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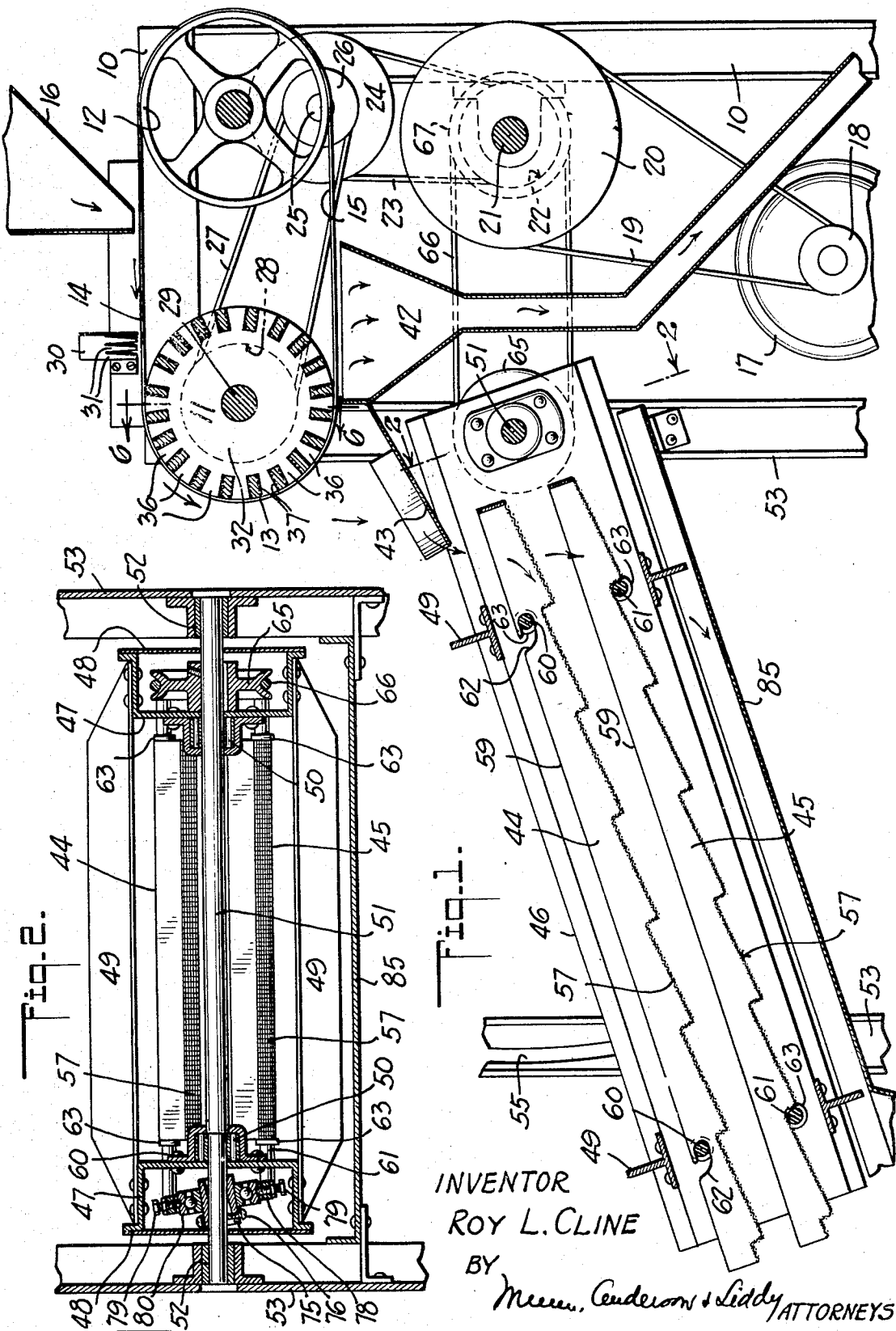
R. L. CLINE

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ORE CONCENTRATOR

Filed Aug. 2, 1935

2 Sheets-Sheet 1



INVENTOR
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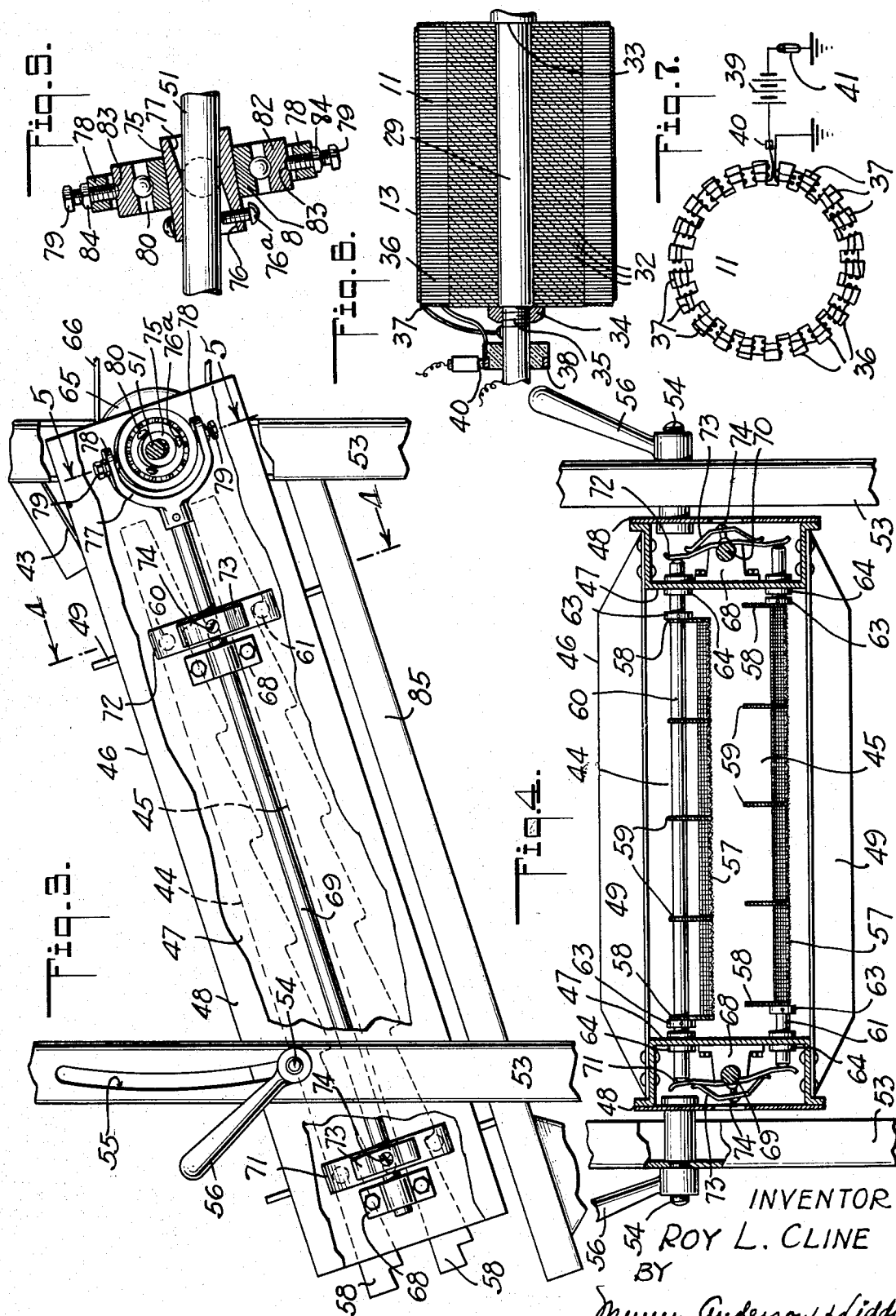
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UNITED STATES PATENT OFFICE

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ORE CONCENTRATOR

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Application August 2, 1935, Serial No. 34,472

8 Claims. (Cl. 209—442)

This invention relates generally to the recovery of valuable metals from their ores, and particularly to a concentrator which utilizes the dry process of separation.

5 An object of the invention is to provide a concentrator structurally characterized in a manner to insure maximum recovery of valuable metal particles by the dry process, which is enabled to be carried on in a continuous operation of the concentrator over a relatively long period of time so as to reduce to a minimum the shut-down periods in order to clear the riffles of valueless material which when accumulated in sufficient quantity causes the values to pass over the riffles and be lost.

15 More specifically, an object of the invention is to provide in an ore concentrator riffles of reticulated or screen construction which in conjunction with a novel mode of actuating the riffle board, permit particles of such small size as to be of no practical value in their gold bearing content, to pass through the riffles so that the riffles will not become filled with such valueless particles and will trap the maximum quantity of gold.

25 Another object of the invention is to provide an ore concentrator embodying means for preliminarily separating all magnetizable substances from the material to be treated so that such substances will not reach the riffle board and detract from the efficiency of the riffles.

30 With these and other objects in view, the invention consists in the combinations, arrangements, and functional relationships of elements as set forth in the following specification and particularly pointed out in the appended claims.

In the accompanying drawings,

Figure 1 is a view showing in vertical longitudinal section the ore concentrator embodying this invention;

40 Figure 2 is a transverse sectional view taken on the line 2—2 of Figure 1;

Figure 3 is a view in side elevation partly broken away, and illustrating novel driving mechanism for the riffle boards;

45 Figure 4 is a view in transverse section taken on the line 4—4 of Figure 3;

Figure 5 is an enlarged detail sectional view taken on the line 5—5 of Figure 3;

50 Figure 6 is a detail sectional view taken on the line 6—6 of Figure 1;

Figure 7 is a diagrammatic view illustrating the electrical circuit for an electro-magnet embodied in the invention to separate the magnetizable substances from the material under treatment.

55 Referring specifically to the drawings, the invention comprises a frame 10 in which is journaled an electro-magnetic wheel 11 and an idler pulley 12 over both of which is trained an endless belt 13 of non-magnetic material such as brass, to provide upper and lower horizontally disposed stretches 14 and 15 onto the former of which is deposited from a hopper 16 the metalliferous material to be treated.

5 In the present instance, the wheel 11 is driven in the direction of the arrow in Figure 1 by an electric motor 17 or any other suitable form of prime mover to the drive shaft of which is fixed a pulley 18 having a belt connection 19 with a pulley 20 fixed to a countershaft 21 journaled in the frame 10. Also fixed to the countershaft 21 is a relatively small pulley 22, having a belt connection 23 with a larger pulley 24 fixed to a jack shaft 25 also journaled in the frame. To the jack shaft 25 is also fixed a relatively small pulley 26 having a belt connection 27 with a pulley 28 fixed to the shaft 29 of the wheel 11, all to the end that when the motor is in operation the material deposited on the belt 13 will be advanced and be distributed in a substantially uniform layer over the width of the belt by a spreader 30 having a number of depending spaced apart fingers 31 supported in the path of the material on the belt.

15 The electro-magnetic wheel is composed of a multiplicity of disk laminations 32 clamped together on the shaft 29 between a shoulder 33 on the latter and a nut 34 on the threaded portion 35 of the shaft as shown in Figure 6. The laminations 32 are radially slotted to provide a number of cores 36 which, together with a continuous or series winding 37 from one core to the next in reverse directions, provide electro-magnets around the entire periphery and along the full width of the wheel, the relatively reversed winding of successive cores providing alternate north and south poles. One end of the winding 37 is connected to a collector ring 38 fixed to the shaft 29 and to which current is fed from a source of current supply 39 through a brush 40 contacting the ring. The opposite end of the winding is grounded to the frame 10 through the shaft 29, and the other side of the current source is also grounded so that when a switch 41 is closed, current will be supplied to the series of electro-magnets. Thus, with the wheel 11 being driven, it will be clear that as the metalliferous material is advanced on the belt 13 into the magnetic fields of the magnets, all magnetizable particles will be carried around on the belt to the lower stretch 15 until they are beyond the range of the magnetic

25 30 35 40 45 50 55

field, at which location these magnetizable particles gravitate into a discharge conduit 42.

The remainder of the metalliferous material containing the values gravitates from the belt 13 into a chute 43 from which the material gravitates onto the upper end of one of a number of riffle boards, of which two designated generally at 44 and 45 are shown in the present instance. However, it is to be understood that a greater number may be provided without involving invention.

The riffle boards are mounted in a rectangular frame 46 composed of longitudinal channel members 47—47 and cover plates 48—48, the former 5 of which are rigidly tied together in spaced parallel relationship by transverse angle members 49—49. The frame 46 is freely mounted by roller bearings 50—50 to pivot on a drive shaft 51 journaled in bearings 52 on the vertical members 53 of the main frame 10, all as clearly shown in Figure 2. This pivotal mounting of the riffle board supporting frame 46 enables the inclination of the frame and hence of the riffle boards to be varied in accordance with variations of the 25 moisture content of the ore in order to effect maximum recovery of the values. The frame can be clamped in any selected position of angular adjustment by clamp screws 54—54 projecting from the frame through arcuate slots 55—55 in the frame members 53, and having handled 30 clamping nuts 56—56 threaded thereon as shown in Figures 3 and 4.

The riffle boards 44 and 45 are of similar construction and each has its riffle forming bottom 35 57 composed of a sheet of reticulated material such as extremely fine mesh metallic screening. The bottoms are each rigidly supported in the riffle forming shape shown in Figure 1 by longitudinal side walls 58 and intermediate longitudinal partitions 59 which co-act with the steps 40 of the riffles to divide the bottoms 57 both longitudinally and transversely to form compartments arranged in rows along the lengths of the bottoms.

The riffle boards 44 and 45 are supported between the members 53 of the frame 46 by rods 45 60—60 and 61—61, respectively, the side walls 58 and partitions 59 of the board 44 being slotted at 62 to receive the rods 60, and the board 45 resting on the rods 61. The boards are confined 50 between collars 63 fixed to the rods; and the rods are mounted in bearings 64 in the members 47 for reciprocating movement axially in order to reciprocate the boards transversely.

The boards are reciprocated by the following 55 mechanism, including the drive shaft 51 to which is fixed at one end between the respective member 47 and cover plate 48 a pulley 65 having a belt connection 66 with a pulley 67 fixed to the countershaft 21 so that when the motor 17 is in operation, the shaft 51 will be rotated in the 60 direction of the arrow in Figure 1.

Journaled in bearings 68—68 on the members 47 are rock shafts 69 and 70, the axes of which 65 are disposed longitudinally of and parallel to the riffle boards. Fixed to the rock shafts are flexible spring arms 71 and 72, respectively, the opposite ends of which bear against the ends of the rods 60 and 61. Shorter flexible spring-adjusting arms 73 overlie the arms 71 and 72 and 70 are secured to the respective rock shafts by screws 74 which enable the adjusting arms to exert greater or less stress against the actuating arms 71 and 72 in order to vary the flexibility thereof.

75 The shaft 69 is adapted to be rocked in re-

sponse to rotation of the drive shaft 51 by means of a novel operative connection between the shafts. This connection comprises a hub 75 receiving the drive shaft, and having its bore radially enlarged at diametrically opposite points 5 and ends as indicated at 76 and 77 in Figure 5, so as to enable the hub to be disposed on the drive shaft with its axis intersecting or at an angle to the axis of the shaft. A plurality of adjusting screws 76a threaded through the hub adjacent 10 one end thereof and bearing against the shaft enable the angularity of the hub to be varied and a selected position of angular adjustment maintained.

A yoke 77 is fixed to the rock shaft 69, and its 15 arms 78 are pivotally connected by studs 79 to the hub through the medium of a ball bearing structure 80. The inner race 81 of such structure is fixed on the hub, and the outer race 82 is provided with diametrically opposed recesses, 20 receiving the inner rounded ends of the studs 79, which latter are threaded into the yoke arms 78 and are locked by jam nuts 84. It follows that as the drive shaft 51 is rotated, the angularly disposed hub 75 in rotating with the shaft, will 25 convert the rotary motion of the shaft into a rocking motion at the yoke 77 so as to rock the shaft 69. The rocking movement thus imparted to the arms 71 by the shaft 69 will effect reciprocation of the rods 60 and 61 in relatively re- 30 versed directions. It will be appreciated that the other rock shaft 70 and its arms 72 co-act with the rods at the other ends of the latter to actuate the rods in the opposite directions.

The operation of the invention is as follows: 35

Assuming that current is being supplied to the motor 17 and to the electro-magnetic wheel 11, and that the metalliferous material to be treated is discharging from the hopper 16 onto the upper stretch 14 of the belt 13, it will be clear that all 40 magnetizable particles in the material will be held on the belt as the remainder of the material discharges into the chute 43 and thence onto the upper riffle board, so that the magnetizable particles will be deposited in the discharge conduit 42. 45

As the upper and lower riffle boards 44 and 45 are being reciprocated rapidly in directions transverse with respect to their lengths, the values will collect in the riffles of the bottoms 57. All 50 those particles which are so small as to pass through the mesh of the upper riffle board will be subjected to further concentrating by the lower riffle board.

The mesh of the lower riffle board, which it will 55 be remembered is finer than that of the upper riffle board, is calculated to permit the passage of all particles which are so minute as to be of no practical value in their gold bearing content, so that the riffles will not become filled with such 60 valueless particles and are thus utilized with maximum efficiency to collect practically all the values in the material. The extremely small particles which pass through the mesh of the lower riffle board gravitate into an inclined tray 85 65 and thence into a discharge conduit 86 for further treatment if desired.

What is claimed is:

1. In an ore concentrator, a plurality of riffle boards having reticulated riffle forming bottoms; 70 reciprocally mounted rods on which the riffle boards are supported for reciprocating movement transverse with respect to the lengths of the boards; a pair of rock shafts; arms on the rock shafts engaging said rods to reciprocate the lat- 75

ter when one of the shafts is actuated; and means for actuating said one of the rock shafts.

2. In an ore concentrator, a plurality of riffle boards having reticulated riffle forming bottoms; reciprocably mounted rods on which the riffle boards are supported for reciprocating movement transversely with respect to the lengths of the boards; a pair of rock shafts; arms on said rock shafts engaging said rods to reciprocate the latter when one of the shafts is actuated; and means for actuating said one of the rock shafts, including a drive shaft on which the riffle boards are mounted to tilt in order to vary the inclination thereof in a direction longitudinally of the boards.

3. In an ore concentrator, a frame including spaced apart longitudinal members; rods spanning and reciprocably mounted by said members; riffle boards supported by the rods between the frame members for reciprocating movement transversely; rock shafts mounted on said frame members to extend longitudinally thereof; means for operatively connecting the rods to the rock shafts so that the rods will be reciprocated upon actuation of the shafts; and actuating means for the shafts.

4. In an ore concentrator, a frame including spaced apart longitudinal members; rods spanning and reciprocably mounted by said members; riffle boards supported by the rods between the frame members for reciprocating movement transversely; rock shafts mounted on said frame members to extend longitudinally thereof; arms fixed to the rock shafts and engaging the rods to reciprocate the latter when the shafts are actuated; a drive shaft journaled in the frame members; and means for rocking one of the rock shafts when the drive shaft is rotated.

5. In an ore concentrator, a frame including spaced apart longitudinal members; rods spanning and reciprocably mounted by said members; riffle boards supported by the rods between the frame members for reciprocating movement transversely; rock shafts mounted on said frame members to extend longitudinally thereof; arms fixed to the rock shafts and engaging the rods to reciprocate the latter when the shafts are actuated; a drive shaft journaled in the frame members; a yoke fixed to one of the rock shafts; means swiveled in the yoke and mounted on the drive shaft at an angle to the axis of the latter, for rocking said one of the rock shafts when the drive shaft is rotated.

6. In an ore concentrator, a frame including spaced apart longitudinal members; rods spanning and reciprocably mounted by said mem-

bers; riffle boards supported by the rods between the frame members for reciprocating movement transversely; rock shafts mounted on said frame members to extend longitudinally thereof; arms fixed to the rock shafts and engaging the rods to reciprocate the latter when the shafts are actuated; a drive shaft journaled in the frame members with its axis intersecting the axis of at least one of the rock shafts; a yoke fixed to said one of the rock shafts; a hub mounted on the drive shaft with its axis disposed at an angle to the axis of the shaft; and an anti-friction bearing structure mounted on the hub and swiveled in the yoke in order for said one of the rock shafts to be rocked when the drive shaft is rotated.

7. In an ore concentrator, a frame including spaced apart longitudinal members; rods spanning and reciprocably mounted by said members; riffle boards supported by the rods between the frame members for reciprocating movement transversely; rock shafts mounted on said frame members to extend longitudinally thereof; arms fixed to the rock shafts and engaging the rods to reciprocate the latter when the shafts are actuated; a drive shaft journaled in the frame members with its axis intersecting the axis of at least one of the rock shafts; a yoke fixed to said one of the rock shafts; a hub mounted on the drive shaft with its axis disposed at an angle to the axis of the shaft; an anti-friction bearing structure mounted on the hub and swiveled in the yoke in order for said one of the rock shafts to be rocked when the drive shaft is rotated; and means by which the angularity of the hub on the drive shaft can be varied and the hub fixed in a selected position of angular adjustment in order to vary the rocking motion transmitted to said one of the rock shafts.

8. In an ore concentrator, a frame including spaced apart longitudinal members; rods spanning and reciprocably mounted by said members; riffle boards supported by the rods between the frame members for reciprocating movement transversely; rock shafts mounted on said frame members to extend longitudinally thereof; arms fixed to the rock shafts and engaging the rods to reciprocate the latter when the shafts are actuated; a drive shaft journaled in the frame members and upon which the frame can tilt to vary the inclination of the riffle boards in a direction longitudinally thereof; means by which the frame can be secured in various tilted positions; and means for rocking one of said rock shafts when the drive shaft is rotated.

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