A. J. GORE.

PULVERIZING MILL.

APPLICATION FILED JULY 6, 1909.

960,893.

Patented June 7, 1910.

4 SHEETS—SHEET 1.

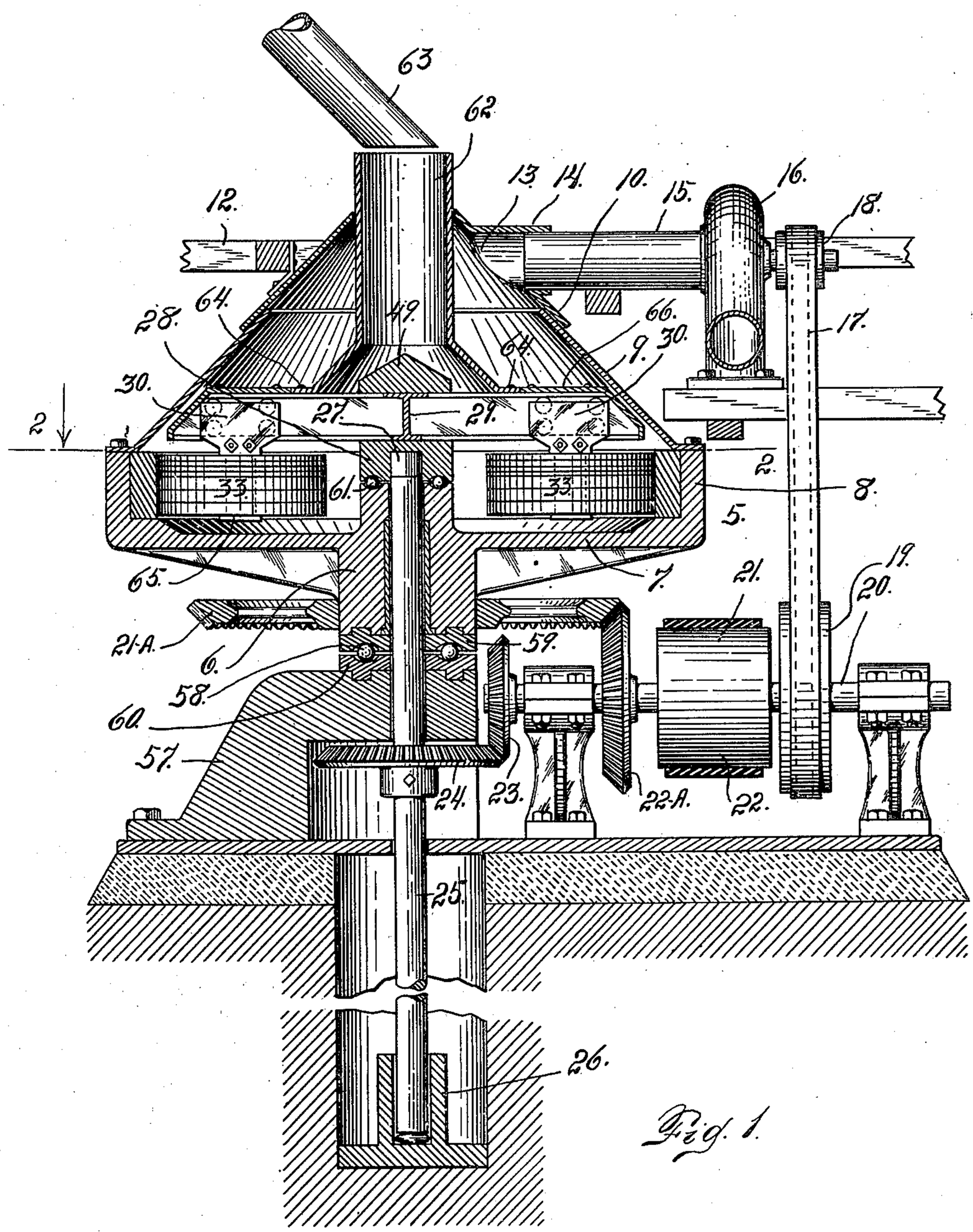

Fig. 1.

Witnesses

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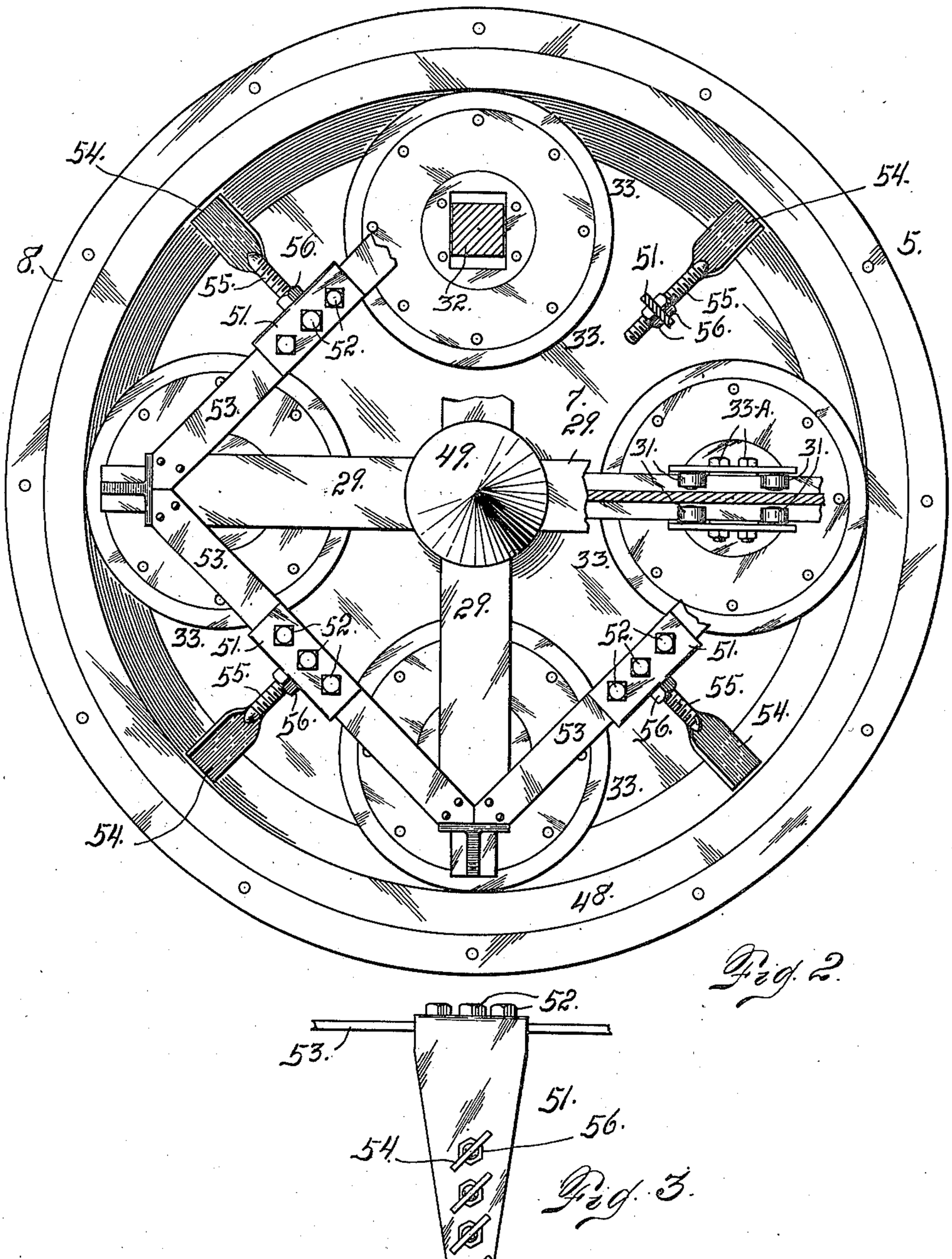

Fig. 2.

Fig. 3.

Witnesses

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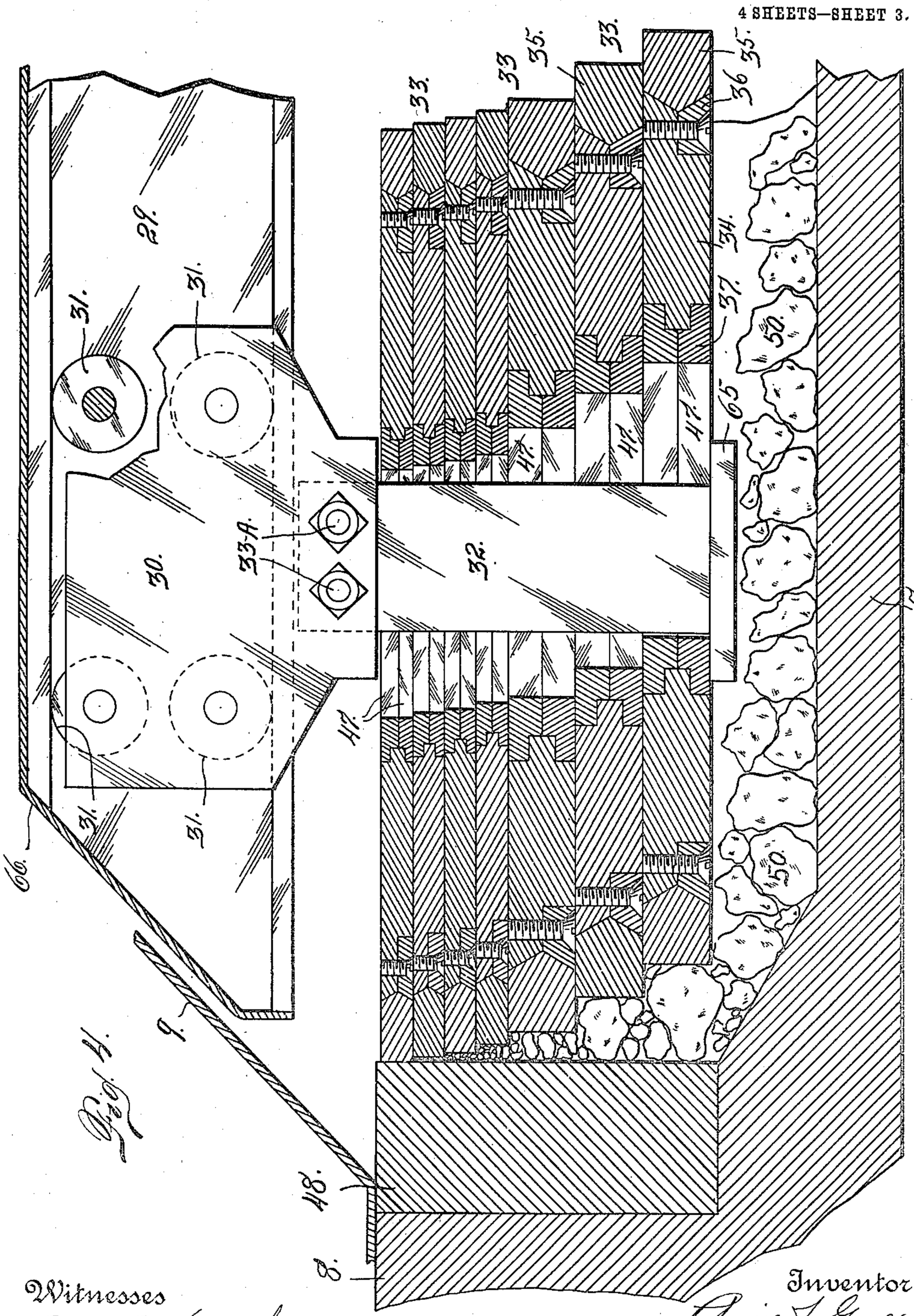

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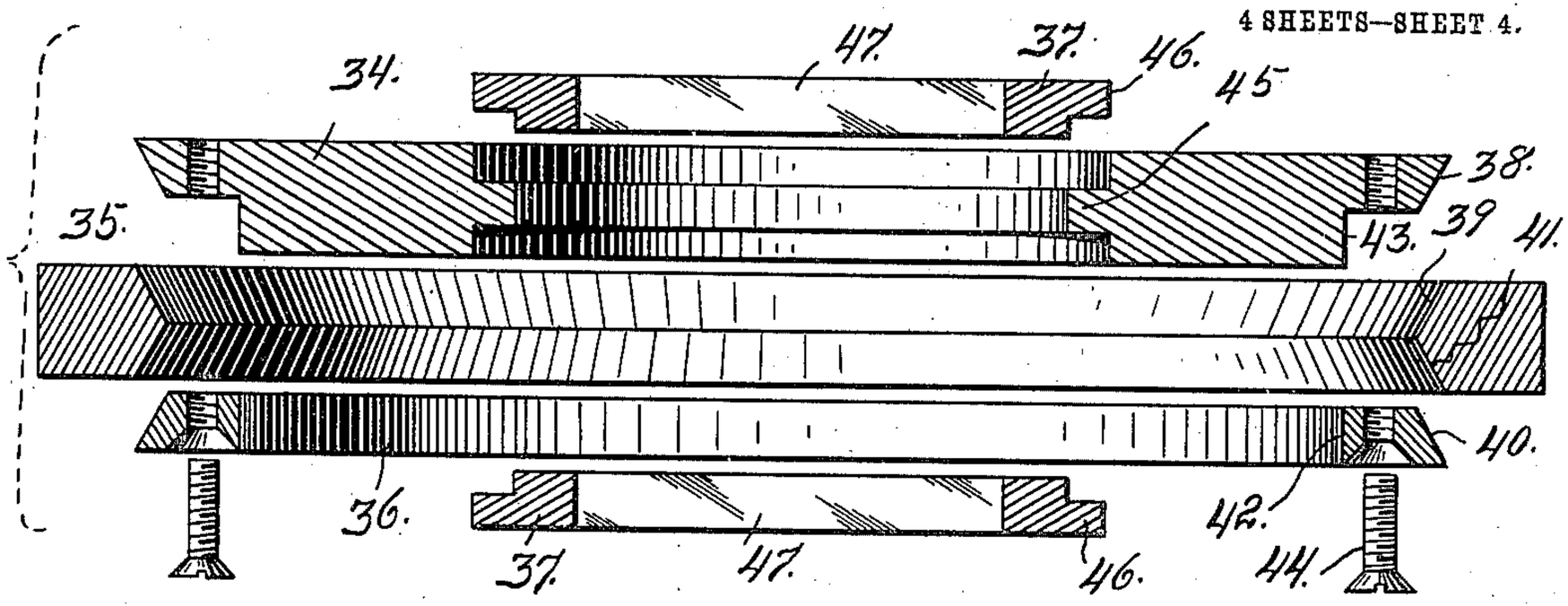

Fig. 5.

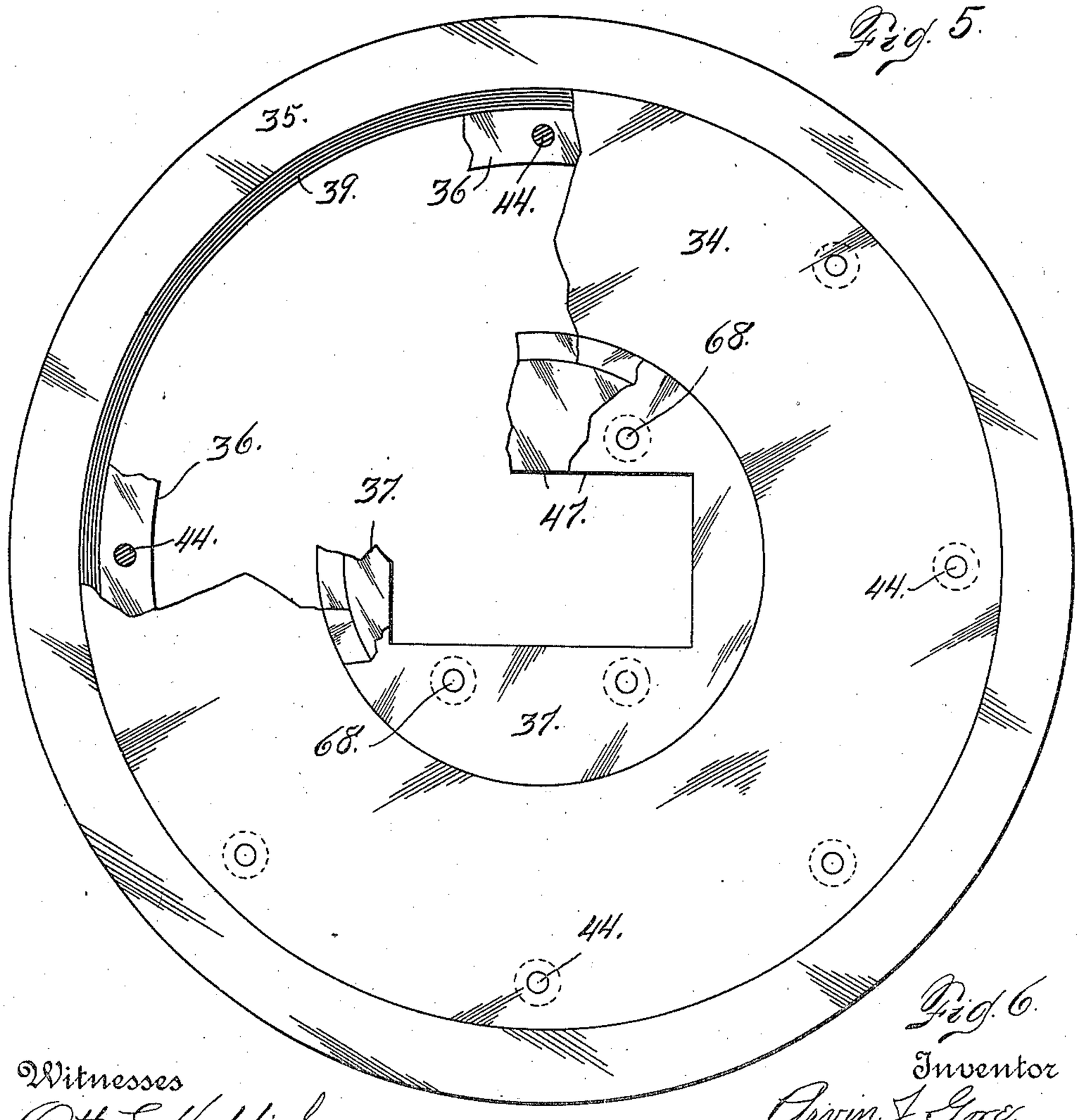

Fig. 6.

Witnesses

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UNITED STATES PATENT OFFICE.

ARVIN JAMES GORE, OF DENVER, COLORADO.

PULVERIZING-MILL.

960,893. Specification of Letters Patent. Patented June 7, 1910.

Application filed July 6, 1909. Serial No. 506,248.

To all whom it may concern:

Be it known that I, ARVIN J. GORE, a citizen of the United States, residing in the city and county of Denver and State of Colorado, have invented certain new and useful Improvements in Pulverizing-Mills; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to improvements in pulverizing mills, my object being to provide a construction in which rock or quartz may be reduced to any desired fineness.

The machine is more especially intended for use in pulverizing ore containing precious or other metals, the required pulverization in this case being sufficient to release the metallic values contained therein.

In my improved construction, I employ a revolving mortar, in which is located a number of pulverizing members, carried by a frame mounted to revolve in a direction opposite from the rotary movement of the mortar. These pulverizing members are each mounted to slide horizontally upon a radial arm or eye beam, connected with a hub of the rotary pulverizing structure. Each pulverizing member is composed of a number of circular, horizontally arranged parts or disks, mounted one above another, the lower disks being preferably thickest while the upper disks are relatively thin. The various disks of each pulverizing member are laterally movable, independently of each other, upon a depending stem or holder, with which the movable frame, mounted upon the eye beam, is provided.

As the pulverizing structure is rotated, each pulverizing member is caused to move outwardly, bodily, upon its eye beam arm, under the influence of centrifugal force. The individual disks of each member also are adapted to move outwardly, independently of each other.

When the material to be crushed, is placed in the mortar, and the two rotary members set in motion, the lower and heavier disks are moved outwardly with the necessary force to reduce the coarse or large pieces of rock to a suitable degree. The reduced rock or amorphous material, under the influence of the action of the machine, aided by special plows or blades, is caused to move upwardly, where it is successively acted upon by the various disks of each pulverizing member, the material as it works upwardly, increasing in fineness. The upper disks, therefore, move farther outwardly than the lower disks, since, the material when it reaches the top of the mortar and is acted upon by the uppermost disk, is reduced to the necessary or desired fineness, after which provision is made for removing the pulverized material, by suction or in any other suitable manner.

Having briefly outlined my improved construction, I will proceed to describe the same in detail, reference being made to the accompanying drawing, in which is illustrated an embodiment thereof.

In this drawing: Figure 1 is a central, vertical section, taken through my improved pulverizing machine, the rotary pulverizing members suspended within the mortar, being shown in elevation. Fig. 2 is a horizontal section taken approximately on the line 2—2 Fig. 1, looking downwardly, the parts being shown on a larger scale. Fig. 3 is a detail view of a plow equipped with a series of blades for elevating the material in the mortar during the operation of pulverizing. Fig. 4 is an enlarged, vertical section taken through one of the pulverizing members, illustrating the operation of the same, a fragment only of the mortar being illustrated. Fig. 5 is a vertical section of the various elements composing one of the disks of a pulverizing member. Fig. 6 is a top plan view of one of the disks of a pulverizing member, parts being broken away. This view is shown on the same scale as Fig. 5.

The same reference characters indicate the same parts in all the views.

Let the numeral 5 designate a mortar having a hub 6, a bottom 7 and an upwardly projecting, circular wall 8. To the top of the wall 8 is secured a frusto-conical housing 9. Above this housing is a stationary cone-shaped member 10, which is secured to a suitable frame work 12. Within the stationary member 10 is formed an opening 13, from which leads a short pipe 14, communicating with a suction conduit 15, leading to a fan 16, operated by a belt 17, which connects a pulley 18 with a larger pulley 19, fast on an operating shaft 20, equipped

with a pulley 21, which is connected by means of a belt 22 to the line shaft or motor not shown.

The hub 6 of the mortar is equipped with a beveled gear 21^A, engaged by a smaller vertically disposed similar gear 22^A, fast on the operating shaft 20. Also mounted upon the shaft 20, is a smaller gear 23, meshing with a larger horizontally disposed gear fast on a vertical shaft 25, the lower extremity of the shaft engaging a step box 26, while its upper portion passes through the hub 6 of the mortar, its upper extremity protruding beyond the hub of the mortar and entering a socket 27 formed in a hub member 28, to which is secured radially disposed eye beam members 29, four of these members being shown. The socket 27 is polygonal, preferably square, and the upper extremity of the shaft 25 is of counterpart shape, whereby as the shaft rotates, the hub member 28 and its attachments are caused to travel therewith. Upon each of the eye beam members 29, is mounted a sort of carriage 30, provided with upper and lower rollers 31, which engage the top and bottom flanges respectively of the eye beam member. To the lower extremity of this carriage is secured a depending stem 32 by means of bolts 33 or other suitable fastening devices. The various disks comprising the pulverizing member are mounted upon this stem. As shown in the drawing, the lower three disks (see Fig. 4) are of the same thickness, while the upper four disks are of less thickness, being approximately one-half of the thickness of the lower disks. All of the disks are substantially of the same construction and may therefore be designated by the same reference character, since they vary only in weight or thickness.

The various parts of which each disk is composed are illustrated in Fig. 5 and consist of a circular body member 34, a tire member 35, a member 36 for securing the body member to the tire and two coöperating inner members 37, which enter the central part of the member 34 and are open to permit the entrance of the stem 32 upon which the disks are mounted, as heretofore explained.

In assembling the members of the disk, the tire 35 is applied to the body member, the outer edge of the tire being beveled, as shown at 38, to engage a beveled face 39, formed on the inner surface of the tire. The locking member 36 also has a beveled face 40, engaging the opposite inner beveled face 41 of the tire. When the two members 34 and 36 are applied to the tire, the inner surface 42 of the member 36 engages a shoulder 43, formed on the body member and the two members 34 and 36 are connected by screws 44. The inner surface of the body member, which has a central opening, is provided with a centrally located circumferential tongue 45, which is engaged by flanges 46 formed on the members 37. These members meet within the opening of the body member, and completely cover the inner face of the latter. They are composed of steel, or other suitable hard material, adapted to endure a great amount of wear. The tire 35 is also composed of steel, since great wearing capacity is required, on this part of the disk. It is evident that the body member of each disk may be composed of cast iron or any suitable material, since the same is protected both internally and exteriorly from the wear incident to the use of the pulverizing member.

While I have described in detail a special construction of disk, it is evident that the invention is not limited thereto. Hence in the subsequent description, the various parts or members of the disks will be ignored and they will be referred to as if each were composed of integral pieces of material.

Each disk is provided with a central opening 47, through which the stem 32 passes. This opening is considerably larger than the stem, allowing the disks a predetermined lateral movement upon the stem, under the influence of centrifugal force. As illustrated in the drawing, the openings of all of the disks are of the same size. The lateral movement, however, of each disk upon the stem is independent of its companion disks and is controlled by centrifugal force and by the action of the pulverized material. This is best illustrated by referring to Fig. 4, in which the position of the various disks of a pulverizing member is supposed to be the same as when the said member is in use.

As shown in the drawing, the inner part of the mortar is composed of a heavy steel ring 48, whose inner surface forms a pulverizing face, against which the material to be pulverized is carried by the peripheries or pulverizing faces of the various disks, of each pulverizing member.

As shown in the drawing (see Fig. 4), each pulverizing member, when the parts are assembled, is supported some distance above the bottom of the mortar. The material to be treated is fed into the mortar, and falls upon a centrally located, distributing member 49, whose upper surface is cone-shaped, the inclination from the apex of the cone, however, being comparatively slight. As the material is fed upon this member, it passes downwardly in all directions and falls into the central part of the bottom of the mortar and between the various pulverizing members. Under the action of centrifugal force, this material is carried outwardly against the pulverizing ring 48, passing both underneath the pulverizing members and between them. Simultaneously with the outward movement of the material,

which may be designated 50, the disks of each pulverizing member are thrown outwardly by centrifugal force, whereby the said disks are caused to act upon the material and crush the same. The lower disks, which are heaviest, act to crush and break up the material, whereby it is considerably reduced in size. After having been acted on by any lower disk, it is caused to move upwardly into position to be acted on by the disk next above, and so on, the action of each disk further reducing the size of the material, until after it has been acted on by the uppermost disk of the series of each pulverizing member, it is reduced to the desired fineness. The centrifugal force may be sufficient to cause this material to travel upwardly, successively, into the planes of the various disks from the bottom to the top of the pulverizing members. However, in order that the material may be positively caused to travel upwardly from the bottom to the top of the mortar, and successively into the planes of the various disks, the frame work of the pulverizing structure is equipped with plows, each of which is composed of a depending member 51, which is secured by means of bolts 52, to one of the top bars 53, which connect the radial eye beam members upon which the pulverizing devices are movably mounted, as heretofore explained. There are four frame parts 53, and as shown in the drawing, each of these parts forms one side of a square. There is a plow 51 attached to the center of each of these frame parts 53, whereby there is a plow located intermediate each two pulverizing members. Each of these plows, as shown in the drawing, is equipped with a number of inclined blades 54, each of which has a threaded shank 55 passing through the opening formed in the depending member 51, nuts 56 being applied to the stem on opposite sides of the said member, thus maintaining the blades exactly in place, their inclination being sufficient to cause the material to travel upwardly in the manner heretofore explained.

In order to facilitate the rotary travel of the mortar hub 6 upon the stationary frame, or bed plate 57, ball bearings 58 are interposed between the hub and the said frame member. In order to increase the wearing capacity of the engaged parts, the hub and stationary member are equipped with steel plates 59 and 60 respectively, in which are formed races for the bearing balls 58. Inasmuch as the two hubs 6 and 28 are rotated in opposite directions, the movement of the one upon the other is facilitated by the introduction of bearing balls 61, between the two members, whose adjacent surfaces are provided with ball races for the purpose (see Fig. 1).

Secured to the top of the radial eye beams 29 is a funnel-shaped feed device 62, whose upper extremity is open to receive the material from the feed pipe 63. The lower part of the device, which is outwardly flared, is secured to the eye beams by suitable fastening devices 64. The cone-shaped distributer 49 has its apex centrally located with reference to the vertical center of the feed device, to facilitate the distribution of the material as it is delivered to the mortar.

From the foregoing description, the use and operation of my improved pulverizing apparatus will be readily understood.

Assuming that the parts are assembled as shown in Fig. 1 and that motion is communicated to the shaft 20, the mortar and the rotary pulverizing structure will be rotated in opposite directions and at suitable speeds for the purpose required. The material to be treated is discharged from the feed pipe 63 into the device 62, and falls upon the cone-shaped spreader or distributer 49, whence it passes to the mortar, and is thrown outwardly by centrifugal force, against the steel ring of the latter.

Attention is called to the fact that the central opening formed in the various disks of each pulverizing member has its width so arranged as to fit closely two opposite sides of the stem 32, whereby the inner member of each disk is prevented from rotating upon the stem. The outer faces, however, of these inner members are circular and the body members of the disks may rotate thereon during the operation of the machine, thus facilitating the crushing action, of the pulverizing members, and reducing the wear to which the disks of the said members would be subjected if they were stationary and only moved in their orbit of travel around the center of the mortar. When the disks are constructed, as illustrated in the drawing, heretofore described, each disk, in addition to its orbital travel, also has a rotary action around its inner member, which is locked against rotation by the depending stem, as heretofore explained. As the pulverizing structure rotates, the carriages 30 travel outwardly upon their eye beam supports under the action of centrifugal force, and the disks of which the various pulverizing members are composed, are independently acted upon by the same force, whereby the disks occupy positions unequally distant from the center of the mortar. As the lower disks act upon the relatively coarse material, these disks occupy positions farther away from the steel ring of the mortar than the upper disks, (see Fig. 4). However, as the lower disks act upon the material, the latter is gradually carried upwardly toward the top of the mortar by the action of the blades 54 of the various members, carried by the rotary pulverizing structure, whereby the material is successively

acted upon by the various disks from the bottom toward the top of each pulverizing member, being finally discharged to a position above the uppermost disk 33, of each pulverizing member. As this material is now very finely pulverized, being practically reduced to dust, it is removed from the mortar through the action of the suction fan 16, heretofore described.

Attention is called to the fact that the depending stem 32, upon which the disks of each pulverizing member are mounted, is provided at its lower extremity with a stop plate 65, which supports the pulverizing member upon the stem. This plate has a width greater than the width of the openings 47 in the disk, and therefore prevents the disks from slipping off from the stem. In order that the suction may act advantageously upon the pulverized material, after it passes upwardly above the mortar, a sort of housing 66, is applied to the top of the eye beam structure, supporting the pulverizing members 33. This housing extends downwardly at the outer ends of the eye beam members, nearly to the top of the mortar, and as it is continuous with the outwardly flanged lower member of the feed device 62, there is no opportunity for the suction to act upon the pulverized material except outside of the said housing, and through the space between the housing and the cone-shaped member 9, connected with the top of the mortar, hence the suction acts directly upon the pulverized material as it leaves the mortar, and there is no opportunity for the pulverized device to interfere in any way with the passage of the material to be treated into the mortar.

The two disk members 37, which are applied to the interior of the body member 34, as heretofore explained, are connected with each other by fastening screws 68, see Fig. 6. These screws are not shown in Fig. 5, since the suction is taken between the screws, see Fig. 6.

Having thus described my invention, what I claim is:

1. In apparatus of the class described, the combination of a mortar and a pulverizing structure mounted to rotate in the mortar, and equipped with a number of horizontally disposed circularly arranged pulverizing members, a frame on which the said members are mounted to travel outwardly under the action of centrifugal force, each pulverizing member being composed of a number of independently movable disks, whereby the various parts of each pulverizing member are allowed movement upon the frame of the structure independently of each other.

2. In pulverizinng apparatus, the combination of a mortar, having a vertically disposed circularly arranged pulverizing face, a pulverizing structure mounted to rotate in the mortar and composed of pulverizing members suspended above the bottom of the mortar, and mounted to move outwardly on a track of the frame under the action of centrifugal force, each pulverizing member being composed of a number of horizontally disposed disks, mounted to slide outwardly toward the pulverizing face of the mortar, independently of each other, under the action of centrifugal force, substantially as described.

3. In pulverizing apparatus, the combination with a mortar, of a pulverizing structure mounted to rotate in the mortar, a frame equipped with radially arranged arms, provided with depending stems adapted to travel, movably mounted on the arms, and a horizontally disposed pulverizing member mounted upon each stem, which passes through a relatively large opening formed in the said member, whereby the member is allowed to move bodily outwardly upon its radial frame arm, under the action of centrifugal force, each pulverizing member being composed of a series of disks, independently movable upon the supporting stem, under the action of centrifugal force, for the purpose set forth.

4. In pulverizing apparatus, the combination of a mortar, having a vertically disposed, circularly arranged pulverizing face, and a pulverizing structure, mounted to rotate and having its axis coincident with the axis of the mortar, the said structure consisting of a frame work, composed of arms radiating from the center, a carriage mounted to travel upon each arm and equipped with a depending stem, a pulverizing member mounted upon each stem and composed of a number of disks arranged one above another and in contact, the said disks being independently movable upon their supporting stem, under the action of centrifugal force, substantially as described.

5. In pulverizing apparatus, the combination of a mortar, mounted to rotate, a pulverizing structure mounted to rotate and having its axis coincident with that of the mortar, the pulverizing face of the mortar being circular and vertical, the pulverizing structure consisting of a frame having radially disposed arms, carriages mounted to travel outwardly on the arms, under the action of centrifugal force, each carriage having a depending stem, and pulverizing members, mounted upon the said stems, each members being composed of a number of disks, mounted upon the stem, each disk having an opening through which the stem passes, the opening being sufficiently large in a radial direction to allow the disks to travel outwardly on the stem independently of each other, for the purpose set forth.

6. In pulverizing apparatus, the combina-

tion of a mortar, mounted to rotate and having a circularly arranged, vertically disposed pulverizing face, the bottom of the mortar, below the said face being beveled to facilitate the outward and upward travel of the material, a pulverizing structure mounted to rotate on an axis coincident with the axis of the mortar, the said structure being equipped with a number of pulverizing members, each movably mounted to travel outwardly, independently of the other, under the influence of centrifugal force, each pulverizing member being suspended above the bottom of the mortar to allow the material fed to the mortar to pass outwardly under the said members, the frame of the structure being equipped intermediate the pulverizing members, with plows, each composed of a number of inclined blades arranged one above another, and means for rotating the mortar and pulverizing structure in opposite directions.

7. The combination of a mortar, mounted to rotate, a pulverizing structure composed of a frame work, and a number of depending members, movably mounted on the frame work to move outwardly under the action of centrifugal force, each member being composed of a number of distinct disks movable independently of each other, under the action of centrifugal force, the movement of the disks being in a radial direction, a housing secured to the top of the mortar and rotatable therewith, a feed device mounted on the pulverizing structure, and adapted to receive the material to be treated, and deliver it to the mortar, the pulverizing structure being equipped below the feed device with a spreader or distributer for the said material, a stationary housing mounted on the frame work, above the mortar housing, and suction apparatus connected with the stationary housing for removing the pulverized material, substantially as described.

8. A pulverizing member, composed of a stem or holder and a number of disks arranged one above another and having openings fitting the stem on two opposite sides, but larger than the stem in one direction, whereby the disks are allowed to move on the stem, independently of each other, each disk having a central member fitted to the stem to prevent rotation, and a body member surrounding the central member and rotatable thereon.

In testimony whereof I affix my signature in presence of two witnesses.

ARVIN JAMES GORE.

Witnesses:

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W. R. Ferry.