(No Model.)

5 Sheets—Sheet 1.

J. FREY.

CONCENTRATOR.

No. 552,995.

Patented Jan. 14, 1896.

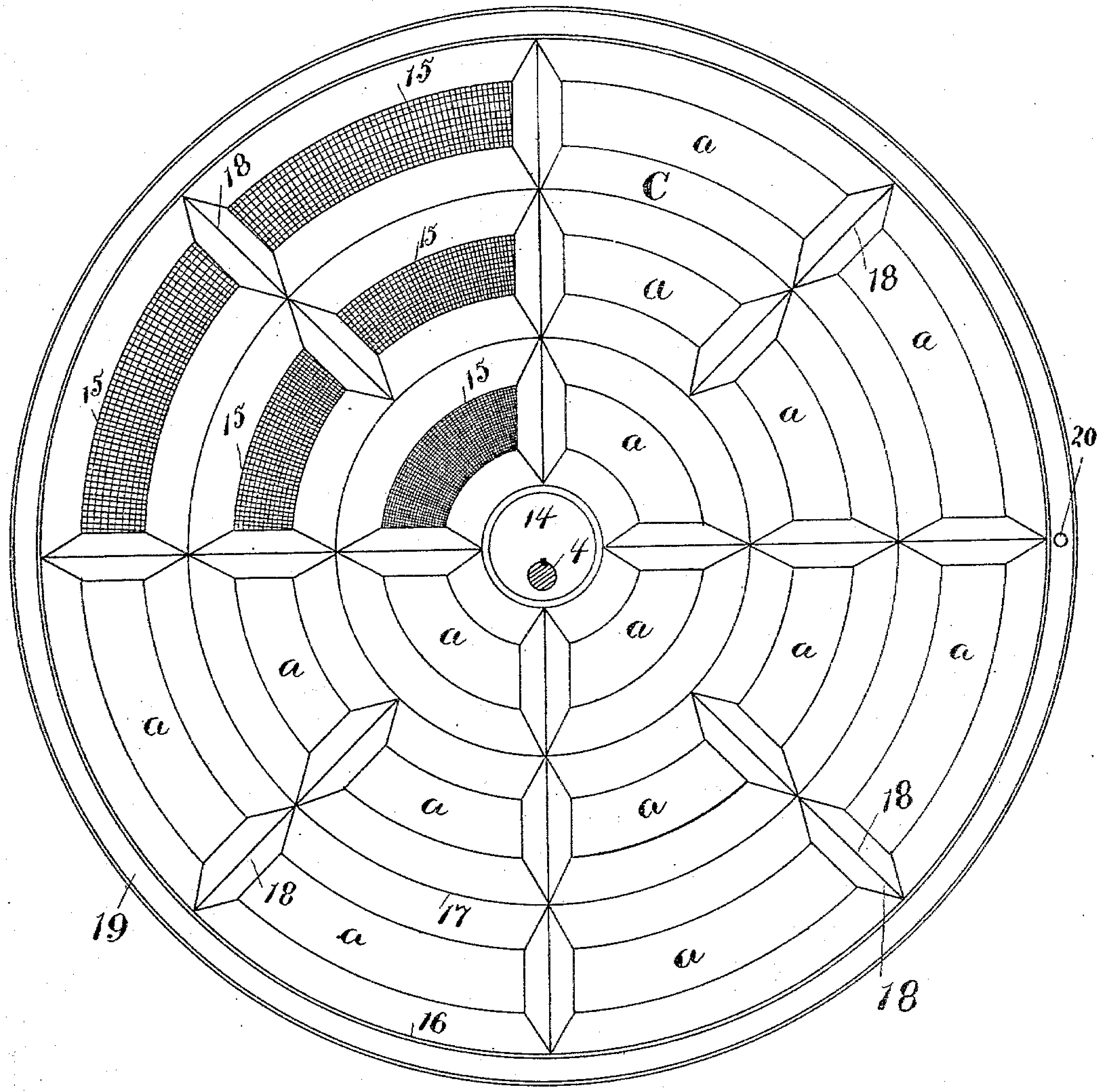

Fig. 1

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CONCENTRATOR.

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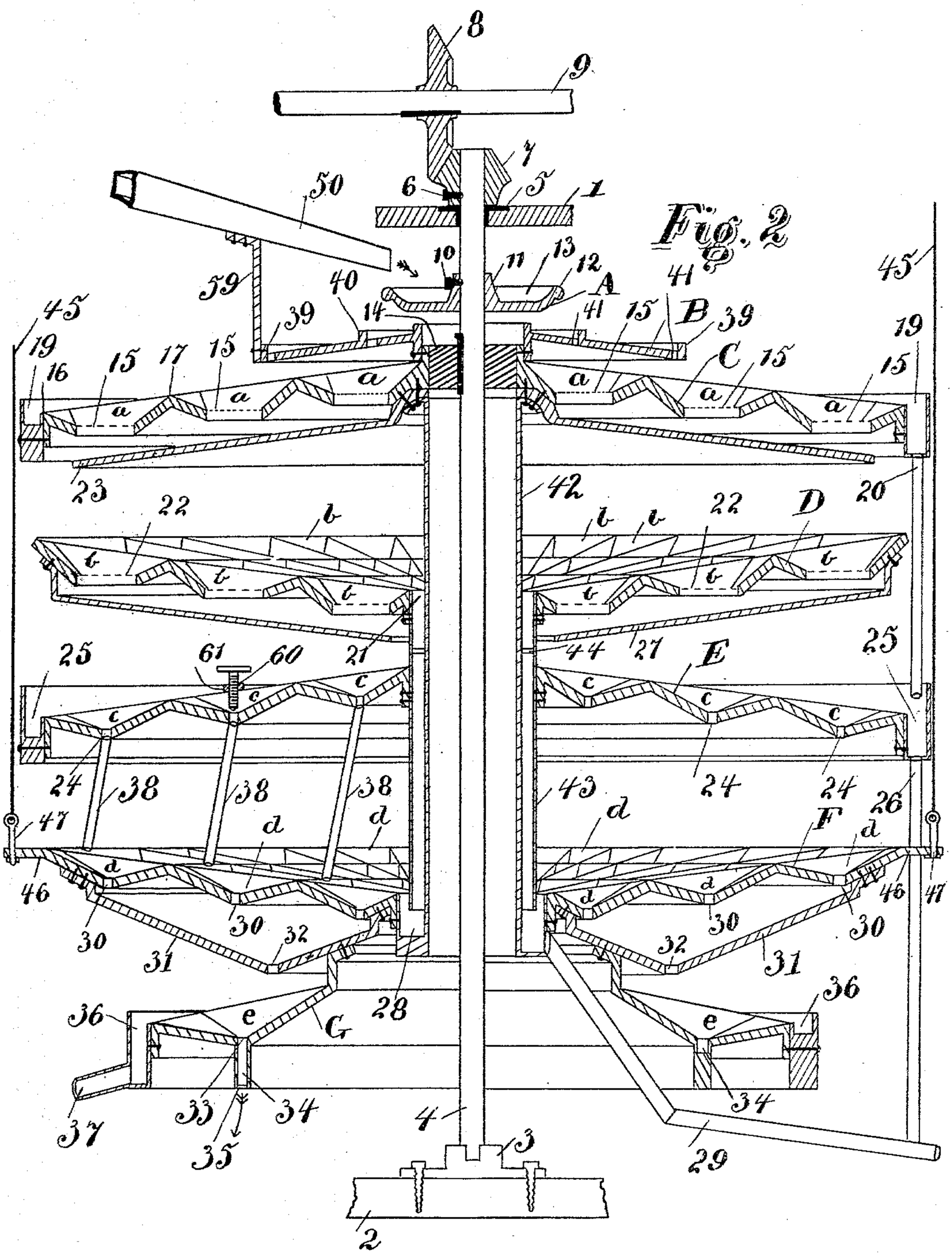
Fig. 2



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5 Sheets—Sheet 3.

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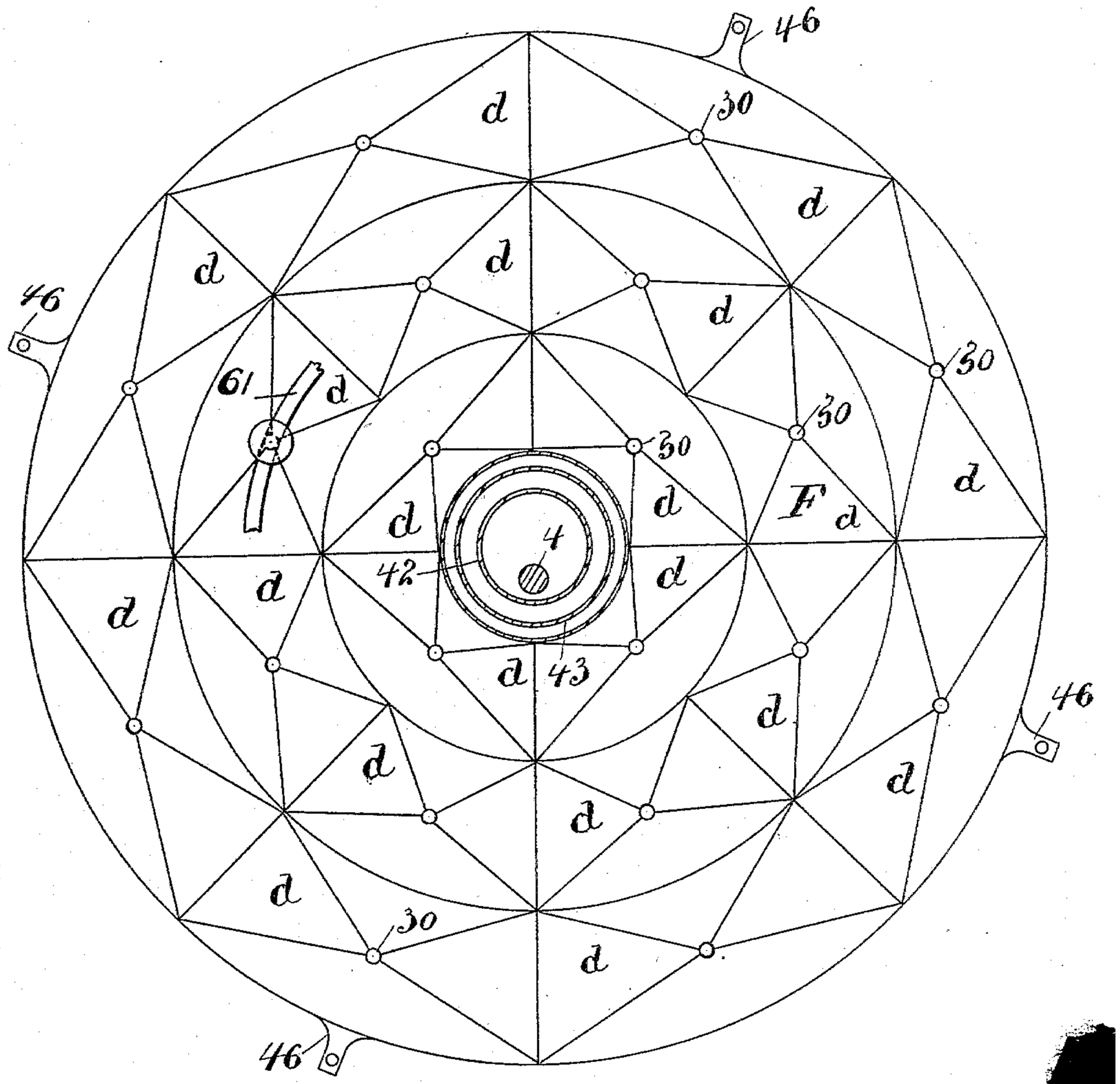

Fig. 3

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(No Model.) 5 Sheets—Sheet 4.

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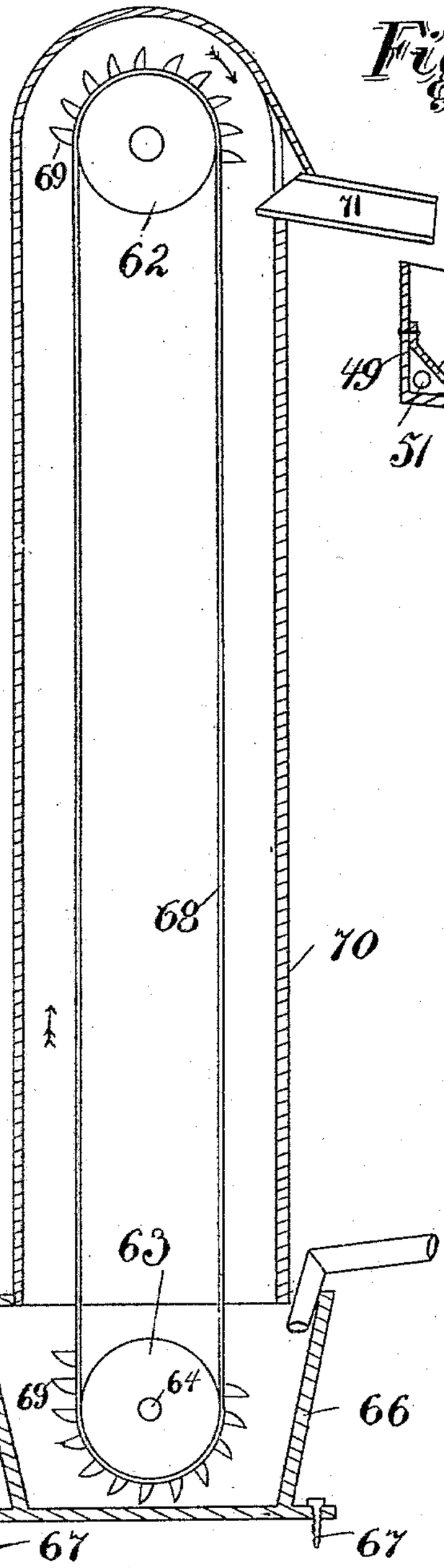

Fig. 4

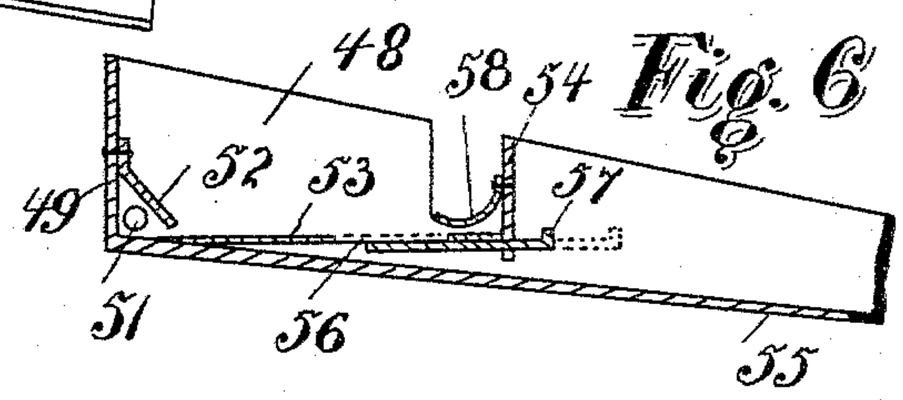

Fig. 6

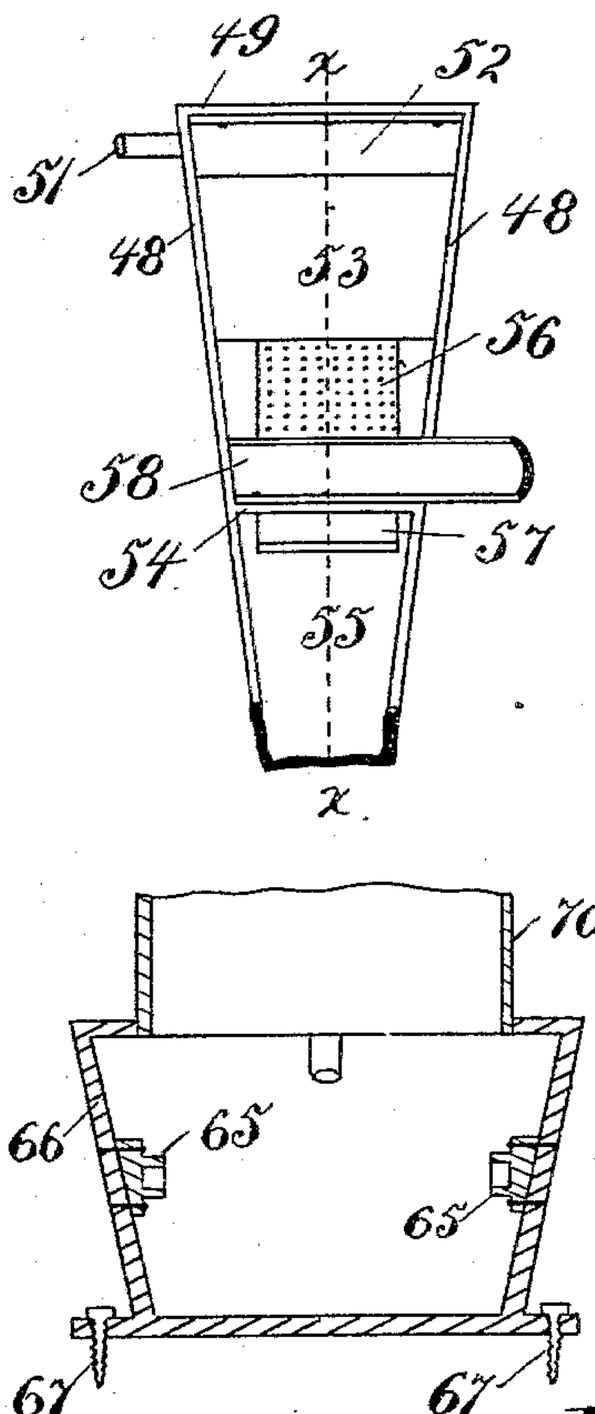

Fig. 5

Fig. 7

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(No Model.) 5 Sheets—Sheet 5.

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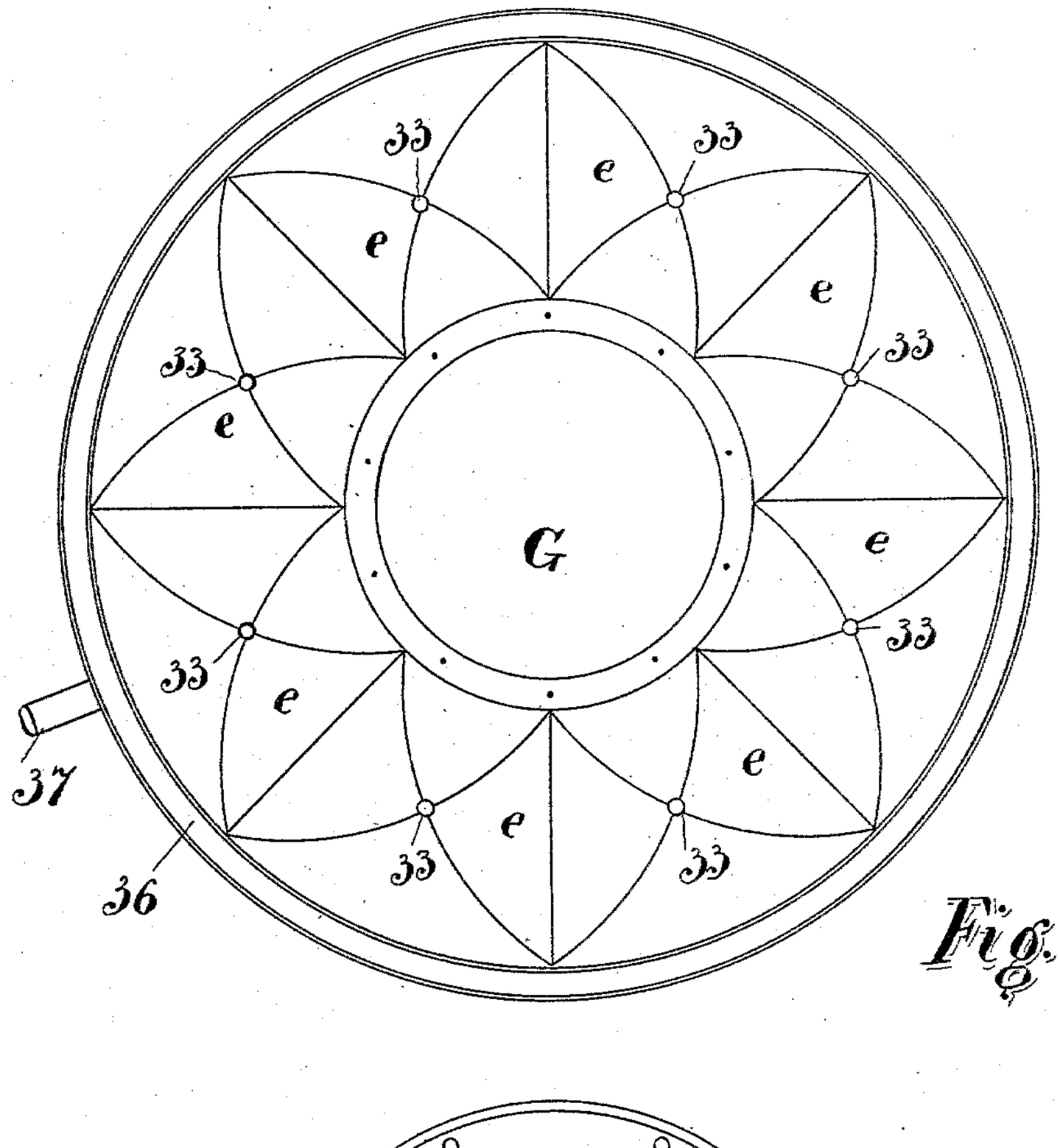

Fig. 8

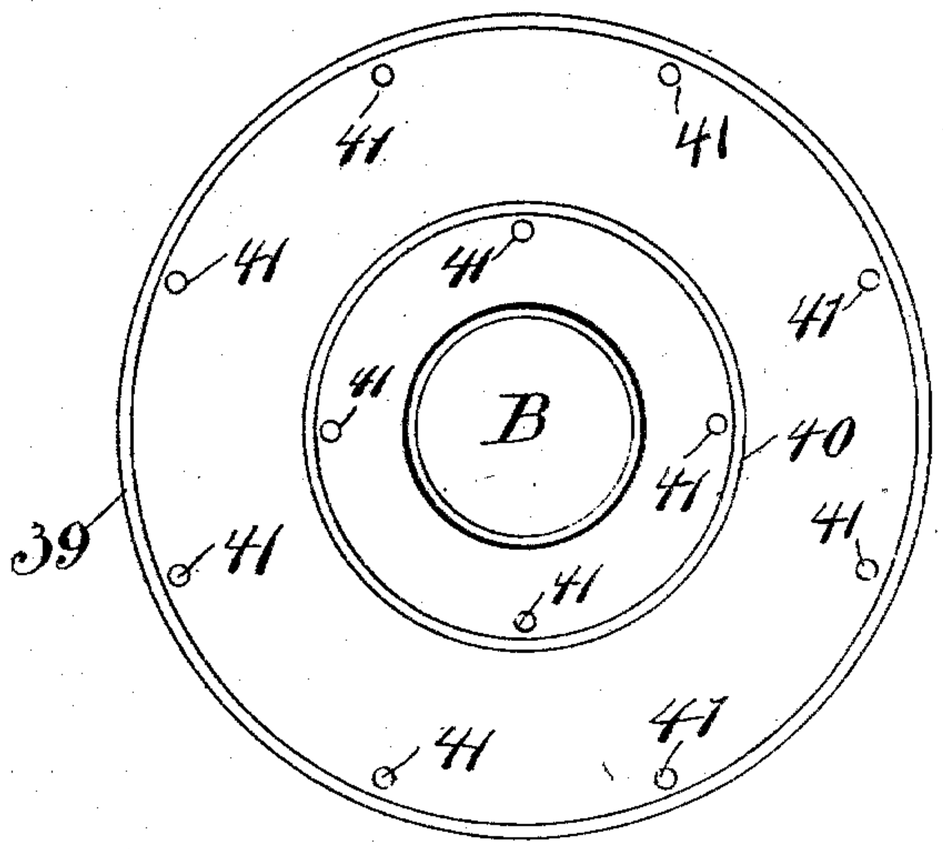

Fig. 9

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UNITED STATES PATENT OFFICE.

JOHN FREY, OF BERKELEY, CALIFORNIA.

CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 552,995, dated January 14, 1896.

Application filed January 24, 1894. Serial No. 497,944. (No model.)

To all whom it may concern:

Be it known that I, JOHN FREY, a citizen of the United States, residing at Berkeley, in the county of Alameda and State of California, have invented new and useful Improvements in and Connected with Concentrators for Ores, Minerals, Valuable Sands, or other Dense Bodies, of which the following is a specification.

My invention relates to a device for use in ore concentration, in which the ore is separated from intermingled or alluvial material by the use of water, through an agitative action and the attraction of gravity. In some cases the water may be omitted and the material concentrated in a dry state.

The objects of my invention are to furnish a concentrator of simple, light, portable, and economic construction, durable and reliable in operation, readily adjustable in its various parts, obviating waste of valuable material and arranged to accomplish the more perfect separation of the precious metals by the least degree of agitation of the water.

The great difficulty experienced in practically and economically concentrating and saving the valuable materials which are so light compared with the gangue or intermingled material as to be carried off by the slightest over-agitation or disturbance of the water is illustrated in innumerable tailings-deposits from reduction-works, which show an assay value equal to or, in many cases, greater than what has been separated in the works. Therefore the preliminary and repeated subsequent concentrations and devices therefor are of value as the material becomes more and more attenuated, and it is the purpose of my invention to successfully cope with ore, sand or gravel of low grade and extreme fineness and low specific gravity. I attain these objects by the features of construction, and the combinations and arrangement of devices hereinafter described and claimed, reference being had to the accompanying drawings, in which similar letters and numbers of reference represent corresponding parts.

Figure 1 is a plan view of the upper pan or concentrating-table. Fig. 2 is a vertical central section of the main portion of my concentrator. Fig. 3 is a plan view of one of the lower concentrating-pans. Fig. 4 is a vertical section of the elevator. Fig. 5 is a plan view of the hopper or feed-trough. Fig. 6 is a vertical section of the hopper, taken through the line *x x*, Fig. 5. Fig. 7 is a vertical section of the tailings receptacle or basin, taken on a plane at right angles to that represented in Fig. 4. Fig. 8 is a plan view of the bottom concentrating-pan; and Fig. 9 is a plan view of the upper distributing-table.

The entire machine, with the exception of the elevator shown in Fig. 4, is inclosed and supported by a light rectangular framework composed of four uprights with the necessary cross-braces to insure rigidity, and for sake of simplicity in the drawings I have merely shown the upper and lower parallel cross-bars or bearing-seats 1 and 2, the lower supporting the bearing 3, in which the shaft 4 revolves, while the upper, 1, is furnished with a bearing 5, through which the shaft 4 passes and is held in a steady perpendicular position during revolution.

Rigidly secured to the upper extremity of the shaft 4 by means of the set-screw 6 is a beveled pinion 7, the teeth of which are adapted to mesh with a corresponding bevel-wheel 8 which is keyed or rigidly secured to a horizontal shaft 9, the latter having suitable bearings in the upper portion of the framework.

Rigidly secured to the upper part of the shaft 4 immediately below the guide-bearing 5, by means of a set-screw 10, is a circular pan or basin A, having an inner and an outer flange or rim 11 and 12 respectively and a central depressed portion 13.

Directly below the circular pan A and secured or keyed to the shaft 4 is the eccentric or cam 14, which is adapted to impart the desired motion or agitation to the concentrating parts which I will now describe.

Encircling the eccentric 14 is a circular concentrating-pan C, (shown in plan view in Fig. 1,) the surface of which inclines downward from the center to the outer edge. On the upper surface of this pan is a series of concentric depressions *a*, the bottom of each depression being cut out and covered with a screen or sieve 15, increasing in degree of coarseness as the depressions approach the outer rim of the pan. It will be readily seen

from Fig. 2 that the elevation of each successive depression toward the outer rim is lower than the one nearer the eccentric 14 and that the outer rim of each depression is lower than its inner rim. In order to equalize to a greater extent the areas of the bottoms of succeeding depressions I have bisected the two outer depressions on each quadrant of the pan by a radial rib 18, the surfaces of which incline to form a wedge-shaped partition. Secured to the periphery or rim of the pan or table C is a circular roadway 19, which gradually inclines downward to a discharge-pipe or tailings-outlet 20.

Situated beneath the table C is a second pan D similar in construction to the pan C, with the exception that the surface inclines toward the center, or, in other words, is concave in form, and further the discharge 21 for the tailings is at the center. The screens 22 at the bottom of each depression *b* in this pan D are of a finer mesh than those in the upper pan C in order to further separate the material passed through the upper screens 15. In order to convey the material passed through the upper screens 15 to the outer depressions on the pan D, I have provided and secured to the pan C a conical-shaped conveyer 23, its upper face inclining toward its outer edge.

The third pan E, which is situated beneath the pan D, is similar in construction and inclination to the upper pan C, with the exception that the faces of the depressions *c* incline toward a central depressed opening 24, the screens being omitted. The discharge-pipe 20 from the upper roadway empties into a similar roadway 25, secured to the periphery of the pan E, which in turn has a discharge-pipe 26.

To the under surface of the pan D is secured a centrally-depressed or inclined conveyer 27, which conveys the concentrated material from the pan D to the inner depressions *c* on the pan E.

Below the pan E is a similar pan F, which slopes downwardly toward the center, the inner or discharge edge of which is secured to the circular roadway 28, from the lowest portion of which is led a discharge-pipe 29, which connects with the discharge 26 from the roadways 19 and 25.

The material issuing from the openings 30 in the pan F are caught by the circular apron 31, the surface of which inclines downwardly from the inner and outer edges, thus forming a central depressed portion through which is perforated a series of holes 32, which lead the material to a pan G, (shown in plan view in Fig. 8,) having depressions *e* and discharge-openings 33. Beneath the depressions *e* is a roadway 34, which conveys the concentrated and valuable material through the discharge-orifice 35 into a suitable receptacle. Situated about the periphery of the pan G is an inclined roadway 36, with a suitable discharge-pipe 37.

Leading from the openings 24 in the pan E to the correspondingly-situated depressions *d* in the pan F is a conducting-pipe 38. For simplicity in the drawings I have shown only three pipes 38, but it is my intention to employ a conducting-pipe for each depression *c* in the pan E.

In order to more evenly distribute the material on the upper pan C, I have placed between the revolving pan A and the pan C and secured to pan C a distributing-pan B, (shown in plan view in Fig. 9,) which inclines downward from the center to its outer edge and is constructed with an outer upwardly-extending flange 39 and a central flange 40. At the inner side of these flanges are a series of holes 41 to convey the material to the first and second series of depressions *a* on the pan C.

The manner of securing the separate parts of the concentrator together is clearly shown in Fig. 2. The upper pan C is rigidly secured to a casing 42, which surrounds the shaft 4 and terminates at its lower extremity in the roadway 28. The pans D and E are secured to a second casing 43 of larger diameter and encircling the inner casing 42, which is secured to and held at the required distance from the inner casing 42 to form a discharge-conduit 21 for tailings from the pan D by means of radiating ribs 44. The diameter of the inner casing 42 is sufficient to permit of the required motion imparted to the concentrating-pans by the revolution of the eccentric 14. The whole series of pans described above which are effected by the revolution of the eccentric 14 are held or suspended in the required vertical elevation relative to the shaft 4 and eccentric 14 by means of four suspension wire ropes 45, which are secured to the projections 46 on the outer edge of the pan F by means of the eyebolts 47, the upper extremities of the ropes 45 being secured to upper cross-braces of the framework, which I did not deem necessary to show in the drawings, as it may be made of any form of construction.

I will now explain the construction of the feeding-hopper. (Shown in Figs. 5 and 6.) The vertical sides 48 converge from the back 49 toward the outlet 50, which is shown broken off, in Fig. 2. In order to break the force and prevent the splash of the water as it enters the hopper through the inlet-pipe 51 I have supplied the plate 52, which is secured to the vertical back or end 49 of the hopper and extends downwardly and outwardly to within a short space from the horizontal partition 53. Situated at a point about midway of the hopper is a vertical partition 54 with a space between its lower edge and the bottom 55 of the hopper. Between the horizontal partition 53 and the partition 54 is situated a wire or perforated metal screen or sieve 56, and immediately below the screen and sliding through the vertical partition 54 is an adjustable slide 57 which is in-

tended to regulate the amount of material allowed to pass through the sieve 56. Extending directly across the hopper and secured to the vertical partition 54 is a concave discharge-trough 58, which is adapted to convey from the hopper the material too large to pass through the meshes in the sieve 56. The hopper is secured to the pan B by means of the upright support 59.

The construction of the principal parts of the concentrator, as well as their relative positions being described, I will now follow the ore as it is being concentrated and explain the method of operation of each component part.

Either hand, water, steam or other motive power is connected with the horizontal shaft 9 by means of cranks, belts or other connections, thus causing the shaft 9 to revolve, the motion therefrom being transmitted to the vertical shaft 4 through the bevel-gears 7 and 8 described above. It will be seen that all the concentrating-pans to which agitation is imparted through the eccentric 14 are caused to swing in an even motion free from any jarring effect, and further the hopper connected with the pan B is caused to receive a like agitating motion. The crushed ore, gravel, black sand, or other material to be concentrated, is fed by hand or other suitable means into the hopper onto the horizontal partition 53, when the water from the inlet-pipe 51 washes the finer material through the sieve 56, whence it travels along the inclined bottom 55 of the hopper and is fed onto the revolving pan A. As a result of centrifugal force the material in pan A is thrown over the outer rim 12 and lodges on the distributing-pan B. The particles of greater specific gravity pass through the openings 41 into the first or inner series of depressions *a* in the pan C, while the lighter material passes over the central flange 40 and through the perforations 41 into the second series of depressions *a*. The lower rim of each depression, or that farthest from the shaft 4, being on a lower level than the inner or upper rim, the lighter material passes over the lower rim into the second series of depressions, while the heavier or coarser material is deposited on the sieve 15, a part of the water with the finer impurities passing through the sieve. A similar action takes place in the remaining depressions *a*, the final tailings from the pan C passing into the roadway 19, from which it is conducted by the pipe 20. The water and intermingled material which has passed through the sieves 15 are conducted to the outer depressions on the pan D by means of the conical table 23. The concentrating action of the second pan D is identical with that of the upper pan C, with the one exception that the tailings are discharged from the center of the pan into the roadway 28, from which they are conducted by the pipe 29.

A similar concentrating process occurs in the lower pans E, F and G, the tailings from the pan E being deposited into the roadway 25, and those from the pan F into the central roadway 28.

In order to regulate the amount of material allowed to escape through the perforations 24 in the bottom of each depression *c* on pan E into the depression *d* immediately below on the pan F, I have constructed a screw-valve 60, one for each depression, in the three pans E, F, and G, which has a bearing on a cross-bar 61, cast or secured to the pan E, the lower extremity of the valve being adapted, when screwed down, to completely close the perforations 24 in the bottom of each depression *c*. For the sake of simplicity in the drawings I have shown but one of these screw-valves; but it is my intention to supply one for each depression in the pans E, F, and G.

After the concentrated material is led to the depressions *e* in the bottom pan G the last and final result of the successive concentrations described above passes into the roadway 34, from which it is led through the orifice 35 into a suitable receptacle. The tailings from the last concentration in the pan G are led from the roadway 36 through the discharge-pipe 37. It is obvious that the latter tailings are valuable compared with the tailings from the other pans, and in cases where the degree of concentration resulting from a single passage of the material through the series of concentrating-pans is not sufficiently great, the tailings from the pan G are led through the discharge-pipe 37 to an elevator, (shown in Fig. 4,) where they are returned to the hopper, Fig. 6, and again passed through the concentrating process described above.

The construction of the elevator is simple and inexpensive. It consists, essentially, of belt-wheels 62 and 63, the former being secured to an extension of the horizontal shaft 9, while the latter is situated on a horizontal shaft 64, having bearings 65 on the inner surface of the pan or receptacle 66, the latter being bolted or secured to a proper foundation by means of the bolts or screws 67. Passing over the wheels 62 and 63 is an endless belt 68, to the outer surface of which is secured a series of cup-shaped buckets 69, only a portion of which are shown. To prevent the loss of material to be hoisted I have inclosed the belt and connections in the housing or casing 70. The method of operation of this elevator is simple and readily understood from Fig. 4. The endless belt 68 is caused to travel in the direction indicated by the arrow. The material in the pan 66 is gathered up by the buckets 69 and carried over the upper belt-wheel 62, when it is thrown by gravity onto the trough 71 and led to the hopper. (Shown in Fig. 6.)

It is my intention to construct the concentrating-pans of cast-iron, as I have found that the grain of cast-iron is such that it does not appear to be acted upon by the motion of the

concentrated materials, but I do not wish to confine myself to the use of cast-iron alone, as any material may be used.

It will be manifest that the concentrating-pans may be constructed with any number of concentric depressions, and I therefore do not desire to confine my invention to the exact number shown in the drawings. Further I do not wish to limit myself to the exact number of concentrating-pans shown or their relative positions.

In the case of the sieves the particles of material having a greater specific gravity than the intermingled water lodge on the screens and allow only that proportion of the water to pass through as to permit of concentration in the lower pans, the degrees of fineness and the areas of the screens being properly regulated to accomplish the desired result.

As many of these machines as may be required for a plant in any desired locality may be placed side by side and all connected to a single line-shaft, and in that case operated simultaneously and by the same motive power. The machines may be also made portable, whereby they may be transferred from mill to mill or from one point on a bar, stream, or deposit to another where it is desired to concentrate any substance.

In my concentrator, as thus described and shown, I have provided means that may be easily operated by a single workman at but a slight expense and under conditions that would otherwise require a large outlay in preparing for the concentrating process.

I am aware that changes in the form, number, relative position and proportion of parts of the devices herein described as an embodiment of my invention can be made without departing from the spirit or sacrificing the advantages thereof, and I therefore reserve the right to make such changes and alterations as fairly fall within the scope of my invention.

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

1. The combination of a revoluble upright shaft, an eccentric rigidly secured thereto; suspension ropes or rods; a vertical series of circular pans or tables supported by said rods, and agitated by said eccentric; the upper surfaces of said pans inclining downward alternately toward the center, and the circumference, and formed with a series of concentric depressions, and discharging perforations therein; means for regulating the discharge through said perforations; and a circular trough or spout secured to the lower rim of each of said pans substantially as set forth.

2. The combination of a revoluble upright shaft, an eccentric rigidly secured thereto; suspension ropes or rods; a vertical series of circular pans or tables supported by said rods, and agitated by said eccentric; the upper surfaces of said pans inclining downward alternately toward the center, and the circumference, and formed with a series of concentric depressions, and discharging perforations therein; means for regulating the discharge through said perforations; a circular table having an outer flaring rim rigidly secured to said shaft and above said series of pans; and a circular trough or spout secured to the lower rim of each of said pans substantially as set forth.

3. The combination of a revoluble upright shaft, an eccentric rigidly secured thereto; suspension ropes or rods; a vertical series of circular pans or tables supported by said rods and agitated by said eccentric; the upper surface of said pans inclining downward alternately toward the center, and the circumference, and formed with a series of concentric depressions, and discharging perforations therein; means for regulating the discharge through said perforations; a circular trough or spout secured to the lower rim of each of said pans; and an elevator adapted to carry the tailings from the lower pan to the upper substantially as and for the purpose set forth.

JOHN FREY.

Witnesses:
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J. B. LARUE.