

Feb. 19, 1924.

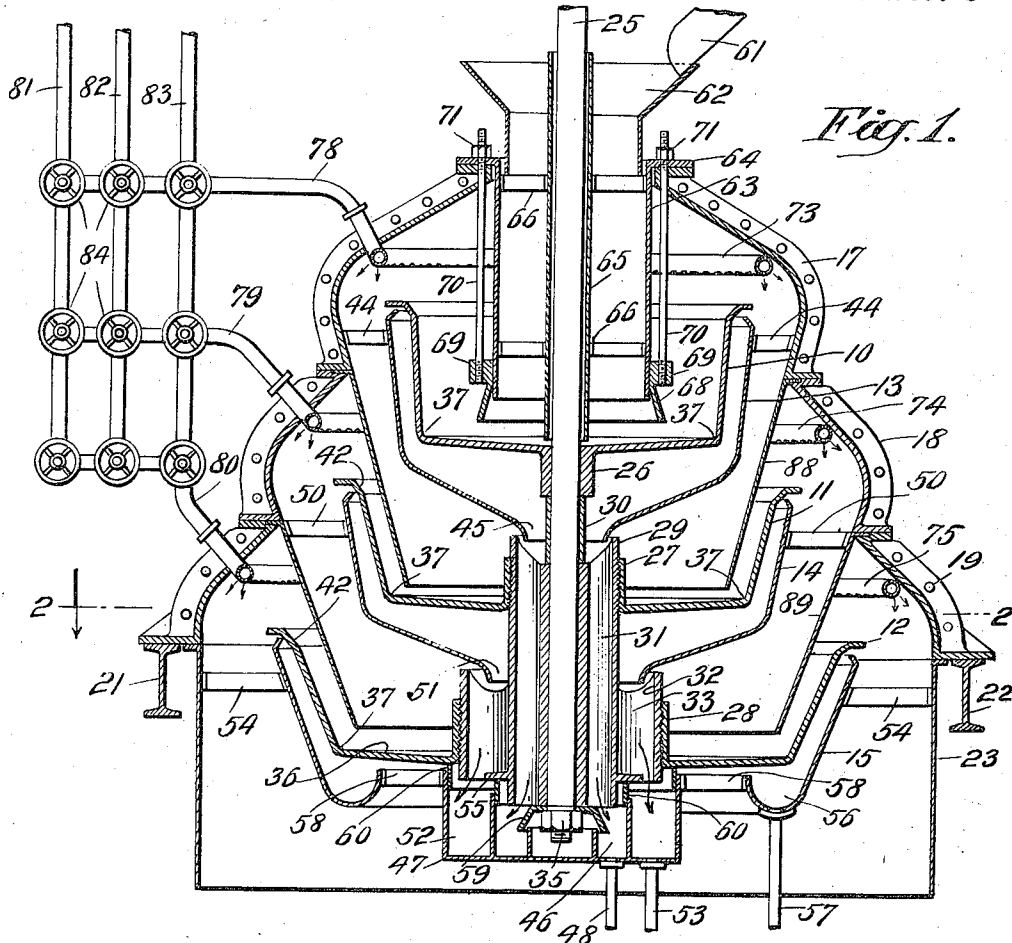
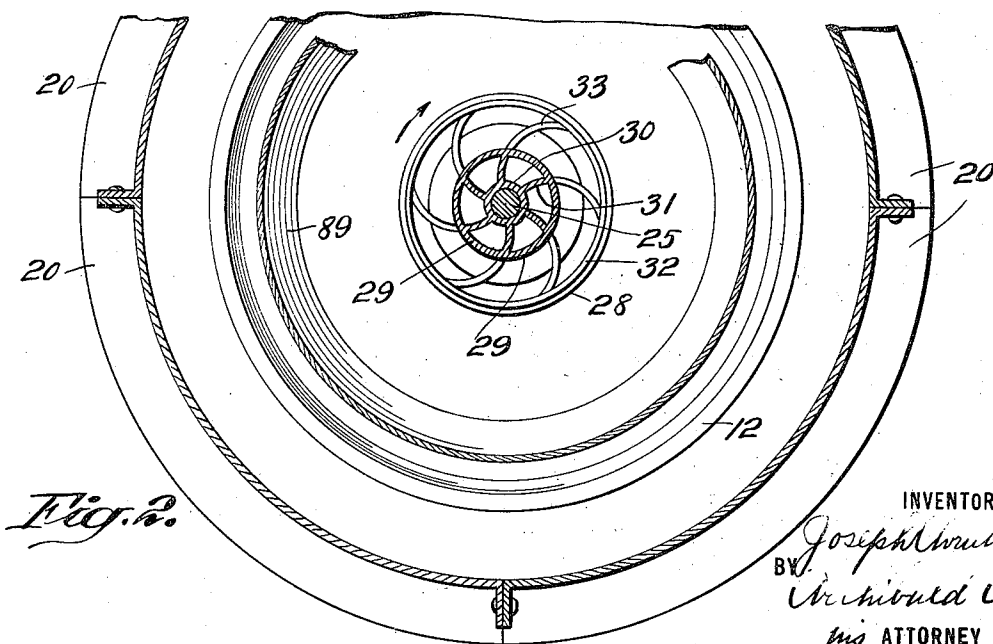
J. AVRUTIK

1,484,002

APPARATUS FOR SEPARATING LIQUIDS FROM SOLIDS

Filed Nov. 26, 1920

3 Sheets-Sheet 1



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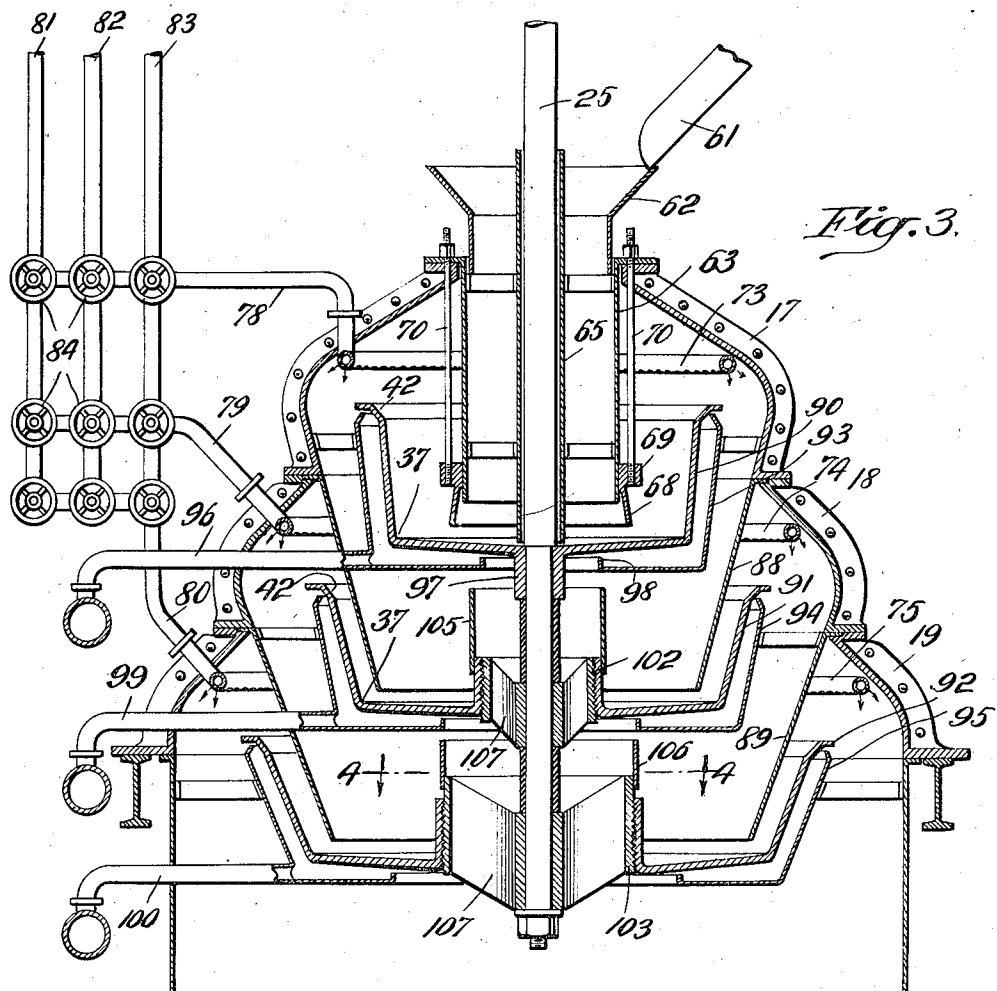
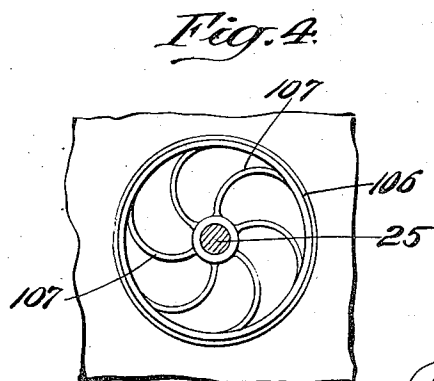
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APPARATUS FOR SEPARATING LIQUIDS FROM SOLIDS

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3 Sheets-Sheet 2



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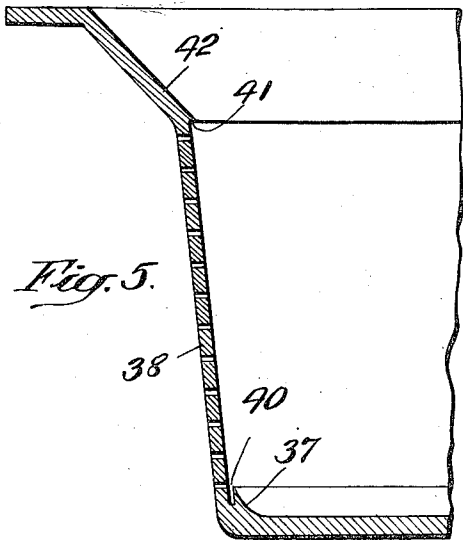
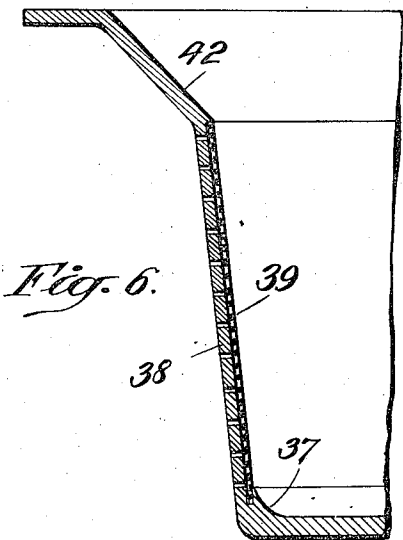
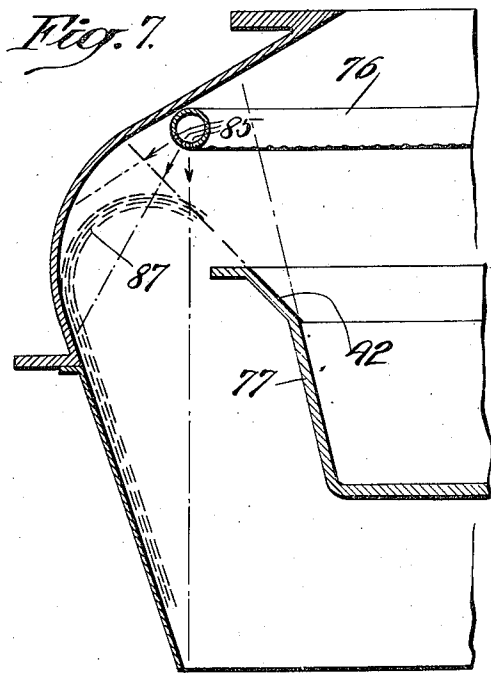
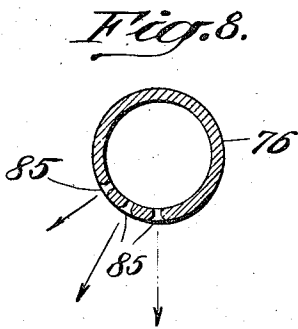
1,484,002

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APPARATUS FOR SEPARATING LIQUIDS FROM SOLIDS

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3 Sheets-Sheet 3



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1,484,002

UNITED STATES PATENT OFFICE.

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APPARATUS FOR SEPARATING LIQUIDS FROM SOLIDS.

Application filed November 26, 1920. Serial No. 426,687.

To all whom it may concern:

Be it known that I, JOSEPH AVRUTIK, a citizen of the United States, residing in Yonkers, in the county of Westchester, in the State of New York, have invented certain new and useful Improvements in Apparatus for Separating Liquids from Solids, of which the following is a specification.

The present invention relates to an apparatus for separating liquids from solids, and more particularly to an improvement in the liquid and solid separating apparatus shown and described in my Patent No. 1,360,708 dated November 30, 1920.

The object of the invention is to improve upon the construction and arrangement of parts of a liquid and solid separating apparatus such as that described in my said patent in order that it may perform its functions more efficiently. To this end the invention consists in providing the apparatus with means for accurately regulating the quantity of material fed into the apparatus; with means for facilitating the passage of material through and out of the receptacles in which it undergoes the liquid and solid separating operation; with means for assisting the passage or feed of the partially treated material from one receptacle into the next succeeding receptacle; and with improved means for conducting away the liquid which has been separated from the solid constituents of the substance treated. The invention also consists in providing the apparatus with subsidiary improvements conducting toward the more efficient operation thereof, the advantages of which will be apparent to those skilled in the art. The various features of the invention are described in the following specification and particularly pointed out in the appended claims.

In the accompanying drawings illustrating the preferred form of the invention, Fig. 1 is a vertical section through one form of apparatus embodying the invention; Fig. 2 is a horizontal section taken along the line 2—2 of Fig. 1, looking in the direction of the arrow; Fig. 3 is a vertical section of another form of apparatus embodying the invention; Fig. 4 is a section taken on the line 4—4 of Fig. 3; Figs. 5 and 6 are detail sections showing the method of attaching the gauze or wire screen to the inside of the perforated drums; Fig. 7 is a schematic view to illus-

trate the action of the means for facilitating the feed of the treated material from one receptacle into the next succeeding receptacle; and Fig. 8 is an enlarged sectional detail showing the shape of the holes in the perforated pipe.

The forms of apparatus illustrated in Figs. 1 and 3 are alike in all particulars except with respect to the method of conveying away the separated liquid from the apparatus. Whether the one form or the other will be employed will depend upon the nature of the material treated. Although the liquid and solid separating apparatus of the present invention is adapted for use in treating all kinds of substances, whether organic or inorganic, it has been adapted particularly for and used in the separation of the molasses residuum from the crystallized sugar in the sugar making industry. The character of the syrup treated varies considerably in density and viscosity, and for certain types of syrups the one form of apparatus will be preferred to the other. In any large manufactory, however, both forms of apparatus would be employed. For the sake of clearness of description, the features of construction common to both forms of the apparatus will be pointed out in describing the form of apparatus shown in Fig. 1 and then the features of construction peculiar to the form of apparatus shown in Fig. 3 will be described separately.

The liquid and solid separating apparatus comprises, in the illustrated embodiments of the invention, a series of superposed, concentrically arranged, perforated drums or baskets 10, 11 and 12. These constitute the receptacles in which the material undergoing treatment is subjected to the liquid and solid separating force. In this instance, the force employed is the centrifugal force generated by the rotation of the receptacles. The number of drums employed will depend upon the nature of the substance or material treated and the degree to which the liquid and solid separating treatment is carried. In the sugar making industry, it has been found that ordinarily three separate drums are sufficient for thoroughly separating the molasses residuum from the sugar crystals.

In connection with each perforated drum there is a liquid receiving pan arranged immediately below the drums and having

side walls extending upwardly to enclose the sides of the drums and thereby catch the liquid thrown out by the drums as they rotate. These liquid receiving pans are designated at 13, 14 and 15 and correspond respectively to the drums 10, 11 and 12. The apparatus as a whole is enclosed in a sectionally made casing. There are three longitudinal sections designated at 17, 18 and 19. These sections correspond respectively to the drums 10, 11 and 12. Each longitudinal section is divided into a number of separate sections as shown at 20 in Fig. 2. This construction is for the purpose of providing a ready and convenient access to the interior of the apparatus without the necessity of dismantling the whole apparatus. The apparatus as a unit is supported on the I-beams 21 and 22. A cylindrical apron 23 depends from the bottom of the casing and surrounds the lower part of the apparatus. The drums are secured to a vertically arranged shaft 25 connected with a source of power (not shown). The revolutions of this shaft generate the centrifugal force by which the liquid and solid content of the material or substance passing through the apparatus are separated.

The uppermost drum 10 is provided with a hub 26 which is secured to the shaft 25. The lower drums 11 and 12 are provided with internally-threaded upturned flanges 27 and 28 respectively. The flange 27 is threaded on to the upper part of the exterior of a hollow cylinder 29 which is supported from a hub 30 by means of the radially and spirally arranged ribs 31. The hub 30 is secured to the shaft 25. The flange 28 is threaded on to the exterior of the hollow cylinder 32 which is supported by the radially disposed spiral ribs 33 from the lower part of the hollow cylinder 29. The reason for the radial and spiral disposition of the ribs 31 and 33 will be explained later. The hub 30 is secured in place by a nut 35 threaded onto the lower end of the shaft 25. The side walls of each drum are more or less obliquely disposed. It will be observed by reference to the drawings that the walls of the uppermost drum 10 are disposed at a very slight angle, that the walls of the middle drum 11 are disposed at a greater angle, and that the walls of the lowermost drum 12 are disposed at the greatest angle. The reason for this construction is that when the sugar syrup or massecuite is fed into the uppermost drum, it contains a large proportion of liquid and is therefore more or less free-flowing and consequently under the action of the centrifugal force passes up the side walls of the drum readily. As the liquid is removed from the syrup, the travel of the more or less dried crystals up the side

walls of the drums is somewhat slower, and accordingly it is necessary to construct the walls of the succeeding drums at a greater flare to facilitate the passage of the crystals through the drums.

It will be observed that the bottom portion 36 of each drum is depressed or cone-shaped, constituting an angle with the horizontal. The reason for this is that inasmuch as the centrifugal force acts on a horizontal plane, the material undergoing treatment is first thrown with considerable violence against the lowermost corners 37 of the drums, where the material has a tendency to accumulate. To prevent the accumulation of the material at these points, the bottoms of the drums have been depressed so that the action of the centrifugal force on the material resting on the bottom of the drums will have a tendency to lift the material out of the corners of the drums and force it up the side walls thereof. In this connection, attention is called to Figs. 5 and 6 where it is shown in detail that the corners 37 of the drums are rounded or fluted. It will be observed further that the perforated side walls 38 of the drums are faced with an internally arranged gauze or wire mesh 39. In order that this gauze may not present any corners and therefore offer an obstruction to the travel or passage of the material up the interior faces of the walls of the drums, the bottoms of the drums are provided with a slot or kerf beyond the rounded corner 37, as shown at 40 in Fig. 5. Into this kerf or slot 40 the lower end of the gauze 39 is inserted. The upper end of the gauze abuts the corner 41. Any convenient means which will offer no impedance to the passage of the material may be employed for securing the upper edge of the gauze in place. It will be observed that the above described construction is such that a substantially smooth surface is provided from the bottom of the drums past the lower interior corners thereof, up the side walls and over the beveled upper edges 42.

The uppermost liquid receiving pan 13 is secured in place by means of the brackets 44 which extend from the interior surface of the uppermost section 17 of the casing to the upper part of the pan 13. The lower central portion 45 of the conically-shaped bottom of the pan 13 is open and discharges into the upper end of the hollow cylinder 29. The rotation of this cylinder causes the radial, spirally arranged ribs 31 to create a slight vacuum at the lower end of the cylinder and this causes the cylinder to act somewhat on the principle of an-exhaust blower by which the liquid discharged into the cylinder 29 from the pan 13 is caused to pass downward more rapidly than if it were solely dependent upon the action of

gravity. The liquid from the pan 13 is discharged through the openings in the lower end of the cylinder 29 and passes into the compartment 46 of a receptacle 47 arranged below the central portion of the lowermost drum. From the compartment 46 the liquid is discharged from the apparatus through the pipe 48.

The liquid receiving pan 14 is of substantially the same construction as the pan 13. It is secured by means of the brackets 50 to the casing of the apparatus. A central aperture 51 is provided in the sloping bottom of the pan and through this aperture the liquid received from the drum 11 is discharged into the upper end of the hollow cylinder 32.—The radial, spirally arranged ribs 33 of this cylinder produce an exhaust action and this assists the liquid in flowing down through the cylinder, whence it is discharged into the compartment 52 of the receptacle 47 and is discharged from the apparatus through the pipe 53. The lowermost liquid receiving pan 15 is secured to the apron 23 by means of the brackets 54. The bottom of this pan is provided with an annular depression 56. The liquid from the lowermost drum 12 collects in this depression 56 and is discharged from the apparatus through the pipe 57. The central portion of the pan 15 is open and surrounds the lower part of the drum 12 and its connected mechanism, as clearly shown in Fig. 1. The receptacle 47 is supported from the pan 15 by the brackets 58.

It has sometimes been found desirable to keep the liquid being discharged through the hollow cylinders 29 and 32 separate. Inasmuch as the drums are attached to a vertically arranged shaft suspended from a motor, the lower end of the shaft is liable to oscillation. For this reason, and to prevent the liquid being discharged from one cylinder from mixing with the liquid discharged from the other cylinder, the cylinder 29 is provided with a longitudinally arranged flange 55 which causes the liquid flowing through the cylinder 32 to be thrown outwardly toward the outer walls of the compartment 52. Under the discharge openings of the cylinder 29 is arranged a truncated cone 59 which causes the liquid to be thrown toward the outer walls of the compartment 46. This construction in connection with the height of the walls of the compartments 46 and 52, and the rubber gaskets 60, effectively prevents the commingling of the different kinds of liquid. It will be observed in this connection that the lower end of the cylinder 29 projects beyond the lower end of the cylinder 32 and that the walls between the compartments 46 and 52 project upwardly beyond the lower end of the cylinder 29.

The material or substance to be acted upon

to separate the liquid and solid contents thereof is fed into the apparatus through a trough 61. In the instance under consideration this material is crystallized sugar syrup and it passes through the trough 61 into the hopper 62 under hydrostatic pressure as well as by the action of gravity. The hopper 62 discharges into a cylindrical chute 63, set into the top of the apparatus. The flanged upper end 64 of the chute 63 rests on the top of the casing section 17. In order that the incoming syrup may not strike the revolving shaft 25 and adhere thereto and so block up the passageway, a sleeve 65 surrounds the shaft 25 and is held in place by brackets 66 fastened to the interior of the chute 63. The lower end of the chute 63 is separated from the bottom of the uppermost drum 10 by a space sufficient to permit the passage of enough material to maintain the apparatus at its maximum capacity. The quantity of material permitted to pass into the uppermost drum is regulated by means of an annular apron 68, which surrounds the lower end of the chute 63. The lower part of the apron 68 flares outwardly at an angle. The apron is provided with ears 69 into which are threaded the studs 70 which pass upwardly through the top of the casing section 17 and through the chute flange 64. On the upper threaded ends of the studs 70 are nuts 71. It will be observed that the length of stud projecting beyond the tops of the nuts 71 equals the distance the lower edge of the apron 68 is separated from the bottom of the uppermost drum. This construction provides a convenient means for adjusting the space between the lower edge of the apron 61 and the bottom of the uppermost drum so as to regulate the quantity of material permitted to pass into the drum to be subjected to the liquid and solid separating force. By noting the amount the studs project out of the nuts 71, the operator knows at a glance how far the lower edge of the apron 68 is from the bottom of the drum and can regulate this space according to the nature of the material treated.

It is desirable that the material discharged from the uppermost drum 10 be fed into the next succeeding drums as rapidly as it is fed into drum 10. Inasmuch as the material is fed into drum 10 under hydrostatic pressure as well as by force of gravity, it will be observed that the feeding of the material into drum 10 will be more rapid than the feeding of the material into drum 11 from drum 10, because once the material in drum 10 is acted upon by centrifugal force, the hydrostatic pressure loses its influence and the feeding of the material from drum 10 to drum 11 is by the force of gravity alone. Hence the desirability or necessity of providing means to supplement the force of

gravity in causing the material discharged from the drum 10 to descend rapidly into drum 11. In like manner means are provided for assisting the feed of the material from drum 11 into drum 12 and from drum 12 out of the apparatus. This means consists of some fluid, such as compressed air, steam or water, discharged through a series of coils or pipes 73, 74 and 75, which are located above the drums 10, 11 and 12 respectively. The relative position of the pipes and the rims of the drums with respect to the inner surface of the casing is clearly shown in Fig. 7. The pipe 76 in this figure, and the drum 77 are representative of any of the pipes and drums in Fig. 1. The pipes 73, 74 and 75 are connected respectively with feed pipes 78, 79 and 80, which in turn are connected with the mains 81, 82 and 83, which are controlled by the valves 84. The specific construction of the connections between the feed pipes and the mains is old and well known and needs no further description, it being understood that each main is connected with each feed pipe so that different kinds of fluids can be fed to each pipe. The bottom outer quarter of each coil pipe 73, 74 and 75 is provided with a series of discharge openings 85. By reference to Fig. 8 it will be seen that the discharge ends of these openings or holes are flared. This is for the purpose of securing an overlapping of the fluid discharged through these openings so that it will strike the material passing from one drum into the next lowermost drum as a blanket and assist in the feeding of the material, rather than strike it in separate small streams and have a tendency to penetrate it. The openings or holes 85 are arranged in staggered relation.

During the operation of the apparatus in separating the liquid and solid content of the material to be treated, the material is first fed into the drum 10 as explained, and under the action of centrifugal force it passes up the inner sides of the walls thereof and the liquid is forced out through the perforations and passes down through the pan 13 and the hollow cylinder 29 out of the apparatus. The partially treated material which passes over the upper rim of the drum 10 strikes against the corresponding inner walls of the casing section 17. This action is schematically illustrated in Fig. 7 where the dash lines 87 represent the material. In this connection it will be observed that the upper rim 42 of the drums is beveled or flares outwardly to direct the discharging material under the pipe in such a way as to receive the full force of the downwardly directed fluid from the pipes. It has been found that compressed air is a convenient means for forcing the material down into the next succeeding drum. The direction of the center of the air currents passing out of

the coil pipe is represented by the arrows in Figs. 7 and 8 as well as by the arrows in Figs. 1 and 3. In order that the material discharged from the uppermost drum 10 may pass into the center of the next succeeding lower drum 11, an annular chute 88 is provided, and in order that the material discharged from the drum 11 may pass into the middle of the lowermost drum 12 an annular chute 89 is provided. As in the operation of the centrifugal apparatus described in my said patent the operation of the present apparatus is automatic and continuous, the centrifugal force which acts to separate the liquid and solid content of the material also acting to automatically feed the material from one drum into the next succeeding drum. In the present instance the feed of material into the next succeeding drums is assisted by the action of the fluid passing out of the coil pipes 73, 74 and 75. It has been found convenient in the operation of the apparatus to use different forms of fluid at the same time, depending upon the nature of the material treated. For example, compressed air may be used in conjunction with the uppermost drum in order to assist the feed of the material discharged therefrom into the next lower drum. If the material treated needs decolorizing, a water or steam spray may be discharged upon it from the pipe 74 as it passes from drum 11 into drum 12. This treatment, of course, puts an undesirable amount of liquid into the material again, and so air either hot or cold will be turned on to the material as it passes out of the lowermost drum 12, thereby completely drying the material. It will be observed that the fluid under compression being discharged through the openings in the coil pipes 73, 74 and 75 acts to prevent the material discharged from the drums from striking too forcibly against the corresponding parts of the inside of the casing. Were this permitted, the tendency would be for the material, if sticky, to adhere to the inside of the casing, whereupon there would speedily be built up a layer of material which would obstruct the passage of material from one drum to the next.

The form of apparatus shown in Fig. 3 is, as stated above, of exactly the same construction as the form of apparatus shown in Fig. 1 with the exception of the means for conducting away the liquid. In this construction the drums 90, 91 and 92 are provided respectively with the liquid receiving pans 93, 94 and 95. The uppermost liquid receiving pan 93 is provided at one side with a discharge pipe 96 which passes through the annular chute 88 and through one side of the casing section 18. The central portion of the bottom of the pan 93 is cut away to accommodate the hub 97 of the drum 90 and an upturned flange 98 pre-

vents the liquid from passing through the opening. In like manner the pans 94 and 95 are provided respectively with the discharge pipes 99 and 100. It will be observed that the cylinders 102 and 103 on the exteriors of which the drums 91 and 92 are respectively threaded differ somewhat in construction from the cylinders 29 and 32 on which the drums 11 and 12 are threaded. The cylinder 102, however, equals in size the cylinder 29 and the cylinder 103 equals in size the cylinder 32, so that if desired or necessary the drums 10, 11 and 12 of the one form of apparatus may be substituted for the drums 90, 91 and 92 of the other form of apparatus. In other words, the drums of both forms of apparatus are made respectively interchangeable. Cylindrical guards 105 and 106, surrounding respectively the upper ends of the hubs of the drums 91 and 92, prevent the material undergoing treatment in them for falling through the apertures between the ribs 107 of these cylinders. The ribs 107 project radially from hubs which are supported on the lower end of the vertical shaft 25.

The mode of operation of the form of apparatus shown in Fig. 3 is exactly the same as the mode of operation of the apparatus shown in Fig. 1, except that the separated liquid instead of being discharged through the bottom of the liquid receiving pans and thence down through the bottom of the apparatus, is discharged out through the sides of the apparatus through the pipes 96, 99 and 100.

Having thus described the invention, what I claim as new is:—

1. An apparatus for separating liquids from solids comprising a series of drums having perforated side walls, a vertically-arranged shaft for supporting the drums, means for rotating the shaft, means for feeding a stream of substance to and through the drums, a receptacle located beneath each drum for receiving the liquid thrown out therefrom, and a perforated pipe located above each drum for directing a stream of fluid onto the substance as it passes from the drum to assist the feed of the substance into the next succeeding lower drum.

2. An apparatus for separating liquids from solids comprising a drum consisting of a bottom and side walls, means for rotating the drum, the side walls of the drum being perforated and adapted to support a wire gauze, the corner at the junction of the lower edge of the said walls and the outer edge of the bottom being slotted to receive and hold, without other fastening means, the lower end of the wire gauze, the upper edge of the wire gauze being secured to the upper edge of the side walls.

3. An apparatus for separating liquids

from solids, comprising a series of receptacles, means for actuating the receptacles, a casing for enclosing the receptacles, a perforated pipe located above each receptacle, and means for forcing fluid through the perforations in the pipe, said perforations being directed toward the point of discharge from the receptacle.

4. An apparatus for separating liquids from solids comprising a series of drums having perforated side walls, means for rotating the drums, a casing for enclosing the drums, means for feeding a stream of substance to and through the drums, a liquid and solid separating force acting to feed the substance from one drum to another, and means associated with each drum for assisting the feeding of the substance into the next succeeding drum.

5. An apparatus for separating liquids from solids comprising a series of drums having perforated side walls, means for rotating the drums, means for feeding a stream of substance into the first drum, the liquid separating force acting to feed the substance from one drum into the next succeeding drum, and means located above each drum for directing a stream of fluid on to the substance as it passes out of the drum.

6. An apparatus for separating liquids from solids comprising a plurality of drums having perforated side walls, means for rotating the drums, means for feeding a stream of substance to and through the drums, a discharge outlet for the substance, means for directing a stream of fluid onto the substance when it has passed from one drum and before it enters the next.

7. An apparatus for separating liquids from solids comprising a drum having perforated side walls, means for rotating the drum, a liquid receiving pan having an open bottom located below the drum, and a hollow cylinder connected with the drum and located below the opening in the pan, said hollow cylinder having spirally arranged ribs to facilitate the passage of liquid down through the cylinder.

8. An apparatus for separating liquids from solids comprising a drum having perforated side walls, means for rotating the drum, means for feeding a stream of substance to the drum consisting of a chute extending into the drum, a movable piece surrounding the bottom of the chute, and means for adjusting the position of the movable piece relatively to the bottom of the drum to regulate the amount of material permitted to be acted upon in the drum.

9. An apparatus for separating liquids from solids comprising a drum, means for feeding a stream of substance into the drum consisting of a chute set into the drum, a movable piece surrounding the lower end of the chute, a surface from which the mov-

able piece is suspended, a stud extending from the movable piece through the surface and having a nut on its exposed end, said parts being so arranged relatively to the
5 bottom of the drum that the end of the stud projecting beyond the nut equals the space separating the lower end of the piece from the bottom of the drum.

10 10. An apparatus for separating liquids from solids comprising a series of superposed drums having perforated side walls, means for rotating the drums, liquid receiving pans located below the drums, means for feeding a stream of substance into the

first drum, means for regulating the feed 15 of the substance, and means associated with each drum for facilitating the feed of the substance into the next succeeding drum.

11. The method of separating the liquid from the solid content of substances which 20 comprises feeding the substance to a series of receptacles, utilizing centrifugal force to discharge the substance from the receptacles and utilizing fluid under pressure to assist in feeding the discharged substance from 25 each receptacle into the next succeeding receptacle.

JOSEPH AVRUTIK.