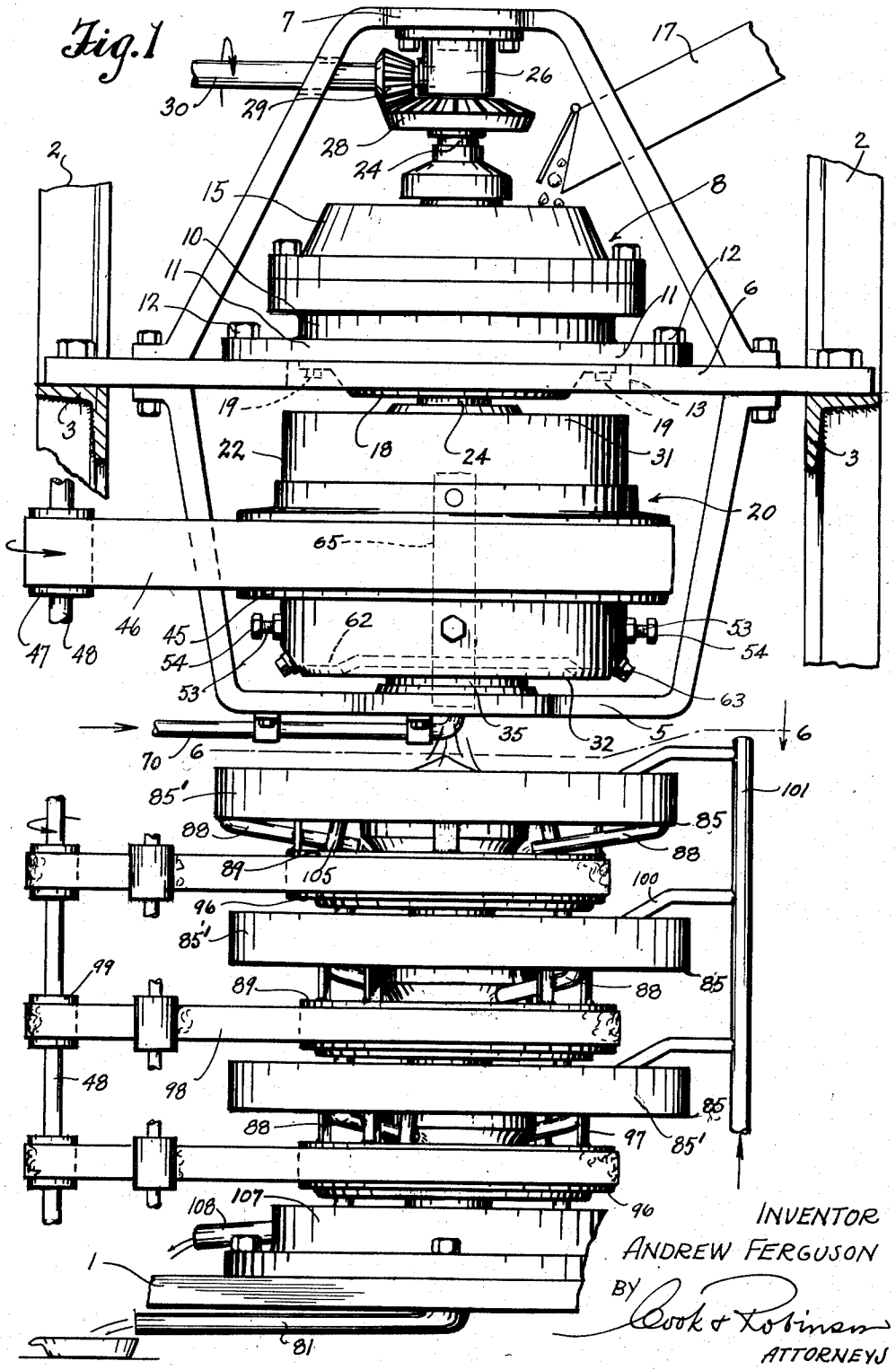
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AMALGAMATOR

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Fig. 1



INVENTOR
ANDREW FERGUSON
BY Cook & Robinson
ATTORNEYS

Oct. 21, 1952 A. FERGUSON 2,614,756

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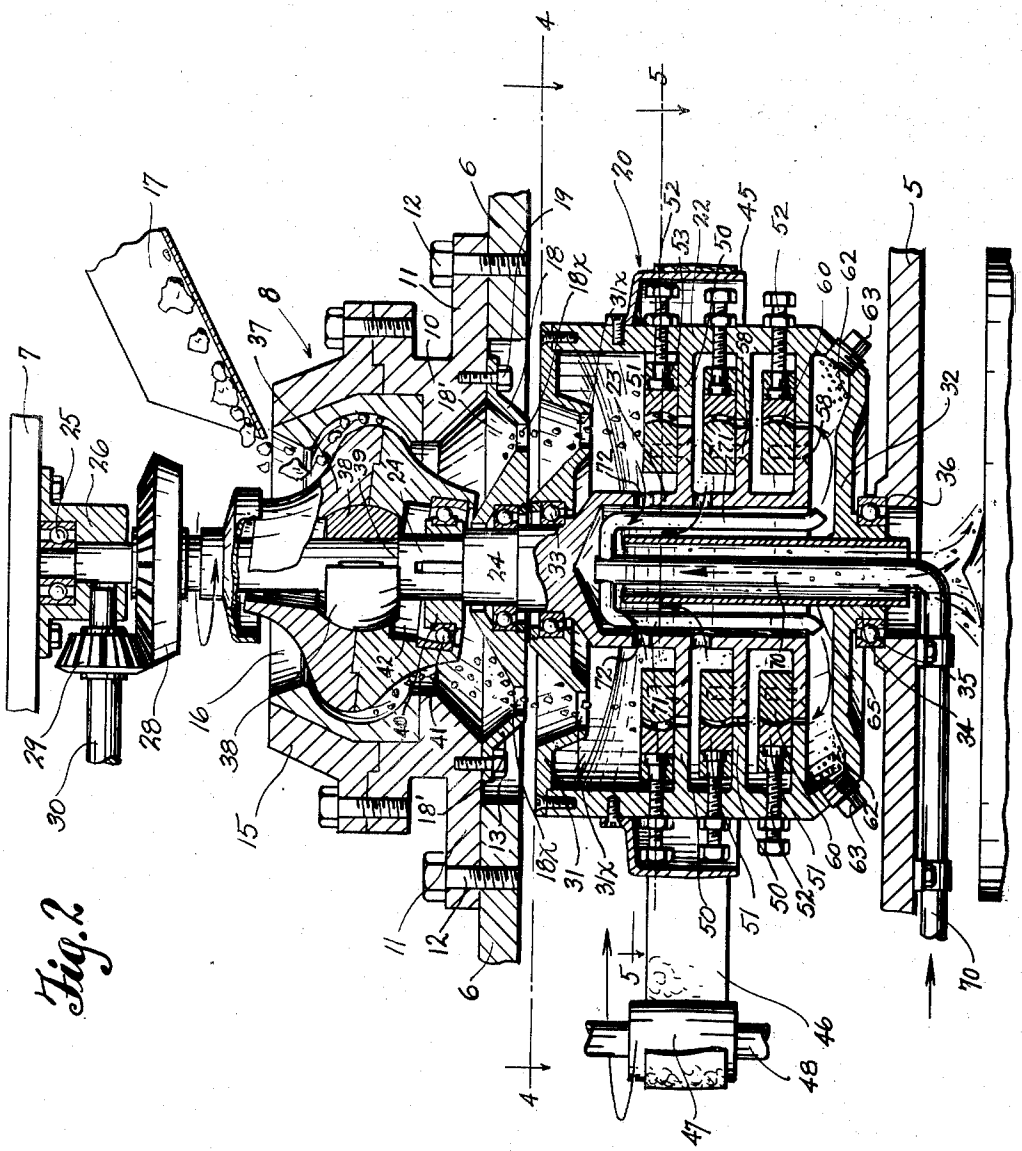


Fig. 2

INVENTOR
ANDREW FERGUSON
BY Cook & Robinson
ATTORNEY

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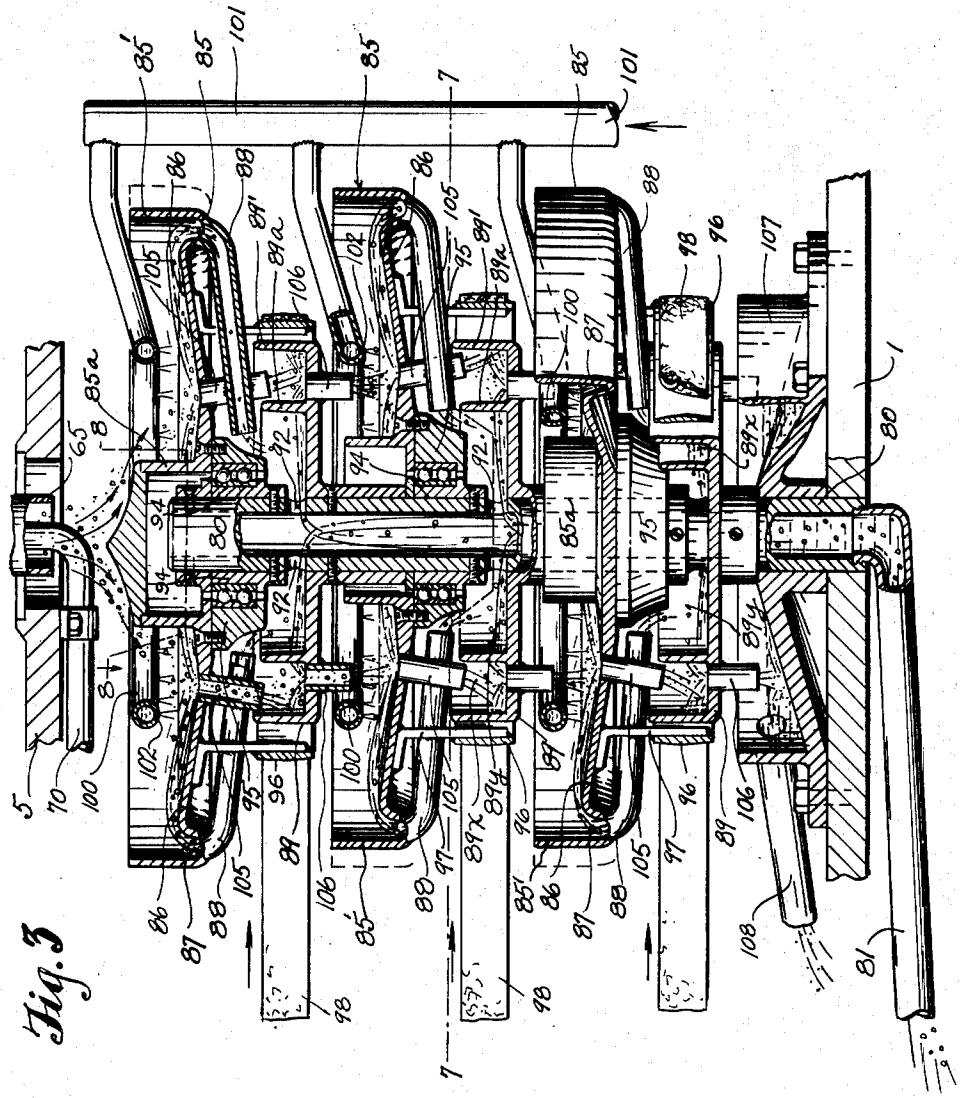


Fig. 3

INVENTOR
ANDREW FERGUSON
BY Cook & Robinson
ATTORNEYS

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Fig. 4

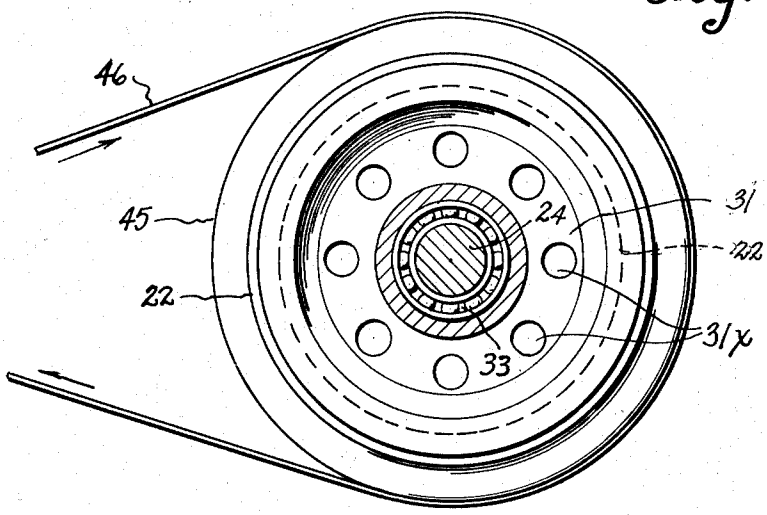
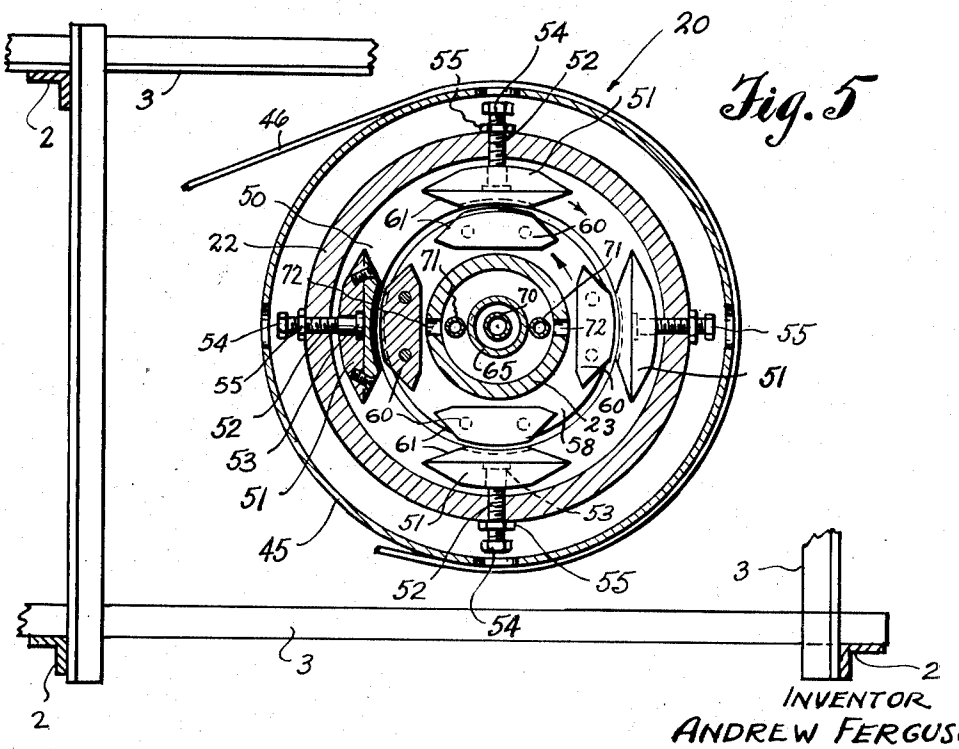


Fig. 5



INVENTOR
ANDREW FERGUSON
BY Cook & Robinson
ATTORNEYS

Oct. 21, 1952 A. FERGUSON 2,614,756

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Fig. 8

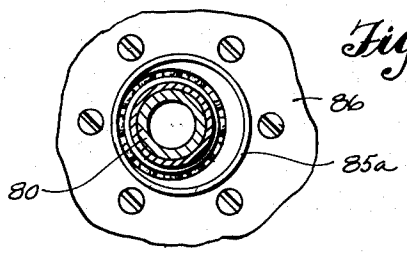


Fig. 6

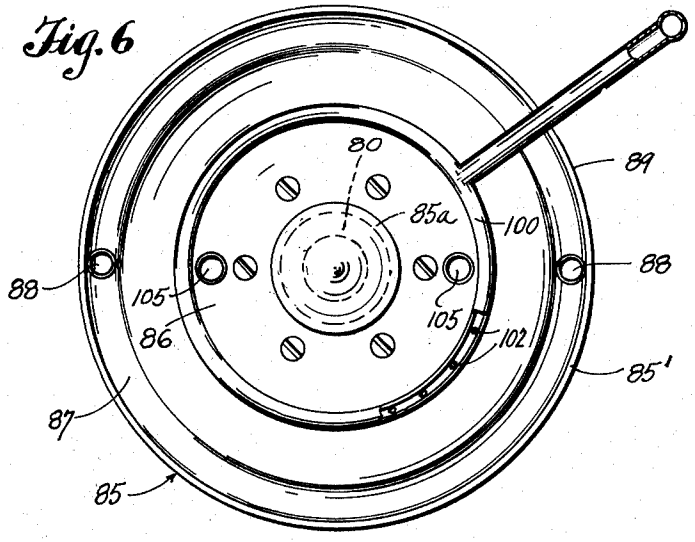
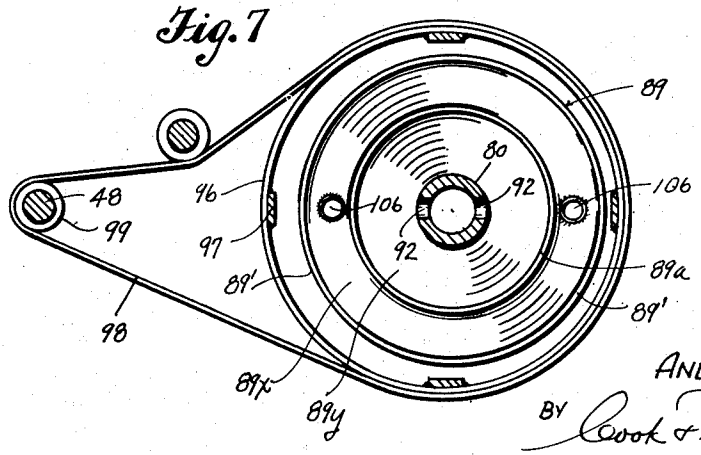


Fig. 7



INVENTOR
ANDREW FERGUSON
BY Cook & Robinson
ATTORNEYS

Patented Oct. 21, 1952 2,614,756

UNITED STATES PATENT OFFICE

2,614,756

AMALGAMATOR

Andrew Ferguson, Pasadena, Calif.

Application May 3, 1947, Serial No. 745,777

5 Claims. (Cl. 241—38)

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This invention relates to amalgamators and it has reference more particularly to improvements in amalgamators of that type wherein the separation of the precious metals from the crushed ore is effected by grinding, washing and an application of centrifugal force to the crushed and ground material while it is being washed; it being the principal object of the invention to provide an amalgamator of the character above stated that is relatively simple in its construction and mode of operation and exceptionally effective in the separation of sand and concentrates.

It is also an object of the invention to provide an amalgamator of the character above stated, wherein the reduction of the ore to any desired degree of fineness may be accomplished without direct contact of steel on steel as embodied in the grinding elements and wherein the precious metals are separated from the crushed ore by a rubbing and scouring process rather than by the usual pounding, stamping or rolling operations.

Another object of the present invention is to provide novel and efficient means for separation of the concentrates from the waste or sand.

Other objects of the invention reside in the novel details of construction and combination of parts embodied in the amalgamator and in their mode of operation, as will hereinafter be fully described.

In accomplishing the above mentioned and other objects of the invention, I have provided the improved details of construction, the preferred forms for which are illustrated in the accompanying drawings wherein—

Fig. 1 is a side view of the present amalgamator, eliminating from the view the supporting frame structure for better illustration.

Fig. 2 is a central vertical section of the ore grinder.

Fig. 3 is a central vertical section of the separating unit.

Fig. 4 is a horizontal section, taken on the line 4—4 in Fig. 2.

Fig. 5 is a horizontal section, taken on line 5—5 in Fig. 2, showing the relationship of ore grinding and metal polishing elements.

Fig. 6 is a horizontal section of a portion of the machine as seen in line 6—6 in Fig. 1.

Fig. 7 is an irregular horizontal section substantially on the line 7—7 in Fig. 3, showing one of the sand and concentrate separating pans.

Fig. 8 is a horizontal sectional detail of a bearing, as on line 8—8 in Fig. 3.

Referring more in detail to the drawings:

In its present preferred form of construction,

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the machine comprises a horizontal bed or plate 1 constituting the base member of a frame structure, not herein shown except in part, whereby the various parts of the machine are supported. As noted in Fig. 5, the frame structure comprises corner posts 2 and cross members 3 which in a general way indicate the type of frame structure used.

Fixed rigidly in the frame structure at vertically spaced intervals, are horizontal plates 5, 6 and 7, to which various parts of the machine are attached as will presently be described; the plate 7 being a part of a bracket located at the top of the frame structure; plate 5 also being part of a bracket and is substantially mid-way between the plates 1 and 7 and the plate 6 being mid-way between plates 5 and 7 and fixed on the frame structure. In Fig. 1, I have shown the brackets of which plates 5 and 7 are parts, as being bolted rigidly to the plate 6 at lower and upper sides thereof. Plate 6 is rigidly fixed in the frame.

Supported by the various plates 1, 5, 6 and 7, in succession from the lower end of the machine upwardly, are the concentrate separating pans, the ore grinding and polishing elements, the ore crusher and the driving gearing for the drive shaft of the ore crushing and the grinding elements. The ore crusher which is located at the upper end of the machine is designated in its entirety by numeral 8 and it comprises an exterior housing 10 which is cylindrical in cross-section and disposed with its axial line in vertical position. This housing is formed with an encircling, horizontally projecting flange 11 that is secured by bolts 12 to the plate 6; the plate 6, as noted in Fig. 2, being formed with an opening 13 into which the lower end portion of the housing extends.

At the top of the housing 10 there is attached an upwardly directed, conically tapered member 15, formed with a central opening 16 into which the ore that is to be ground may be fed by suitable means, for example, as from the chute 17. The lower end of the cylindrical housing 10 is open, but has a perforated closure plate 18 applied thereover; the plate being held in place by bolts 19 applied through its peripheral portion and threaded into the lower end of housing 10. The plate 18 is so shaped as to provide an annular trough-like portion 18' concentric of the housing 10 and it is formed with a central opening through which the grinder drive shaft extends as will later be explained.

Located between the plates 5 and 6 is the ore grinder which is designated in its entirety by

numeral 20. This grinder comprises a cylindrical housing 22, coaxially aligned with the crusher housing 10. Disposed coaxially within the housing 22 is a grinder hub 23 from which a drive shaft 24 extends, upwardly and coaxially through and above the crusher housing. At its upper end, the shaft 24 is revolvably contained in a ball bearing raceway 25, and this in turn is supported in a housing 26 fixed to the frame plate 7. A bevel gear wheel 28 is fixed on the upper end of shaft 24 just below the bearing 25 and this is driven by a bevel gear pinion 29 that is fixed on a driven shaft 30.

The cylindrical housing 22 is of slightly greater diameter than housing 10 and is closed at upper and lower ends by end plates 31 and 32 respectively. The upper plate 31 is formed with a central opening for passage of the drive shaft 24, and within this opening it mounts a ball bearing 33 through which the shaft 24 extends. The lower end plate 32 has an axial, downwardly directed hub portion 34 that is rotatably confined within a ball bearing 35 disposed in a seat 36 upon the plate 5. Thus, the housings of the crusher and grinder are held in axial alignment.

The crushing of the ore that enters the machine through the top opening 16 is effected by the eccentric, rotary action of a crusher head 37 that is mounted on the shaft 24. As seen in Fig. 2, a spherically shaped bearing 38 is mounted on the shaft 24 and seated against a shoulder 39 thereon. The head 37 is mounted for pivotal action on this bearing. Keyed on the shaft 24, below the bearing 38, is an eccentric 40 about which a ball bearing 41 is mounted. The bearing is contained within a cylindrical socket 42 formed in the lower end portion of the head 37 and through this means, rotation of the shaft 24 will effect an oscilliating and rotary action of the head that causes the crushing of the ore as it feeds downwardly through the opening 16 and thence between the surface of the head and the inner surfaces of the member 15.

The ore, as it is crushed, falls into the housing 10 and is caught in the annular trough 18' of the plate 18, and then passes downwardly through the openings 18x therein into the basin-like plate 31 that closes the upper end of the grinder housing 22. The plate 31, like plate 18, is provided with openings 31x through which the crushed ore falls into the grinder for further reduction.

The grinder comprises the housing 22 that is mounted for rotation as previously explained, about the central, axial line of shaft 24 and the hub member 23. In operation of the machine the housing is rotated at a substantial speed in one direction, while the hub member rotates in an opposite direction. As seen in Figs. 1 and 3, the housing 22 has a belt wheel 45 fixed concentrically thereabout and about this wheel, a driving belt 46 is extended; the belt passing also about a driving pulley 47 fixed on a vertical drive shaft 48 that is mounted in the frame structure.

Within the housing 22, a plurality of annular, vertically spaced shelves 50 are cast integrally with the housing wall; mounted on these shelves at spaced intervals are grinding blocks 51 held in place by bolts 52 as seen in Fig. 2. The bolts have inner end portions 53 rotatably fixed in the blocks and have shank portions threaded through the housing wall and equipped at their outer ends with wrench heads 54 whereby the bolts may be rotatably adjusted for the purpose of adjusting the blocks inwardly or outwardly. Lock nuts 55 applied to the shanks retain the adjustment.

The hub member 23 is a cylindrical body, disposed coaxially of the housing 22 and formed with a plurality of encircling flanges 58 at the same levels of the shelves 50. Fixed on each of these several flanges, at spaced intervals, are grinder blocks 60 as shown in Fig. 5, and these blocks have cylindrically curved outer surfaces that are adapted, incident to relative rotation of the housing and hub, to pass in close relationship to the grinding surface of the blocks 51, thus to effect a fine grinding of ore passing between them.

From the upper end of the housing 22 downwardly, the grinding blocks 51 at the various levels are adjusted closer to the grinding heads so as to produce a progressive reduction in the material as it moves downwardly through the grinder.

It is shown in Fig. 5 that the ends of the blocks 51 and ends of the grinding heads 60 are bevelled as at 61 in such manner to facilitate the automatic advancement of the crushed ore between the grinding surface of these parts with the rotation of the housing and hub in opposite directions.

Formed within the bottom wall plate 32 of the housing 22, just within the side wall is an annular trough 62 in which mercury may be contained. With the passing of the crushed and ground ore into the lower end of the housing, the free metal will be taken up in the mercury as is well understood. Removable plugs 63 are applied within openings in the trough to permit draining of the amalgam whenever this is required or desired.

The reduced ore, or what is usually referred to as the sand, is washed out of the housing 22 by reason of means which will now be described.

Applied vertically through the lower end wall 32 of the housing 22 and coaxially of the housing, is a tubular, vertically extending member 65. The open lower end of this tube extends downwardly and through an opening in the plate 5. The upper portion of the tube extends within and close to the upper end of the cylindrical chamber formed within the hollow hub member 23, and is open at its upper end. It is shown in Fig. 2 that there is a substantial amount of clearance between the tube 65 and the side walls of the hub chamber and also that the upper end of the hub chamber is closed and that the lower end opens into the lower part of housing 22.

A water supply pipe 70 enters the open lower end of the tube 65 and is contained therein with substantial clearance and at a point just above the upper end of the tube, a plurality of branch pipes 71 lead outwardly then downwardly therefrom, outside of the tube 65 and within the hub chamber and open at their lower ends into the lower end of the housing 22. Water that is discharged from the lower ends of pipes 71 creates an upflow of water in the hub chamber and a suction of material that carries it into the upper end of tube 65 for discharge at the lower end of the tube to the separator pans.

It is also shown in Fig. 2 that the hub member 23 has a plurality of ports 72 opening laterally therefrom at the different levels of the grinding heads and keeps the material at the various levels flushed with water from the hub chamber. Thus, sulphides, sand and concentrates will be washed out through tube 65, while the free metal

and heavy concentrates may be caught in the mercury trough 62.

The apparatus that is located between the plates 1 and 5, and which is shown in vertical section in Fig. 3, is designed to effect the separation of the heavy concentrates from the sand that is discharged from tube 65. This apparatus comprises a series of separation pans and associated equipment which will now be described.

Fixed rigidly on the plate 1, in coaxial alignment with the driving shaft 24, is a tubular, upwardly extended post or standard 80. The lower end of this post extends through the plate 1 and is there connected with a drain pipe 81.

Revolubly mounted on the post 80, in vertically spaced relationship, are the separation pans 85, three being herein shown; each being like the others and therefore one will be described with the understanding that its description applies equally to the others.

Each pan 85 is circular in form, and has a vertical, upstanding rim 85', a bottom wall 86 that slopes from the rim downwardly and inwardly to an upstanding wall 85a about a central opening through which the mounting post 80 extends.

Below each pan 85 is a horizontal basin 89 that is rigidly supported from the post. Each basin, which is of lesser diameter than the pans 85, as noted in Fig. 3, has a peripheral flange 89', and a vertical wall 89a concentrically of the basin but spaced inwardly from the flange 89, thus to divide the basin so as to provide an annular outer compartment 89x and an inner compartment 89y, which are best shown in Figs. 3 and 7.

Drain tubes 88 lead downwardly and inwardly from the trough 87 of each pan 85 and, as seen in Fig. 3, discharge into the inner compartment 89y of the next lower basin.

Each basin 89 is fixed by means of a hub portion to the post 80 and has drain ports 92 opening from its inner compartment into the tubular post which, in turn, drains into the pipe 81, as seen in Fig. 7.

Each pin 85 is mounted for rotation about the post 80, and it is shown in Fig. 3 that for each pan a supporting bearing 94 is fixed to the post, and the pan is equipped on its under side, and eccentrically of the pan axis, with a mounting bearing 95 rotatably about the inner bearing 94; there being anti-friction means disposed between the bearings 94 and 95. Thus, with the rotation of the pans about the support 80, they will be given an eccentric motion that is very helpful in the operation of separating the gold from the sand.

The several pans are individually rotatably driven and for this I provide each with a belt wheel 96; each wheel being rigidly suspended from the bottom of the pan by a plurality of brackets 97. Belts 98 operate about the wheels 96 and about pulley wheels 99 on the drive shaft 48 as seen in Figs. 1 and 7. Belt tighteners of suitable kind are used to keep the belts tight and permit the eccentric action of the pans.

Closely overlying each pan 85 is an annular water pipe 100 and these are connected with a water supply pipe 101. Water supplied through the pipe 101, under pressure, is discharged downwardly through perforations 102 in the pipe 100 into the pan 85 thus to wash down the material received from tube 65 and facilitate the concentrating and separating action and the flushing of the pans. From near the hub portion of the bottom wall 86 of the uppermost pan, a plurality of drain pipes 105 extend downwardly and discharge into the outer compartments of the next lower basin. Each basin is likewise equipped with the drain pipes 106 discharging into the next lower pan in order that the sand may be subjected to repeated separation operations. The sand from the lowermost basin 89 drains into a receptacle 107 and from this, through a pipe 108 to waste. The concentrates which are discharged downwardly through the tubular post 80 are carried through the pipe 81 to a suitable receptacle in which the concentrate may be retained.

In the separation operation just described, the concentrate that is collected in each of the several pans 85 is not again allowed to mix with the sand but is discharged to the tube or post and from this to a storage receptacle. The sand, however, is repeatedly subjected to an operation for further segregation of the concentrates therefrom.

Having thus described my invention, what I claim as new therein and desire to secure by Letters Patent, is:

1. In an amalgamator of the character described, a cylindrical housing mounted to rotate about a vertical axis and adapted to receive crushed ore thereinto at its upper end, a cylindrical hub member mounted coaxially therein for rotation; said housing having a bottom wall forming an annular amalgam trough adjacent the outer wall of the housing; said cylindrical housing having annular shelves formed therein on its side walls at different levels; said hub having flanges formed thereabout at the levels of said shelves, ore grinding blocks fixed on said flanges, ore grinding blocks adjustably mounted on said shelves to coact with those on said flanges for the gradual reduction of ore as it moves downwardly from grinding blocks of higher level to those of lower level, a water outlet pipe extended upwardly through said bottom wall into said tubular hub, with clearance between them; said tubular hub having openings in its side walls between the flanges thereon for flow of water to said outlet pipe, means for discharging wash water into the lower end of said housing for the upward washing of ground ore into the hub through its wall openings, for outflow through said pipe, and means for revolving the hub and housing in opposite directions to effect the grinding operation.

2. In an ore reducing mill of the character described, a rotatably mounted, cylindrical and vertically disposed housing, closed at its lower end and adapted to receive crushed ore thereinto at its upper end for downward progression and formed with an annular amalgam basin concentrically thereof at its lower end, a rotatably mounted, hollow hub contained coaxially within the housing and formed with radially opening inflow ports, ore scouring and polishing blocks within the housing, fixed to the hub member and to the housing wall to coact, but without contact, for the pulverizing of ore and polishing of metal passing between the coacting surfaces thereof in its downward progression, an outflow pipe leading from within the upper end portion of the hollow hub through the base of the housing, means for rotating the said housing and hub at high and differential rates of speed and means for admittance of a flow of water under pressure into the lower end of the housing for an upward washing of pulverized

material through the hub ports to the outflow pipe.

3. Apparatus as recited in claim 2 wherein the annular space between the housing and hub is divided by horizontal flanges on these parts into a succession of compartments with restricted passages from each into the one next lower for the downward progression of the ore and for the up-flow of the wash water through the several compartments, and from them into the said hollow hub through the said inflow ports and thence to the outflow pipe, and wherein ore pulverizing blocks are arranged in coacting relationship on the hub and housing in each of the compartments for a progressively finer pulverization of material as it progresses downwardly through the compartments.

4. Apparatus as recited in claim 2 wherein the annular space between hub and housing is divided by horizontal flanges on these parts at the same level, into a succession of coaxial, annular compartments with inter-communicating passages between the edges of coacting flanges for the progression of ore from each compartment to the one next lower, and for the up-flow of wash water through the compartments, and into the hub through the inflow ports and wherein coacting blocks are arranged spaced apart and in concentric, circular rows on the housing and hub flanges in each of the compartments for the progressive reduction of the crushed ore as it progresses from one compartment to the other.

5. In an ore reducing mill of the character described, a vertically disposed cylindrical housing designed to receive crushed ore thereinto at its upper end, and including a closing wall at its lower end, formed about the housing wall with an amalgam basin, a tubular hub member

contained coaxially within the cylindrical housing, means for effecting high speed relative rotation of the hub member and housing, a succession of annular shelves formed in vertical spacing on the walls of said housing interiorly thereof, annular flanges formed about the hub at levels corresponding to those of the housing and with clearance between them; said shelves and flanges defining a succession of annular compartments, each adapted to receive material from the one next higher through the clearance provided between corresponding shelves and flanges, ore grinding and scouring blocks fixed in co-operating relation on the shelves and flanges, means for the admittance of water under pressure into the lower end of the housing, and an outlet tube extending upwardly through the closing wall of the housing and into the tubular hub, and having ports for the succession of compartments for the outflow of wash water into the tube.

ANDREW FERGUSON.

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