

June 24, 1930.

W. C. WALKER

1,767,905

CONTINUOUS CENTRIFUGAL SEPARATOR

Filed Feb. 27, 1926

4 Sheets-Sheet 1

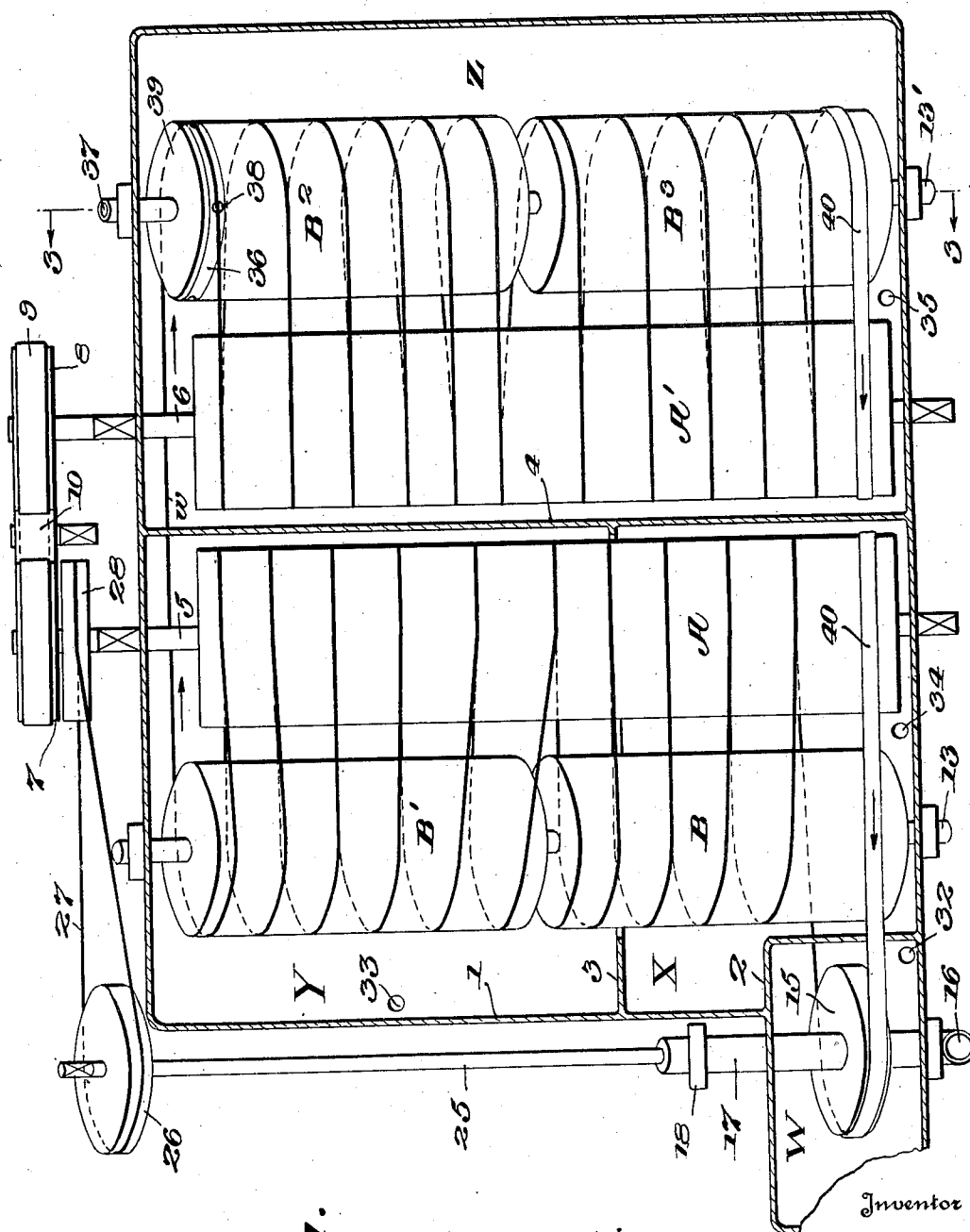


Fig. 1.

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4 Sheets-Sheet 2

Fig. 2.

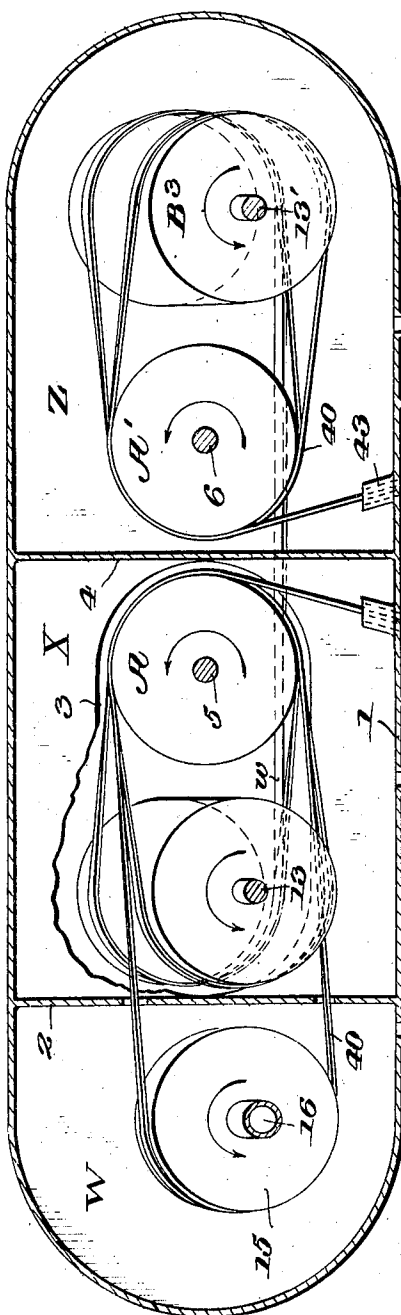


Fig. 5.

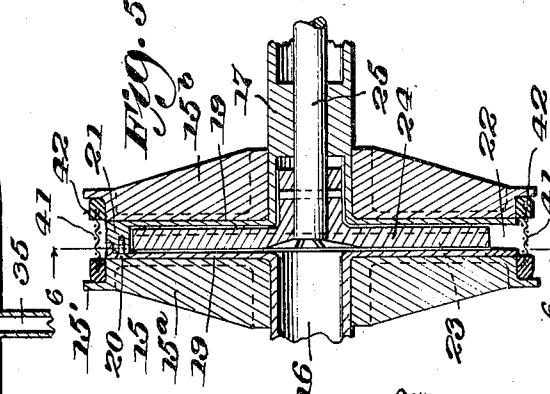
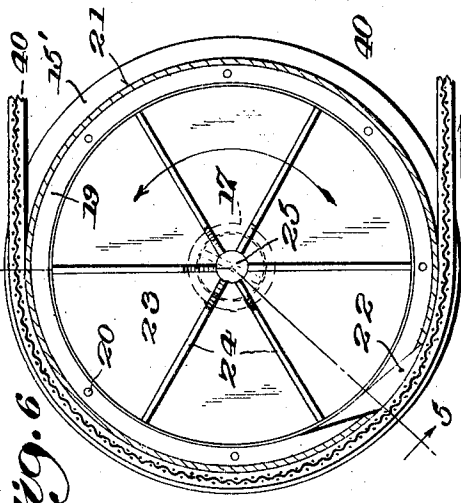


Fig. 7.



Fig. 6.



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4 Sheets-Sheet 3

Fig. 3.

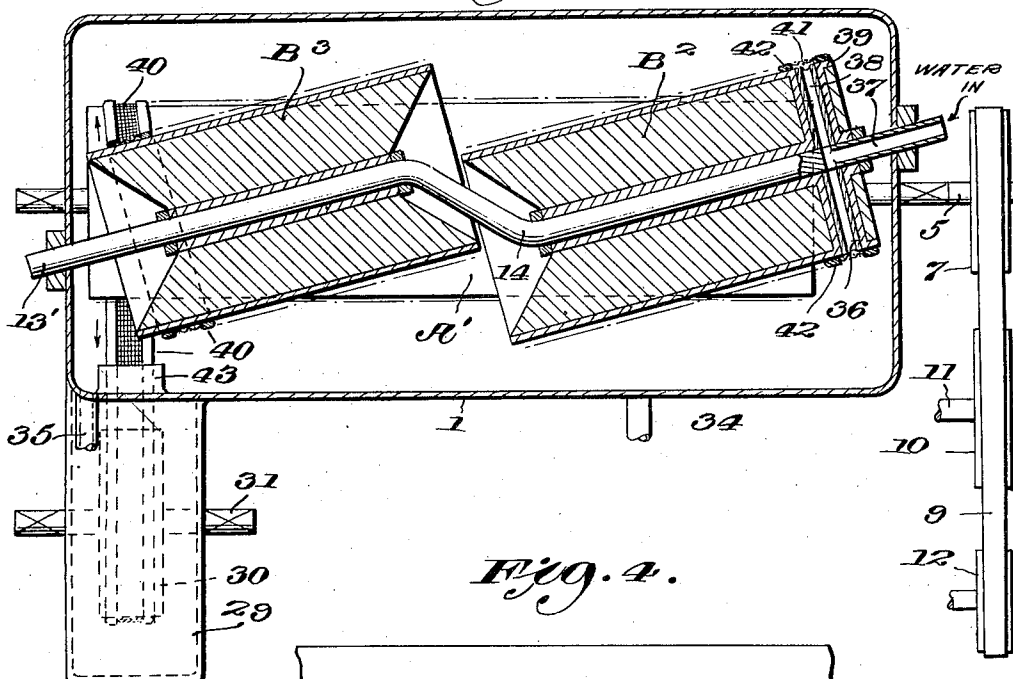


Fig. 4.

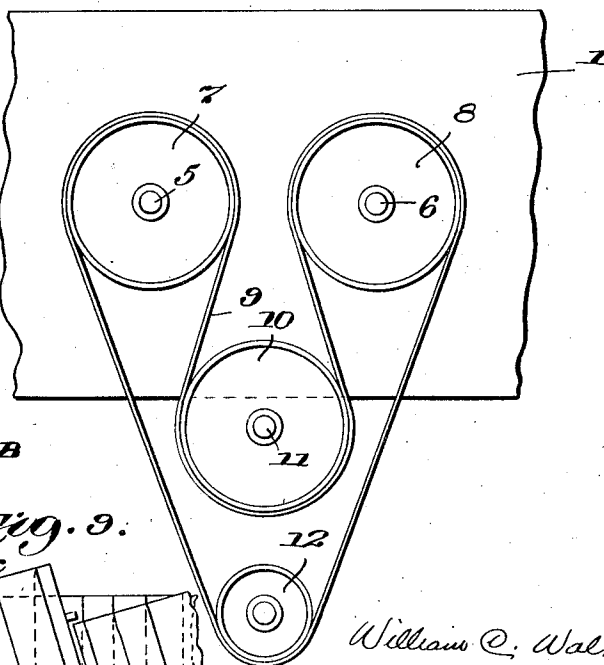


Fig. 8.

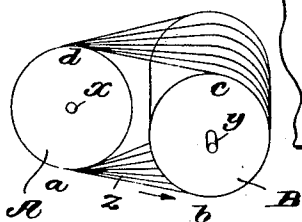
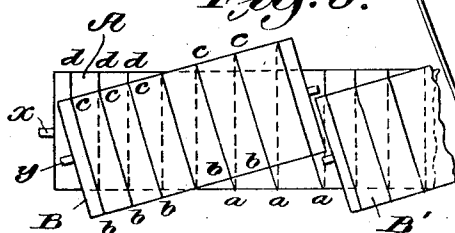


Fig. 9.



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4 Sheets-Sheet 4

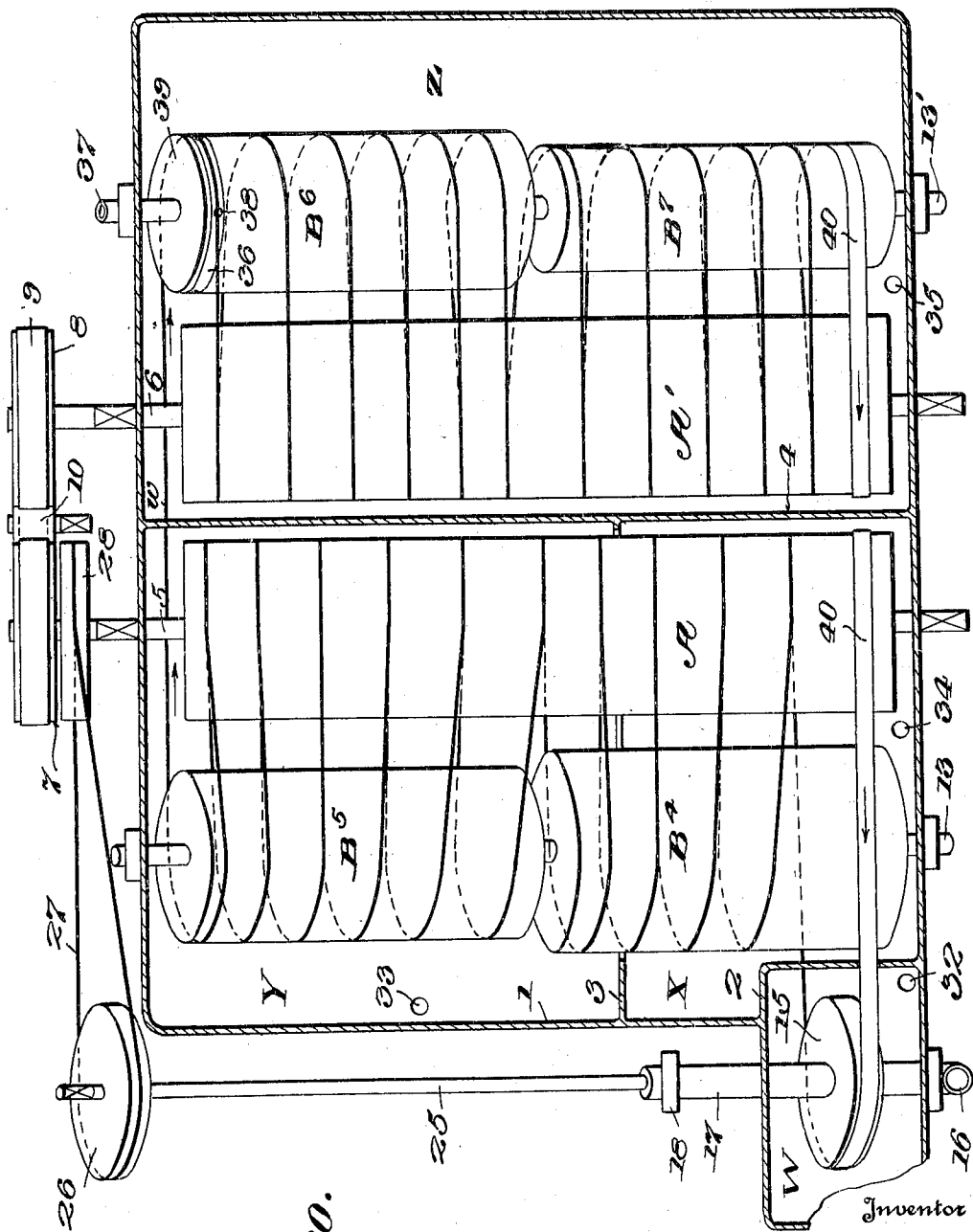


Fig. 10.

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UNITED STATES PATENT OFFICE

WILLIAM C. WALKER, OF NEW YORK, N. Y.

CONTINUOUS CENTRIFUGAL SEPARATOR

Application filed February 27, 1926. Serial No. 91,145.

This invention relates to means for effecting the continuous separation of liquids from solids, and for the continuous discharge of the latter, and more particularly to means utilizing centrifugal force for this purpose.

Centrifugal separation has usually entailed the use of a rotary cylindrical basket, having walls of filtering material, and the most common practice has been to operate such a basket intermittently, loading into it the pulp or slurry to be separated, a batch at a time. Such a method, however, is slow and tedious, and requires costly attendance.

Attempts have also been made to operate a centrifugal basket continuously by removing the solids therefrom while the basket is rotating, by means of various form of scrapers or unloading devices. This has been found impractical, however, on account of the necessity of moving the solids against the action of the tremendous centrifugal force, and the impossibility, in any event, of running the scraper very close to the walls of the basket on account of the danger of damage to the latter.

It has also been heretofore proposed to substitute a foraminous flexible belt for the basket, and to lead such a belt over pulleys, the material to be separated being fed onto the inside of the belt as it approaches one of the pulleys, and the liquids being thrown off as the belt passes around such pulley. Also it has been proposed to carry the belt around a discharge pulley in such manner that the curvature is reversed, and the solids thus thrown off.

While there are many advantages inherent in the belt method of centrifugal separation, apparatus hitherto constructed to operate on this principle has not met with much commercial success, because of its inefficiency, structural defects, or for other reasons.

The present invention is directed to continuous separators of the belt type, and its general object is to so improve the construction and arrangement of apparatus of this character as to render its operation highly efficient and commercially desirable.

Specifically, I contemplate greatly increasing the efficiency of the apparatus by subjecting the material on the belt to the action of centrifugal force a number of times before it is discharged. To this end, I propose to lead the belt a plurality of times around the same pulley or roller, the successive runs being maintained in spaced relation. I have discovered that this can be accomplished by means of passing the belt over an auxiliary drum arranged with its axis inclined to and lying in a different plane from that of the main drum or roller, so that as each run of belt is returned to the latter, it is displaced axially thereof. The amount of this displacement is determined by the inclination of the axis of the auxiliary drum, and by other factors.

I further propose to subject the material on the belt to the action of centrifugal force of progressively increasing intensity as the belt travels from the charging to the discharging point, and to this end I lead the belt successively over a plurality of pairs of rollers or drums, one or both of the rollers of each pair being of smaller diameter than the preceding pair.

A further specific object of the invention is to provide improved means for feeding material onto, or charging the belt. I have recognized the fact that if the material is fed onto the belt in the same direction and at the same speed as that in which the belt is traveling, the work which would otherwise be required to accelerate the material is eliminated, and the load on the machine noticeably reduced, and I have embodied this principle in the construction of my apparatus.

A still further and subsidiary object is to provide means for effectively supplying wash water to the material on the belt at one or more points in its travel. This is often desirable, in order to free the solids more completely from any of the original liquids which may tend to adhere thereto. Moreover, I propose to independently collect the liquids which are separated previous and subsequent to the addition of wash

water, so that each may be appropriately treated.

With the above and other objects in view, the invention consists in the construction and arrangement of parts hereinafter described and claimed, and illustrated by way of example, in the accompanying drawings, forming part of this specification, and in which:—

Figure 1 is a plan view conventionally illustrating one embodiment of my invention;

Figure 2 is a side elevation thereof, the front wall of the housing being removed;

Figure 3 is a transverse section substantially on the line 3—3 of Figure 1, looking in the direction of the arrow;

Figure 4 is a fragmentary side elevation showing the method of driving the rollers or drums;

Figure 5 is a transverse section on an enlarged scale through my improved feeding or charging pulley, the section being taken substantially on the line 5—5 of Figure 6;

Figure 6 is a section on the line 6—6 of Figure 5, looking in the direction of the arrows;

Figure 7 is a fragmentary plan view showing the structure of the improved belt which I employ;

Figures 8 and 9 are diagrams illustrating end and side views, respectively of rollers arranged at an angle to each other, with a plurality of runs of a belt extending continuously around the same and passing from one to the other; and

Figure 10 is a conventional plan view similar to Figure 1, but illustrating a modified arrangement.

As stated in the preamble, one of the characteristic features of the present invention consists in leading a belt a plurality of times continuously around a pair of drums or rollers, and in spacing the successive runs of the belt axially along the rollers. So far as I am aware, the accomplishing of this result embodies a radically new mechanical principle which I have worked out, and in order to understand the theory of such an arrangement, reference will be had first to the geometric diagrams shown in Figures 8 and 9.

As is well known, in all belt and pulley work, that portion of the belt which is approaching the pulley must lie in the plane of the pulley. Otherwise, it will tend to progress axially and eventually run off. Therefore, it is obvious that any attempt to operate a continuous belt passing a plurality of times around a pair of drums or rollers with parallel axes must fail. The runs of the belt would tend to crowd together and overlap in order to set themselves at right angles to the axes of the drums.

Referring to Figures 8 and 9, however, I have diagrammatically illustrated an arrangement in which two drums A and B are disposed with their axes x and y lying in different planes and crossing one another when viewed in side elevation. An endless belt or cable z is shown as extending continuously around the two drums, passing alternately from one to the other. Considering the direction of rotation and movement of the cable to be as indicated by the arrow, I have found that the various runs of cable will become stable and remain fixed in spaced relation when they have assumed the position shown in the drawings.

It is obvious that in order for these cable runs to remain fixed, axially of the drums, the fundamental condition above referred to must be satisfied, namely, each run must lie in a plane normal to the axis of the drum which it is approaching. That is to say, the tangent portion $a b$ of the cable must lie in the plane defined by the arc portion $b c$. In other words, the three points a , b and c must lie in one plane and this plane must be normal to the axis y . Similarly, the points $c d a$ must all lie in a plane normal to the axis x . Therefore, as viewed in Figure 9, the portions $c d$ appear to form an angle with the portions $b c$. The reason for this is that the portions $b c$ are necessarily in a plane normal to the axis y , while the portions $c d$ are in a plane normal to the axis x . It will therefore be obvious that as the cable travels successively around the drums from the points a to the points b and thence to the points c and d , the runs will be progressively shifted axially of the drums and will take up a position in which they are spaced apart, as shown, being in stable equilibrium in such position. The peculiar fact will be noted that the spacing of the runs at the right hand end of the drum B is greater than at the left hand end, the spacing gradually diminishing from one end to the other. It is obvious that the amount of this spacing is proportional to the degree of inclination of the drum B. In other words, the spacing can be made anything desired, within certain limits, by varying the angle or inclination of the drum B.

If the drum A be considered as relatively long in extent, I find that it is quite possible to provide a series of relatively short inclined drums or rollers B, B', etc. and to pass a cable continuously around the drum A and successively around the drums B, B'. In Figure 9, I have illustrated a fragment of such a second drum B' and it is obvious how the cable passes from it around the drum A and thence to the drum B, with the runs maintained in spaced relation, as above described. I utilize this prin-

ciple in the construction of my improved centrifugal separating apparatus.

Referring now to Figure 1, I provide a housing or casing 1 of any suitable shape, enclosing a plurality of drums or rollers. As shown, I employ two main drums or rollers A, A', disposed horizontally in parallel spaced relation. Associated with the roller A are two auxiliary rollers or drums B, B' and associated with the roller A' are two auxiliary inclined drums or rollers B², B³. For a purpose hereinafter described, I provide the housing with partitions 2, 3 and 4, dividing the same into a plurality of independent compartments designated W, X, Y and Z.

The two main drums or rollers A and A' are secured to shafts 5 and 6, supported in suitable bearings and carrying driving pulleys 7 and 8. As shown in Figure 4, a driving belt 9 passes around the pulleys 7 and 8, and thence around a power pulley 10, mounted on a shaft 11 connected to any suitable source of power, the belt also passing under a guide pulley or idler 12. Any other convenient method of driving the drums A and A' may, of course, be employed.

The drums B and B' are loosely mounted on an inclined shaft 13, and the drums B² and B³ are loosely mounted on a similar inclined shaft 13', each of these shafts being offset at its middle portion, as shown at 14 in Figure 3, so that one of the drums is dropped below the other, step fashion, as shown. It is more desirable to have a plurality of relatively short auxiliary inclined drums than to use a single relatively long one, on account of the fact that with the plurality of drums, it is possible to keep the different runs of belt or cable more nearly uniform in length. It will be particularly noted that in the embodiment shown, the axes of all of the auxiliary drums or drum sections are out of line with each other, but that they all lie in the same plane, such plane being parallel with the plane of the axis of the main drum A. I propose to pass my improved filter belt around these various drums by employing the principles illustrated in Figures 8 and 9, all as will hereinafter more fully appear.

In order to supply to the traveling belt the material to be separated (hereinafter referred to as slurry), I employ a charging or feeding pulley, designated in its entirety by the numeral 15 in Figure 1. The actual construction of this pulley is clearly shown in Figures 5 and 6, and by reference to these figures, it will be seen that the pulley, in fact, comprises two similar halves or sections 15^a and 15^b, mounted to rotate loosely on aligned hollow shafts 16 and 17. The shaft 16 is supported in the side of the housing 1, while the shaft 17 is carried by

any suitable fixed support 18 (see Figure 1). It will, of course, be understood that the halves 15^a and 15^b of the feed pulley are held against axial movement on their respective shafts by any suitable means. Each half 15^a and 15^b carries at the outer edge of its periphery, a radial flange 15', which serves to confine the belt.

At this point, it may be well to point out that my improved belt comprises a strip of flexible foraminous material 41, such as woven wire or the like, secured at each edge to a relatively thick bead 42 of flexible, impervious material, such as rubber or suitably treated canvas. By reference to Figure 5, it will be seen that the bead 42 projects on each side of the strip 41, thus serving to hold such strip spaced from the center of both the charging pulley and the wash water supplying device hereinafter described. The two halves of the charging pulley, shown in Figure 5, are spaced apart a distance substantially equal to the width of the strip 41 between the beads 42.

At the inner ends of the hollow shafts 16 and 17 are circular plates or flanges 19, one of which is provided with a rim 21, into which are set screws 20 or the like, for holding the two plates together to constitute a central disk-shaped body. This, it will be understood, is stationary.

The disk-shaped body, above described, is hollow, and its interior communicates with the hollow shaft 16. Formed in the rim portion 21 of the disk is a tangentially directed discharge port 22, best shown in Figure 6, such port serving to direct the slurry from the hollow shaft 16 and interior of the disk onto the belt.

If necessary, and as shown in the drawing, I may provide, within the hollow disk, a rotary pump or impeller comprising a wheel 23, carrying on one face radial ribs 24. This acts on the principle of the well known centrifugal pump to draw the slurry in through the hollow shaft 16, and forcibly eject it through the port 22. The pump or impeller is secured to the end of a shaft 25, which carries at its other end a pulley 26, driven by means of a belt 27 from a pulley 28, secured to the shaft 5.

As mentioned in the preamble, it is very desirable to deliver the slurry to the traveling belt in the same direction and at substantially the same speed as that at which it is traveling. To this end, the tangential port 22 is positioned to deliver the slurry against the belt in the same direction as that in which it is traveling. In some cases, the mere hydrostatic head or natural flow of the slurry will be sufficient to give it the desired velocity at the port or nozzle 22, but in other cases, I generate the necessary velocity by means of the impeller above described. Obviously, the speed of this im-

5 peller can be so adjusted as to deliver the
 slurry from the nozzle 22, at a velocity
 approximating that of the belt. In this way,
 the belt is relieved of the strain to which
 it would otherwise be subjected in contin-
 10 ually accelerating the mass of slurry. With
 the arrangement described, the slurry passes
 smoothly onto the belt, without any exces-
 sive spattering and without any shock or
 impact. The slurry is, of course, received
 15 in the channel-shaped trough or groove
 formed by the beads at each side of the flex-
 ible strip constituting the bottom of the
 belt, and is laterally confined by the beads.

20 Below the main housing 1 is formed an
 auxiliary housing or chute 29, which encloses
 the discharge pulley 30, mounted on a shaft
 31. The manner in which the belt 40 is led
 around this pulley will be hereinafter de-
 scribed.

25 The several compartments W, X, Y and
 Z are provided at their bottom with dis-
 charge pipes 32, 33, 34 and 35, for convey-
 ing away the liquid as it accumulates.

30 In order to supply wash water or other
 liquid to the belt at a point between the
 charging pulley and discharging pulley, I
 may utilize, if desired, an arrangement such
 as illustrated at the right of Figure 3, and
 also in Figure 1. This consists in dividing
 one of the auxiliary drums, such as B², into
 two parts, in a manner generally similar to
 that shown in Figure 5, in connection with
 35 the pulley 15. One of the parts is shown
 as relatively narrow and is designated by
 the numeral 39. Between it and the main
 body of the drum B² is interposed a fixed
 disk 36, having one or more radial ports
 40 extending therethrough from the center to
 the periphery, such ports communicating at
 their inner end with a passage 37 formed
 in the fixed shaft 13'. It will be understood
 45 that the parts are so proportioned that as
 the belt passes over this water supplying
 device, one of the beads 42 engages the sec-
 tion 39, while the other bead rests upon
 the drum B², thus causing the foraminous
 portion 41 of the belt to bridge the fixed
 disk 36. Therefore, water entering the pas-
 50 sage 37 will be delivered outwardly through
 the radial ports 38 onto and against the ma-
 terial carried on the inside of the belt.

I propose to lead my improved belt con-
 tinuously around each of the main and aux-
 55 iliary drums a plurality of times, and also
 around the charging and discharging pul-
 leys. Beginning at the bottom end of drum
 A in Figure 1, the belt passes horizontally
 over the adjacent drum B and thence
 60 around the charging pulley 15, where it is
 loaded with slurry, as above described.
 Any of the slurry which is in excess or
 which escapes for any reason, will collect
 in the compartment W and flow off through
 65 the pipe 32. From the charging pulley, the

charged or loaded belt passes underneath
 the drum B to and around the drum A,
 and from this point, travels continuously
 and alternately around the main drum A
 and auxiliary drums B and B', until the
 70 farther end of drum B' is reached. The
 run of the belt leaving the lower side of
 the drum B' then passes direct to the lower
 side of the drum B², where it first extends
 around the water supplying device and is
 75 thence led continuously and alternately
 around the auxiliary drums B² and B³ and
 the main drum A' until the lower end of
 these drums is reached.

80 After the last run of the belt leaves the
 drum A', it is carried downward between
 this drum and the partition 4 through the
 bottom of the housing into the compartment
 or chute 29, where it passes under and
 85 around the discharge pulley 30, suitable
 guard rims 43 being provided around the
 openings where the belt goes through the
 bottom of the housing to prevent the escape
 of liquid therethrough. The belt coming up
 90 from the discharge pulley passes thence
 over the end of drum A and goes to the
 charging pulley 15, where the cycle is re-
 peated. It will be understood that in Fig-
 ure 1, I have used, for the sake of clearness
 and simplicity, only a single line to illus-
 95 trate the path followed by the various runs
 of the belt, this line representing the cen-
 ter line of the belt. By means of this line,
 the course of the belt, as it travels through-
 out the apparatus, passing a plurality of
 100 times around each of the drums, may be
 clearly traced, and it will be observed that
 the same law as to spacing obtains in Fig-
 ure 1 as was discussed in connection with
 Figure 9. It will further be observed that
 105 the spacing is reversed as to drums A and
 A', this being due to the fact that the runs
 of the belt pass from the drum A onto the
 auxiliary drums while they pass from the
 auxiliary drums onto the drum A'.

110 It will also be seen, by reference to Fig-
 ures 1 and 2, that the drums A and B pass
 through the partition 3 dividing the com-
 partments X and Y, and that the belt trav-
 els continuously from one of these compart-
 115 ments to the other. In this way, it is pos-
 sible to collect the liquors thrown off from
 the belt during the first few revolutions and
 treat them independently of the liquors
 thrown off during succeeding revolutions. 120
 The partition 3 may, of course, be placed at
 any desired point axially of the roller A.

Similarly, by reason of the fact that the
 rollers A', B² and B³ are in a separate com-
 125 partment, it is possible to independently
 collect the liquors coming from the belt
 after the wash water has been supplied
 thereto. It will be understood, however,
 that the wash water supplying device may
 130 be located at any desired point, and that,

if necessary, two or more water supplying devices may be employed and located at different points.

In conclusion, it will be understood that the material on the belt is subjected to centrifugal force repeatedly or a plurality of times, as the belt travels along, centrifugal force being, of course, generated each time that the belt passes around any of the drums. It will also be seen that the material is subjected to centrifugal force a plurality of times both before and after being treated with the wash water.

It is, of course, obvious that as the belt passes around the discharge pulley 30, it is flexed in the opposite direction to that in which it was flexed when passing around the separating rollers A, B etc. and as a result, the solid material which has accumulated thereon and which may have worked into the interstices of the belt, is effectively dislodged and thrown off.

In certain prior apparatus which has been proposed, the slurry is fed to the belt as it approaches a pulley, thus causing charging and separating to take place substantially at the same point. With my arrangement, on the contrary, the charging pulley is located in a different compartment from the separating drums, no separation taking place until the belt begins to travel around the drum A after leaving the charging pulley. Moreover, by reference to Figure 6, it will be particularly observed that the supply nozzle 22 is so located as to deliver the slurry onto the belt at substantially the point where the belt leaves the pulley. Thus, the material is not subjected to centrifugal force at the charging pulley.

An important feature of the invention resides in the fact that by a slight modification, it is possible to subject the material on the belt to centrifugal force of progressively increasing intensity, as the belt travels along. An arrangement for accomplishing this is conventionally illustrated in Figure 10. In this figure, it will be seen that instead of having the auxiliary drums all of the same size, as in Figure 1, I make them of progressively decreasing diameters. These auxiliary drums are designated in Figure 10 by the numerals B⁴, B⁵, B⁶ and B⁷, and it will be seen that B⁴ is the largest, while B⁵, B⁶ and B⁷ are progressively smaller and smaller.

The result of this is, that, since all parts of the belt must necessarily travel at the same speed, the smaller the drum, the greater number of revolutions per minute it must make; in other words, the greater must be its angular velocity. Thus, it is evident that the centrifugal force at each drum will vary inversely as its diameter, and that therefore, the centrifugal force is greater and

greater as the belt travels around drums of successively decreasing diameter.

As indicated in Figure 10, it is necessary to arrange the drums B⁵, B⁶ and B⁷ with their axes at progressively increasing angles to the axes of the drums A, in order to secure and maintain the spacing of the belt runs illustrated; that is to say, the same spacing as in Figure 1.

While in Figure 1 I have shown all of the rollers as of the same size, it is obvious that the auxiliary rollers can all be smaller or larger than the main rollers, if desired. Also, while I have shown each auxiliary drum as consisting of but two rollers or sections, such as B and B', it is obvious that each may be made up of any desired number of sections arranged in stepped relation. Thus, if desired, a separate drum section or pulley may be provided for each run of the belt.

Furthermore, while in the drawings I have shown each run of belt as passing over only two drums or rollers, it is obvious that each run may be made to pass over three or more rollers, if desired. This becomes particularly advantageous where the rollers are very small.

Although I have found that my improved method of arranging the axes of the drums in angular relation results in maintaining the runs of the belt effectively spaced apart, still in some cases, guide flanges on the rollers may be provided, if necessary, or the drums or rollers may be crowned in places.

While in the drawings I have shown the drums A, A' as horizontal, it will, of course, be understood that I do not limit myself to this arrangement, but that these drums may be disposed at any angle desired.

What I claim is:—

1. In apparatus for separating liquids from solids, the combination with an endless foraminous belt, of means for feeding onto said belt the material to be separated, and pulleys around which said belt continuously passes in such manner that the material is subjected to the action of centrifugal force in the same direction a plurality of times while on the belt.

2. In apparatus for separating liquids from solids, the combination with an endless foraminous belt, of means for causing the belt to travel continuously, means for feeding onto the belt at one point the material to be separated, means for removing the solids from the belt at another point, and means between the feeding and removal points for subjecting the material on the belt to the action of centrifugal force a plurality of times in the same direction.

3. In apparatus for separating liquids from solids, the combination with an endless foraminous belt, of means for causing the belt to travel continuously, means for feeding onto the belt at one point the ma-

terial to be separated, means for removing the solids from the belt at another point, and means between the feeding and removal points for subjecting the material on the belt to the action of centrifugal force a plurality of times, the centrifugal force applied being of progressively increasing intensity.

4. In apparatus for separating liquids from solids, the combination with an endless foraminous belt, of means for causing the belt to travel continuously, means for feeding onto the belt at one point the material to be separated, means for removing the solids from the belt at another point, and means for subjecting the material on the belt to the action of centrifugal force which increases progressively in intensity from the feeding to the removal point.

5. In apparatus for separating liquids from solids, the combination with an endless foraminous belt, of means for causing the belt to travel continuously, means for feeding onto the belt at one point the material to be separated, means for removing the solids from the belt at another point, means for supplying liquid to the belt at an intermediate point, and means for subjecting the material on the belt to the action of centrifugal force both before and after it reaches the liquid supply point.

6. In apparatus for separating liquids from solids, the combination with an endless foraminous belt, of means for causing the belt to travel continuously, means for feeding onto the belt at one point the material to be separated, means for removing the solids from the belt at another point, means for supplying liquid to the belt at an intermediate point, means for subjecting the material on the belt to the action of centrifugal force both before and after it reaches the liquid supply point, and means for independently collecting the liquid thrown off from the belt at each side of said point.

7. In apparatus for separating liquids from solids, the combination with an endless foraminous belt, of means for causing the belt to travel continuously, means for feeding onto the belt at one point the material to be separated, means for removing the solids from the belt at another point, means for subjecting the material on the belt to the action of centrifugal force a plurality of times in the same direction between the feeding and removal points, and means for independently collecting the liquid thrown off from the belt at different stages of its travel.

8. In apparatus for separating liquids from solids, the combination with a pair of spaced drums, and means for rotating one of them, of a foraminous endless belt arranged to pass continuously over each of said drums a plurality of times, and means

for feeding onto said belt the material to be separated.

9. In apparatus for separating liquids from solids, the combination with a feed pulley, of a pair of spaced drums, means for rotating one of them, and a foraminous endless belt arranged to pass continuously over said feed pulley and drums, said belt running around said drums a plurality of times.

10. In apparatus for separating liquids from solids, the combination with a feed pulley, and a discharge pulley, of a pair of spaced drums and means for driving one of them and a foraminous endless belt arranged to pass continuously over said feed pulley, drums, and discharge pulley, said belt running around said drums a plurality of times before going to said discharge pulley.

11. In apparatus for separating liquids from solids, the combination with a feed pulley, discharge pulley, and liquid supply pulley, of a plurality of spaced drums and means for driving one of them, and a foraminous endless belt arranged to pass continuously over said pulleys and drums, said belt running from said feed pulley to and around some of said drums, thence over said liquid supply pulley, and thence around others of said drums to said discharge pulley.

12. In apparatus for separating liquids from solids, the combination with a feed pulley, of a pair of spaced drums, means for rotating one of them, and a foraminous endless belt arranged to pass continuously over said feed pulley and drums, a housing enclosing said drums and divided into compartments, said drums lying partly in different compartments, and said belt being led several times around the drums in one compartment, then passing to another compartment, and being led several times around the drums therein.

13. In apparatus for separating liquids from solids, a feeding chamber, a feed pulley therein, an independent separating chamber, a separating drum therein, means for driving said drum, and a foraminous endless belt arranged to pass continuously over said pulley and drum, whereby, material deposited on the belt by the feed pulley is subjected to centrifugal action in the separating chamber as the belt passes around said drum.

14. In apparatus for separating liquids from solids, a feed pulley, a separating drum and means for driving it, and a foraminous endless belt arranged to pass continuously over said pulley and drum, whereby material deposited on the belt by said feed pulley is subjected to centrifugal action as the belt passes around the separating drum.

15. In apparatus for separating liquids from solids, a feed pulley, a separating drum and means for driving it, a foraminous end-

less belt arranged to pass continuously over said pulley and drum, and means for feeding material to be separated tangentially onto said belt as it passes around said feed pulley, the velocity of delivery being substantially equal to the speed of the belt.

16. In apparatus for separating liquids from solids, a feed pulley, a separating drum and means for driving it, a foraminous endless belt arranged to pass continuously over said pulley and drum, and means for feeding material to be separated tangentially from the periphery of said pulley onto said belt at a point just before the belt leaves the pulley.

17. Means for feeding fluent material to a foraminous belt comprising a pulley over which said belt passes, said pulley having a central fixed hollow portion, and means for discharging the material tangentially from said fixed hollow portion onto the belt.

18. Means for feeding fluent material to a foraminous belt comprising a pulley over which said belt passes, said pulley having a central fixed hollow portion provided with a substantially tangential port, and means for drawing the material into said hollow portion and forcing it out through said port onto said belt.

19. Means for feeding fluent material to a foraminous belt comprising a pulley over which said belt passes, said pulley having a central fixed hollow portion provided with a substantially tangential port, and a rotary pump element mounted within said hollow fixed portion and serving to draw in the material and eject it through said port onto said belt.

20. In combination, a filter belt, a smooth surface roller around which said belt passes, said belt comprising a porous flexible strip having at each edge a marginal flange or bead for engaging said roller, whereby the strip itself is spaced from the roller, and means for feeding the material to be filtered onto the inner side of said belt so that it occupies the space between said strip and roller.

In testimony whereof I affix my signature.

WILLIAM C. WALKER.