No. 682,087. Patented Sept. 3, 1901.

# W. KITTO.

## CRUSHING OR PULVERIZING APPARATUS.

(Application filed Dec. 29, 1897.)

(No Model.) 3 Sheets—Sheet 1.

*Fig. 1.*

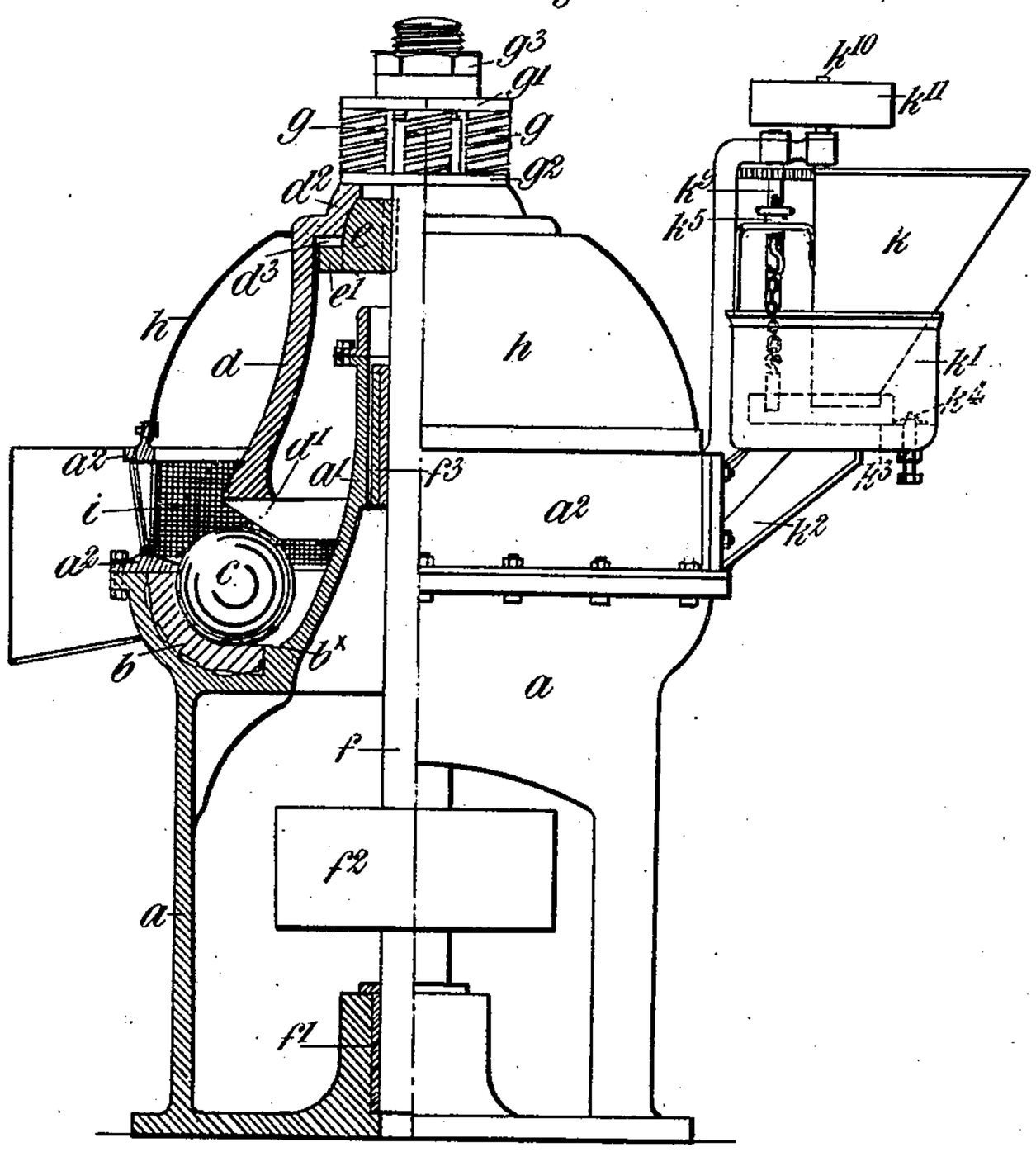
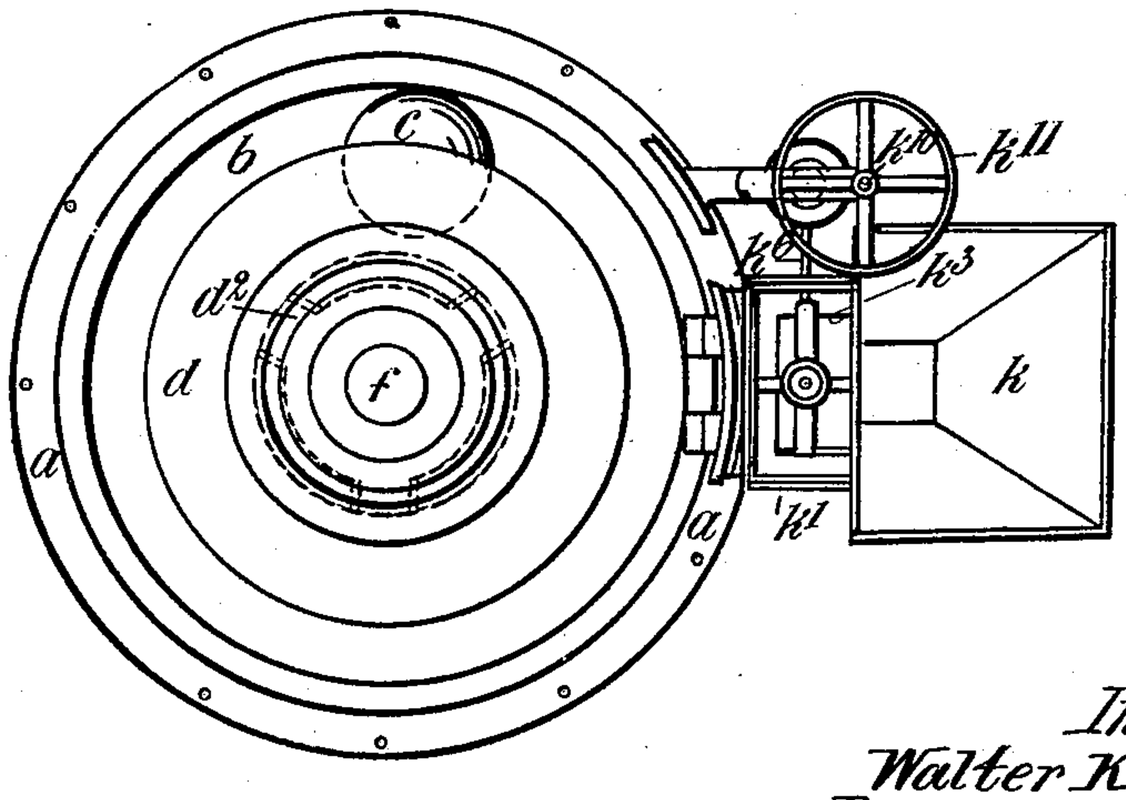



*Fig. 2.*

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Robert Everett.

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(No Model.) 3 Sheets—Sheet 2.

Fig. 3.

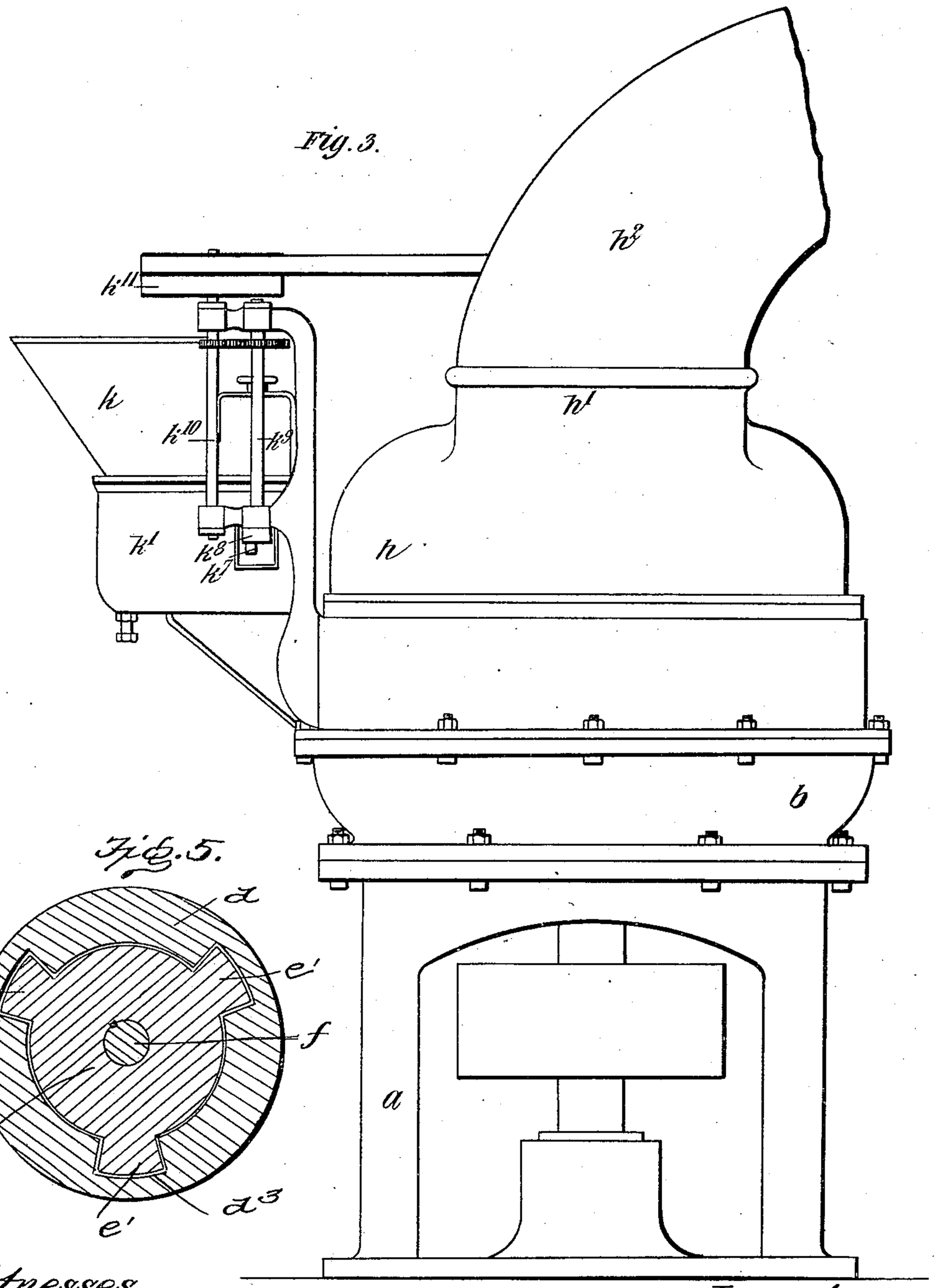


Fig. 5.




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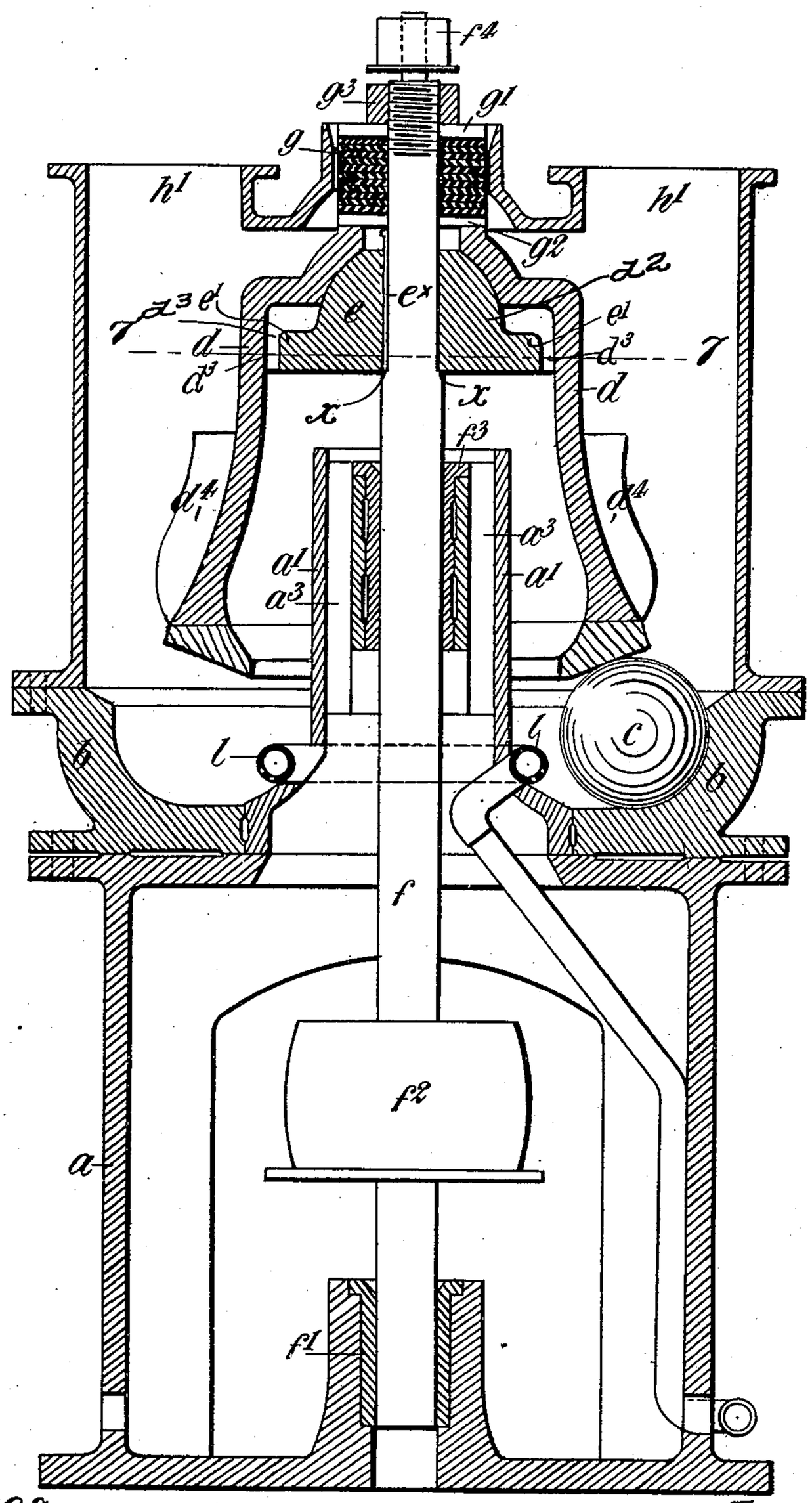
(Application filed Dec. 29, 1897.)

(No Model.) 3 Sheets—Sheet 3.

*Fig. 4.*

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# UNITED STATES PATENT OFFICE.

WALTER KITTO, OF HAMMERSMITH, ENGLAND.

## CRUSHING OR PULVERIZING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 682,087, dated September 3, 1901.

Application filed December 29, 1897. Serial No. 664,334. (No model.)

*To all whom it may concern:*

Be it known that I, WALTER KITTO, engineer, a subject of the Queen of Great Britain, residing at 21 Westcroft Square, Hammersmith, in the county of Middlesex, England, have invented certain new and useful Improvements in or Relating to Crushing or Pulverizing Apparatus, (for which I have obtained a patent in Great Britain, No. 18,741, dated October 7, 1895,) of which the following is a specification, reference being had to the accompanying drawings.

This invention has for its object to provide a new and improved crushing or pulverizing mill of the class or type wherein balls travel in a circular raceway and a rotary part or propeller rests and turns upon the balls.

The object of my invention is accomplished in the manner and by the means hereinafter described and claimed, reference being made to the accompanying drawings, in which—

Figure 1 is a compound view, partly in vertical central section and partly in elevation, showing a construction of crushing apparatus adapted for wet grinding. Fig. 2 is a plan of the said crusher. Fig. 3 is a side elevation showing a modification of the apparatus adapted for dry crushing. Fig. 4 is a vertical central section of the said modification, and Fig. 5 is a detail sectional view taken on the line 7 7, Fig. 4.

In order to enable those skilled in the art to make and use my invention, I will now describe the same in detail, referring to the drawings, wherein the letter *a* indicates the body or case of the ore-crusher constructed with a concave annular ball path or raceway *b*, containing a ball *c*, which is caused to traverse the ball-path through the medium of the rotary propeller *d*. In practice I have found a single ball to give the best results, in that it avoids the jamming which sometimes occurs when a series of balls is employed. I do not, however, limit myself to a single ball.

The propeller is bell-shaped, and its lower inclined edge is preferably composed of a wearing-ring *d'*, of chilled or hardened or other material, suitably secured in position. The upper end of the propeller is formed with a concaved contracted neck $d^2$, fitting a partly spherical or substantially hemispherical block or collar *e*, secured to a perpendicular spindle or shaft *f* by means of a key $e^\times$ or otherwise. The spindle or shaft *f* is mounted in a lower bearing *f'* and an upper bearing $f^3$, by which it is steadied and supported and within which it is susceptible of rising and falling to suit the conditions required—as, for example, when the ball *c* encounters and rides over some obstacle in the ball-path, as will be obvious. The spindle or shaft is provided with a pulley $f^2$, by which it may be turned for th purpose of turning the partly spherical or substantially hemispherical collar *e*, which serves as a driver for the propeller. To effect this, the collar is formed with a plurality of radial lugs *e'*, entering notches or recesses $d^3$ in the inner side of the propeller, as clearly shown in Figs. 1, 4, and 5.

*g g* are the springs which are employed in combination with the aforesaid universal joint at the top of the propeller. These springs may either be ordinary spiral steel springs or may be formed of india-rubber rings or disks. They are arranged between a pair of disks or washers *g' g²*, the latter of which rests upon the top edge of the propeller, and their tension is adjusted by means of a tightening-nut $g^3$ on the screw-threaded upper extremity of the spindle *f*.

The upper spindle-bearing $f^3$ is shown as arranged within a central contracted extension or neck *a'* of the body or case *a*, and above said bearing the spindle is provided with an annular shoulder *x*, against which the block or collar *e* bears to make the latter more secure and to facilitate the assembling of the parts in correct position. After the block or collar is applied to the spindle the propeller is slipped over the block or collar, and the lugs *e'* are made to enter the notches or recesses $d^3$. The washers *g' g²* and the spring-plates *g* are then placed upon the spindle and all secured together by the nut $g^3$, after which the spindle carrying the parts specified is dropped or pushed down into its bearings until the annular bearing-surface *d'* of the propeller rests upon the ball *c*. This ball, therefore, entirely supports the weight of the spindle, the block or collar, and the propeller. There is no rigid connection between the washers *g' g²* or the spindle and

the body, case, or frame of the machine, since the spindle or shaft, the block or collar, and the propeller are susceptible of rising and falling—as, for instance, when the ball *c* rides over an obstacle in the ball-path. The concaved contracted neck $d^2$, the partly spherical or substantially hemispherical collar *e*, and elastic plates or springs *g* constitute in effect a universal joint.

*h* is a sheet-metal casing or dome surrounding the propeller and serving in the arrangement in question to arrest any splashes from the crushing-path *b*.

*i* is a sieve which is secured in an opening formed in one side of a ring $a^2$. This ring is bolted on the casing *a* and serves to carry the dome *h*.

*k* is the hopper for the supply of ore. This hopper opens into a casing *k'*, from which a chute $k^2$ serves to carry the material into the crushing-path. Below the mouth of the hopper and inside the casing *k'* is arranged a tray $k^3$, pivoted at one end at $k^4$ and having its other end suspended from an adjusting device $k^5$, whereby the tray can be moved toward or away from the mouth of the hopper. The fall of the material from the hopper is checked by this tray, and in order to prevent the material sticking on the tray means are provided for automatically shaking the latter. These means, as shown also in Figs. 3 and 4, comprise a connecting-rod $k^6$, extending from the tray to a crank-pin $k^7$, carried by a disk $k^8$ on the end of a shaft $k^9$, driven by gearing from a parallel shaft $k^{10}$, to which motion is imparted by means of a belt and pulley $k^{11}$ from a pulley $f^4$ at the upper end of the spindle *f*. The connecting-rod $k^6$ passes through a suitable opening in the side of the casing *k'*.

The operation of this form of apparatus is as follows: When the spindle *f* is driven by the pulley $f^2$, it in turn drives the propeller *d* through the medium of the projections *e'* on the block *e*. The propeller presses on the ball or balls *c* with a force due to its weight and to the springs *g*, which force is ample to cause the said ball or balls to travel around the crushing-path *b*. While the crushing is proceeding, the propeller will all the time be working or yielding slightly on the block *e*, so giving an elastic movement and moderating the strain on the shaft. The latter will also be constantly moving up and down slightly in its bearings as the balls travel over the material to be crushed. During the crushing operation water is fed into the crushing-path and flows away through the sieve *i*, carrying with it the crushed material. Any fine gold in the said washings is collected by amalgamated plates over which the water is allowed to flow, while any coarse gold is retained by mercury placed in a recess $b^{\times}$ in the crushing-path.

Referring now to the arrangement for dry crushing shown in Figs. 3 and 4, the crusher employed in this case is substantially similar to that hereinbefore described, with the exception that instead of the ground material being removed by water means are provided for carrying it away by an air-blast. For this purpose a circular air-pipe *l* is arranged around the lower part of the neck *a'* of the casing and is provided with apertures adapted to direct the air-blast onto the crushing-path *b*. The said neck *a'* is provided with passages $a^3$, through which also air is led, this air flowing downward between the neck *a'* and the inner surface of the propeller *d* and serving to prevent dust from the roller-track finding its way into the bearings or onto the block *e*. The air entering by the circular pipe *l* and the passages $a^3$ escapes by a pair of trunks *h'* above the dome or casing *h*. The propeller *d* may in this case be provided on its outer surface with inclined air-propelling wings or vanes $d^4$, which in the rotation of the propeller serve to suck the air away from the crushing-path, and so assist in the withdrawal of the pulverized material. In this case also the ball-path is provided with its own flanges, whereby it is bolted direct to the casing *a* instead of merely resting in the upper part thereof, as in Figs. 1 and 2. Furthermore, india-rubber rings or disks *g* are used as springs at the upper part of the propeller instead of ordinary spiral springs. The action of this construction of dry crusher is analogous to that of the wet crusher hereinbefore described. The ore or material is supplied from a hopper, as before, and after it has become sufficiently reduced the air-currents strike it and carry it away up the trunks *h'* to the depositing apparatus through a curved cowl or hood $h^2$. The air is caused to pass into the mill and mix with the ground material, thus facilitating its being drawn off by an exhaust-fan. The bell-shaped propeller is so formed that a partial vacuum is created in its interior, thereby causing the air to rush through the open spaces. The air is caused to pass continuously through the interior of the propeller and prevents dust or grit settling on the bearings. The air in passing around the bearings tends to keep them cool. In the case of wet grinding water or ground material is prevented from being washed over into the bearings.

I claim—

1. In a ball crushing-mill, the combination of a vertical driving-spindle, a bell-shaped ball-propeller driven by the spindle and provided on its outer surface with vertical, radiating wings, a ball-raceway containing a ball, a tubular neck rising centrally from the ball-raceway into the bell-shaped propeller, open to the atmosphere at its lower end and through which and the propeller an air-current is created by said radiating wings, ascending air-escape trunks arranged outside the propeller, and an air-supply pipe constructed to direct air onto the ball-raceway, substantially as described.

2. In a ball crushing-mill, the combination

of a vertical driving-spindle, a bell-shaped propeller driven by the spindle and having radiating wings mounted on its exterior, a ball-raceway containing a ball, a tubular neck rising from the center of the ball-raceway, having an open top, open at its lower end to the atmosphere and through which and the propeller an air-current is created by said radiating wings, and ascending air-escape trunks arranged outside the propeller, substantially as described.

In testimony whereof I have hereunto set my hand this 13th day of December, 1897.

WALTER KITTO.

Witnesses:
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A. B. CROFTS.