

No. 673,195.

Patented Apr. 30, 1901.

J. K. CLARK.

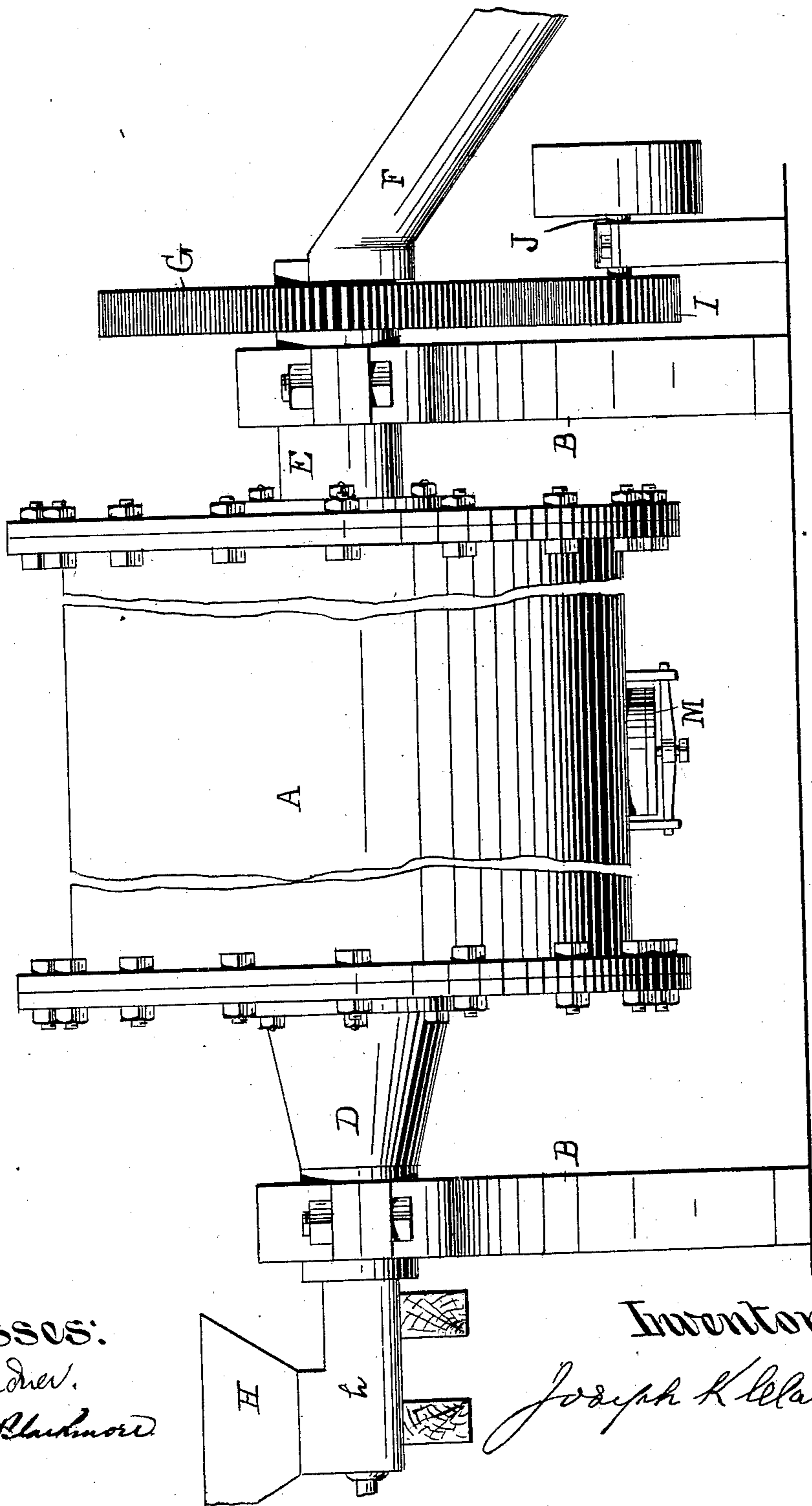
APPARATUS FOR PULVERIZING ORES.

(Application filed June 9, 1900.)

3 Sheets—Sheet 1.

(No Model.)

Fig. 1.



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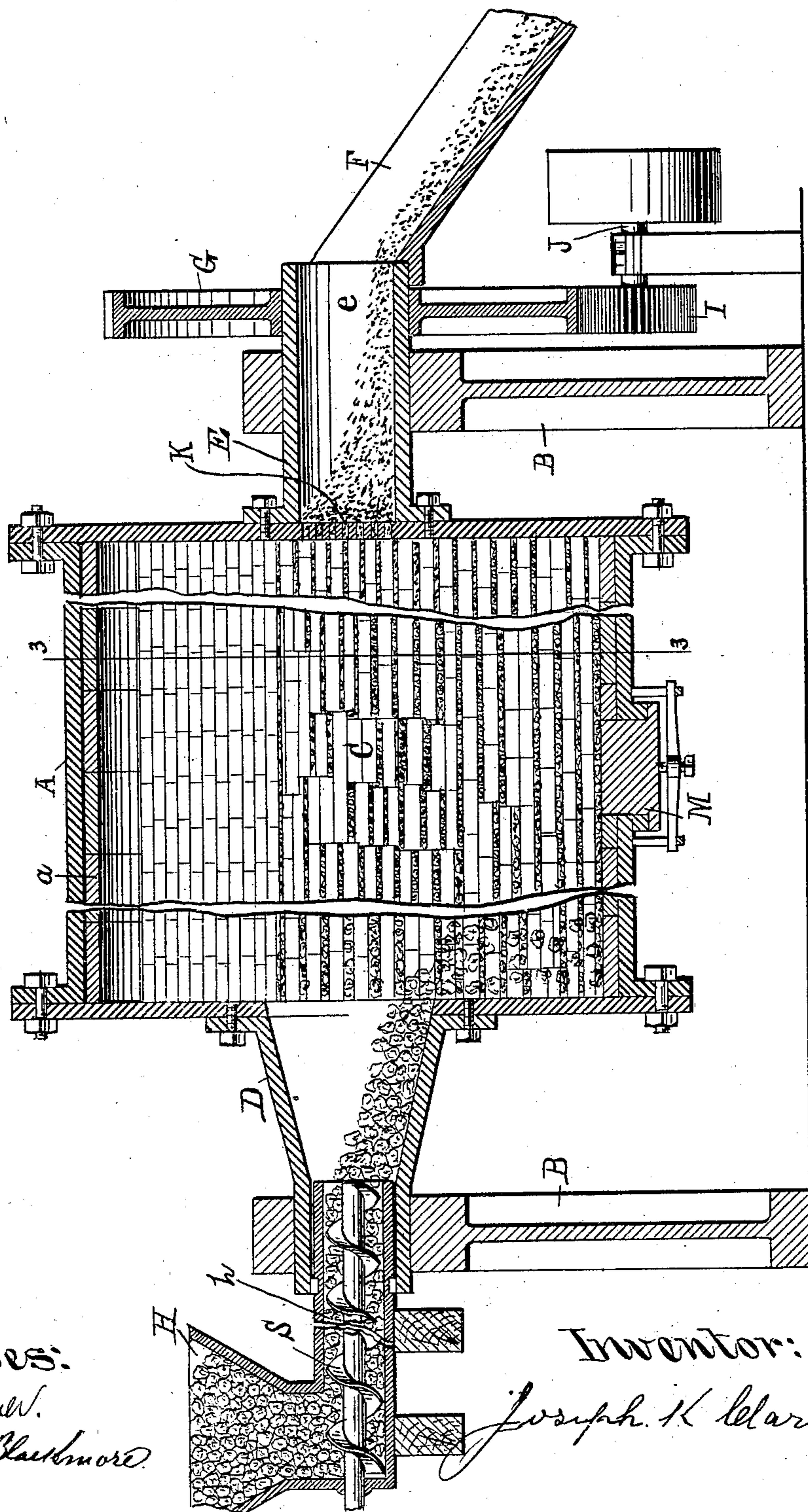
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Fig. 2.



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Fig. 3.

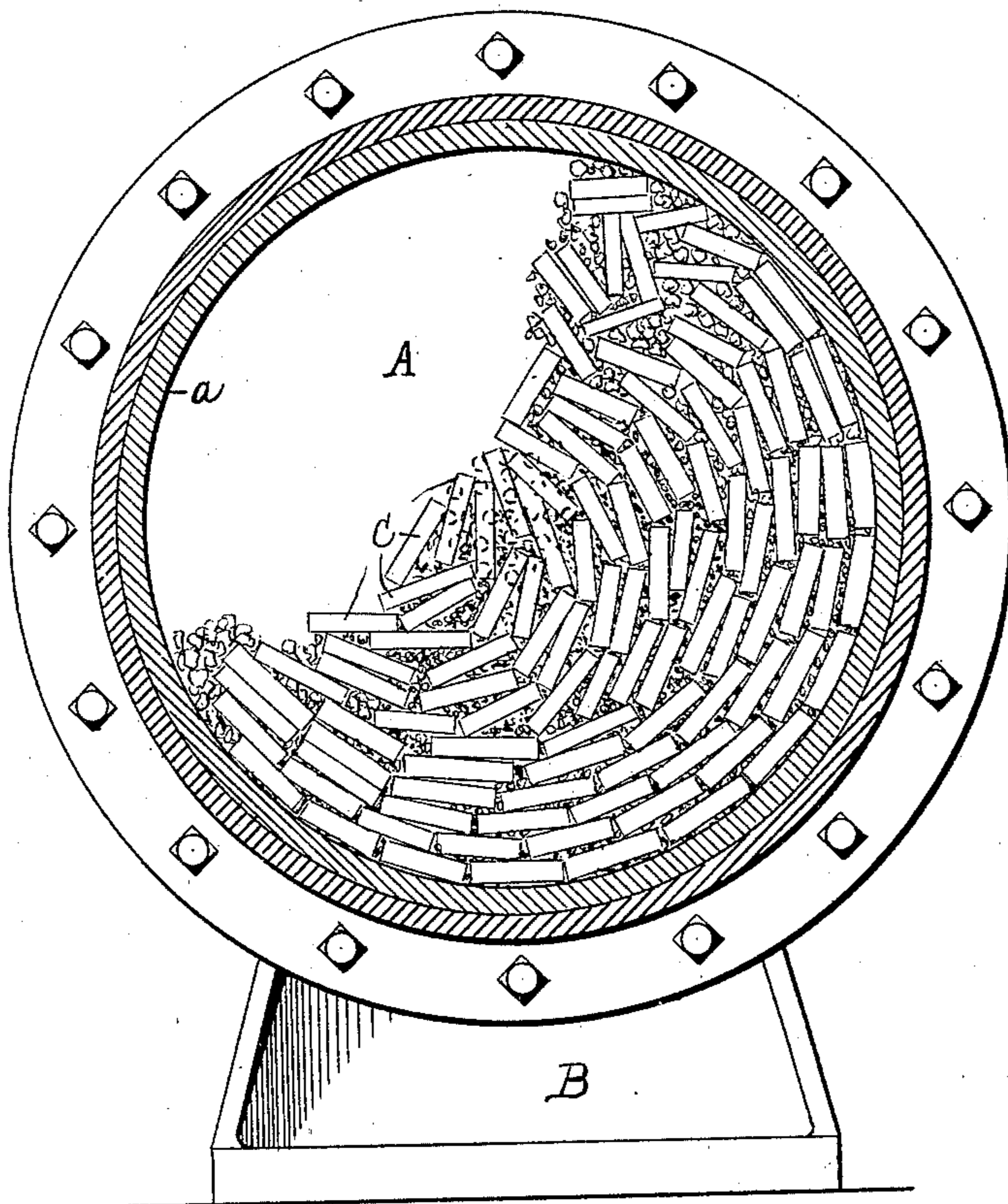
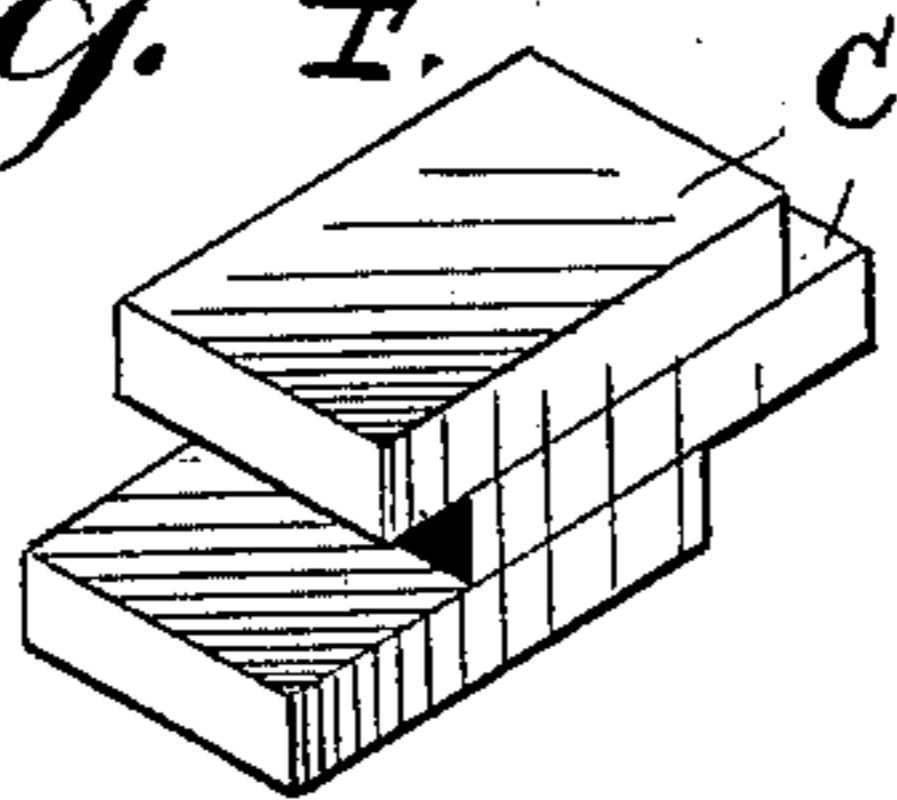


Fig. 4.



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APPARATUS FOR PULVERIZING ORES.

SPECIFICATION forming part of Letters Patent No. 673,195, dated April 30, 1901.

Application filed June 9, 1900. Serial No. 19,694. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH KITHCART CLARK, a citizen of the United States, residing at Butte, in the county of Silverbow and State of Montana, have invented certain new and useful Improvements in Apparatus for Pulverizing Ores; and I do hereby 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.

The object of my invention is to pulverize or comminute ores by a continuous process; and it consists in supplying ore to a pulverizing apparatus during process of pulverization below the comminuting or pulverizing devices and conveying the comminuted ore out of the apparatus from above the unpulverized material by displacement without the use of air-blast, which is impractical in that it carries large quantities of valuable substances into the atmosphere, where they are lost, no efficient means having been devised as yet whereby the fine particles can be wholly separated from the current of suspending-air; also, the quantity of fine ore suspended being small in comparison with the amount of air required, much time and power are consumed without attaining practical results.

Hitherto in the class of pulverizing the ball-and-drum type has been conceded the most efficient; but I have found that if a number of blocks or pieces of metal or other substance of sufficient hardness having one or more plane surfaces are substituted for the balls much more grinding or comminuting surface is exposed and employed, as the ball really has no pulverizing-surface, but crushes only from contact-points.

When a drum is nearly filled with blocks or pieces of metal or other hard substance having one or more plane comminuting-surfaces, each move of the receptacle, either in revolution, oscillation, or vibration, causes the blocks or comminuting devices to move, thereby comminuting any ore or substance which may be between them by the grinding coaction of the opposing surfaces, and it is thus found that more material may be pulverized with less power and in less time than with the drum-and-ball devices.

My improved apparatus is so constructed that coarse ore may be introduced and comminuted ore displaced continuously during pulverization, by which means I avoid loss of time consumed in filling and emptying apparatus having no means of introducing and withdrawing material during operation.

In the accompanying drawings, Figure 1 is an elevation of my improved apparatus, portions of the drum being broken away. Fig. 2 is a central vertical section, partly in elevation, showing the practical operation of the apparatus. Fig. 3 is a transverse section on the line 3 3, Fig. 2. Fig. 4 is an isometrical view of three of my improved comminuting devices.

A represents a drum or receptacle provided with a lining *a*, as heretofore, said receptacle being provided with a manhole M for the introduction of the comminuting devices C C.

The receptacle A is supported on suitable bearings B by means of the hollow trunnions D E.

The ore is fed into the receptacle A through the trunnion B by positive means, as by the screw S, (shown in Fig. 2,) which screw transfers the ore from the hopper H through the horizontal passage *h* into said hollow trunnion D, which is preferably made flaring, substantially as shown in the drawings, so as to introduce the ore into receptacle A below the point of discharge of the comminuted ore through the opposite trunnion E, from which trunnion the comminuted ore is received by conduit F. Secured to the trunnion E is the driving-gear G, meshing with the power-pinion I on the power-shaft J. It is obvious that any other mechanical expedient may be resorted to for rotating, oscillating, or vibrating the receptacle A.

The distinguishing feature of the comminuting devices C is that they are formed with substantially plane surfaces, thereby affording great area of contact with the ore introduced between and below them. As shown in the drawings, they are represented in the form of oblong rectangular blocks or billets geometrically termed "rectangular parallelepipeds," consisting of a material having sufficient hardness, although it is obvious that any other form may be substituted, provided

they are formed with one or more plane surfaces.

In order to exclude the comminuting devices C from the axial discharge-passage *e* in the trunnion E, a perforated screen K, of any desired or appropriate construction, is interposed between the receptacle A and said passage *e*.

As the ore is conveyed into the drum below the comminuting devices C by the positive action of the screw S through the trunnion C it falls by gravity to the lower part thereof, and as it becomes pulverized or comminuted by attrition with the comminuting devices C it is gradually forced up by the continuous introduction of heavier material, and as the pulverized material reaches the level of the outlet through trunnion E it overflows and is conveyed to storage tanks or bins through the conduit F.

Thus it can be seen that the essential feature of the operation of my apparatus consists in employing upward displacement in combination with a large moving attrition or comminuting surface attained by the plane surfaces on the comminuting devices C and utilizes gravity and vibration, oscillation, or revolution as a means of both pulverizing and separating the ore of various degrees of comminution. It may be also noted that in my improved mill the comminution of minerals or other substances is performed by the combined tumbling or stamping, attrition between the opposing plane surfaces, and crushing by sharp edges of my plane-surface comminuting devices during the motion of the receptacle, so that three distinct comminuting forces are at work simultaneously.

I am aware that ores have been introduced into drums containing balls and depending upon a peripheral outlet as a means of discharge; but it can be readily seen that a peripheral discharge retards the pulverization, as the lighter or finer pulverized substances are above on account of the less density of the particles, and hence the drum becomes choked with powdered material, its discharge being obstructed by unpulverized ore introduced. I therefore avoid the difficulties experienced in said apparatus by discharging the fine pulverized material from above, where it naturally accumulates on account of its less density and by action of centrifugal displacement by the heavier unpulverized substances introduced from below the discharge.

By way of illustrating the practical advantages of my improved apparatus it is found that a mill having a receptacle forty-two inches in diameter and eight feet long will carry four tons of iron-comminuting devices of the character described three inches square and one-half inch thick, which will give a grinding-surface of something over twelve thousand four hundred and eighty square feet per minute running at twenty revolu-

tions, which is found to give the best results for the size stated.

It can be seen that the fineness of the pulverization of ore may be regulated by the rapidity of revolution, oscillation, or vibration of the receptacle and the feed of unpulverized material in a given time.

Having now described my invention, what I desire to secure by Letters Patent is—

1. In an apparatus for pulverizing minerals and other substances, the combination of a pulverizing-receptacle, means for agitating the same, free comminuting devices presenting plane surfaces which are adapted during the motion of the cylinder to come into grinding coaction, an inlet to the receptacle for feeding ore below the level of the comminuting devices and an outlet for the comminuted ore at a higher level than the immediate entrance of the coarse ore to the drum whereby the discharge of the comminuted ore is effected by the upward displacement of the coarse ore introduced.

2. In an apparatus for pulverizing minerals or other substances, the combination of a pulverizing-receptacle, means for agitating the same, free comminuting devices presenting plane surfaces which are adapted during the motion of its cylinder to come into grinding coaction, an axial discharge for the comminuted ore and the immediate entrance to the drum adapted to feed the ore at a point below the axial discharge, whereby the discharge of the ore is facilitated by the feed thereof, substantially as described.

3. In an apparatus for pulverizing minerals or other substances, the combination of a pulverizing-receptacle, means for agitating the same, free comminuting devices presenting plane surfaces which are adapted during the motion of the cylinder to come into grinding coaction, an axial discharge for comminuted ore and the immediate entrance to the drum adapted to feed the ore below the axial discharge and also below the level of the comminuting devices whereby the discharge of the ore is facilitated by the feed thereof, substantially as described.

4. In an apparatus for pulverizing ores or other substances, the combination of a pulverizing-receptacle, disconnected comminuting devices therein of substantially uniform shape adapted to move freely in all directions, said devices being severally provided with opposing plane surfaces whereby an increased attrition effect is obtained, substantially as described.

5. In an apparatus for pulverizing ores or other substances, the combination of a pulverizing-receptacle, means for rotating the same, disconnected comminuting devices therein adapted for movement in all directions and consisting of suitable abrading material having the form of rectangular parallelepipeds, substantially as described.

6. In an apparatus for pulverizing ores and
other substances, the combination of a pul-
verizing-receptacle, means for moving the
same, comminuting devices therein adapted
5 to move freely in all directions and having
substantially plane surfaces whereby sub-
stances are comminuted during motion of the
receptacle by the grinding coaction of the op-

posing plane surfaces of said devices, sub-
stantially as described. 10

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

JOSEPH KITHCART CLARK.

Witnesses:

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