K. SENN.

PAN MOTION CONCENTRATING TABLE.

APPLICATION FILED DEC. 29, 1911.

1,056,305.

Patented Mar. 18, 1913.

3 SHEETS—SHEET 1.

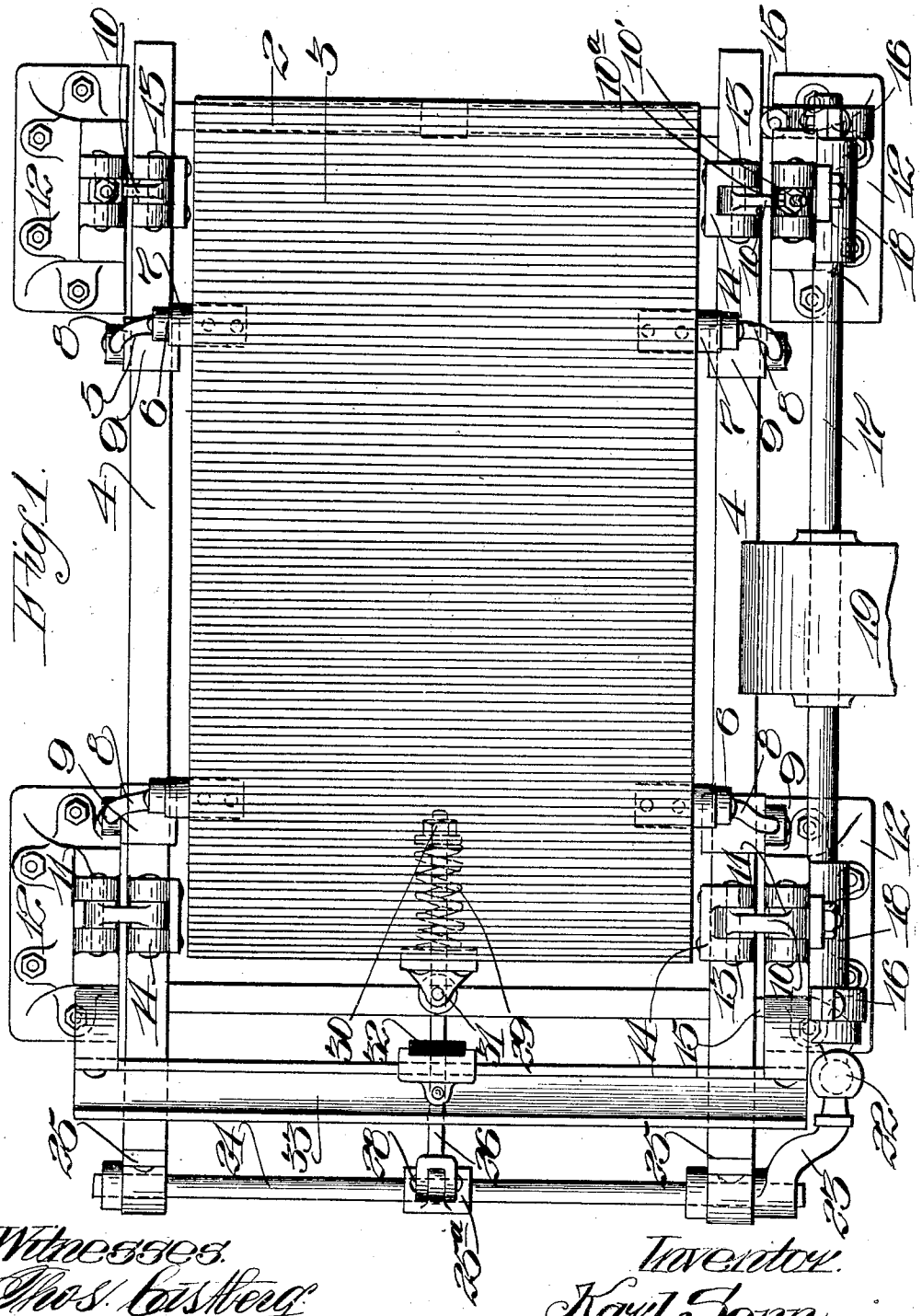

Fig. 1.

Witnesses.
Thos. Eastberg.
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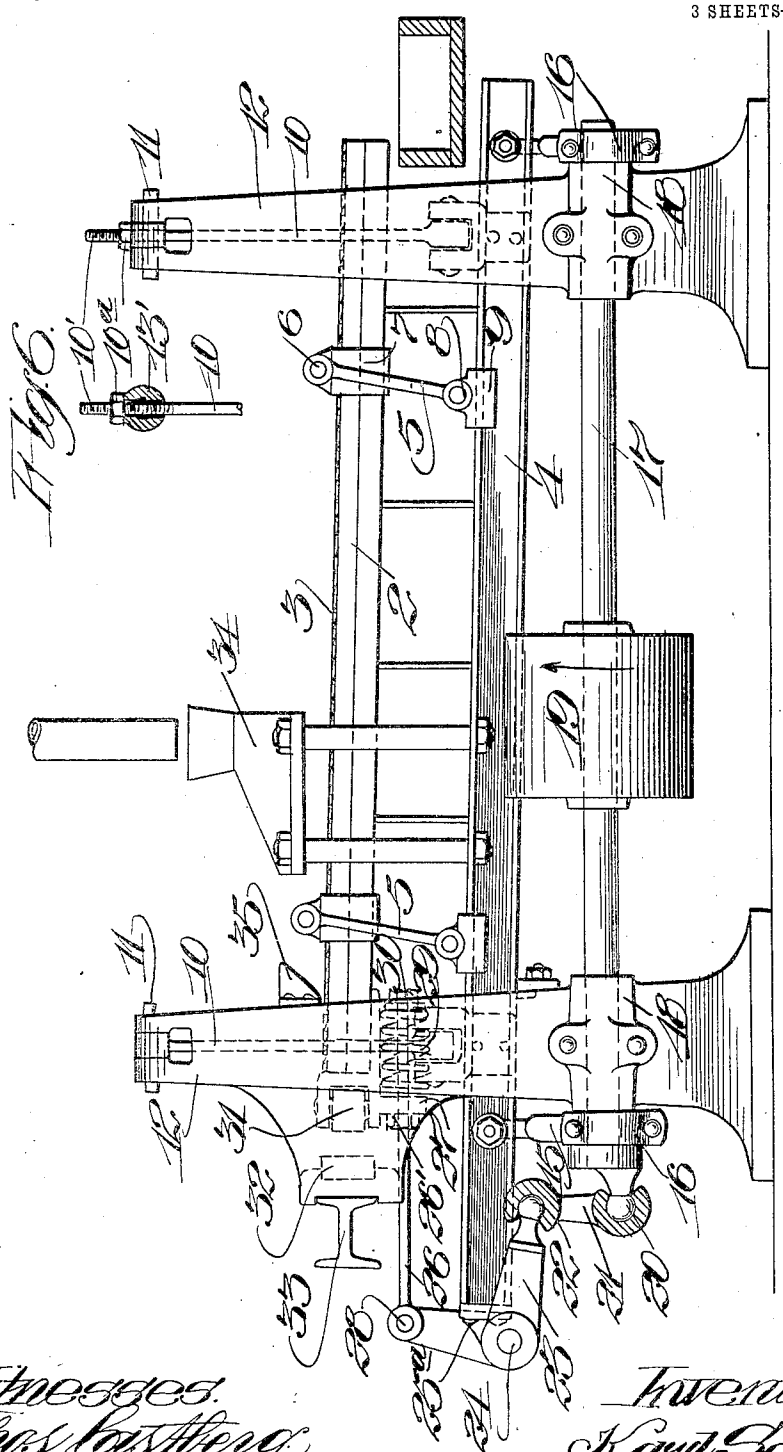

Fig. 2.

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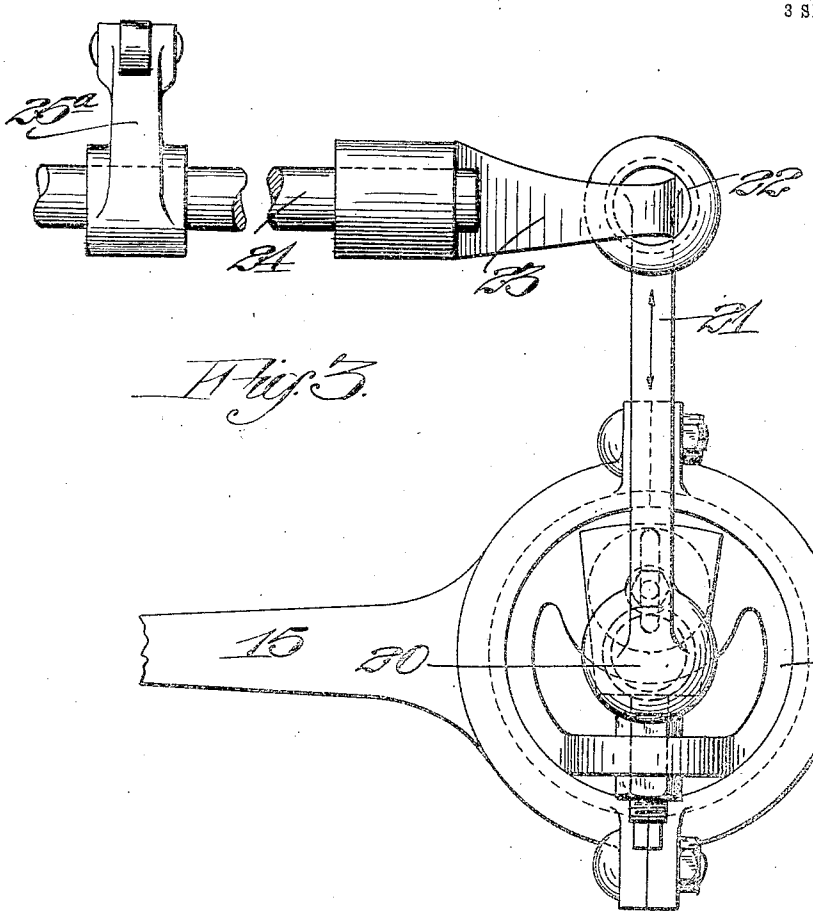

Fig. 3.

Fig. 5.

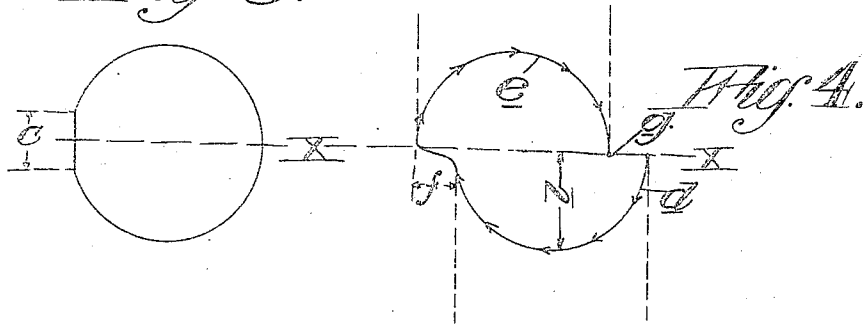

Fig. 4.

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UNITED STATES PATENT OFFICE.

KARL SENN, OF ALAMEDA, CALIFORNIA.

PAN-MOTION CONCENTRATING-TABLE.

1,056,305. Specification of Letters Patent. Patented Mar. 18, 1913.

Application filed December 29, 1911. Serial No. 668,575.

To all whom it may concern:

Be it known that I, KARL SENN, a citizen of the United States, residing at Alameda, in the county of Alameda and State of California, have invented new and useful Improvements in Pan-Motion Concentrating-Tables, of which the following is a specification.

This invention relates to concentrating machinery, and particularly to an apparatus for concentrating materials according to their specific gravities; the apparatus including a table having a pan motion.

Many forms of mineral concentrators have been provided in which some portion of the apparatus is given a reciprocating, oscillating or other vibratory movement, the effect of which is to segregate the components of a mineral pulp into classes of different specific gravities. Apparatus involving a shaking movement as now designed requires a very large amount of floor space, consumes a great deal of power and is not as efficient as is desired.

The object of the present invention is to provide a concentrating apparatus having a table in combination with which there is a mechanism capable of transmitting to the table a movement of sufficient amplitude to amply segregate the several constituents of the ore, and which apparatus is also provided for the purpose of greatly reducing the necessary floor area for a machine of certain capacity; and to further provide a concentrating table, the ore carrying part of which is given such a peculiar movement that in a given length of time the ore particles are compelled to travel a distance far greater than at present possible by machines now in use.

The invention consists of the parts and the construction and combination of parts as hereinafter more fully described and claimed, having reference to the accompanying drawings, in which—

Figure 1 is a plan view of the improved table. Fig. 2 is a side elevation of the same. Fig. 3 is an enlarged detail view of the table actuating mechanism. Fig. 4 is a diagram representing a movement of the concentrate in one cycle of the table movement. Fig. 5 is a diagram representing the path of movement of the table in one cycle. Fig. 6 is a sectional detail of the table adjusting device.

In the illustrated embodiment of my invention, 2 represents a table of suitable proportions, the upper surface of which may be provided with riffles 3. The table is here shown as flexibly connected to and supported above a transversely movable frame 4 by supporting links 5. The links 5, of which there may be a suitable number, are here shown as connected upon each side of the table 2 to pivots 6 in appropriate hangers or bearings 7; the lower ends of the supporting links 5 being connected by pivots 8 to appropriate brackets 9 fastened to or formed upon the side rails of the frame 4. The table 2 is adapted to have a longitudinal movement relative to the frame 4; this movement being permitted by the swinging of the links 5 upon the pivots 8 of the frame 4. The frame 4, which may be of suitable design and proportions, is supported for transverse oscillation by suitable suspending links 10, the upper ends of which are mounted upon supporting shafts or pivots 11 which are provided in uprights 12 on each side of the front and rear ends of the frame 4. The lower ends of the suspending links 10 are mounted upon pivots or shafts 13 in suitable brackets or bearings 14 on the frame 4.

The table-carrying frame 4 is adapted to have a lateral or transverse reciprocatory movement which is imparted thereto by connecting rods 15, suitably connected to the table 2. The outer ends of the connecting rods 15 are mounted upon eccentrics 16 which are appropriately secured upon a driving shaft 17 mounted in appropriate bearings 18 on the standards 12 on one side of the apparatus. Power is transmitted to the shaft 17 from any suitable source of power by means of a suitable driving member on pulley 19 secured on the shaft. When the shaft 17 is in operation, the eccentrics 16, which may be designed to give a desired lateral stroke to the frame 4, (and in practice it has been found that a 1½ inch total side shake is sufficient) and the superposed table 2 will all be simultaneously shifted laterally and return to the starting point at a complete revolution of the eccentrics 16.

For the purpose of transmitting to the table 2 a longitudinal, reciprocatory movement, there is mounted upon the shaft 17 a crank or eccentric which is connected for universal movement by the link 21, the upper end of which is connected by a ball joint 22 to a lever 23 secured upon the transverse

shaft 24. The shaft 24 is mounted in suitable bearings 25 at the ends of the frame 4, and by reason of the universal joints by which the link 21 is connected to the crank 20 and the arm 23, the lateral movement of the table frame 4 is not interfered with by the rotation of the crank 20 and the oscillation of the rocker-shaft 24.

At a suitable location on the rocker-shaft 24 is secured a rocker-arm or lever 25^a which has one end connected to a link 26 extending toward the table 2 and slidable through a bearing 27 fastened thereon. The link 26, which is connected to the lever arm 25^a by a pivot or stud 28, is of sufficient length to project well past the bearing 27. The projecting portion is surrounded by an expansible spring 29 reacting against an adjustable nut or other device 30 at the end of the link 26.

When the shaft 17 is rotating, a side shake is given to table-supporting frame 4 and at the same time the crank 20 oscillates the rocker-shaft 24, which in turn, by means of its connection 26, will move the table 2 endwise, the operation being that when the lever arm 25^a moves forward it pulls on the link 26, resisted by the spring 29 interposed between the device 30 on the end of the link 26 and the bearing 27 against which the spring 29 reacts; the pull on the link 26 moving the table 2 forwardly until it is interrupted in its forward movement by the engagement of a device 31, here represented as a roller mounted in the bearing 27 at the forward end of the frame 4. The roller 31 in moving forward approaches and abuts a fixed and rigid buffer 32, which may be of yieldable material, as rubber, which is supported in a transverse beam 33 rigidly connected to the standards 12 at the forward end of the apparatus.

Manifestly any desired amount of forward and return movement may be imparted to the table 2. It is found in practice that an endwise movement of 1½ inches is ample and sufficient to produce the desired concentration of the pulp or ores flowing on the surface of the table 2. It will thus be seen that the table 2 is given an endwise movement by reason of its connection with the rocker-shaft 24 and the carrying-frame 4 is given a side shake by reason of its connection with the shaft 17 through means of the connecting or eccentric rods 15 and the eccentrics 16. If the side shake is adjusted to equal 1½ inches and the end shake of the table 2 is equal to 1½ inches, then if the parts 2 and 4 be adjusted in a given position or relation, every part of the table 2 will move in a perfect circle of 1½ inches diameter. Preferably the parts are so arranged, relatively, that when the table 2 is in the center of its sidewise movement, at which time the eccentric 16 will be at its lowermost point of revolution below the shaft 17, the table 2 will be at the rearmost point of its endwise movement and the crank 30 will be at its lowermost point of rotation relative to shaft 17. Then when the shaft revolves, as indicated by the arrow, Fig. 2, the frame 4 and its superposed table 2 will move simultaneously in the direction indicated at *b* in the diagram, Fig. 4.

While the eccentric 16 is moving from its lowermost to its uppermost position, relative to the shaft 17, representing a half revolution of the latter, the table-carrying frame 4 and the table 2 will have started from and returned to the center of their side shake while the rocker-shaft 24 will have been oscillated by the one half revolution of the shaft 17 as the crank 20 moves from its lowermost to its uppermost point of revolution relative to the shaft 17. This upward movement of the crank 20 oscillates the rocker-shaft 24 so that the link 26 will pull the table 2 forwardly the desired distance.

The combined side movement, beginning at the central point of the frame 4 and table 2, and the forward movement of the table 2 results in giving to the latter a movement closely approximating a true semicircle beginning at the rearmost point of movement of the table 2 and swinging sidewise and forwardly during the half revolution of the shaft 17 which will swing the eccentric 16 and crank 20, vertically, above the center of the shaft. Further continued revolution of the shaft 17 turns the eccentric 16 on the other half of revolution so that the table-carrying frame 4 is carried from its center position to the opposite side of maximum movement and back again. Meanwhile the downward travel of the crank 20 for the remaining half of revolution will oscillate the rocker-shaft 24 to force the link 26 rearward, when, by reason of the engagement of an adjustable nut 26′ the table 2 will be forced backward.

During one complete revolution of the shaft 17 and the eccentrics 16 the frame 4 will be moved from a central position, laterally, to one side ¾ of an inch, then back again from the maximum side movement 1½ inches in the opposite direction, and then return to the point of starting, representing the center of movement of the table indicated, as at *x*, Figs. 5 and 4. The combined side shake of the carry-frame 4 with the end shake of the superpose table 2 results in imparting to the table 2 an approximately complete circular movement during one revolution of the shaft 17. This movement alone given to the table would not efficiently separate or feed the concentrates from the ore fed to the table through means of a distributer 34, Fig. 2, which is mounted above and transverse the table 2 and connected to

the frame 4 so that the distributer 34 is also given a side shake uniformly with the carrying-frame 4.

It is for the purpose of causing the advance of separation of the heavy values from the ore fed to the table that the buffer 32 is interposed, so that as the table 2 is moved forwardly and reaches its limit of forward movement, the device or roller 31 will encounter the buffer 32, thus impeding further forward movement of the table 2, this being permitted without effecting the total movement of the link 26 by reason of the compression of the spring 29.

In actual practice, the table 2 is allowed to make an almost complete circular orbit without interference of the buffer 32, but as the table 2 approaches its forward limit of movement the parts are so adjustable that the roller 31 will engage the buffer 32 in sufficient time so that the side movement of the table 2 will cause the roller 31 to roll for a short distance, indicated at *e*, Fig. 5, on the buffer 32. In other words, the table instead of having a true circular motion has a motion nearly circular with a straight line *c*, Fig. 3, at one side which is produced at the end of the forward portion of the movement of the table.

The movement of the pulp during the operation of the table 2 is clearly indicated in Fig. 4 in which the semicircular, diagrammatic line *d* represents the forward and side movement, combined, of the table 2 reproducing a semicircular path which terminates approximate the forward limit of movement of the table 2 when the roller 31 engages the buffer 32 and checks the movement of the table 2. This sudden checking of the table's forward motion causes the concentrated particles on the surface of the table to be projected forwardly due to their momentum while the table is traversing a straight path *c*, Fig. 3. As the return movement of the table 2 starts and the roller 31 leaves the buffer 32, all of the heavy particles on the table will be carried back uniformly in the path *e*, Fig. 4, resting upon and moving with the table. It will be seen that by reason of the substantial connections between the carrier or frame 4 and the table 2 that these members will move sidewise, uniformly, when actuated by the eccentric 16 and that the supporting links 5 will permit the table 2 to move endwise relative to the frame 4 when actuated by the link 26. The combined side shake and endwise movement of the table give to the latter a movement which is substantially circular throughout except at one portion which is slightly flattened; this being due to the abutment of the table roller 31 against the stationary buffer 32. While every point in the surface of the table 2 swings in a substantially circular orbit yet the path of travel through which a grain or particle of concentrate moves is represented in Fig. 4 by two oppositely disposed but diametrically offset semicircles. Thus practically all concentrate beginning its path at the end of the arc *d* will be carried in a semicircular line sidewise and forward simultaneously until the table is abruptly stopped by reason of the engagement of its roller 31 with the stop structure 32, at which instant the forward momentum of the concentrates will cause their forward projection, indicated as at *f*, Fig. 4. At the time the rearward or return movement of the table 2 is started, the concentrates will have become inert and will be carried backwardly with the table in a path represented by the arc *e*, Fig. 4, in which the point *g* represents the center position of the table 2 relative its side shake.

One of the important features of this invention to which attention is particularly called is that since every point on the surface of the table 2 is carried substantially in a circle whose diameter is 1½ inches, all of the pulp on the table is for each revolution of the shaft 17 carried in a path, the length of which is approximately equal to the circumference of the 1½ inch circle; whereas in contradistinction to many forms of concentrators now used, an endwise shake is imparted to the table; the movement of the particles being limited to the direct amount of throw or stroke of the table. Thus it will be seen that I am enabled to use a comparatively short and narrow table and give to it a desired movement endwise and sidewise, the resulting line of which at every point produces substantially a curve, the length of which is approximately equal to the circumference of a circle of 1½ inches in diameter. At each forward reciprocation of the table 2 the mass of concentrates settling on its surface will be projected forwardly at the instant the table is abruptly stopped in its forward movement; the concentrates being projected at each movement a slight distance so that by the time the ore has settled upon the table the successive jolts incurred by the particles at the stopping of the table feeds the concentrates forwardly while the lighter portion of the pulp or material fed to the table is washed downwardly toward the rear of the table which is shown as slightly inclined, being higher at its front end. Wash water may be admitted to the apparatus through a suitable distributer 35 attached to the forward standards 12.

It is well known that the loss of efficiency in reciprocating concentrators is largely due to the fact that particles of the concentrates known as "fines" are frequently coated with a sticky or slimy substance, and unless these are washed from the included par-

ticles or values the latter will be carried away with the tailings. This is avoided in the present apparatus by forming upon or providing the table with riffles 3 which are adapted to catch particles of slime, including values, and the continued flow of wash water over the table, combined with the pan motion of the latter, causes the particles of concentrate and pulp to be thoroughly agitated and scoured, thereby removing the slime from the particles or values. Once the concentrates or values have been thoroughly cleansed, due to their agitation by the pan motion of the table, the particle will then be projected forwardly from riffle to riffle by the constant jolting of the table and finally discharged from the forward end into a suitable launder not shown.

The inclination of the table 2 may be varied readily to suit conditions by means of the links 10 at the rear or low end of the table; these links being threaded at their upper ends at 10′ and extending through hubs or collars 13′ on the pivots 13. The threaded portions 10′ of the links 10 are adapted to receive nuts 10^a which may be advanced or receded along the threads a given amount to shorten or lengthen the depending portions of the links 10 below the hubs 13′. By this means an extremely careful and accurate adjustment of the slant of the table may be produced.

Having thus described my invention, what I claim and desire to secure by Letters Patent is—

1. The combination with a concentrating table and supports upon which it is capable of movement in a single plane, of eccentrics upon a horizontally revoluble shaft, connections between said eccentrics and the side of the table, a shaft parallel with the head of the table having a rocker arm and a link connecting said arm with the table, a horizontally disposed arm fixed to the end of said shaft, an eccentric carried by the first named shaft, and a link connecting the arm and the eccentric.

2. The combination with a concentrating table and supports upon which it is capable of movement in a single plane, of eccentrics upon a horizontally revoluble shaft, connections between said eccentrics and the side of the table, a shaft parallel with the head of the table having a rocker arm and a link connecting said arm with the table, a horizontally disposed arm fixed to the end of said shaft, an eccentric carried by the first named shaft, and a link connecting the arm and the eccentric, said link having globular sockets fitting corresponding ends of the crank and rocker arms, to allow a horizontal circular movement of the table.

3. In a concentrator, a horizontally supported table capable of universal movement in a single plane, a shaft with eccentrics and rocker arms connected to simultaneously actuate the table in a transverse and a longitudinal direction, whereby a composite circular movement in substantially a single plane is produced, and a spring actuated buffer connected to act at the end of half of the semicircular movement, so as to produce an advance of the particles upon the surface of the table.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

KARL SENN.

Witnesses:
CHARLES EDELMAN,
M. COOK.