

April 21, 1936.

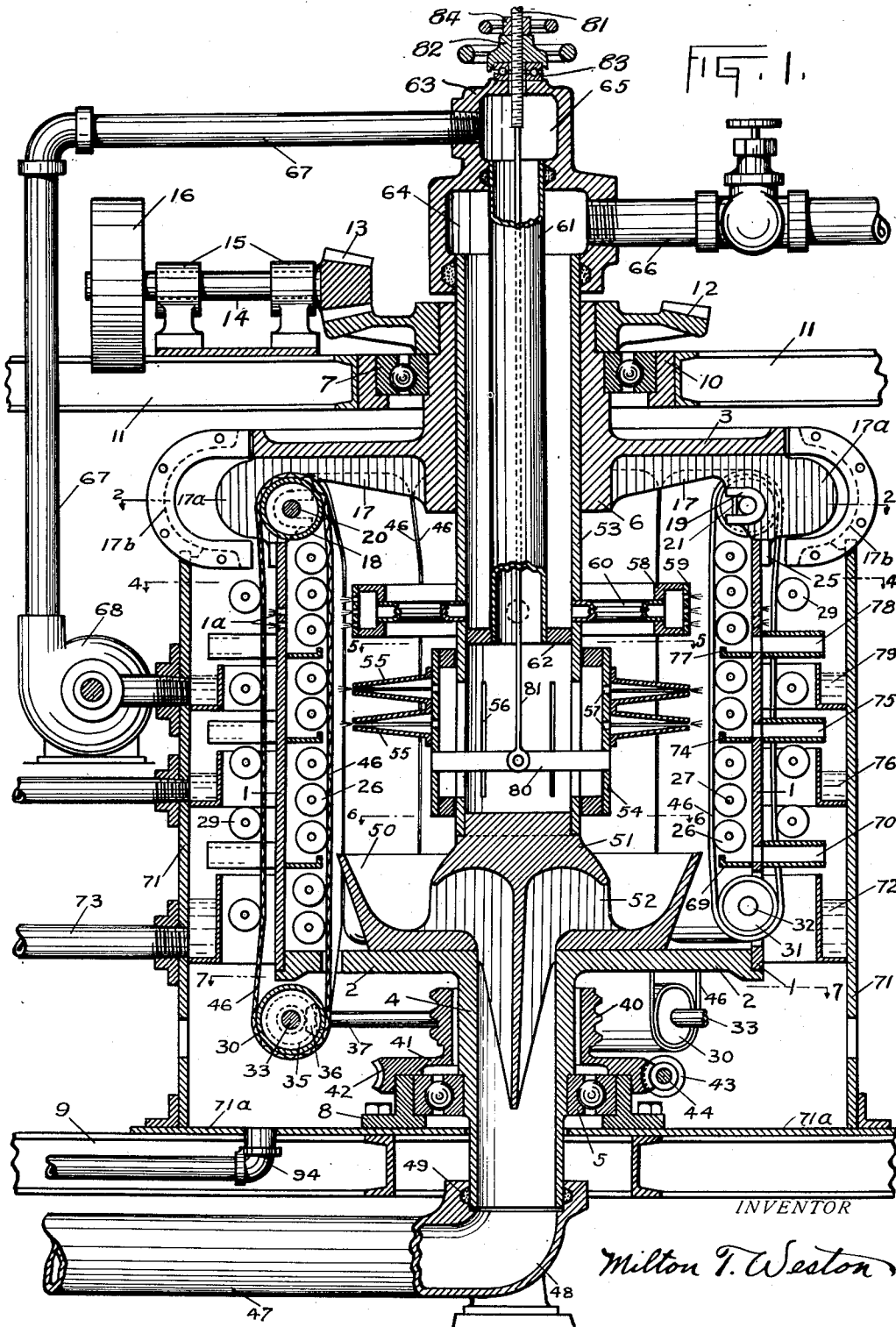
M. T. WESTON

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CONTINUOUS CENTRIFUGAL WASHING AND DEWATERING MACHINE

Filed Feb. 16, 1934

4 Sheets-Sheet 1



April 21, 1936.

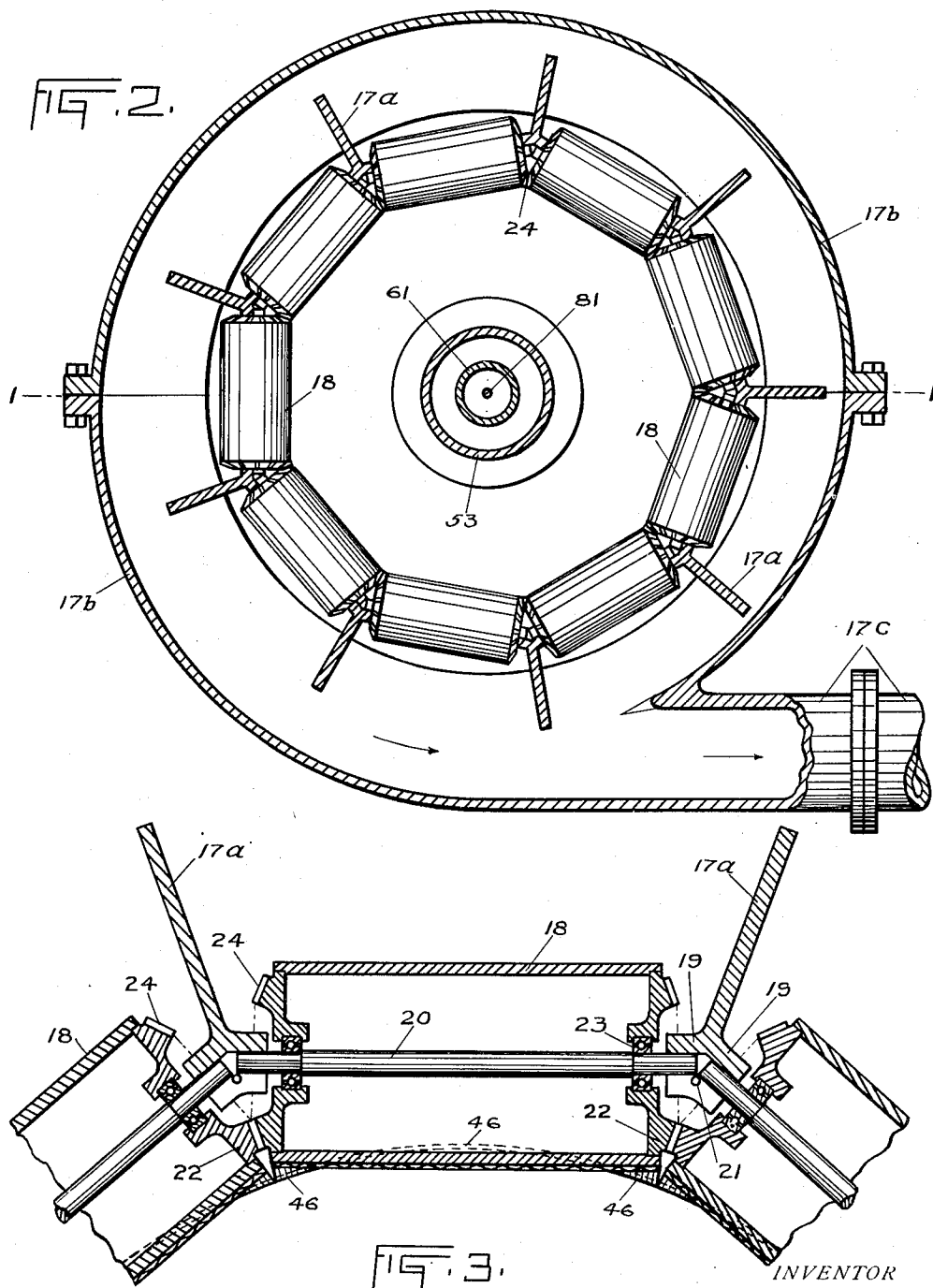
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CONTINUOUS CENTRIFUGAL WASHING AND DEWATERING MACHINE

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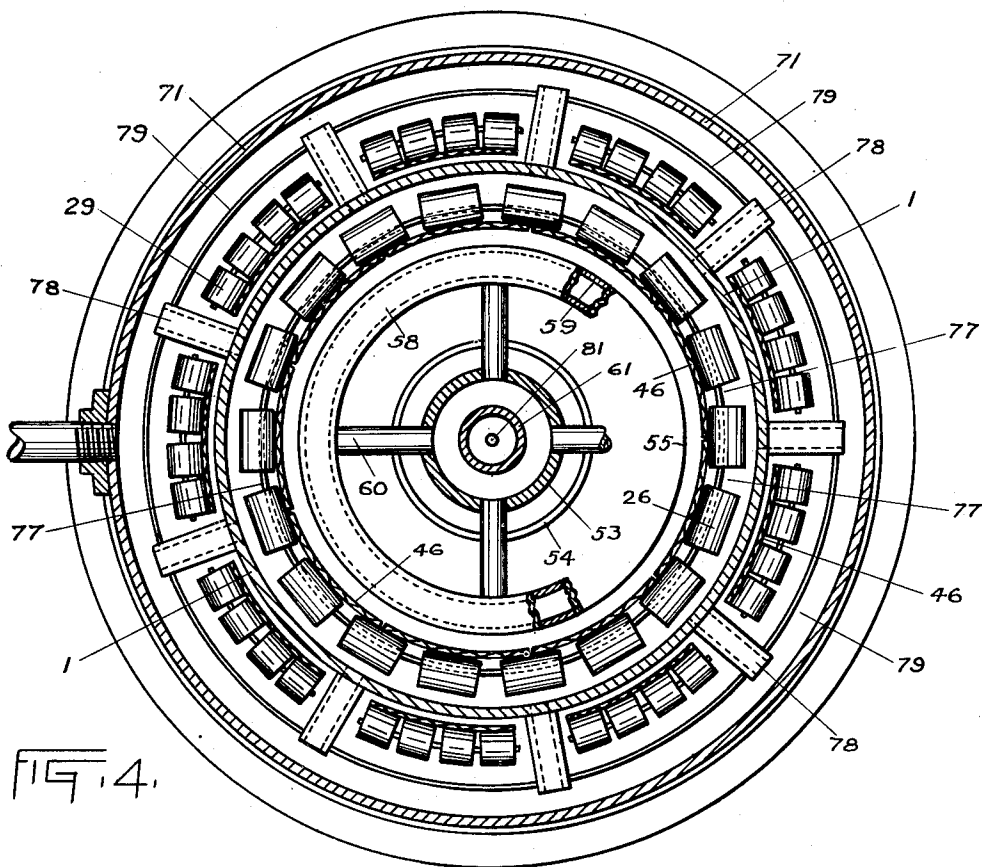


FIG. 4.

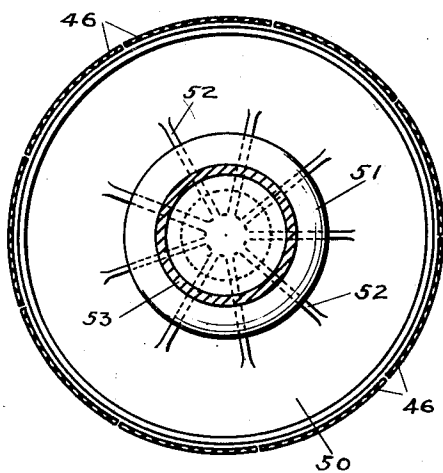


FIG. 6.

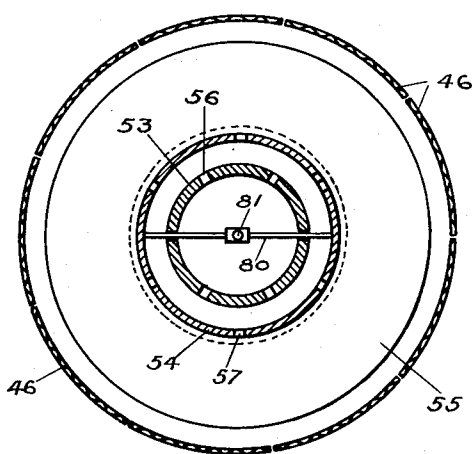


FIG. 5.

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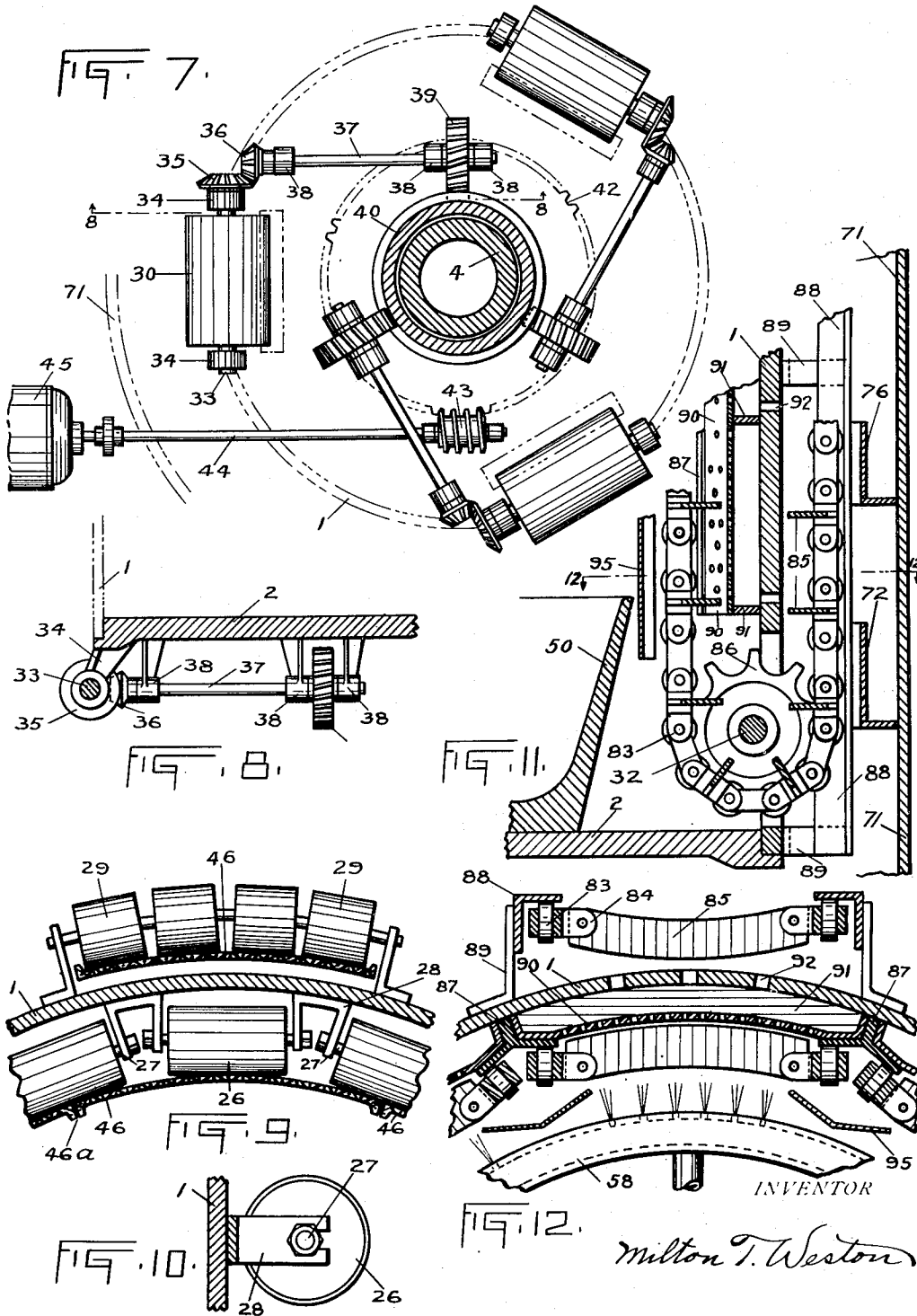
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CONTINUOUS CENTRIFUGAL WASHING AND DEWATERING MACHINE

Filed Feb. 16, 1934

4 Sheets-Sheet 4



UNITED STATES PATENT OFFICE

2,037,840

CONTINUOUS CENTRIFUGAL WASHING
AND DEWATERING MACHINE

Milton T. Weston, Keansburg, N. J.

Application February 16, 1934, Serial No. 711,616

15 Claims. (Cl. 210—68)

My invention relates to improvements in continuous centrifugal washing and de-watering machines and has for its principal object to provide a machine of this character which shall be simple in construction, economical in operation and which shall have a relatively great capacity with comparatively small power requirements. A further object is to combine in one machine the several operations now performed separately.

In its preferred embodiment, as illustrated in the principal views on the accompanying drawings, my invention is particularly well adapted to the washing and de-watering of fibrous materials such as wood pulp and the like, especially when it is desired to first recover, without dilution, the "liquor" in which the pulp is "cooked" before the actual washing process begins.

Another object of my invention is to deliver the washed and de-watered pulp centrifugally and convey it, preferably by blowing, to storage or to the next point in the manufacturing process. Other objects, such as the washing and conveying of granular and similar materials, will appear and will be pointed out in the following specifications and are shown in the accompanying drawings in which similar reference numerals refer to like parts in all of the views.

Fig. 1 is a vertical sectional view of my complete machine showing practically all of the parts and the method of operation. The section is taken on the transverse line 1—1 of Fig. 2.

Fig. 2 is a horizontal sectional view showing the conveyor head pulleys and the blower-like construction for delivering the washed and de-watered material. The section is taken on a line 2—2 of Fig. 1.

Fig. 3 is an enlarged detail sectional view of one of the driven conveyor head pulleys and shows how the adjacent head pulleys are driven by it. This partial detail view is taken from Fig. 2 and shows further details of the construction and mounting of the head pulleys.

Fig. 4 is a horizontal sectional view taken on a line 4—4 of Fig. 1. This is a typical sectional view in which practically all of the parts are shown. The drum spray is shown partially broken away to disclose the disc sprays below.

Fig. 5 is a horizontal sectional view of the disc sprays showing the vertically movable drum on which the disc sprays are mounted. The view is taken on a line 5—5 of Fig. 1 and stops at the encircling ring of pervious conveyor belts.

Fig. 6 is a horizontal sectional view showing the target and the feeding bowl with their relation to the encircling ring of pervious conveyor

belts. The section is taken on a line 6—6 of Fig. 1.

Fig. 7 is a horizontal sectional view showing the method of driving the lower driven conveyor tail pulleys. The mechanism for varying the speed of these driven tail pulleys is also shown. The view is taken on a line 7—7 of Fig. 1.

Fig. 8 is a detail sectional elevation on a line 8—8 of Fig. 7 and shows a method of supporting the gears and shafts used in driving the lower driven tail pulleys.

Fig. 9 is an enlarged horizontal detail view of one set of carrying and return idlers with their relation to the pervious conveyor belts. This detail view is taken from Fig. 4.

Fig. 10 is a side view of a supporting bracket for the conveyor idlers shown in Fig. 9.

Fig. 11 is an enlarged partial sectional elevation of a modification in the method of conveying the material to be washed. This view corresponds to the lower right hand side of the revolving member in Fig. 1.

Fig. 12 is a horizontal sectional view of the modification shown in Fig. 11 and is taken on a line 12—12 of that figure. The relation to the drum spray is shown in this view.

In the drawings, Figs. 1 to 10 inclusive illustrate the preferred form of my invention. In order to more readily explain the application and operation of my device, I have shown it applied to the handling of wood pulp as it comes from the digesters.

In the present system it is customary to "blow" a digester into a "cyclone" or separator tank wherein expansion and the separation of steam takes place. The pulp and liquor then flows through a pipe from the separator tank to a large drainer tank with a perforated false bottom through which the liquor, in which the pulp is cooked, is allowed to drain off by gravity. Obviously as the "head" of the liquor decreases the drainage operation becomes still slower since a considerable amount of the liquor will be held in the pulp mass by capillary attraction. In order to hasten the operation, the washing process is begun before all of the liquor is drained off. This washing is usually done by directing streams of water from fire hose on the mass of pulp in the drainage tank. As this water passes down through the mass, also by gravity, it increases the head of the liquor thus hastening its passage through the drainer bottom. It will be clear that a considerable amount of dilution of the liquor will take place in this system. When this dilution reaches a predetermined percentage the re-

maintaining diluted liquor and wash water is diverted to the sewer or is collected for some other process. Any dilution of the "strong liquor" is undesirable since the extra water must be driven off at the evaporators. It will also be evident that washing by this process is very slow and unreliable and extremely wasteful of water. When pulp is not thoroughly and evenly washed the bleaching process is affected and the quality of the pulp and paper is correspondingly lowered.

In applicant's device, centrifugal force is taken full advantage of, not only in the initial separation of the liquor from the pulp but for feeding the pulp and liquor to the device, delivering wash water from sprays under relatively high pressure and for de-watering, delivering and blowing the washed pulp to storage or to the next point in the manufacturing process. All of this is accomplished in my device in an exceedingly short space of time.

Briefly, applicant's device comprises a plurality of conveyors with pervious carrying surfaces, preferably of the belt type, arranged in circular order with their edges abutting each other and mounted on a continuously revolving support. These conveyors form a complete cylindrical pervious carrying surface which moves upwardly as a unit until it reaches the top where it separates into its component parts and returns outside of the cylindrical support to the bottom where it again re-forms progressively into the upwardly moving cylindrical carrier. The cylindrical support with conveyors, feeder and sprays mounted thereon, revolves at a speed which gives the desired centrifugal effort. The material is fed centrifugally to the bottom of the pervious belt conveyors. The free liquids will instantly pass through the pervious surface of the conveyors while the fibers will remain on the surface. As the conveyors move upward the fibers are presented successively to suitable sprays, the water from which agitates and thoroughly washes them as it passes through them. This wash water continues through the pervious surfaces of the conveyors and is finally collected in troughs on the inner wall of a fixed cylindrical shell. The different liquids collected in these troughs are drawn off and re-used or disposed of as desired. After passing the final sprays, the fibers on the conveyor surfaces are automatically de-watered by the action of centrifugal force to the desired percentage of moisture and are then thrown off radially in all directions as they reach the top. The fibers are caught in a fixed blower-like casing and are swept around by vanes or blades which are a part of the revolving cylindrical support and are discharged through a suitable duct. A full detailed description follows.

Fig. 1 shows the preferred form of my invention in which I employ a revolvable cylindrical support comprising preferably a cylindrical shell 1 in the lower end of which is secured a disc head 2 and in the upper end a disc head 3. Disc head 2 has a downwardly extending hollow trunnion hub 4, mounted in a combined radial and thrust bearing 5 which is designed to take the weight of the entire revolving member. Upper disc head 3 has an upwardly extending hollow trunnion hub 6 mounted in a radial bearing 7. The lower bearing 5 is carried by a suitable casting 8 properly supported on structural steel members 9 or in any other desirable manner. Similarly, the upper bearing 7 is carried by a casting 10 suitably supported by structural members 11.

The cylindrical support just described is rotatably driven by means of a bevel gear 12, secured on the upper trunnion hub 6 above the bearing 7, which meshes with a bevel pinion 13 on the end of the horizontal shaft 14 revolvably mounted in suitable bearings 15 carried by the structural steel members 11. The outer end of the shaft 14 carries a pulley 16 which may be driven from any available source of power.

On the under side of the upper disc head 3 are a plurality of special ribs 17 which are designed to carry a plurality of head pulleys 18 in the following manner. On each side of each rib 17 toward the outer ends are bosses 19 shown open on the inner sides in order that the head pulley 15 shafts 20 may easily be put in place. These shafts 20 do not rotate and since centrifugal force acts to hold them in place in the bosses 19 I show them retained simply by the pins 21. The head pulleys 18 are revolvably supported on the non-rotating shafts 20 by the heads 22 revolving on anti-friction bearings 23 supported by the shafts 20. Each head 22 carries a bevel gear 24, shown integral on the drawings, and designed to mesh with the mating bevel gear 24 on the adjacent head pulley 18. By reference particularly to Figs. 2 and 3 it will be seen that in this construction all of the head pulleys 18 are positively geared together so that they all must revolve at identical speeds.

In Figs. 1, 2 and 3 the ribs 17 on the underside of upper disc head 3 are shown extending radially outward some distance beyond the head pulleys 18. These rib extensions 17a are intended to perform the same function as vanes or flights in a blower and sweep around in the fixed blower casing 17b which is supported on the top of the fixed outer shell 11. Casing 17b is shown in halves bolted together in order that it may readily be put in place. An annular space is left between the lower edge of the casing 17b and the top edge of the revolving shell 1 to allow the passage of the belts, to be referred to later. The lower edges of the ribs 17 at their peripheries rest upon the shell 1 and have lugs 25 which may be welded or otherwise secured to the shell 1 thus firmly attaching the upper disc head 3 to the shell 1.

On the interior surface of the shell 1 is mounted a plurality of relatively small carrying idler pulleys 26 which revolve on anti-friction bearings carried by the non-rotating shaft 27 held securely in brackets 28 attached to the shell 1. These idlers are spaced relatively close together in staggered relation to each other and cover substantially the entire inner surface of the shell 1 and constitute what may be regarded as a cylindrical anti-friction surface over which a plurality of belts 46 travels in a manner to be further described hereinafter. On the outside of shell 1, in line with the several head pulleys 18 are mounted a series of return idlers 29. The arrangement of the carrying idlers 26 and return idlers 29 is clearly shown in the detail views in Figs. 9 and 10.

Directly below the head pulleys 18 are corresponding tail pulleys some of which are shown located below the lower disc head 2 and others above it. In Fig. 1 the driven tail pulleys 30 are below the disc head 2 and the idling tail pulleys 31 are above it. The reason for lowering the driven tail pulleys 30 with respect to the idling tail pulleys 31 is to obtain sufficient room to install suitable driving mechanism which is clearly shown, particularly in Figs. 7 and 8. Idling tail pulleys 31 are revolvably supported on the non-

rotating shafts 32 in a manner similar to the corresponding head pulleys 18 except that they are not geared together. The driven tail pulleys 30 are keyed to shafts 33 mounted in suitable bearing brackets 34 attached to the underside of the lower head 2. On one end of each shaft 33 is a bevel gear 35 meshing with a bevel pinion 36 on drive shaft 37 which is revolvably mounted in bearing brackets 38 attached to the underside of lower head 2. A worm wheel 39 is shown on the inner ends of drive shafts 37, meshing with a specially constructed worm 40 which is designed with a bore large enough to permit the lower trunnion hub 4 to pass through it without interference. Worm 40 is provided with a special hub 41 which is adapted to fit over and revolve on the lower bearing casting 8. The revolution of the special worm 40 is controlled by a worm wheel 42, shown integral with the special hub 41, meshing with worm 43 on the control shaft 44 which may be driven by a variable speed motor 45 or by any other suitable means. When the motor 45 is idle the worm 43 will lock worm wheel 42 and thus prevent the rotation of the special worm 40. The worm wheels 39, being carried around special worm 40 by the rotation of the cylindrical support will revolve at a rate which is in direct proportion to the speed of the cylindrical support. When it is desired to change or vary this normal speed relation in order to change or vary the speed of the several conveyors, the motor 45 is started causing the special worm 40 to revolve and thus change the normal speed relation of the conveyors with respect to the revolving cylindrical support. If the motor revolves the special worm 40 in the same direction as the rotation of the cylindrical support the worm wheels 39 will make fewer revolutions and the speed of the conveyors will be relatively slower thus giving more time for spraying and de-watering the fibers. Revolving the worm 40 in the opposite direction will obviously have just the opposite effect.

Webs or belts 46 made of suitable material, hereinafter referred to simply as belts 46, are passed over the head pulleys 18 and down through the interior of the shell 1 and around the tail pulleys 30 and 31 and up on the outside of shell 1 between the shell and return pulleys 29 and their ends joined to make them endless. Centrifugal force causes the belts 46 to bear against the idlers 26 and to assume the transverse cylindrical shape shown in the several views. The transformation of the belts from the straight face of the head and tail pulleys to the circular form at the idlers 26 is shown in Fig. 3. In Fig. 9 I show the belts 46 with reinforced edges 46a raised above the surface to prevent loss of liquid between the abutting edges.

As there is a wide variety of uses for a centrifugal washer of this type there will be correspondingly diversified types of belts 46 required to meet these various uses. I therefore hold that it is within the spirit and scope of my invention to use the type of belt best suited to any particular requirement, both in type of construction and in kind of material from which it is made. Accordingly these belts may be made of woven wire of flexible construction or of woven fabric or of perforated or otherwise pervious material. If material is to be conveyed only, then rubber belts of standard or special construction may be used.

The material to be separated or washed enters through a pipe 47 which is shown terminating in a foot elbow 48. The lower end of the revolving hollow trunnion 4 enters the upper bell end of the foot elbow 48 which is provided with a stuffing box

49 to prevent loss of liquid. The material in solution passes up through the hollow trunnion hub 4 and enters the feeding bowl 50. If it is under considerable pressure and velocity, the material will strike the target 51 and will be deflected outwardly due to the shape of the target 51 and to the action of centrifugal force. The material coming through pipe 47 and rising in the hollow trunnion hub 4 is not rotating axially with respect to the bore of the trunnion hub. On the other hand the hollow trunnion hub 4 and the bowl 50 with its target 51 are all rotating as a unit. In order to bring the entering liquid from a non-rotating to a rotating condition I provide the bowl 50 with a number of ribs or vanes 52 which support the target 51 above and which are shown extending downward into the hollow trunnion hub 3 and terminating in a point. The liquid is thus gradually brought to a rotating state by the pointed vanes 52 before it enters the bowl 50. Centrifugal force then acts upon the mass radially and as a consequence the material is forced outwardly and upwardly over the rim of the bowl 50 and is delivered to the belts 46 in the same direction in which they are travelling. Since the belts 46 and bowl 50 as well as the material are all rotating at identical speeds as a unit, the material will be delivered to the belts 46 with the least possible disturbance and wear.

Resting on top of the target 51 and concentric therewith is a wash water supply pipe 53 which extends upward and projects through the hollow trunnion 6 of the upper disc head 3. Surrounding the water supply pipe 53 above the target 51 and slidable vertically thereon is a drum 54 on the periphery of which are fixed a series of disc sprays 55 each composed of a pair of opposing dished discs whose edges are spaced close together in order to deliver a continuous circular spray radially, the necessary pressure being furnished by centrifugal force acting on the water held back by the restricted area of egress between the two discs. This type of spray is advantageous in washing fibrous material especially when the wash water is re-used and may contain fibers which would quickly clog small perforations. Water enters the drum 54 from the supply pipe 53 through a series of slots 56 and passes into the spaces between the pairs of discs 55 through a small number of relatively large holes 57 in the periphery of the drum 54. Water is furnished to the lower end of supply pipe 53 through a smaller concentric supply pipe 61 which terminates in a disc 62 located in supply pipe 53 above the slots 56. This disc 62 separates the lower part of the supply pipe 53 from the upper part so that the wash waters for the different sprays may be kept separate, when desirable, and thus permit their re-use as shown in Fig. 1.

Above the disc sprays 55 I show a drum type spray which comprises a hollow annular ring 58 with its outer periphery 59 perforated with relatively fine holes. This annular ring 58 is supported by the spoke-like pipes 60 radiating from the supply pipe 53. The clean wash water passes through these pipes 60 to the annular ring 58. Centrifugal force creates the necessary pressure to project the sprays radially with considerable force. This type of spray is satisfactory when clean wash water is used. The upper ends of both supply pipes 53 and 61 terminate in the fixed casting 63 which has two separate chambers 64 and 65. The supply pipe 53 enters the lower chamber 64 and receives its supply of water 75

from a clear water pipe 66. The supply pipe 61 enters the upper chamber 65 and receives its supply of water through a pipe line 67 in which a pump 68 is located.

5 It has been seen that the material is delivered from the bowl 50 to the pervious belts 46 in the direction in which they are travelling. As soon as the material strikes these belts 46 the liquid will instantly pass through and impinge against 10 the inner wall of the shell 1 while the fibrous or granular material will remain on the surface of the belts. An annular trough 69 is secured to the inner wall of the shell 1 and catches the liquid which passes thru the pervious belts 46. 15 Spouts 70 are attached to the outside of the shell 1 and communicate with the trough 69. I show these spouts 70 projecting outwardly from the shell 1 between the outer return runs of the belts 46. The liquid which passes through the pervious 20 belts 46 by the action of centrifugal force passes from the trough 69 through the spouts 70 and impinges on the inner wall of the stationary outer shell 71. This outer shell surrounds the revolving mechanism and acts as a guard or 25 shield as well as a means of collecting the various wash waters and is shown as resting upon a bottom plate 71a supported by the structural members 9. A waste pipe 94 is provided for cleaning purposes. The liquid thrown outwardly from the spouts 70 collects in the lower stationary annular trough 72 secured to the inner 30 surface of the fixed shell 71 at a level just below the spouts 70. An outlet pipe 73 communicates with the annular fixed trough 72 and allows the liquid caught by it to pass out to storage or to process. If a simple washing operation is all that is necessary then one annular trough 69, one set of spouts 70 and one annular fixed trough 72 will be all that is required. 40 However, in certain lines of manufacture, such as the soda process in the making of wood pulp, it is necessary first to recover the process liquor and then to proceed with the washing operations. As before mentioned, the process liquor is the 45 first to be separated out of the mass and will obviously be caught in troughs 69 and pass off through spouts 70 and will collect in troughs 72 without dilution. In this case the first washing operation begins above trough 69 where the 50 fibers on the surface of the belts 46, as they travel continuously upward, are exposed to the agitating and washing action of the disc sprays 55. The water from these sprays is caught in intermediate trough 74 and passes off through spouts 55 75 and is collected in fixed trough 76 from which point it may be stored as "weak liquor" or sent to waste.

In the arrangement illustrated in Fig. 1, I show a second and in this case, a final washing 60 operation where the fibers on the surfaces of the belts 46 are finally exposed to the jets of water from the drum spray 58. Clean water is preferably used in these sprays and is caught in the same manner as before in a third trough 77 from 65 which it passes out through a third set of spouts 78 and is collected in a third fixed trough 79. This water being reasonably clean but perhaps containing some fibers is shown as passing through pump 68 and back to the disc sprays 70 55 through pipe line 67 and supply pipe 61, to be re-used. However the pump 68 can be connected up to furnish clean water or any other type of washing compound. Disc sprays are 75 used here because the fibers in the re-used wash

water will not foul this type whereas the perforations in the drum type would soon become clogged and useless. In Fig. 1 I show perforations 1a in the wall of shell 1 opposite the drum spray 58. These perforations are also opposite 8 the outer return runs of the belts 46 and allow a small amount of the spray water to pass through and strike the belts 46 on the reverse side and thus drive off particles clinging to the carrying surface of these belts and which were 10 not thrown off by centrifugal force. The belts then present progressively clean carrying surfaces for a new charge of material from the bowl 50.

The disc sprays 55 are shown adjustable as a 15 group on supply pipe 53. This is accomplished by providing a cross bar 80 extending through slots 56 in supply pipe 53 and which is anchored in the walls of the disc drum 54. Disc drum 54 is movable on supply pipe 53 by means of a rod 20 81 attached to the cross bar 80 and extending upward through the center of supply pipe 61 and through the top of the casting 63. The top of the rod 81 is threaded for a hand wheel 82 by which it may be raised or lowered as desired. 25 This construction permits considerable latitude in the use of the disc sprays 55. For example, if we lower them so that the lower spray discharges below the annular trough 74 the water from this one spray will be caught with the "strong liquor" 30 in trough 69 and find its way to the lower trough 72. This results in some dilution of the "strong liquor" but it also recovers some of the residual "strong liquor" adhering to the fibers, which would otherwise be washed out above trough 74 and 35 which would then find its way to the "weak liquor" tank or to waste. The disc sprays 55 can also be adjusted to partially discharge above the upper trough 77 if so desired. Obviously the drum type of spray 58 may be made similarly 40 adjustable.

Fundamentally my invention is based upon the use of a plurality of pervious conveyors arranged in a circular group about a common axis and movable parallel to this common axis to subject 45 material carried by them to the washing action of a series of sprays while simultaneously these pervious conveyors are being revolved as a group about the same common axis to subject the same material carried by them to the action of centrifugal force to effect separation of the liquids 50 from the solids. In the preferred form I show conveyors of the "belt" type but I hold that I may substitute conveyors of the "scraper" type and keep within the scope of my invention. In Figs. 55 11 and 12 I show how this may be accomplished. Each conveyor is composed of two side roller chains 83 with attachments 84 to which are secured the scraper bars 85. The roller chains 83 60 pass over head and tail sprockets 86 and are driven thereby exactly in the same manner as the belts 46. The roller chains 83 run on tracks 87 secured to the inside of the revolving shell 1 and are shown accommodating two adjacent chains. 65 The roller chains 83 return outside the shell 1 on angle tracks 88 supported on the shell 1 by brackets 89. Perforated plates 90 are shaped to be positioned between the tracks 87 leaving a space between them and the shell 1. At intervals the diaphragm plates 91 are located to separate 70 the different wash waters coming from the sprays and this water passes off through the openings 92 in the shell 1 in the same relative positions with respect to the sprays as the spouts 70, 75 and 78. The liquids are thrown against the inner walls 75

of the fixed shell 71 and are collected in the corresponding ling troughs 72, 76 and 79, as described for the belt type of conveyors. Guard plates 95 are shown positioned in front of the several runs of chains 83 in order to deflect the material away from them. The essential difference between the two methods is simply that in the preferred form the material is carried past the various sprays while in the latter case the material is scraped past them. All other phases of operation are identical in both types.

The detailed operation of my invention has been clearly described herein and only a brief summary follows.

15 The material to be separated, washed and de-watered enters through the pipe 47 and turns upwardly through the hollow trunnion 4 and enters the bowl 50. The vanes 52 cause the entering material to revolve with the bowl 50 and centrifugal force acts to throw the material radially outward and over the rim of the bowl 50 and onto the pervious belts 46. The free liquid instantly passes through the pervious belts 46 leaving the fibers on the surface. Centrifugal force continues to act to de-water the fibers on the surface of the belts 46 as they travel vertically and all liquid which is thrown off below the central trough 74 will collect in the lower trough 69 and will then be thrown off by the lower series of spouts 70 and will collect in the lower fixed trough 72 and will pass out through outlet pipe 73 to storage or to process. This is the undiluted liquor.

As the belts 46 continue to travel upward the fibers are carried above the central trough 74 and are subjected to the action of the bank of disc sprays 55. All of the water thrown off between troughs 74 and 77 will be caught in trough 74 and will pass out through spouts 75 and will collect in trough 76. The amount of water used in this washing zone may be regulated by adjusting the position of the disc sprays 55 with respect to troughs 74 and 77.

The further upward travel of the belts 46 subjects the fibers thereon to the agitating and washing effect of the jets from the drum spray 58. Water from these sprays, after passing through the fibers and the pervious belts, is caught in upper trough 77 and passes off through spouts 78 and is collected in upper fixed trough 79. In Fig. 1 this water passes to pump 68 and is returned for re-use in the disc sprays 55 through pipe line 67 and supply pipe 61.

The vertical distance between the various troughs is determined by the length of time required for the washing and de-watering operation and by the speed of the belts 46, which combine to determine the output capacity of the apparatus.

After passing the upper sprays the de-watering of the fibers by centrifugal force continues until they reach the top where they are thrown off radially by centrifugal force between the vanes 17a and are caught by fixed blower casing 17b and are swept around and discharged through a suitable duct 17c which conveys the fibers to storage or to the next point in the manufacturing process. On account of the relatively wide carrying surface presented by the pervious belts as a group, the fibers are evenly distributed in a relatively thin layer which permits the spray water, projected by centrifugal force, to agitate and to come into intimate contact with all of the fibers and then to instantly pass through them and the pervious surfaces of the belts. My invention, therefore, gives almost instantaneous washing and de-

watering of the material fed to the pervious conveyors. It is also extremely economical in the use of water not only for washing purposes but because it is economically possible to handle pulp stock by blowing instead of pumping from one point to another.

Any class of material that can be slushed through feeder pipe 47 and upward into the feeder bowl 50 can be handled by my apparatus substantially as described. It is evident that other arrangements of sprays and troughs may be made to suit the various requirements, all of which will be within the scope of my invention.

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

1. In a continuous centrifugal washing and de-watering machine the combination with a revolvable cylindrical support, of a plurality of belt conveyors operably mounted on and extending longitudinally of said cylindrical support the carrying runs thereof being interior to said cylindrical support and the edges of said carrying runs abutting each other to form a continuous cylindrical carrying surface every point on which is equidistant from the axis of said cylindrical support, anti-friction means mounted on said cylindrical support intermediate of the end pulleys of said belt conveyors to positively support the carrying runs thereof in continuous cylindrical order and against which the said carrying runs are operably held by centrifugal force, and means for driving said belt conveyors.

2. In a continuous centrifugal washing and de-watering machine the combination with a cylindrical support mounted to revolve continuously about its longitudinal axis, of a plurality of endless pervious belts having their carrying runs operably mounted within said cylindrical support and adapted to move parallel to the axis thereof the edges of said carrying runs abutting each other to form a continuous cylindrical carrying surface spaced inwardly from the periphery of said cylindrical support, anti-friction means carried by said cylindrical support for positively maintaining the carrying surfaces of said belts in continuous cylindrical order, and means for driving said endless pervious belts.

3. In a continuous centrifugal washing and de-watering machine the combination with a revolvable cylindrical support, of a plurality of endless pervious belts operably mounted to move parallel to the axis of said cylindrical support the carrying runs of said pervious belts being located within said cylindrical support with their edges abutting each other to form a continuous cylindrical carrying surface each point on which is equidistant from the axis of said cylindrical support, means carried by the said abutting edges of the pervious belts to seal the line of contact between them, anti-friction means carried by said cylindrical support for positively supporting the carrying surfaces of said pervious belts in continuous cylindrical order against the action of centrifugal force, and means for driving said endless pervious belts.

4. In a continuous centrifugal washing and de-watering machine the combination with a cylindrical support operably mounted to revolve about its longitudinal axis, of a plurality of endless pervious carriers operably mounted longitudinally of said cylindrical support with their carrying runs interior to said support and with their edges adjacent to each other, means carried by said pervious carriers for closing the space between the

adjacent edges of the carrying runs thereof to form a continuous cylindrical carrying surface interior to and co-axial with said cylindrical support, anti-friction means carried by said cylindrical support for positively supporting the carrying runs of said pervious carriers against the pressure created by centrifugal force, and means for driving said pervious carriers.

5 In a continuous centrifugal washing and de-watering machine the combination with a cylindrical support operably mounted to revolve about its longitudinal axis, of a plurality of endless pervious carriers operably disposed in circular order on said cylindrical support parallel to the axis thereof and with their carrying runs positively supported in abutting relation within said cylindrical support and the edges of said carrying runs being provided with means for closing and sealing the abutting line of contact between them to form a progressive continuous cylindrical carrying surface co-axial with said cylindrical support, and means for driving said pervious carriers.

6. In a continuous centrifugal washing and de-watering machine the combination with a cylindrical support operably mounted to revolve about its longitudinal axis, of a plurality of endless pervious carriers operably disposed longitudinally of said cylindrical support with their carrying runs interior to said support said carrying runs being positively supported with their edges in abutting relation to form a continuous cylindrical carrying surface co-axial with said cylindrical support, means carried by the said pervious carriers for closing the line of contact between the abutting edges of said carrying runs, means mounted on said cylindrical support for feeding material in a continuous peripheral stream to the continuous cylindrical carrying surfaces of said pervious carriers in the direction in which they are moving, and means for driving said pervious carriers.

7. In a continuous centrifugal washing and de-watering machine the combination with a cylindrical support operably mounted to revolve about its longitudinal axis, of a plurality of pervious carriers operably disposed in circular order on said cylindrical support parallel to the axis thereof with their carrying runs positively supported in abutting relation interior to said cylindrical support to form a continuous cylindrical carrying surface co-axial therewith, feeding means on said cylindrical support concentric with the axis thereof for supplying material to the continuous cylindrical carrying surfaces of said pervious carriers in a continuous peripheral stream in the direction of travel of said pervious carriers said feeding means comprising a circular bowl with a central orifice for the incoming material and a continuous annular rim substantially parallel to the carrying surfaces of said pervious carriers, and means for driving said pervious carriers.

8. In a continuous centrifugal washing and de-watering machine the combination with a cylindrical support operably mounted to revolve about its longitudinal axis, of a plurality of pervious carriers operably disposed in circular order on said cylindrical support parallel to the axis thereof and with their carrying runs positively supported in abutting relation within said cylindrical support to form a continuous cylindrical carrying surface co-axial therewith, a supply pipe entering said cylindrical support co-axially and revolving therewith said supply pipe being adapted to cooperate with centrifugal spraying means adjustable longitudinally thereon for supplying a washing fluid to the cylindrical carrying surfaces

of said pervious carriers, means for adjusting said spraying means longitudinally on said supply pipe, and means for driving said pervious carriers in co-operation with said spraying means.

9. In a continuous cylindrical washing and de-watering machine the combination with a cylindrical support operably mounted to revolve about its longitudinal axis, of a plurality of endless pervious carriers operably disposed in circular order on said cylindrical support parallel to the axis thereof and with their carrying runs positively supported in abutting relation within said cylindrical support to form a continuous cylindrical carrying surface co-axial therewith, a central supply pipe entering said cylindrical support axially and revolving therewith said supply pipe co-operating with centrifugal spraying means carried by it to supply washing fluid to the continuous cylindrical carrying surfaces of said pervious carriers, means on said cylindrical support for feeding material to the continuous cylindrical carrying surfaces of said pervious belts in a continuous peripheral stream in the direction of travel of said pervious carriers, and means for driving said pervious carriers.

10. In a continuous centrifugal washing and de-watering machine the combination with a cylindrical support revolvable about its longitudinal axis, of a plurality of pervious carriers operably disposed in circular order on said cylindrical support parallel to the axis thereof and with their carrying runs positively supported in abutting relation within said support to form a continuous cylindrical carrying surface co-axial therewith, a primary co-axial supply pipe entering the said cylindrical support and revolving therewith, a secondary supply pipe co-axial with said primary supply pipe and revolving therewith said secondary supply pipe terminating in a diaphragm which divides the said primary supply pipe into two chambers, centrifugal spraying means mounted concentrically on said primary supply pipe and adapted to receive a washing fluid from one of the chambers thereof, other centrifugal spraying means mounted co-axially on said primary supply pipe and adapted to receive a washing fluid from the other chamber thereof, means for supplying different washing fluids to said primary and secondary supply pipes, and means for driving said pervious carriers in co-operation with said spraying means.

11. In a continuous centrifugal washing and de-watering machine the combination with a cylindrical support revolvable about its longitudinal axis and a plurality of pervious carriers operably disposed in circular order on said cylindrical support parallel to the axis thereof and with their carrying runs positively supported in abutting relation within said support to form a continuous cylindrical carrying surface, of a central supply pipe entering said cylindrical support axially and revolving therewith, spraying means adjustably mounted on said supply pipe and co-axial with the continuous cylindrical carrying surfaces of said pervious carriers said adjustable spraying means comprising a drum slidable axially on said supply pipe and adapted to receive washing fluid therefrom and oppositely tapered discs mounted concentrically on said drum and adapted to receive washing fluid therefrom, and means for moving said drum axially on said supply pipe.

12. In a continuous centrifugal washing and de-watering machine the combination with a cylindrical support revolvable about its longitudinal

nal axis, of a plurality of pervious carriers operably disposed in circular order on said cylindrical support parallel to the axis thereof and with their carrying runs positively supported in abutting relation interior to said support to form a continuous cylindrical carrying surface co-axial with said support and with their return runs operably mounted exterior to said cylindrical support, spraying means on said cylindrical support adapted to deliver a washing fluid against the reverse side of the said return runs of the pervious carriers the said washing fluid passing thru the said pervious carriers in the reverse direction under pressure created by centrifugal force to cleanse the pores thereof and thus present progressively clean pervious surfaces to receive the incoming material, and means for driving said pervious carriers.

13. In a continuous centrifugal washing and de-watering machine the combination with a cylindrical support revolvable about its longitudinal axis, of a plurality of pervious carriers alternating in a long and in a short series said pervious carriers being operably disposed in circular order on said cylindrical support parallel to the axis thereof and with their carrying runs positively supported in abutting relation interior to said cylindrical support to form a continuous cylindrical carrying surface within said cylindrical support and co-axial therewith, means for driving said long series of pervious carriers, and separate means for driving said short series of pervious carriers from said long series.

14. In a continuous centrifugal washing and de-watering machine the combination with a cylindrical support revolvable about its longitudinal axis, of a plurality of pervious carriers alternating in a long and in a short series said pervious carriers being operably disposed in circular order on said cylindrical support parallel to the axis thereof and with their carrying runs positively supported in abutting relation interior to said cylindrical support to form a continuous cylindrical carrying surface within said cylindrical support and co-axial therewith, means for driving said long series of pervious carriers, and separate means for driving said short series of pervious carriers from said long series.

tudinal axis, of a plurality of pervious carriers alternating in a long and in a short series said pervious carriers being operably disposed in circular order on said cylindrical support parallel to the axis thereof and with their carrying runs positively supported in abutting relation interior to said cylindrical support to form a continuous cylindrical carrying surface within said support and co-axial therewith, means carried by the edges of said pervious carriers for sealing the abutting surfaces, means for driving the said long series of pervious carriers, and separate means for driving the said short series of pervious carriers from the said long series.

15. In a continuous centrifugal washing and de-watering machine the combination with a cylindrical support revolvable about its longitudinal axis, of a plurality of pervious carriers alternating in a long and in a short series said pervious carriers being operably disposed in circular order on said cylindrical support parallel to the axis thereof and with their carrying runs interior to said cylindrical support and with the edges of said carrying runs positively supported in abutting relation to form a continuous cylindrical carrying surface within said cylindrical support and co-axial therewith, means carried by the said pervious carriers for closing and sealing the abutting edges of said carrying runs, variable geared means including a motor for driving said long series of pervious carriers, and separate geared means operably connecting all of said pervious carriers to maintain them in identical speed relation.

MILTON T. WESTON.