J. B. JARDINE, Jr.

DRY CONCENTRATOR.

APPLICATION FILED APR. 25, 1910.

994,406.

Patented June 6, 1911.

3 SHEETS—SHEET 1.

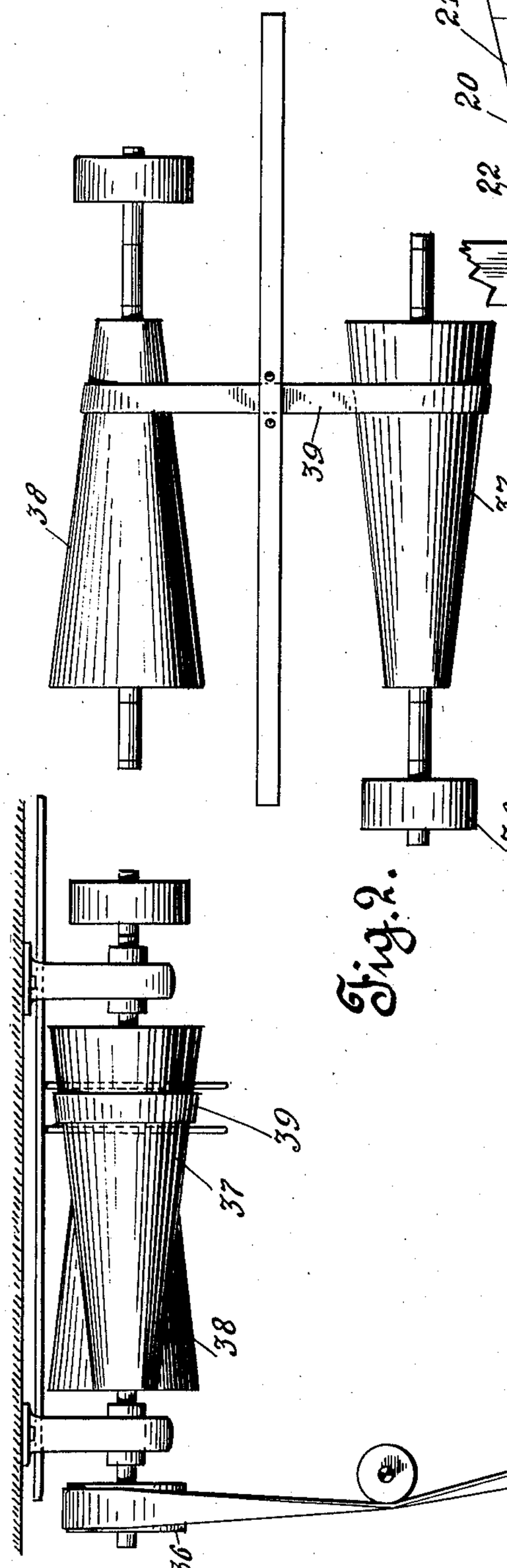

Fig. 2.

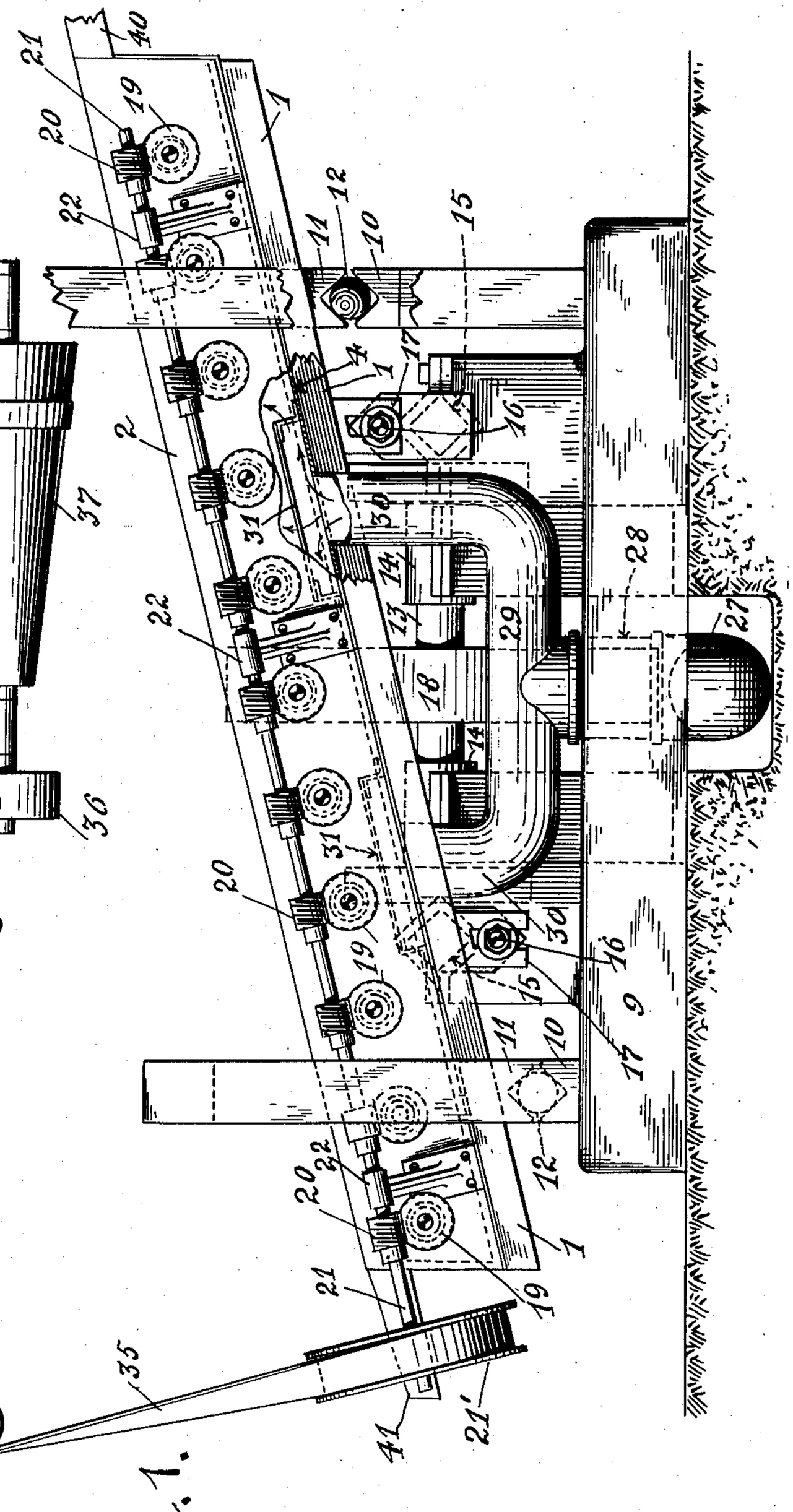

Fig. 1.

Witnesses,

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3 SHEETS—SHEET 2.

Fig. 3.

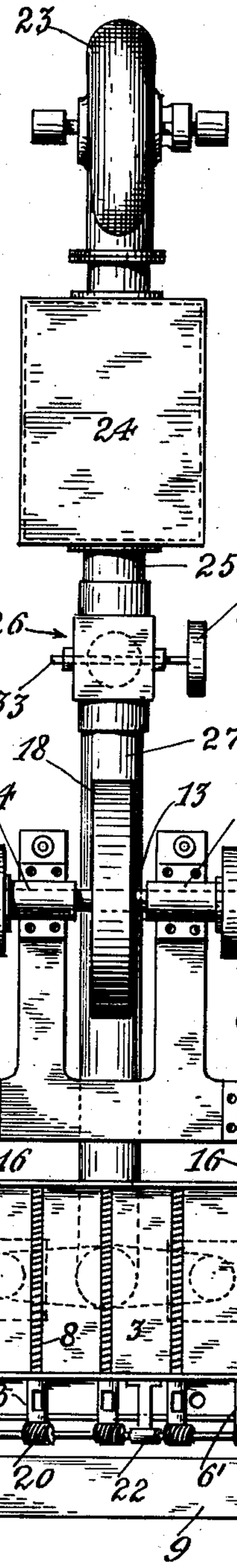


Fig. 5.

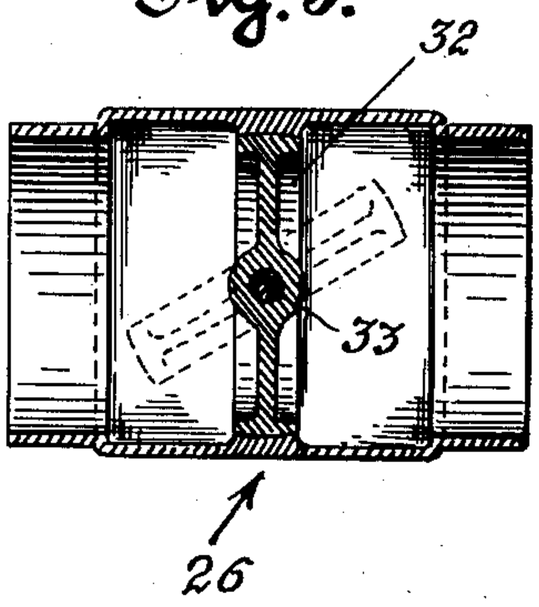
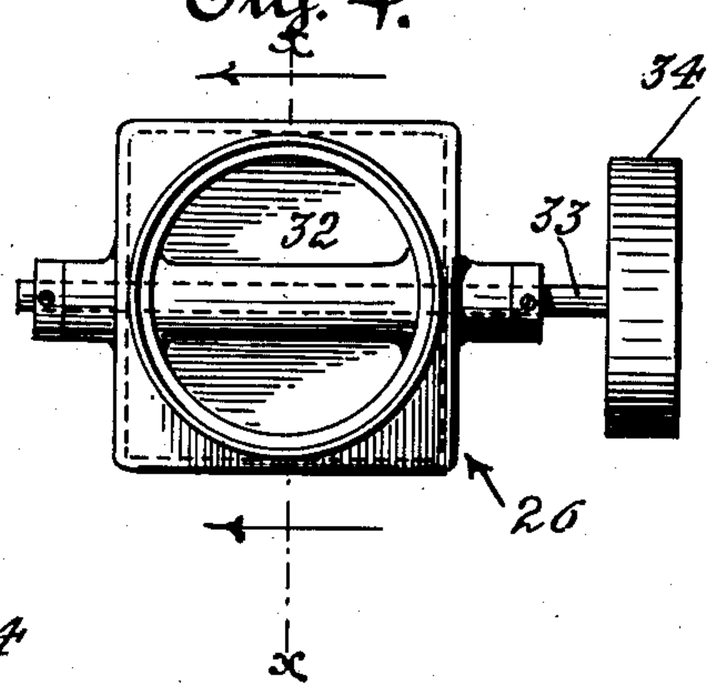


Fig. 4.



Witnesses.

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3 SHEETS—SHEET 3.

Fig. 6.

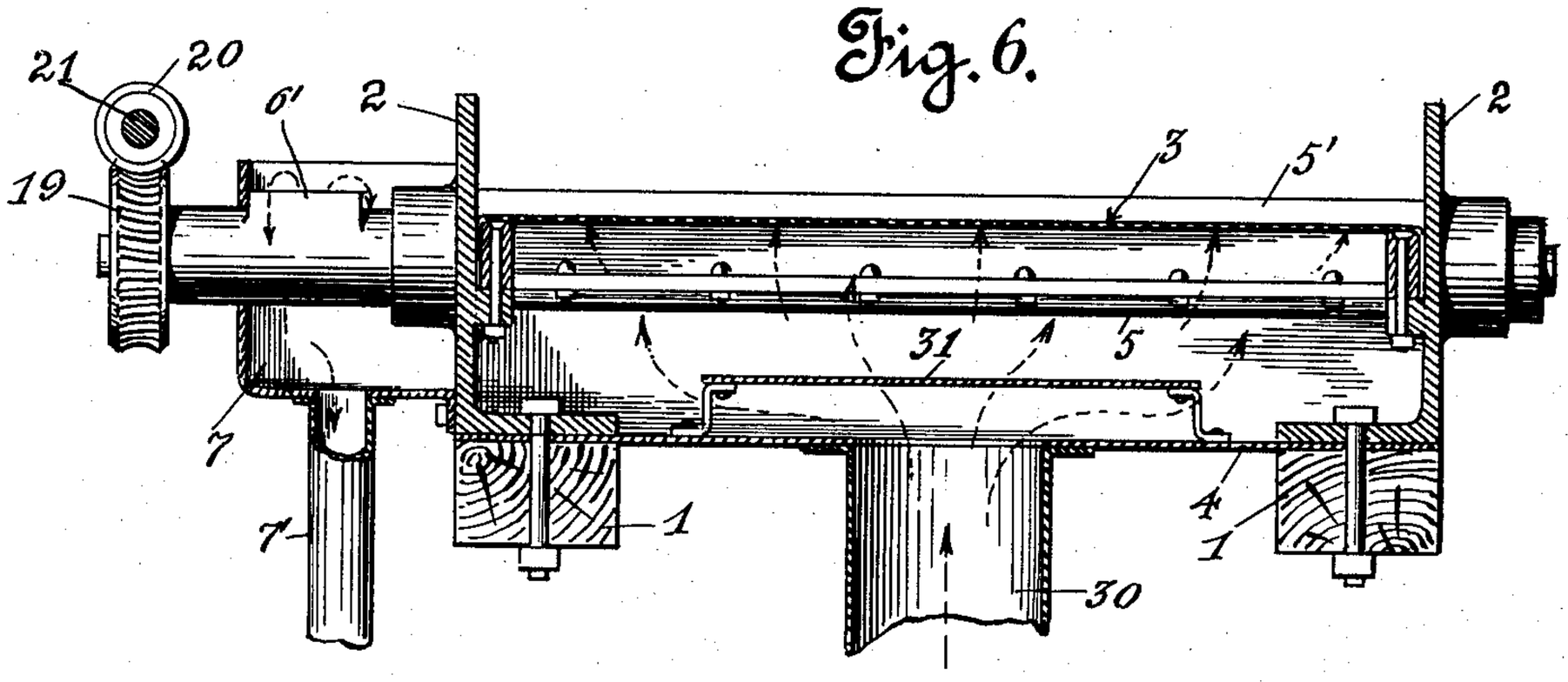


Fig. 7.

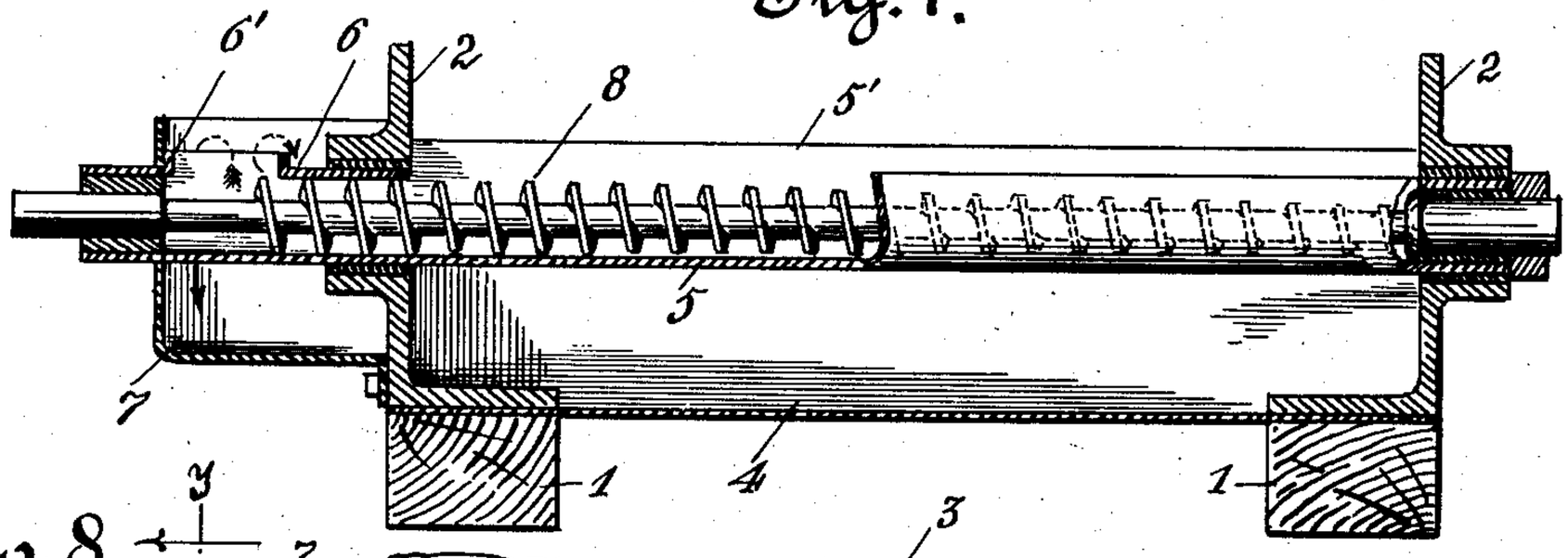


Fig. 8.

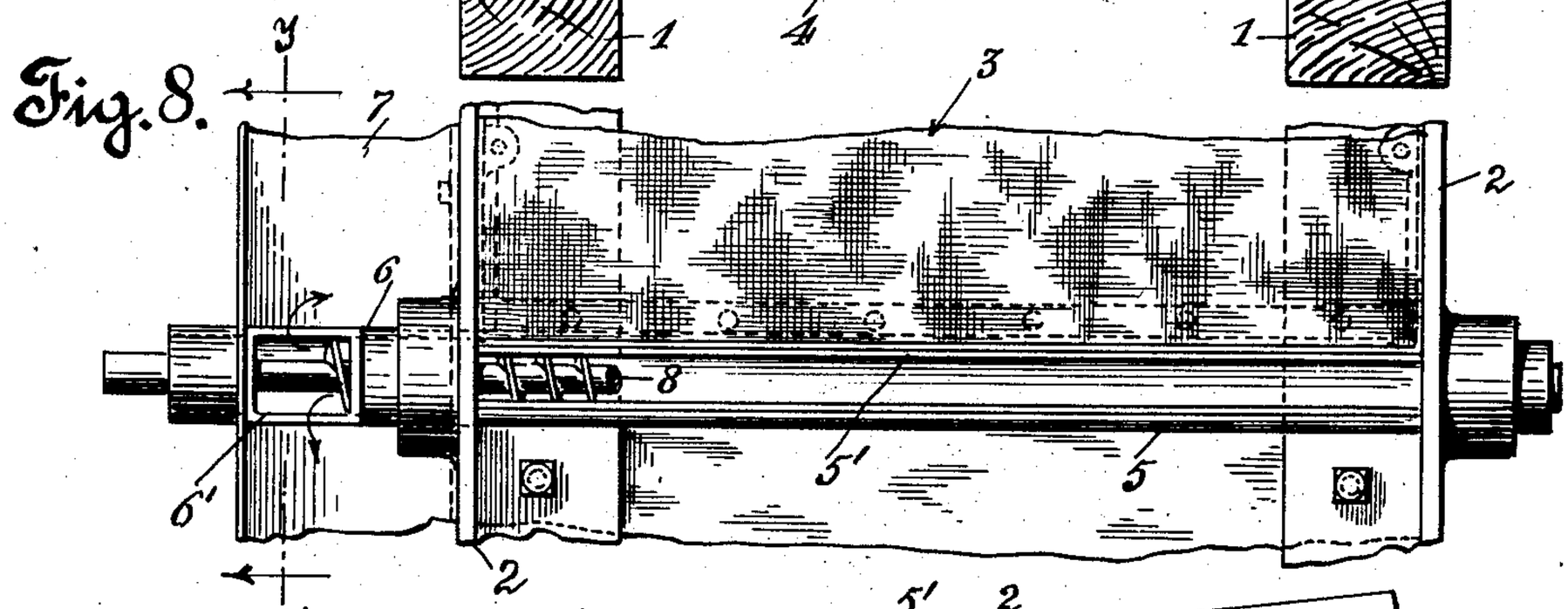


Fig. 10.

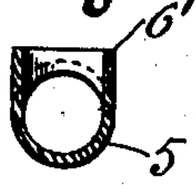
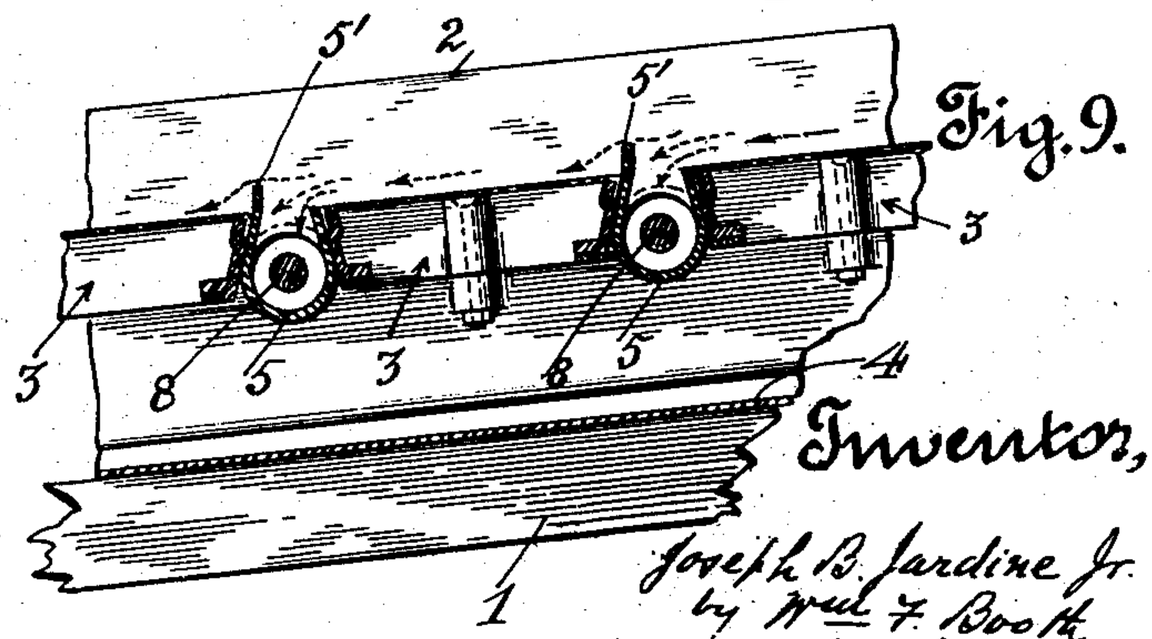


Fig. 9.



Witnesses.

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UNITED STATES PATENT OFFICE.

JOSEPH B. JARDINE, JR., OF SAN FRANCISCO, CALIFORNIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO WESTERN DESERT MINING COMPANY, A CORPORATION OF CALIFORNIA.

DRY CONCENTRATOR.

994,406. Specification of Letters Patent. Patented June 6, 1911.

Application filed April 25, 1910. Serial No. 557,428.

To all whom it may concern:

Be it known that I, JOSEPH B. JARDINE, Jr., a citizen of the United States, residing in the city and county of San Francisco and State of California, have invented certain new and useful Improvements in Dry Concentrators, of which the following is a specification.

My invention relates to the class of concentrators, adapted for the separation of mineral bearing earths and ores, according to the coefficients of gravity of their aggregated particles, and which, from the non-use of water, are commonly termed "dry" concentrators.

There are many basic deposits of mineral bearing earths of low grade minerals which require concentration before it is practical to ship them to the point of consumption. These deposits are often in arid sections where no water is available, and, as a consequence, it is necessary to work them dry, and this, on account of the low primary value of the ores must be done at a low cost per ton, and the concentration must be sufficiently effective to reduce the shipping tonnage, and increase the commercial value per ton of the shipped product.

The efficiency of any dry concentrator is chiefly dependent upon the proper classification of the materials and the perfect mechanical control of the output, and with these ends in view I have provided a machine capable of securing such results.

My invention consists in the novel construction, arrangement and combination of parts, as I shall now fully describe by reference to the accompanying drawings in which—

Figure 1 is a side elevation, partly broken, of my concentrator, showing the application of the variable-speed to its conveyer-screws. Fig. 2 is a plan of the variable speed cone pulleys. Fig. 3 is a plan view of my concentrator. Fig. 4 is a front view, enlarged of the pulsator. Fig. 5 is a section of the same on the line *x—x* of Fig. 4. Fig. 6 is a cross-section, enlarged, of the concentrating table, in the plane of one of its air-inlets. Fig. 7 is a cross-section of the same, through one of its riffle-troughs. Fig. 8 is a plan view of a portion of the table, the conveyer-screw in the riffle trough being broken. Fig. 9 is a broken longitudinal section of the table, showing the fitting of the screen-cloth sections between the riffle-troughs, and the cross section of said troughs. Fig. 10 is a cross section of the riffle trough on line *y—y* of Fig. 8.

The table frame comprises two longitudinal side sills 1 and two side plates 2, bolted to the sills, as shown in Fig. 6.

The table top is composed of a series of independent, separated screen-cloth sections 3, fastened between and to the side plates 2, as shown in Figs. 8 and 9; and the table bottom is formed by an impervious plate 4, which lies and is secured between the base flanges of the side plates and the upper surfaces of the sills, the ends of said bottom plate being turned up, as indicated in Fig. 1, so that the interior of the table is thus a hollow chamber.

Fitted to the table top in the intervals between the screen-cloth sections 3, are the transversely disposed riffle-troughs 5. These are in considerable number as indicated in Fig. 3, and are in parallel series throughout the table length. Each riffle trough is formed and mounted as shown in detail in Figs. 7 to 10. Between the side plates 2 the trough has a cross section as shown in Fig. 9, with an open top, a curved bottom and converging sides, one of said sides 5′ being higher than the other. This higher side extends above the plane of the screen-cloth surface, as shown in said Fig. 9, and said higher side is nearer the foot of the table. The shorter side extends up to the level of the screen plane. One end of the trough is of circular section and is fitted in one side plate, as shown in Fig. 7. The other or delivery end of the trough where it passes through the other side plate is also of circular section as at 6 in Figs. 6 to 8 having about the same curve as the bottom between the side plates. This circular section extends for a short distance and then changes its form again at 6′ to the section shown in Fig. 10, in which the top is open as seen in said Figs. 7 and 8, the sides being vertical and reaching a height about equal to the full diameter of the circular section. Beyond this open top delivery section 6′, the form of the trough is circular and is closed by suitable packing and by the end of the con-

veyer screw, as in Fig. 7. Below the open top delivery section 6′ of the riffle-troughs is a launder 7, which receives the concentrates and delivers them through a pipe 7′ as seen in Fig. 6.

Within each riffle-trough is a conveyer-screw 8. This screw as shown in Fig. 7, has an even spindle except for its ends which are enlarged to form journals within the circular ends of the trough, so that it may be rotated on its axis. The thread or flight of the screw between the side plates of the table frame is tapered from its beginning at one end to its largest diameter at the opposite side plate, and thence said flight continues in its largest diameter through the circular section 6 of the trough, to where the open-top delivery section 6′ begins, at which point said thread or flight terminates, leaving said section substantially clear except for the screw spindle.

Having thus described the concentrating table, I will now describe its manner of mounting and its shaking movement, by referring to Figs. 1 and 3. 9 is the bed or main foundation of the machine. From the bed rise transverse blocks 10, the block at one end being lower than the block at the other end. The table is supported upon these blocks with an inclination downwardly from its head end to its foot, as shown in Fig. 1. The bearings between the table and the blocks 10 may be of any suitable character, though in practice I prefer the construction shown. Blocks 11, are secured to the table frame, and between these blocks and the bed blocks 10 are balls 12, which are housed in V-grooves in the meeting faces of the blocks. The table can, thus, be moved sidewise and have a lateral shake imparted to it. Its inclination in the direction of its length may be varied by increasing the height of the bed block 10 at the head of the table. In order to impart a side-shake to the table, there is a crank shaft 13 mounted at one side of the bed, in suitable bearings 14. This crank shaft is connected by cross heads 15 and rods 16 to lugs 17 secured under the table. The crank shaft 13 has a pulley 18, which serves the double function of a driving pulley and a fly wheel. The conveyer-screws 8 are driven as follows. The end of each screw is provided with a worm gear 19 which meshes with a worm 20, on a shaft 21, mounted in bearings 22 on the side plate 2 of the table-frame, said shaft having a pulley 21′ to drive it. Thus all the conveyer screws 8 are driven in unison and with a uniform speed, but this speed may be varied as I shall presently show.

Air is applied to the table as follows. In Fig. 3, 23 indicates a fan blower, which delivers air into an accumulator or pressure tank 24. The outlet 25 from this accumulator leads to a pulsator 26. The pulsator delivers the air in successive blasts, to a pipe 27, which as shown in Fig. 1 is connected by a flexible joint at 28, with a pipe 29, which has two branches 30 leading up to and opening through the impervious bottom plate 4 of the table, into the hollow interior of the table. Above the entrance of these branches are deflector plates 31 to better direct and distribute the air throughout the table. The pulsator 26, which is shown in more detail in Figs. 4 and 5 consists of a casing the passage through which is controlled by a rotatable valve 32, on a shaft 33, to which rotation is imparted by the driving pulley 34.

The speed of rotation of the conveyer screws 8 may be varied in any suitable manner. For this purpose, I show in Fig. 1, the driving pulley 21′ of the worm shaft 21 as being driven by a belt 35 from a pulley 36 of the secondary cone of a pair of parallel tapered cones 37 and 38 set on rigid bearings with their tapers opposite to each other. Upon these cones is placed a common belt 39 controlled by a shipper motion which controls the speed of the secondary cone by shifting the belt along the cones in a direction parallel to their centers. The head of the table has a head-plate 40; and the foot of the table has a delivery apron 41 for the tailings.

By the following description of the operation of the machine, its construction and the purpose and function of its several improvements will be clearly understood.

The material to be concentrated is fed by suitable means to the head plate 40 of the inclined table and is immediately agitated by the side-shake imparted to the table. As the material continues to descend on the head plate by its own gravity, combined with the effect of the side-shake, it comes in contact with the cloth surface of the screen area, through which are passing a multitude of air pulsations, created by the pulsator which operates as an intermittent cut-off valve, allowing the air which is stored in the accumulator at fixed pressure, to intermittently pass through the pulsator into the main air pipes and through them into the hollow chamber of the table. These air pulsations combined with the violent lateral agitation of the material which is being concentrated cause the different particles to separate and classify themselves according to their specific gravity, the heaviest falling to the bottom during the period between pulsations, which the lighter particles are gradually elevated to the upper strata of the material, and pass over the tops of the elevated riffle walls 5′ of the successive troughs 5 to be eventually discharged over the apron 41 at the foot of the table. As the heavier particles reach their proper position according to their relative specific gravities, they settle upon the cloth covering of the screen area, and grad-

ually advance in a downward direction until they encounter the projecting riffle-wall 5′ and fall into the troughs, the riffle wall accumulating them up to its limit of capacity, when the particles will overflow onto the next screen area to repeat the previous action and so on throughout, as is clearly indicated by the arrows in Fig. 9. As these concentrates or heavier particles settle in the riffle troughs, the conveyer screws 8 revolving, carry them off laterally through the troughs, for the full width of the table. This action of the screws is possible, without choking or overloading them, because of their taper flight, which allows for the material gradually settling in the trough, and gives the conveyer capacity to receive said material from the full width of the table and carry it off sidewise. The screw acting thus as a conveyer, delivers the material at one side and carries it by its straight flight through the circular part 6 of the trough, and crowds it up against the closed end of the trough until it forces said material to discharge upwardly through the open top portion 6′ of the trough, from which it falls into the launder 7. This top discharge through the portion 6′ is of great importance.

The carrying away of the concentrates is to be performed solely by the screws, and they must exercise their function in such a way as to deliver an even and uniform product. Now, due to the violent side shake of the table, there is a strong tendency for the material to be projected or shifted, even to the extent of half the width of the table's surface, and this shifting tends to throw not only the concentrates but some of the tailings out sidewise through the troughs and to discharge them independently of the screw function. Such undesirable discharge, with its uneven product, would, in fact, take place, if the path to the discharge were relatively open, as, for example, if the discharge opening were in the bottom of the trough, and unguarded by any regulation. But in the present case, by having the discharge opening 6′ on top, the freedom of delivery is to that extent impeded, and consequently regulated and the conveying function of the screw is perfect, with the result that an even and uniform product is had. In short, means are thus provided by which the concentrates as they are delivered to this point by means of the screw, are mechanically discharged through the open-top section 6′ without being affected by the violent transverse action of the table, which has a tendency to shift or throw the loose material upon its surface.

As the percentage of concentrates accumulating in the riffle troughs varies at different times, it becomes necessary to meet this variation by providing with some accuracy for the removal of such varied amounts. This is effected by means for varying the speed of rotation of the conveyer screws. The variable-speed double cone device, here shown, serves this purpose. The percentage or pureness of the concentrates may be thus controlled. In this way, with a fixed feed and a fixed material, the control of the metallic content of the concentrates or of the tailings can be automatically and mechanically obtained.

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

1. In a concentrator, the combination of a table inclined in the direction of its length; means for imparting to said table a shaking movement; a series of transversely disposed open-top troughs let into and below the surface of the table, at intervals throughout its length; said troughs extending the full width of the table and opening out beyond one of its sides; and means within said troughs for conveying away to their open ends the trough contents.

2. In a concentrator, the combination of a table inclined in the direction of its length; means for imparting to said table a shaking movement; a series of transversely disposed open-top troughs let into and below the surface of the table, at intervals throughout its length, said troughs having closed sides and bottom and extending the full width of the table and opening out beyond one of its sides; and a rotatable conveyer-screw within each trough adapted to convey away to its open end the trough contents.

3. In a concentrator, the combination of a table inclined in the direction of its length; means for imparting to said table a shaking movement; a series of transversely disposed open-top troughs let into and below the surface of the table, at intervals throughout its length, said troughs extending the full width of the table and opening out beyond one of its sides; rotatable conveyer-screws seated within said troughs and arranged to convey away the trough contents; a common drive for all of said screws and means for varying the speed of said drive.

4. In a concentrator, the combination of a table inclined in the direction of its length; means for imparting to said table a shaking movement; a series of transversely disposed open-top troughs let into and below the surface of the table, at intervals throughout its length, said troughs extending the full width of the table and opening out beyond one of its sides; and a rotatable conveyer-screw seated within each of said troughs, said screw having a thread increasing in diameter in the direction of the open end of the trough and for the full width of the table, to convey away the trough contents.

5. In a concentrator, the combination of a table inclined in the direction of its length; means for imparting to said table a shaking movement; a series of transversely disposed open-top troughs let into and below the surface of the table, at intervals throughout its length, said troughs extending the full width of the table and opening out beyond one of its sides; a rotatable conveyer-screw seated within each of said troughs, said screw having a thread increasing in diameter in the direction of the open end of the trough and for the full width of the table, to convey away the trough contents; and means for simultaneously varying the speed of rotation of said screws.

6. In a concentrator, the combination of a table inclined in the direction of its length; means for imparting to said table a shaking movement; a series of transversely disposed closed bottom and open-top troughs let into and below the surface of the table, at intervals throughout its length, said troughs extending the full width of the table and projecting from one side thereof, said projecting portion having a closed end and an open top; and a rotatable conveyer-screw in each trough, the thread of said screw terminating short of the open-top projecting portion of the trough and adapted to deliver the trough contents through said open top.

7. In a concentrator, the combination of a table inclined in the direction of its length; means for imparting to said table a shaking movement; a series of transversely disposed open-top troughs let into and below the surface of the table at intervals throughout its length, said troughs extending the full width of the table and projecting from one side thereof, said projecting portion having a closed end and an open top; and a rotatable conveyer-screw in each trough, the thread of said screw increasing in diameter in the direction of the delivery end of the trough for the full width of the table and terminating short of the open-top projecting portion of the trough and adapted to deliver the trough contents through said open top.

8. In a concentrator, the combination of a table inclined in the direction of its length; means for imparting to said table a shaking movement; a series of transversely disposed open-top troughs let into and below the surface of the table at intervals throughout its length, and extending the full width of the table and projecting from one side thereof, said troughs having a closed circular section where they pass through the table side, followed by an open-top section in the projecting portion and a closed end; and a rotatable conveyer-screw in each trough, the thread of said screw increasing in diameter in the direction of the delivery end of the trough for the full width of the table, and said thread being of uniform diameter within the circular section of the trough and terminating short of the open-top projecting portion of said trough, and adapted to deliver the trough contents through said open top:

9. In a concentrator, the combination of a table inclined in the direction of its length; means for imparting to said table a shaking movement; a series of troughs comprising connected sides and bottom closed from end to end and transversely disposed below the surface of the table at intervals throughout its length, and having their tops open to the table surface, with that wall of the open top toward the foot of the table projecting above the table surface to form a riffle, said troughs extending the full width of the table and opening through one side thereof; and a movable feed within said troughs for conveying away to their open ends the trough contents.

10. In a concentrator, the combination of a table inclined in the direction of its length; means for imparting to said table a shaking movement; a series of troughs transversely disposed below the surface of the table at intervals throughout its length, and having their tops open to the table surface, with that wall of the open top toward the foot of the table projecting above the table surface to form a riffle, said troughs extending the full width of the table and opening through one side thereof; and means within said troughs for conveying away to their open ends the trough contents, consisting of rotatable conveyer-screws, the threads of which increase in diameter in the direction of the delivery ends of the troughs for the full width of the table.

11. In a concentrator, the combination of a table inclined in the direction of its length; means for imparting to said table a shaking movement; a series of troughs transversely disposed below the surface of the table at intervals throughout its length, and having their tops open to the table surface, with that wall of the open top toward the foot of the table projecting above the table surface to form a riffle, said troughs extending the full width of the table and opening through one side thereof, and projecting beyond said side, said projecting portion having a closed end and an open top; and rotatable conveyer-screws within said troughs, the threads of said screws terminating short of the open-top projecting portion of the troughs and adapted to deliver the trough contents through said open top.

12. In a concentrator, the combination of a table inclined in the direction of its length; means for imparting to said table a shaking movement; a series of troughs transversely disposed below the surface of the table at intervals throughout its length, and having their tops open to the table

surface, with that wall of the open top toward the foot of the table projecting above the table surface to form a riffle, said troughs extending the full width of the table and opening through one side thereof with a circular section, followed by an open top projecting portion with a closed end; and a rotatable conveyer-screw in each trough, the thread of said screw increasing in diameter in the direction of the delivery end of the trough for the full width of the table, and said thread being of uniform diameter within the circular section of the trough and terminating short of the open-top projecting portion of said trough, and adapted to deliver the trough contents through said open top.

13. In a concentrator, the combination of a shaking table inclined in the direction of its length and composed of a surface formed of a lineal series of separated screen frames pervious to air, a series of open-top troughs transversely disposed between and below said screen sections, extending the full width of the table, and discharging through one side of said table, rotatable conveyer-screws in said troughs adapted to convey away to the delivery ends the trough contents, and a bottom plate impervious to air whereby a chamber is formed in said table; and means for supplying air under pressure to said table chamber.

14. In a concentrator, the combination of a shaking table inclined in the direction of its length and composed of a surface formed of a lineal series of separated screen frames pervious to air, a series of open-top troughs transversely disposed between and below said screen sections, extending the full width of the table, and discharging through one side of said table, rotatable conveyer-screws in said troughs adapted to convey away to the delivery ends the trough contents, and a bottom plate impervious to air whereby a chamber is formed in said table; and means for supplying intermittent-blasts of air under pressure to said table chamber.

15. In a concentrator, the combination of a table inclined in the direction of its length; means for imparting to said table a shaking movement; a series of transversely disposed open-top troughs let into and below the surface of the table, at intervals throughout its length, said troughs having closed sides and bottom and extending the full width of the table and opening out beyond one of its sides; a rotatable conveyer-screw within each trough adapted to convey away to its open end the trough contents, a longitudinally extending chamber connected to the outside of the table and communicating with the open end of said troughs, and a discharge outlet from said chamber.

16. In a concentrator, the combination of a table inclined in the direction of its length; means for imparting to said table a shaking movement; a series of transversely disposed open-top troughs let into and below the surface of the table, at intervals throughout its length, said troughs extending the full width of the table and opening out beyond one of its sides; and a rotatable conveyer-screw seated within each of said troughs, said screw having a thread increasing in diameter in the direction of the open end of the trough and for the full width of the table, to convey away the trough contents, a receptacle secured to one side of the table and extending longitudinally of the latter constituting a receiving chamber into which the open ends of the troughs discharge, said receptacle having an outlet.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOSEPH B. JARDINE, JR.

Witnesses:

A. K. DAGGETT,

WM. F. BOOTH.