F. H. ROBERTS.

CONTINUOUS CENTRIFUGAL MACHINE.

APPLICATION FILED MAY 1, 1909.

962,052.

Patented June 21, 1910.

2 SHEETS—SHEET 1.

Fig. 11.

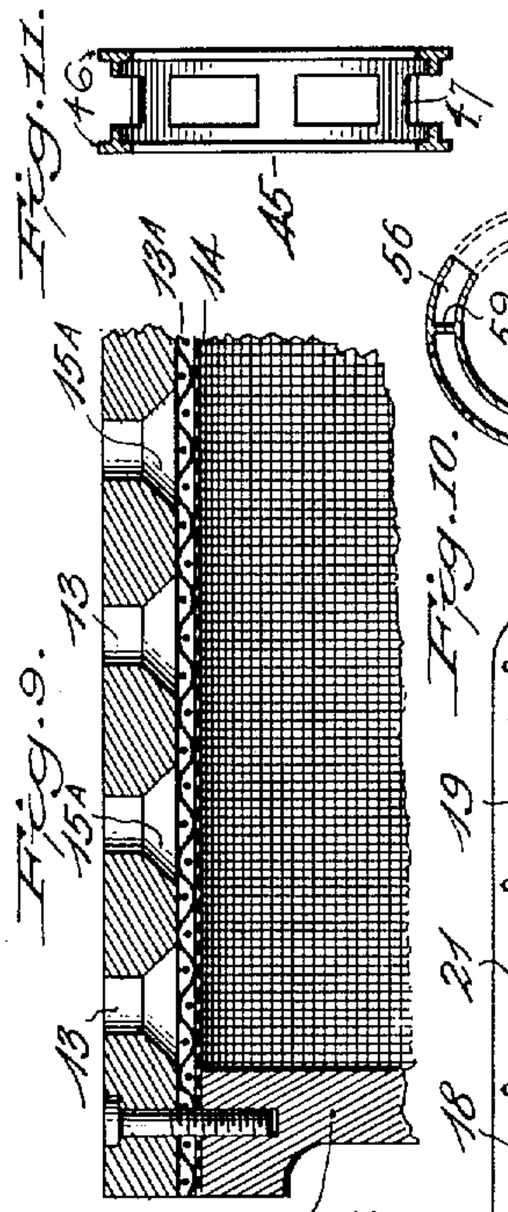

Fig. 9.

Fig. 10.

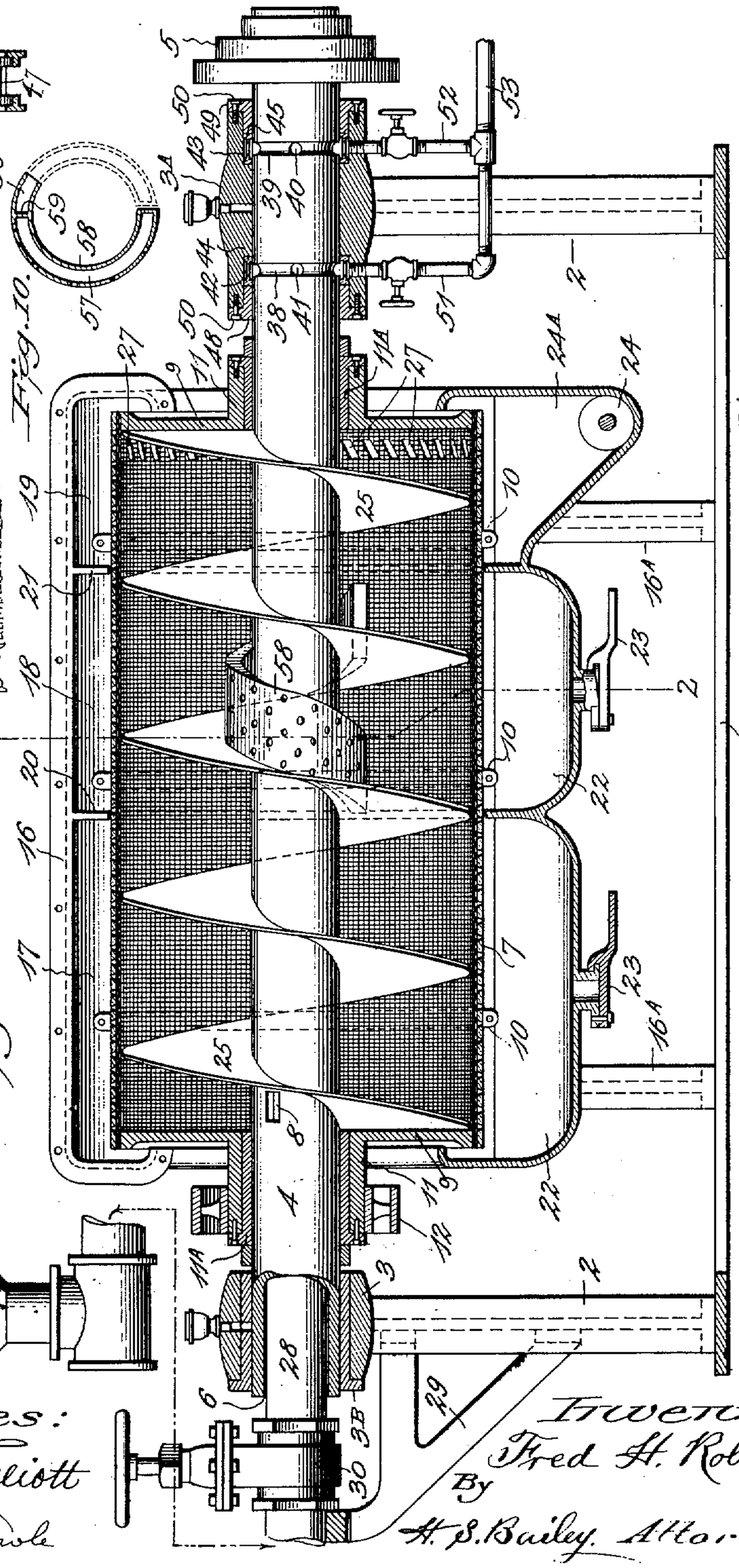

Fig. 12.

Fig. 1.

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2 SHEETS—SHEET 2.

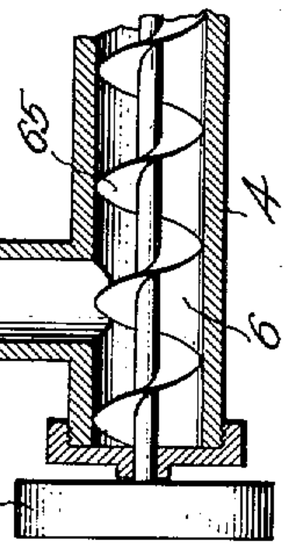
Fig. 8.

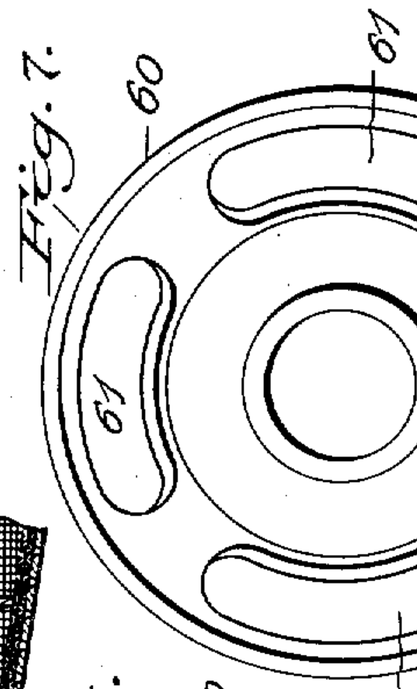
Fig. 7.

Fig. 6.

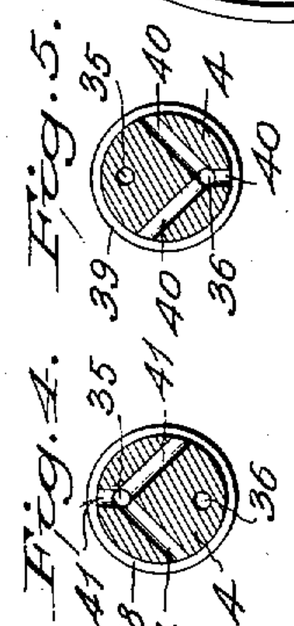
Fig. 5.

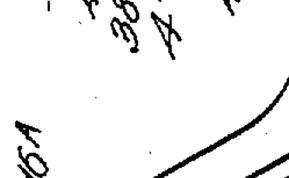
Fig. 4.

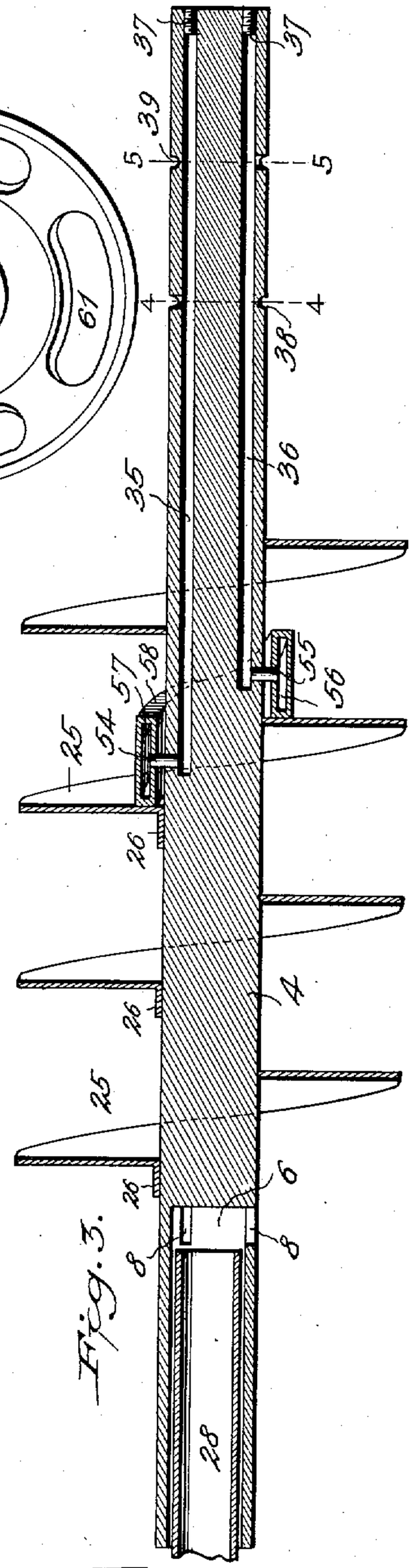
Fig. 3.

Fig. 2.

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UNITED STATES PATENT OFFICE.

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CONTINUOUS CENTRIFUGAL MACHINE.

962,052. Specification of Letters Patent. Patented June 21, 1910.

Application filed May 1, 1909. Serial No. 493,293.

To all whom it may concern:

Be it known that I, FRED H. ROBERTS, a citizen of the United States of America, residing at Sterling, county of Logan, and State of Colorado, have invented a new and useful Continuous Centrifugal Machine, of which the following is a specification.

My invention relates to improvements in continuously operating apparatus for separating liquids from crystallized sugar, other crystalline and non-crystalline or amorphous materials.

The objects of my invention are: first, to provide a continuously feeding treatment centrifugal separator and drier for separating the liquid solutions from the solid matter of such materials as crystallized sugar, salt or other crystalline material, sugar beet pulp, precipitated solids such as carbonate of lime in sugar beet juice, saccharate in the process of sugar making, ore pulps, or any other liquid pulps in which it is desired to separate the liquid from the solid material of which they may be composed. Second, to provide a continuous feeding and operating apparatus that is especially adapted to separate the liquid element of sugar magma from its solid element. Third, to provide a continuously feeding and continuously operating centrifugal separator in which the liquid elements are separated from the solid material elements, and in which the liquid element is divided as desired into solutions of different strengths, such as the full strength solution and wash water solution, which are separated from each other and from the substantially dry solid material. I attain these objects by the mechanism illustrated in the accompanying drawings, in which:

Figure 1, is a vertical, longitudinal, sectional view, partly in elevation, of the improved machine. Fig. 2, is a transverse, vertical, sectional view thereof on the line 2—2 of Fig. 1. Fig. 3, is a longitudinal, sectional view of the conveyer shaft detached. Figs. 4 and 5, are transverse sectional views on the lines 4—4 and 5—5 respectively of Fig. 3. Fig. 6, is a fragmental, longitudinal, sectional view illustrating a modification in the means for feeding the material to the machine, a conical screen being shown in connection therewith. Fig. 7, is a front view of the head shown in Fig. 6. Fig. 8, is a fragmental, sectional view of a modified form of feeding device, illustrating a spiral conveyer which is adapted to be used instead of the feed device shown in Fig. 1. Fig. 9, is an enlarged, sectional view of a portion of the screen cylinder. Fig. 10, is a transverse, sectional view of the hollow spiral water distributer, shown in Figs. 1 and 3. Fig. 11, is an enlarged, transverse sectional view of one of the packing rings used at the water inlet end of the conveyer shaft, as shown in Fig. 1. And Fig. 12, is a fragmental sectional view showing a fabric strip which may be interposed between the two screens shown in Fig. 9.

Similar figures of reference refer to similar parts throughout the several views.

Referring to the drawings, the numeral 1, designates a bed plate upon which is mounted vertical pedestals 2, which are provided with journal boxes 3 and 3^A. The journal box 3 is provided with a removable anti-friction bushing 3^B. A shaft 4 is mounted in these journal boxes, upon one end of which a cone pulley 5 or other differential speed power receiving device is secured. The opposite end of this shaft is provided with an axial feed aperture 6, which extends into its end far enough to feed the material which is to be subjected to the separating and washing process inside of the adjacent portion of a cylindrical screen 7, through radial apertures 8 formed through the shaft. This screen cylinder comprises a perforated casing, which is made in two halves and bolted at their ends to heads 9. The casing sections are also held together at intervals by two-part bands 10, which are bolted together around the said casing, as shown most clearly in Fig. 2. Each head 9 is provided with a hub 11, which is provided with removable anti-friction bushings 11^A, which are rotatably mounted on the shaft 4. A belt pulley 12 is keyed or otherwise secured to the hub 11 of the feed end of the cylinder, by which rotary motion is imparted to the cylinder independent of the rotary motion imparted to the shaft by the cone pulley 5. The shaft and the cylinder may be rotated in opposite directions or in the same direction at different relative revolutions of speed per minute, if desired, to effect the best results.

The two halves of the screen cylinder 7

are provided with closely arranged perforations 13, and are lined with screening material which is preferably inserted in one or two layers, and preferably consist of two layers of screen wire, one of which 13A is a coarse wire and preferably is laid against the inside of the cylindrical casing. A fine wire screen or perforated plate 14 is preferably laid against the coarse screen around the inside of the cylindrical casing. If desired, however, the fine screen or perforated plate may be placed between the coarse screen and the inside of the casing.

In addition to the wire screens, my invention contemplates the use of screening fabrics, such as asbestos, canvas, cocoa-matting, and other suitable screening or filtering material arranged around the inside of and against the casing or between the wire screens, and the screens are clamped at their ends between the screen cylinder and the heads 9, as shown in Fig. 9.

The perforations through the shell of the cylindrical screen are placed close enough together to form a practical screening or filtering surface for the liquids of materials to be treated, and these perforations are preferably provided with countersunk portions 15A. This cylindrical screen is surrounded by a cylindrical casing 16, which is an imperforate casing that is supported on legs 16A, which rest on the bed plate 1. This casing is divided into compartments 17, 18 and 19, by partitions 20 and 21, and in the bottom of the compartments 17 and 18 enlargements 22 are formed, in the bottoms of which discharge valves 23 are placed, and the bottom of the compartment 19 terminates in a trough 24A, in which an endless conveyer 24 is placed to convey any material therein outside of the casing, from which it runs to waste or is conveyed to further treatment. This cylindrical casing is made in sections that are bolted together by bolts 24B. These compartments below the cylindrical screen are curved downward far enough below the cylindrical screen to form the tank portion or enlargements 22, of sufficient capacity to hold the screening liquid and the solid product of the material that is fed into the cylindrical screen, and they are formed eccentric to the concentric portion of the casing that surrounds the cylindrical screen. Upon the shaft I mount an endless spiral screw blade conveyer 25, which is secured thereto by flange portions 26, that are secured to the shaft. This conveyer is made large enough in diameter to extend to the screen lining of the screen cylinder, and it extends from the feed end of the cylinder to its discharge end, and is adapted to feed the material through the cylindrical screen.

A circumferential row of discharge apertures 27 are formed at the discharge end of the cylinder, which are preferably arranged to overlap each other, so that collectively they will form a continuous row of discharge apertures throughout the circumference of the cylindrical shell. At the feeding in end of the shaft a feed pipe 28 extends loosely into the axial aperture 6 in the shaft 4. This feed pipe is preferably supported by a bracket 29, which extends from the pedestal. A valve 30 is placed in this pipe adjacent to the bracket, and a feed hopper 30A is secured to the pipe adjacent to the valve. The top end of this feed hopper is closed by a cover 31, which is preferably removably secured to it in any preferred manner.

A valve controlled pipe 33 is threaded to the cover and extends to a supply of compressed air. A valve controlled pipe 34 is threaded to the side of the hopper adjacent to its cover, which leads to a supply of material to be separated or treated. The shaft is provided at its rear or discharge end portion with water inlet supply passages 35 and 36, two being preferably illustrated, but more may be used if desired. These water inlet passages extend axially into the rear end of the shaft, and their entrance ends are plugged up by threaded plugs 37. These water apertures connect to circumferential grooves 38 and 39, formed around the shaft, which are positioned to come underneath the two opposite side edges of the journal box 3A, and each of these circumferential grooves is provided with radial apertures 40 and 41 respectively. The radial apertures 40 extend from the groove 39 to the axial passage 36, and the apertures 41 extend from the groove 38 to the axial passage 35. The two grooves 38 and 39 register with two water chamber spaces 42 and 43, which are formed in the opposite ends of the journal box, which are each arranged to receive apertured packing rings 44 and 45, which lie between the inner ends of water chambers 42 and 43, and glands 48 and 49, which are loosely mounted on the shaft and are secured to the ends of the boxes by screws 50.

The packing rings are of the form shown in Fig. 11, and comprise parallel rings 46, which are connected by an integral perforated band 47, which permits the water to circulate in the water chambers 42 and 43. These water chamber spaces are connected to pipes 51 and 52, which are threaded to apertures in the journal boxes that connect with the chambers, and that are connected to a general supply pipe 53, which leads to a supply of water under pressure. The inner ends of the axial water passages discharge through radial nipples 54 and 55, into compartments 56 and 57, which are formed in a spiral drum 58 that surrounds the shaft at a short distance from its dis-

charging end to give a wash water treatment to the separated material during the last part of its feeding movement through the cylindrical screen. This drum consists of a flat spirally formed casing that is divided into the two or more compartments 56 and 57 by a partition 59, and the water entering them from the water supply passages of the shaft is discharged in radial jets from one or both compartments of the drum toward the interior screen surface of the cylindrical screen.

In Fig. 6, I illustrate a tapering cylindrical screen, and also a tapering spiral screw shaped flange conveyer, both of which are similar in other respects to the straight cylindrical screen and the screw flange of Fig. 1, except that the feeding in end of the cylindrical screen is provided with a conical head 60, which is provided with apertures 61. In this form of cylindrical screen head the material to be separated is fed through an independent pipe 62, instead of through the shaft 4. This pipe 62 is supported by the bracket which projects from the pedestal. This pulp feeding pipe is arranged to extend close to the apertures in the conical head and discharge into and through them as the head and cylinder are rotated on the shaft 4 by the pulley 12. This arrangement allows a little of the material to fall on the head between the apertures. An introverted flanged ridge 64 is formed around the entrance peripheral edge of the head, which catches this discharged material to be separated, and it flows down or is thrown by centrifugal force into and through the apertures in the head.

In Fig. 8, is illustrated a modified form of feeder, which consists of a spiral conveyer 65, that is supported in the chamber 6 of the shaft 4. This conveyer receives the material from the hopper 30A, and forces it to the inner end of the chamber 6, where it discharges into the screen through the openings 8. The conveyer is operated by a driven pulley 66.

The operation of my improved centrifugal separator is as follows: A supply of material, which may be and preferably is sugar magma, but may be precipitated solids, such as salt, sugar beet pulp, paper, ore or other pulps, is fed into the hopper 30A through the feed pipe 34. A supply of compressed air is also fed into the hopper through the pipe 33. The valve 30 is then opened and the shaft and cylindrical screen are rotated preferably at different speeds in the same directions, but may be operated in the opposite direction if necessary, and a supply of wash water is admitted to the interior of the discharge end portion of the cylindrical screen, through the perforated drum and the water supply pipes and passages. The material is forced through the feed apertures 8 of the shaft, and discharges into the screened cylinder, and the centrifugal action of both the spiral flange screw and of the cylindrical screen, causes it to form in a ring-shaped layer around the interior peripheral surface of the filtering screen surface of the cylindrical screen, and the liquid syrup of the sugar, or the water or chemical solution of an ore pulp, is thrown out of the pulp through the several screens and through the apertures in the shell of the cylinder, as the sugar or other pulp is fed along through the cylinder by the spiral flange screw. The liquid syrup from the material to be treated falls into the compartment 17 of the outer cylindrical casing, and is drawn off from time to time or continuously through the valve 23 in its bottom. When the material to be treated reaches the perforated drum portion its syrup or watery liquid has been mostly separated from it by the centrifugal feeding movement action through the cylinder, and the solid material is subjected to a washing treatment by means of the numerous jets of water flowing from the perforated drum, which separates from it practically all of the remaining liquid syrup or watery fluid in the pulp as it is moved through the screen cylinder from the perforated drum to the discharge aperture 27 at the end of the cylinder, and this liquid product flows through the screens and drops into the bottom portion of the compartment 18 of the outer casing, and is drawn off when desired through the valve 23, and the solid material when the spiral flange screw has fed it to the discharge end of the screen cylinder, has had its liquid portion separated from it by the centrifugal action of the rotating cylindrical screen and the feeding movement of the material through the cylinder, and the semi-dry material is discharged through the apertures 27 into the trough 24A of the compartment 19, as a substantially damp or moist body of the material under treatment. The compartment 18 of the casing 16, may be made as long as the conditions may require, in order that the wash water treatment of the material may be of sufficient duration to thoroughly separate from the material all syrup which is not removed when the material reaches this point. From the trough 24A the separated solid material is conveyed by the screw or other suitable conveyer 24 and surrounding trough to waste or to further treatment.

My invention is simple and enables sugar, salt, or other crystalline material, sugar beet pulp, precipitated solids such as carbonate of lime in sugar beet juices, saccharate in the process of sugar making, or any other liquid material, to be separated from their solid material in a continuously operating treat-

ment that makes a perfectly satisfactory separation.

While I have illustrated and described the preferred construction of my invention, I do not wish to be confined to the detailed arrangement of the same, as many changes might be made without departing from the spirit of my invention.

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

1. A continuous feeding, washing, liquid separating and pulp drying and discharging centrifugal separator, comprising a shaft rotatably mounted, a screening cylinder rotatably mounted on said shaft, means for feeding any fluid material containing suspended solids to said cylindrical screen, means including a hopper and a pipe, provided with a supply of compressed air, for feeding such material through said cylindrical screen, means for discharging semi-dry material from said screen, means including a perforated drum surrounding said shaft for supplying wash water to a predetermined part of said cylindrical screen, and means for rotating said shaft and screen.

2. A continuously feeding, washing, and discharging separator for sugar, other crystalline, non-crystalline, and amorphous materials, comprising a rotatably journaled shaft, a cylindrical screen comprising a perforated cylinder lined with screening material mounted rotatably on said shaft, means including a feed hopper and a pipe attached to said hopper and leading to a supply of compressed air for forcing material into said screen, means including a perforated drum surrounding said shaft for conveying water to the discharging end portion of said screen, a circumferential row of overlapping discharge apertures at the discharge end of said screen, a flange shaped screw conveyer mounted on said shaft and arranged to convey the material to be separated through said cylindrical screen, and means for rotating said shaft and screen independently of each other.

3. In a continuously feeding separator for separating solids from liquids, the combination of the base plate, the standards and the screens, with the shaft rotatably mounted in said standards, a feed chamber in one end of said shaft opening into said cylinder, a valve controlled feed pipe supported by one of said standards, extending loosely into said shaft's feed aperture, a hopper secured to said feed pipe provided with a cover, a feeding supply pipe connected to said hopper at one end, and a valve controlled pipe connected to said cover at one end and extending to a supply of compressed air.

4. In a continuously feeding centrifugal separator for separating solids from liquids, the combination of the rotatably journaled shaft, the cylindrical screen rotatably mounted on said shaft, means including a hopper and a feed pipe for feeding material to be separated to said cylindrical screen, means for discharging the solid material from said cylindrical screen, with the casing surrounding said cylindrical screen provided with three compartments, a valve controlled discharge aperture in two of said compartments, and a conveyer in the third compartment.

5. In a continuously feeding centrifugal separator for separating solids from liquids, the combination of the multiple compartment casing, the cylindrical screen, and means including a hopper for feeding the material to be separated to said cylindrical screen, with journal bearings adjacent to said cylindrical screen, a shaft journaled in said journal bearings and supporting said cylindrical screen, water supply passages in said shaft opening into said screen at a predetermined part of its length, radial apertures in said shaft connecting with said water passages, circumferential grooves in said shaft connecting with said radial apertures, stuffing boxes arranged in the opposite ends of one of said journal boxes, arranged to inclose said grooves, and valve controlled water supply pipes connected to said journal bearings and registering with said grooves.

6. In a machine as specified, a shaft; a cylindrical screen surrounding said shaft and mounted upon the same, and means for rotating said shaft and screen independently of each other; a spiral conveyer secured upon said shaft; a casing surrounding the screen, having separate annular compartments; outlet valves in the compartments preceding the last one; a conveyer in the bottom of said last compartment; means for supplying water to the interior of the screen; and means for feeding material to the interior of the screen through a chamber in one end of the shaft.

7. In a device as specified, the combination with a rotatable shaft, having a chamber in one end and openings extending through said shaft to the inner end of the chamber; longitudinal water passages in the opposite end of said shaft; annular grooves in said shaft; radial apertures connecting each of said grooves with one or the other of said passages; a bearing surrounding the shaft having annular water channels surrounding the said annular grooves; skeleton packing rings in said channels which permit free circulation of the water in said channels, and glands for holding said rings in said channels; water supply pipes connected with the channels; a spiral distributer surrounding the shaft and connected with the water passages in the shaft; a con-

veyer on said shaft; a screen surrounding said conveyer and mounted on said shaft and adapted to be rotated independently of the shaft; a casing surrounding the screen and divided into annular compartments for receiving the screened material; a conveyer in the last compartment and valved outlets in the other compartments; and means for forcing material through the said shaft chamber and its openings to the interior of the screen.

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

FRED H. ROBERTS.

Witnesses:
G. SARGENT ELLIOTT,
ADELLA M. FOWLE.