6. This construction affords a desirable arrangement for adjusting the grinding surfaces.

The hopper I is provided with an adjustable feed-spout I′, of well known construction, and the material to be ground is delivered from the spout to a chute I^2, communicating with another chute I^3, which delivers the coarse or rocky material through an opening *i* to the chambers of the grinders.

A similar mill to that just described may be constructed with a feed-opening at the top, as indicated in Fig. 7. This figure shows the other parts of the mechanism substantially the same as those indicated in Fig. 5.

A mill constructed in accordance with my invention possesses many advantages. It "grinds fine" at one operation. There are no tailings to be returned for re-grinding, and screening is dispensed with. No auxiliary finishing machine is necessary. The mill will act on either wet or dry material, and is not easily clogged. All the parts of the machine are strong and durable, and, as the force required to reduce the material is mainly expended by the larger rocks striking against themselves, and breaking up into granular form, the strain on the working parts is materially reduced, and for this reason the mill runs more easily, works more efficiently, and lasts much longer without repair.

I claim as my invention—

1. A crushing and grinding mill comprising a chamber to which the material to be reduced is fed, a rotary cup-shaped member having an end piece, and a deep casing or bushing projecting at substantially right angles from the end piece, an annular grinder surrounding the outer end of the cup-shaped casing, and connected thereto to revolve therewith, and an opposing grinder adjacent to said rotary grinder.

2. A crushing and grinding mill comprising a chamber to which the material to be reduced is fed, a cup-shaped member revolving about a horizontal axis by which the coarse material is made to act upon itself to reduce itself to a granular form and which comprises a closed end with a cylindrical casing projecting at right angles therefrom and forming a chamber having a smooth interior surface, an annular grinder surrounding the outer end of the chambered member, another annular grinder in close proximity thereto and means for adjusting the chambered member and one grinder relatively to the other grinder.

3. A crushing and grinding mill comprising

a chamber to which the material to be reduced is fed, a rotary cup-shaped member comprising an end piece, and a cylindrical bushing or casing projecting at right angles therefrom and greater in length than one-half the diameter of the head, and adjustable grinding members surrounding the rotary chambered member to further reduce the material before it is discharged from the machine.

4. The combination of a central stationary chambered member, a feed hopper communicating therewith, a rotary cup-shaped member on each side of the stationary member, each comprising a head piece, provided with a cylindrical bushing projecting at right angles from the head piece, means for rotating the chambered members in opposite directions, and grinders having parallel grinding surfaces surrounding the chambered members, substantially as set forth.

5. The combination of a central, stationary grinder having a central chamber, a feed hopper communicating with an opening in the central grinder which leads to the central chamber thereof, a rotary chambered member on each side of the stationary grinder, each comprising an end-piece and a cylindrical bushing projecting at right angles therefrom means for rotating the chambered members in opposite directions, and an annular grinder on each side of the central grinder and surrounding the chambered members, substantially as set forth.

6. The combination of a chambered member to which the material to be ground is fed, a rotary chambered member communicating therewith, and comprising an end-piece and a cylindrical bushing projecting at right angles therefrom grinders surrounding the rotary chambered member composed of small, irregular lumps of emery and a binding material, means for rotating the rotary chambered member and one of the grinders, a casing surrounding the working parts of the apparatus and provided with a discharge opening through which the finely reduced material is delivered.

In testimony whereof I have hereunto subscribed my name.

THOMAS L. STURTEVANT.

Witnesses:

EDWARD H. MASON,

W. H. ELLIS.