H. E. KIER.

SUCTION FILTER.

APPLICATION FILED SEPT. 29, 1909.

978,381.

Patented Dec. 13, 1910.

4 SHEETS—SHEET 1.

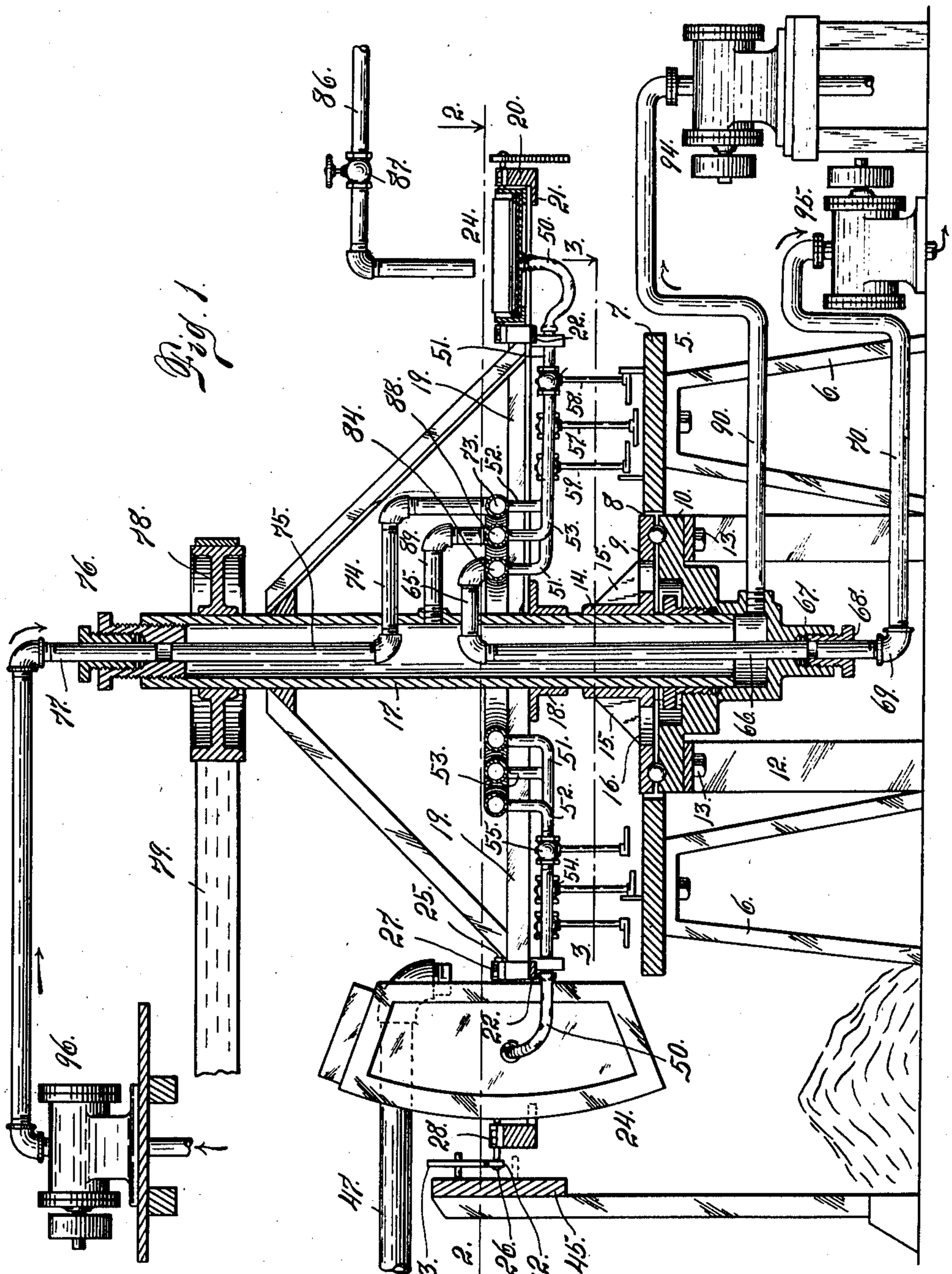

Fig. 1.

Witnesses

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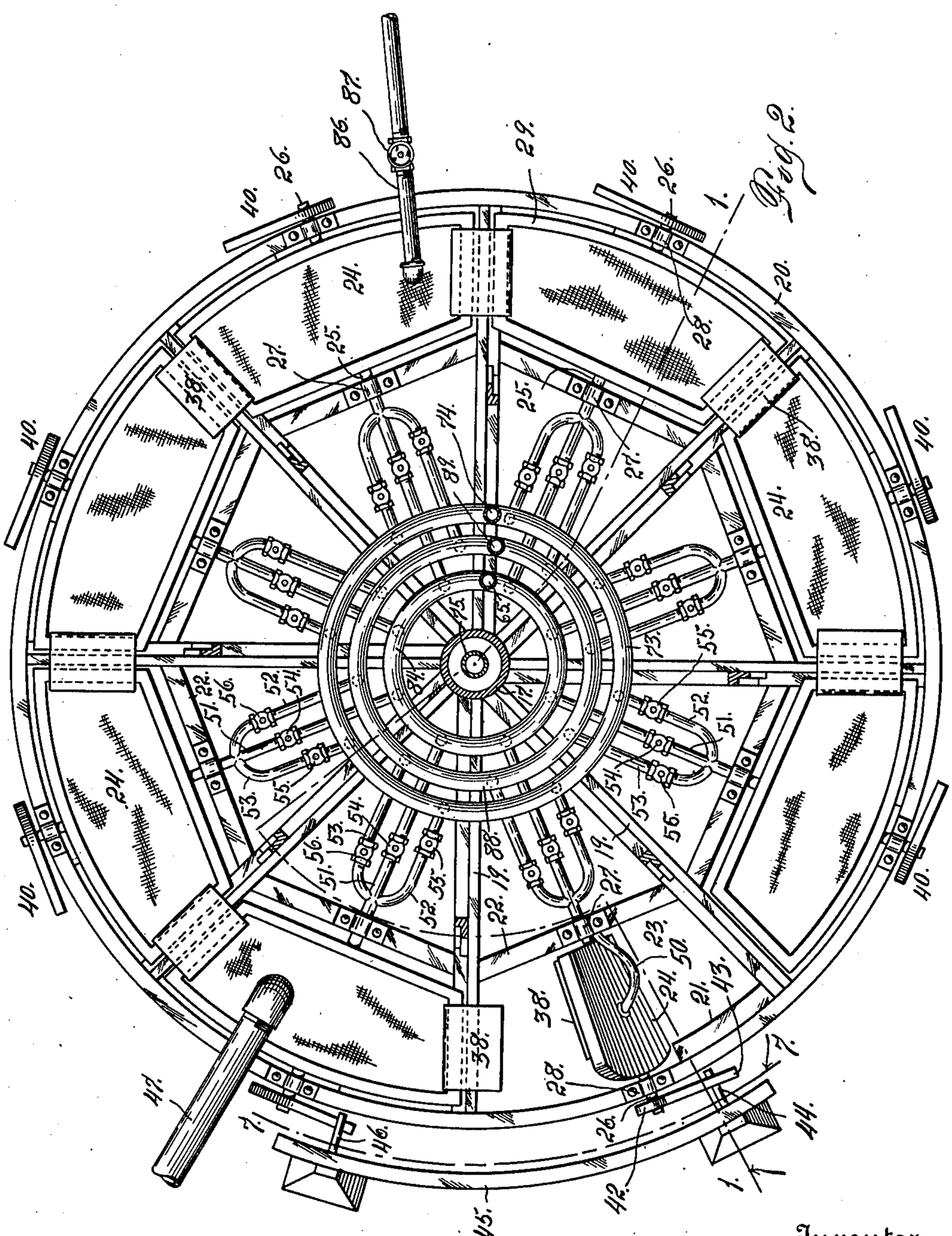

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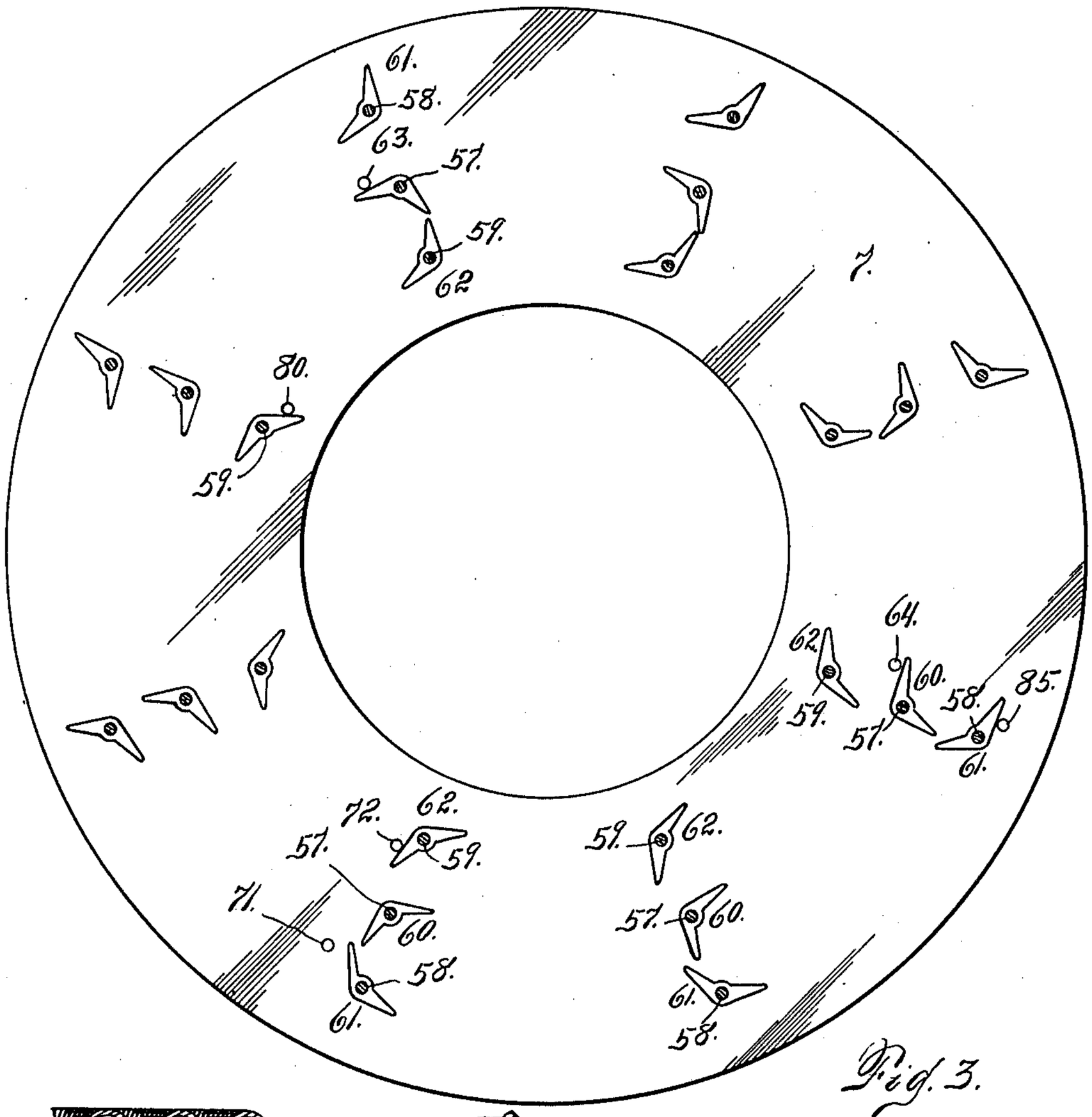

Fig. 3.

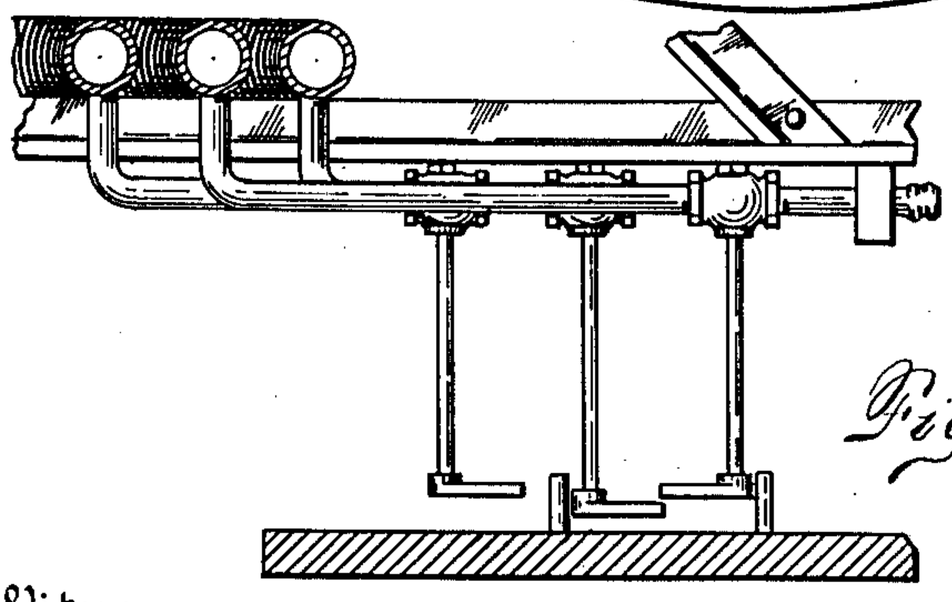

Fig. 4.

Witnesses

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4 SHEETS—SHEET 4.

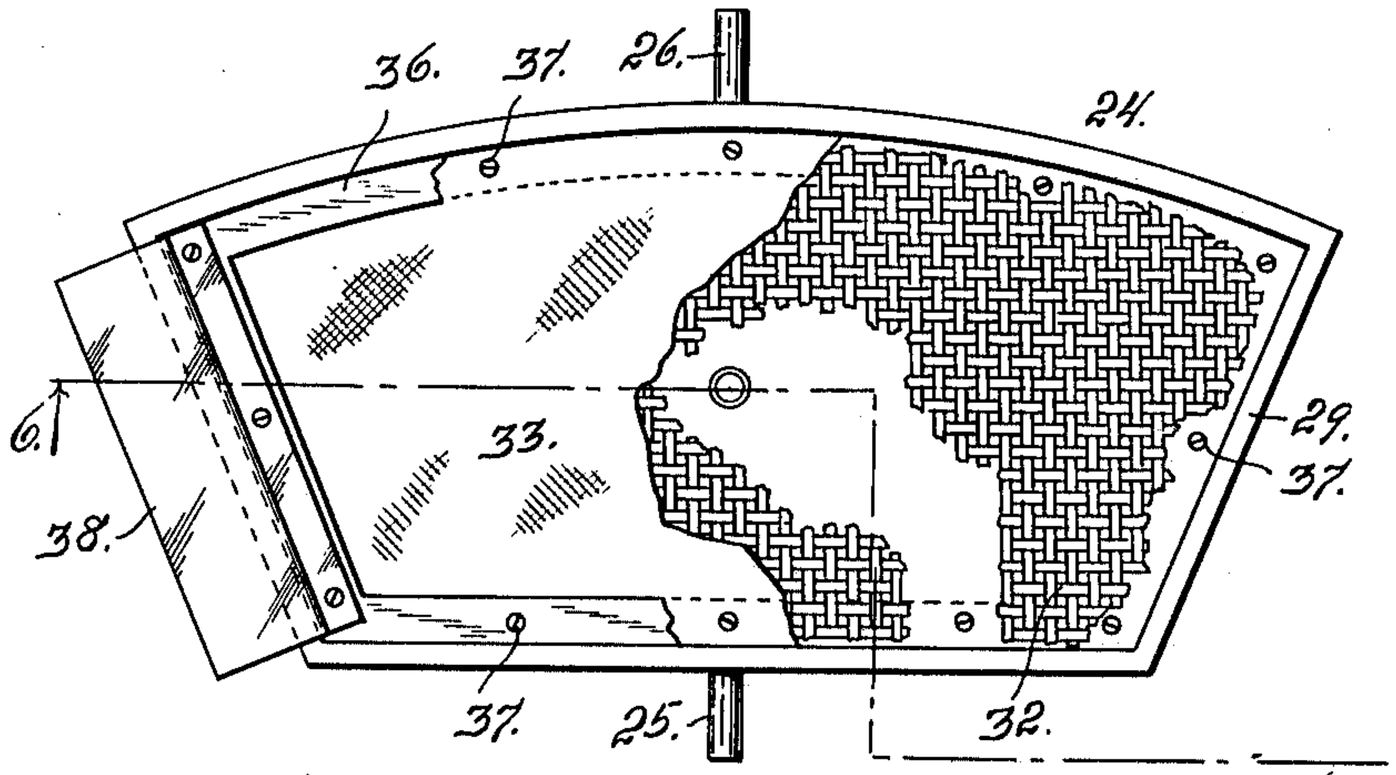

Fig. 5.

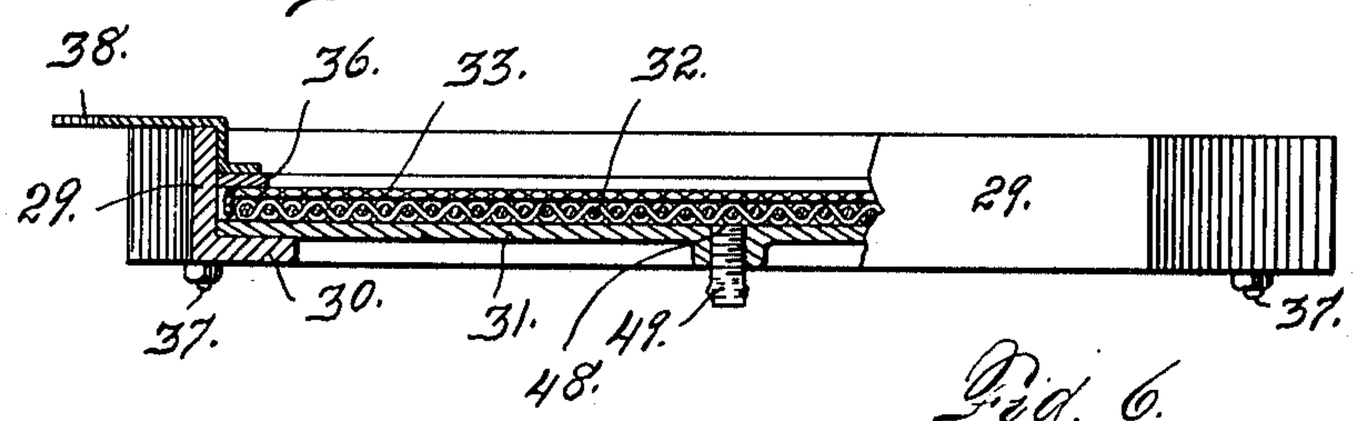

Fig. 6.

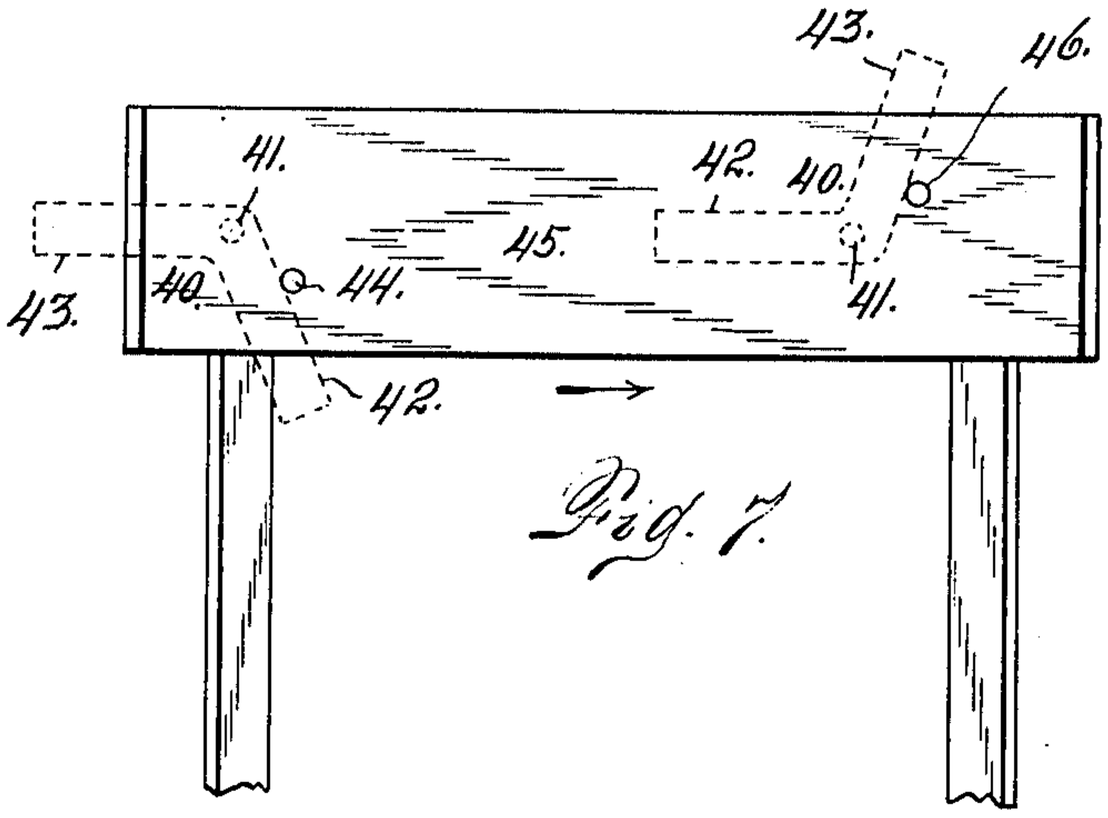

Fig. 7.

Witnesses

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UNITED STATES PATENT OFFICE.

HARRY E. KIER, OF COLORADO SPRINGS, COLORADO.

SUCTION-FILTER.

978,381. Specification of Letters Patent. **Patented Dec. 13, 1910.**

Application filed September 29, 1909. Serial No. 520,190.

To all whom it may concern:

Be it known that I, HARRY E. KIER, a citizen of the United States, residing at Colorado Springs, county of El Paso, and State of Colorado, have invented certain new and useful Improvements in Suction-Filters; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to what I term a suction filter, my object being to provide a construction of this class which shall be continuous and automatic in its action.

In my improvement the filtering apparatus comprises a rotary structure upon which is mounted a series of horizontally disposed trays adapted to receive the pulp or solution to be filtered, a suction pipe being connected with each of these trays, the said pipe communicating with three valve-controlled conduits through one of which the strong solution is drawn; through another of which the weak solution is drawn and through the third of which, air is forced for the purpose of removing the cake of slimes or ore from the tray after the same has been deprived of its precious metal contents in solution. The material in each tray is subjected to these three operations during each rotation of the tray-carrying frame and the valves connected with the three conduits are automatically opened and closed in order to bring about this result since only one operation can be carried on at any one time. Provision is made for automatically tilting each tray to the dumping position, simultaneously with the introduction of air for the purpose of removing the cake of material.

Having briefly outlined my improved construction I will proceed to describe the same in detail reference being made to the accompanying drawing in which is illustrated an embodiment thereof.

In this drawing, Figure 1 is a vertical section taken through my improved apparatus approximately on the line 1—1 Fig. 2. Fig. 2 is a horizontal section taken on the line 2—2 Fig. 1 looking downwardly. Fig. 3 is a section taken on the line 3—3 Fig. 1 looking downwardly. In this view the hollow rotatable shaft and its attachments are omitted, the only object of the view being to illustrate the automatic operation of the valves for opening and closing the various conduits, the parts being shown on a larger scale. Fig. 4 is a fragmentary view with a portion of the apparatus shown partially in section and on a larger scale. Fig. 5 is a top plan view of one of the trays, the fibrous filter being partly broken away. Fig. 6 is a section taken on the line 6—6 Fig. 5. Fig. 7 is a section taken on the line 7—7 Fig. 2 looking in the direction of the arrow. In this view the position of the tray-operating arms with reference to the stops for tilting the trays is indicated by dotted lines.

The same reference characters indicate the same parts in all the views.

Let the numeral 5 designate a stationary frame work which as shown in the drawing consists of upright supports 6 to the top of which is secured a circular platform 7 having a relatively large central opening 8 in which is located a half bearing member 9 cooperating with the stationary member 10 secured to uprights 12 of the frame work by stud bolts 13. The bearing member 9 is provided with a collar 14 connected with the body of the bearing by webs 15 which bridge a space 16 between the collar and the body of the bearing member. The collar 14 is brazed to a vertically disposed hollow column 17 provided with an exteriorly located collar 18 to which is made fast a series of horizontally disposed bars 19 to whose outer extremity is secured a ring 20 having a number of flange members 21 projecting interiorly from the lower surface of the ring. The bars 19 are connected intermediate their extremities by bars 22. Between each bar 22 and the ring 20, and the outer portions of each pair of adjacent arms 19, is a space 23 in which is located a tray 24 provided with trunnions 25 and 26 engaging bearings 27 and 28 respectively, the bearings 27 being mounted on the bar 22 and the bearing 28 upon the ring 20. One of these trays is shown in detail in Figs. 5 and 6 and consists of a frame 29 of the general shape of the space 23. This frame is provided with an interior flange 30 projecting from its lower edge and extending entirely around the tray. Resting upon this flange is a plate 31 which forms the bottom of the tray. Upon this plate is placed a coarse metal screen 32

which forms a support for the filtering medium 33 which may be composed of canvas or other suitable material. Above this filtering medium is placed a retaining frame 36 which engages the outer edge of the filtering medium and is held in place by fastening devices 37. To what I will term the rear extremity of each tray is attached a plate 38 which engages the adjacent extremity of the retaining frame 36 and extends upwardly to the top of the frame 29 and thence rearwardly overlapping the adjacent extremity of another tray. This plate bridges the spaces between the trays and permits a continuous feed of the pulp to be treated while the rotary frame is traveling the space between any two trays. The interiorly projecting flange members 21 of the ring 20, also forms a stop which engages the bottom of the tray whereby the latter is supported in the horizontal position.

The trunnion 26 of each tray, protrudes outwardly beyond its bearing 28 and to this protruding extremity, is attached an arm 40 made fast to the trunnion at 41 and composed of two members 42 and 43. This arm has the shape of a bell crank lever, and a stop 44 is so mounted on a support 45 that it lies in the path of the depending arm 42 (see Fig. 7), whereby when any tray reaches this stop, the angle arm is moved from the position shown at the left of Fig. 7 to the position shown at the right thereof, whereby the tray is thrown to the dumping position or that indicated at the left of Figs. 1 and 2. The depending member 42 of the angle arm is thus moved out of the path of the stop 44 and as the movement of the tray continues, the member 43 of this lever comes in contact with the stop pin 45, which returns the angle-shaped arm together with the tray to its normal position. Hence it will be understood that the dumping of the trays as well as the returning of them to their normal position is entirely automatic. It will be observed that the stops 44 and 46 are mounted on the support 45 at different elevations, the stop 46 being more elevated than the stop 44.

The material to be treated and containing the precious metal values in solution, is delivered to the filtering trays through a feed pipe 47 which overlaps the trays, whereby each tray while passing the feed pipe receives a quantity of the solution. In the bottom of each tray is formed an opening 48 in which is inserted a nipple 49 with which is connected a flexible hose or conduit 50. This conduit communicates with a pipe 51 with which are connected two other pipes 52 and 53. The passage of fluid through these pipes is controlled by valves 54, 55 and 56 respectively. These valves have depending stems 57, 58 and 59, respectively, to the lower extremity of which are made fast bell-crank-shaped triggers 60, 61 and 62. The trigger 60 is actuated to open the valve 54 of the pipe 51, by a stop pin 63 located in position to engage one arm of the trigger 60 and open the valve, after the tray has passed the feed pipe 47, whereby the suction is applied to the tray through the pipe 51 for the purpose of removing the strong solution from the tray by causing it to pass through the filtering medium 33. The inner extremity of this pipe 51 connects with a circle tube 84 from which leads a conduit 65 which passes through an opening in the hollow column 17 and is connected with a vertically disposed pipe 66 which turns with the hollow column. The lower extremity of the pipe 66, projects below the hollow column and enters a stuffing box 67 formed at the lower extremity of the stationary bearing member 10. The pipe 66 communicates with a stationary pipe 68 connected by an elbow 69 with a pipe 70 which leads to a pump 95 or other suitable suction-inducing mechanism whereby the strong solution is drawn from the tray and filtered by passing through the filtering medium 33.

The valve 54 is open for the removal of the strong solution while the tray is traveling from the pin 63 to a pin 64, when the latter acts on the trigger 60 to close the valve 54 and cut off communication with the conduit through which the strong solution passes. Simultaneously with the closing of the valve 54, the valve 56 is opened by the engagement of the trigger 61 with a stop pin 85. Just before the tray reaches the position to close the valve 54 and open the valve 56, water is fed into the tray through a conduit 86 provided with a valve 87 whereby the cake of material within the tray which has been deprived of the stronger solution is washed to remove the remaining values in the form of weak solution; and as soon as the tray reaches the position where the trigger 61 is engaged by the stop pin 85, the valve 56 is opened and the weak solution resulting from the introduction of the water as aforesaid, drawn off through the pipe 53, to a circle tube 88 which communicates with an elbow-shaped pipe 89 which communicates with the hollow column, the latter being in communication with a suction pipe 90 through which the weak solution may be drawn off and delivered to any suitable receptacle. The valve 56 remains open for the drawing off of the weak solution from the tray, until the latter reaches a position to cause the trigger 61 to engage a stop pin 71, when the valve 56 is closed and the removal of the weak solution ceases since the same has been completely withdrawn from the tray. Simultaneously with the closing of the valve 56, the trigger 62 engages a stop pin 72, whereby the valve 55 is opened and air or other fluid forced into the tray from

below through the branch pipe 52, the pipe 51, the pipe 50 and the nipple 49, whereby the hardened cake of material is loosened, and as soon as the tray reaches a position to bring the depending member of its angle arm 40, into engagement with the stop 44, the tray is turned on its trunnions to the position shown at the left of Figs. 1 and 2, whereby the cake of material which has been loosened by the air pressure from below, is dumped out, after which the angle arm 40 of the tray engages the stop pin 46, whereby the tray is returned to its normal position and pulp is again fed thereinto through the conduit 47. The air forced into the tray as aforesaid, passes into the pipe 52, from a circle tube 73 which is in communication with the elbow-shaped pipe 74 which passes through the hollow column and communicates with an upwardly projecting vertically disposed pipe 75 which terminates in a stuffing box 76 inserted in the top of the column. The pipe 75 communicates within this stuffing box with a stationary air delivery pipe 77 which is connected with any suitable source of compressed air. It is assumed that the pipe 77 remains stationary, while the column and the stuffing box 76 turns, the pipe 77 being connected with a stationary air delivery apparatus which makes it impracticable for it to rotate with the column. The stuffing box, however, is of such construction as to prevent the leakage of air between the extremities of the pipes 77 and 75. After the tray has been returned to its normal position, the trigger 62 engages a stop pin 80, which actuates the trigger to close the valve 55 and cut off the introduction of compressed air to the tray, the said valve being closed just before the tray moves into position to be recharged from the feed pipe 47.

I have just traced the filtering operation as applied to a single tray during its entire revolution with the rotary column and the filter-tray-supporting frame. The various operations described in connection with one tray, is repeated in connection with each tray while the filter is in operation, the entire series of operations being entirely automatic assuming that power is applied to the hollow column and the tray-carrying frame rotated.

As shown in the drawing (see Fig. 1), the hollow column is provided near its upper extremity with a fast pulley 78, with which a belt 79 is connected, whereby power may be transmitted to the hollow column from any suitable motor.

Attention is called to the fact that the trigger-actuating stops 63, 64, 71, 72 and 80 are mounted upon the stationary platform 7 and so arranged that they act upon the triggers connected with the stems of the three valves 54, 55 and 56 with which the pipes 51, 52 and 53 employed in connection with each tray, are equipped.

It may be stated that in Fig. 3 eight different positions of the triggers 60, 61 and 62 for controlling the three valves employed in connection with any one tray, are illustrated. For instance after the pin 63 has acted upon the trigger 60 to open the valve 54, the three triggers remain in the same position until the tray reaches a position opposite the actuating pins 64 and 65. It will be observed that in this view the three triggers are illustrated twice between the location of the pin 63 and the locations of the pins 64 and 65. The object of this illustration is to indicate that the triggers do not change their positions while traveling from one of these locations to the other. Again between the location of the pins 64 and 65 and the location of the pins 71 and 72, the three triggers are once illustrated, thus indicating that the valves remain in the same position after leaving the pins 64 and 65, until the pins 71 and 72 are reached. Again the triggers are once illustrated between the pins 71 and 72 and pin 80, for the same purpose. This view also illustrates that the strong solution is being drawn off while any tray is traveling from a position corresponding with the location of the pin 63, to a position corresponding with the pins 64 and 65; also that the weak solution is being drawn off while the tray is traveling from the position corresponding with the pins 64 and 65 until it reaches a position corresponding with the pins 71 and 72; and that the air is forced into the bottom of the tray while the latter is traveling from the position corresponding with the pins 71 and 72 until it reaches a position corresponding with the position of the pin 80. Furthermore Fig. 3 may also be considered as illustrating the stems and triggers of the eight different sets of valves 54, 55 and 56 illustrated in Fig. 2. It will be noted, however, that in Fig. 3 the platform 7 is shown on a larger scale than in Fig. 1 and that the various valve stems and triggers are correspondingly located. In other words Fig. 3 is shown on a larger scale than Figs. 1 and 2. By further comparing Figs. 2 and 3, it will be observed that each tray receives water from the pipe 86 and the latter is so located that the tray begins to receive water before it reaches a position where the trigger 60 engages the pin 64 whereby the valve 54 is closed to cut off the passage of solution from the tray through the strong solution passages; and the opening of the valve 55 by engagement of the trigger 61 with the pin 85, whereby the weak solution is drawn off through other passages as heretofore explained. In explanation of this it may be stated that the water is allowed to enter the tray through the pipe 86 before the passage

through which the strong solution goes is closed since the tray will travel from the position where it receives the water from the pipe 86 to the position where the valve 54 is closed and the valve 56 opened, before the water or weak solution would have passed through the filter. Consequently the weak solution does not have time to reach the strong solution passages while the tray is traveling from the position where it receives the water to the position where the passage of solution through the strong solution passages is cut off and the valve opened for the drawing off of the weak solution through another set of passages as heretofore explained.

From the foregoing description the use and operation of my improved apparatus will be readily understood. Assuming that the parts are assembled as shown in Figs. 1 and 2 of the drawing, the material to be treated as pulp containing precious metal values in solution, is discharged through the pipe 47 into the various trays 24, as they move into position, it being understood that the hollow column 17 and its attachments are rotated in the manner heretofore described. The time during which any tray is passing the discharge extremity of the pipe 47, is sufficient to fully charge the tray with the pulp to be treated. As soon as the tray moves beyond the discharge extremity of the feed pipe, the valve 54 of the pipe 51, is opened by the action of the stop pin 63 upon the trigger 60 attached to the stem 57 of the said valve. As soon as this valve is opened, the suction through the pipe 51 by virtue of the connections heretofore explained, draws the solution containing the precious metal values through the filtering medium of the tray, thence through the pipe 51, into the circle tube 84, thence through the pipes 65, 66 and 70, whereby the said solution may be delivered into any suitable receptacle. This passage of the strong solution through the various pipes and conduits just mentioned, continues until the tray has reached such a position (see Fig. 3) that the pin 64 acts on the trigger 60, to close the valve 54 whereby the passage of solution through what I will term the strong solution passage is cut off. Simultaneously with the closing of the valve 54, the valve 56 is opened by the action of the pin 85 upon the trigger 61 of the stem 58. Prior to the opening of the valve 56, water has been discharged into the tray through the pipe 86 and the tray travels a short distance before the valve 54 is closed and the valve 56 opened, since it takes the water some little time to pass through the filtering medium of the tray. The pins for closing the valve 54 and opening the valve 56 are so located that the strong solution passages are closed against the entrance of the solution and the weak solution passages opened by the time the weak solution due to the introduction of the water has passed through the filter and before any of the weak solution enters the strong solution passages. As soon as the valve 56 is opened, the weak solution passes from the tray through the flexible conduit 50, and thence through the pipe 53, the circle tube 88, and the pipe 89 which communicates with the hollow column 17, the weak solution being drawn from the column through the pipe 90 from which it may be delivered to any suitable receptacle. The drawing off of the weak solution through the aforesaid passages continues until the tray reaches a position whereby the trigger 61 of the stem 58 connected with the valve 56, is actuated by the pin 71 to close the said valve whereby the passage of the weak solution is cut off from the tray. Simultaneously with the closing of the valve 56, the valve 55 is opened by the engagement of the trigger 62 of the valve stem 59, with the pin 72. As soon as this last named valve is opened, air is forced into the bottom of the tray, through the pipes 77, 75, 74, 73, 52, 51 and thence through the flexible pipe 50, whereby the cake of material which has been deprived of the solution, is loosened. Shortly after the introduction of the air under pressure into the bottom of the tray, the latter is tilted on its trunnions to the position shown at the left of Figs. 1 and 2, by the engagement of its lever arm 40 with a pin 44, whereby the cake of material is dumped from the tray. Shortly after this occurs, the lever arm 40 is brought into contact with the pin 46, which returns the tray to its normal or horizontal position, after which it moves again into position to be charged from the feed pipe 47 and the operation heretofore described is repeated.

It will be understood that the filtering operation carried on in connection with each tray, is substantially identical. Hence the description of the said operation in connection with one tray only is sufficient.

As shown in the drawing the suction pipe 90 is connected with a pump 94 or other suitable suction-inducing mechanism; while the pipe 77 is connected with an air pump 96 or other suitable air-forcing apparatus.

Having thus described my invention, what I claim is:

1. In a filter, the combination with a horizontally disposed rotary frame, of a filtering tray tiltably mounted thereon and traveling therewith, means for delivering to the tray the solution to be filtered, a conduit connected with the bottom of the tray, a valve for controlling the passage of solution through said conduit, suction means connected with the conduit for drawing off the solution from the bottom of the filter, means for opening and closing the said valve at

predetermined intervals whereby the period during which the solution is drawn off may be controlled, and means for tilting the tray for dumping purposes, means for automatically returning it to its normal or horizontal position after the dumping operation, substantially as described.

2. The combination with a rotary frame, of a tray mounted thereon and adapted to travel therewith, means for delivering to the tray the solution to be filtered, a conduit connected with the bottom of said tray, two pipes in communication with said conduit, a valve for controlling each pipe, suction-inducing mechanism connected with each pipe, means for automatically opening the valve connected with the first pipe, means for closing the valve connected with the first pipe, and means for opening the valve connected with the second pipe simultaneously with the closing of the valve connected with the first pipe, and means for delivering water to the tray before the closing of the first pipe and the opening of the second pipe, whereby two different grades of solution are drawn off from the tray, substantially as described.

3. The combination with a rotary frame, of a filtering tray mounted thereon and rotating therewith, a conduit connected with the bottom of said tray, two pipes in communication with said conduit, suction-inducing mechanism connected with each pipe, a valve for controlling each pipe, depending stems connected with each valve, pins in operative relation with said stems; means for opening and closing each valve as the frame rotates and at predetermined intervals, the said means being arranged to open the valves of the two pipes at different times and to close one valve simultaneously with the opening of the other.

4. The combination with a rotary frame, of a filtering tray mounted thereon, a conduit connected with the bottom of the tray, three pipes in communication with the said conduit, each pipe being provided with a controlling valve, suction-inducing mechanism connected with two of the pipes, air forcing mechanism connected with the other pipe, depending stems connected with each of said valves, pins in operative relation with said stems as means for opening and closing each valve at predetermined intervals as the tray rotates, substantially as described.

5. The combination with a rotary frame, of a filtering tray mounted thereon, a conduit connected with the bottom of the tray, three pipes connected with the conduit, two of them being suction pipes, and one of them being an air-forcing pipe, each pipe being equipped with a controlling valve, depending stems connected with said valves, pins in operative relation with said stems as means for opening and closing each valve at predetermined intervals, substantially as described.

6. The combination with a supporting frame, of a filter tray mounted thereon, a conduit connected with the bottom of the tray, three pipes in communication with the said conduit, a valve for controlling the passage of fluid through each pipe, depending stems connected with each valve, pins in operative relation with each stem as means for opening and closing the valve of each pipe, the said pins so arranged that no two valves are open at the same time, pumps respectively connected with two of the pipes for drawing off solution from the tray, and air-forcing apparatus for introducing air to the bottom of the tray through the third pipe, the conduit connected with the bottom of the tray being in common communication with all the pipes, substantially as described.

7. The combination with a rotary frame, of a filtering tray mounted thereon, a conduit connected with the bottom of the tray, two pipes in common communication with said conduit, means for feeding the material to be treated to the tray, a valve connected with each pipe, means for feeding water to the tray when at a predetermined position in its rotary travel, depending stems connected with said valves, pins in operative relation with said stems as means for and simultaneously closing the valve of one pipe and opening the valve of the other pipe, and a pump in communication with each pipe, whereby two grades of solution are drawn off from the tray through the respective pipes, substantially as described.

8. The combination with a rotary frame, of a horizontally disposed filtering tray tiltably mounted thereon and traveling therewith, means for feeding the material to be treated to the tray, a pipe in communication with the bottom of the tray for drawing off the solution, a pump in communication with said pipe, a valve for controlling the pipe, means for opening and closing the said valve during the rotary travel of the tray, and means for automatically tilting the tray for dumping purposes and subsequently returning it to its normal or horizontal position at predetermined points of its rotary travel, substantially as described.

9. The combination with a rotary frame, of a series of horizontally disposed trays tiltably mounted thereon, means for feeding the material to be treated to each tray at a predetermined position in its rotary travel, means for drawing off the solution from each tray, means for tilting the tray for dumping purposes, and means for subsequently restoring it to its horizontal position at a predetermined point in its rotary travel, substantially as described.

10. The combination with a rotary frame,

of a series of filtering trays mounted thereon and rotating therewith, of a conduit connected with the bottom of each tray, three pipes in common communication with the said conduit of each tray, three circle tubes with which the respective conduits of each tray are connected, and three separate pumps in communication with the respective tubes, valves connected with each conduit, depending stems connected with the valves, and means for actuating the stems for simultaneously opening and closing the said valves at predetermined intervals during the rotary travel of the trays, for the purpose set forth.

11. The combination with a rotary frame, of a series of tiltably mounted filtering trays mounted thereon and rotating therewith, a conduit connected with the bottom of each tray, a number of pipes in common communication with the said conduit of each tray, a corresponding number of circle tubes in common communication with the corresponding pipes of all the trays, and a number of pumps corresponding with the number of tubes and in respective communication with the latter, means for feeding the material to be treated to each tray in a predetermined position in its rotary travel, means for drawing off the solution from each tray, means for tilting the tray for dumping purposes, and means for subsequently restoring it to its horizontal position at a predetermined point in its rotary travel, for the purpose set forth.

12. The combination with a rotary frame, of a series of filtering trays mounted thereon and rotating therewith, a conduit connected with each tray, a number of pipes mounted on the said frame and in common communication with the conduit of each tray, a number of circle tubes corresponding with the number of pipes of each tray and in common communication with the corresponding pipes of all the trays, a separate pump connected with each circle tube, a valve for controlling the passage of fluid through each pipe, depending stems connected with the said valves, pins in operative relation with the said stems as means for opening and closing the said valve at predetermined intervals during the rotary travel of the trays, substantially as described.

13. The combination of a rotary frame including a centrally located hollow column, a series of filtering trays mounted on the said frame and rotating therewith, a conduit connected with the bottom of each tray, a number of pipes in common communication with the conduit of each tray, a number of circle tubes corresponding with the number of pipes of each tray surrounding the hollow column and in respective and common communication with the corresponding pipes of all the trays, a pump in communication with each tube through the hollow column, means for feeding material to be treated to each tray at a predetermined position in its rotary travel, means for drawing off the solution from each tray, means for tilting the tray for dumping purposes, and means for subsequently restoring it to its horizontal position, at a predetermined point in its rotary travel, substantially as described.

14. The combination of a rotary frame including a hollow vertically disposed column, a series of horizontally disposed filtering trays mounted on the frame and rotating therewith, a conduit connected with the bottom of each tray, a number of pipes mounted on the rotary frame and in communication with the conduit of each tray, a number of circular tubes mounted on the frame surrounding the hollow column and corresponding in number with the said conduits of each tray, said tubes being in respective and in common communication with the corresponding conduits of all the trays, a single pipe connected with each tube and leading into the hollow column, valves located in each conduit, depending stems connected with each valve, and means lying in the path of said stems for actuating the stems to simultaneously open and close the valves, and a pump in communication with each of the last named pipes through the hollow column, substantially as described.

15. The combination with a rotary frame, of a series of horizontally disposed filtering trays tiltably mounted thereon, means for feeding the material to be treated to each tray at a predetermined location in its rotary travel, means for drawing off the solution from each tray, means for tilting each tray to the dumping position at a predetermined point in its rotary travel, and means for subsequently and automatically restoring the tray to its horizontal position, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

HARRY E. KIER.

Witnesses:
F. B. ORGAN,
J. M. SIPPETT.