No. 832,191. PATENTED OCT. 2, 1906.

W. HOLZER.

CENTRIFUGAL SEPARATOR.

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Fig. 1.

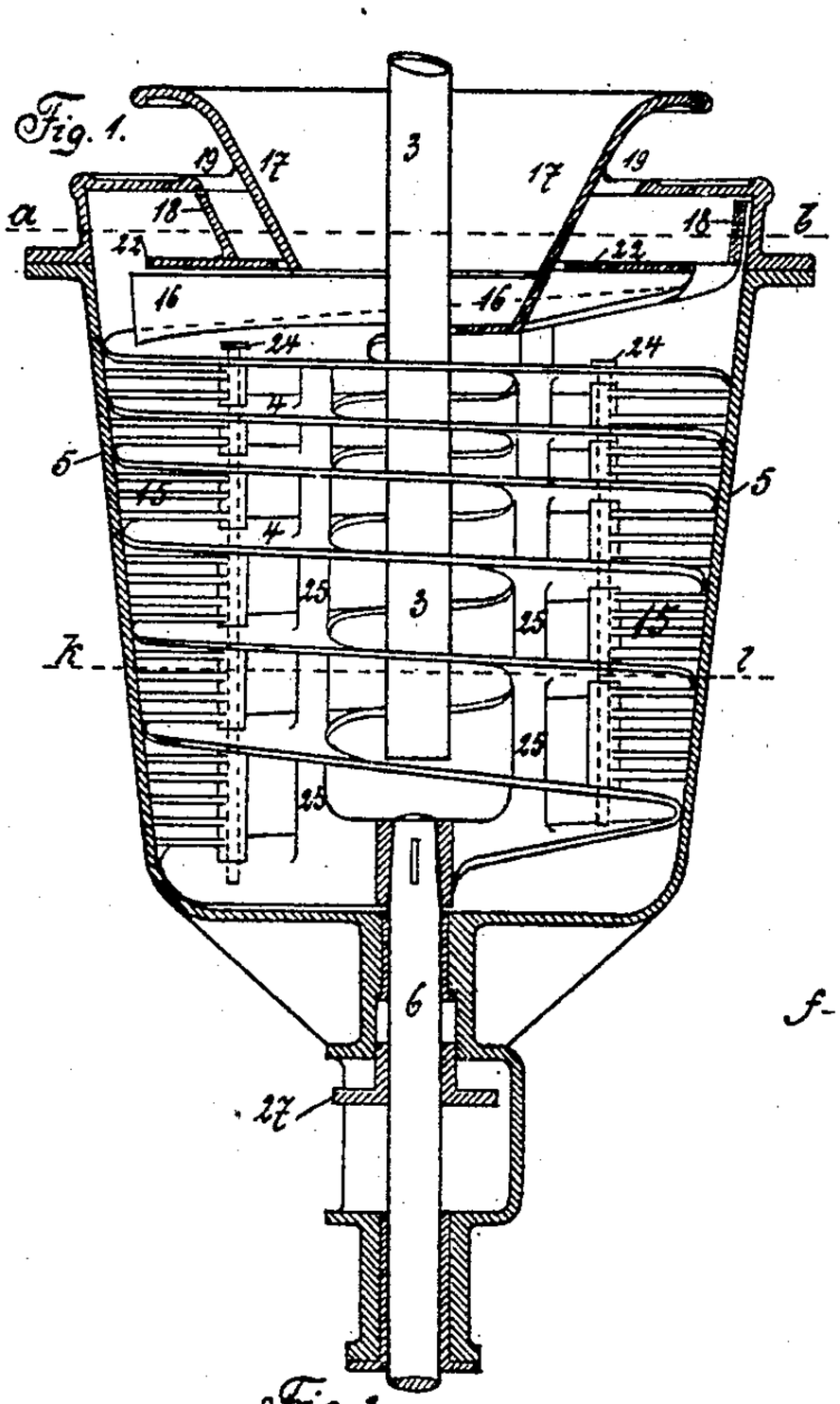


Fig. 4.

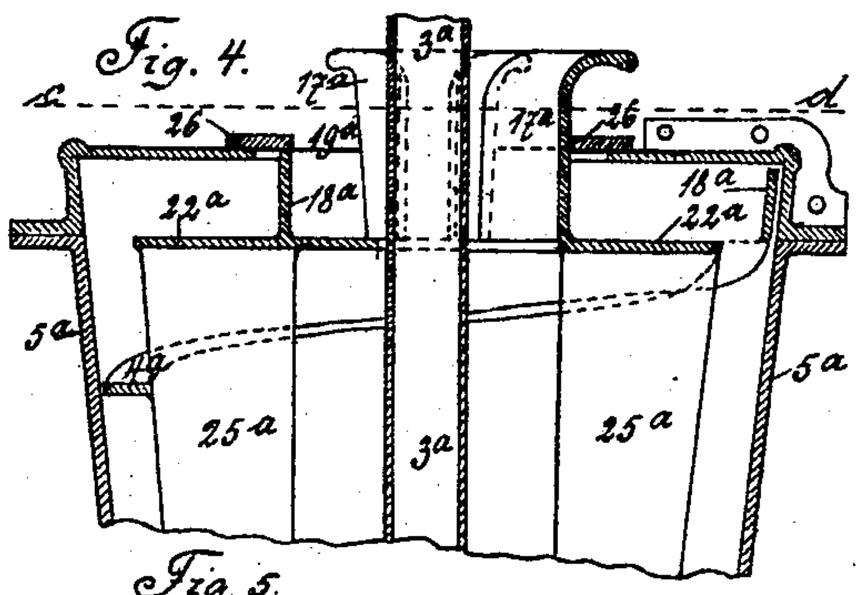


Fig. 5.

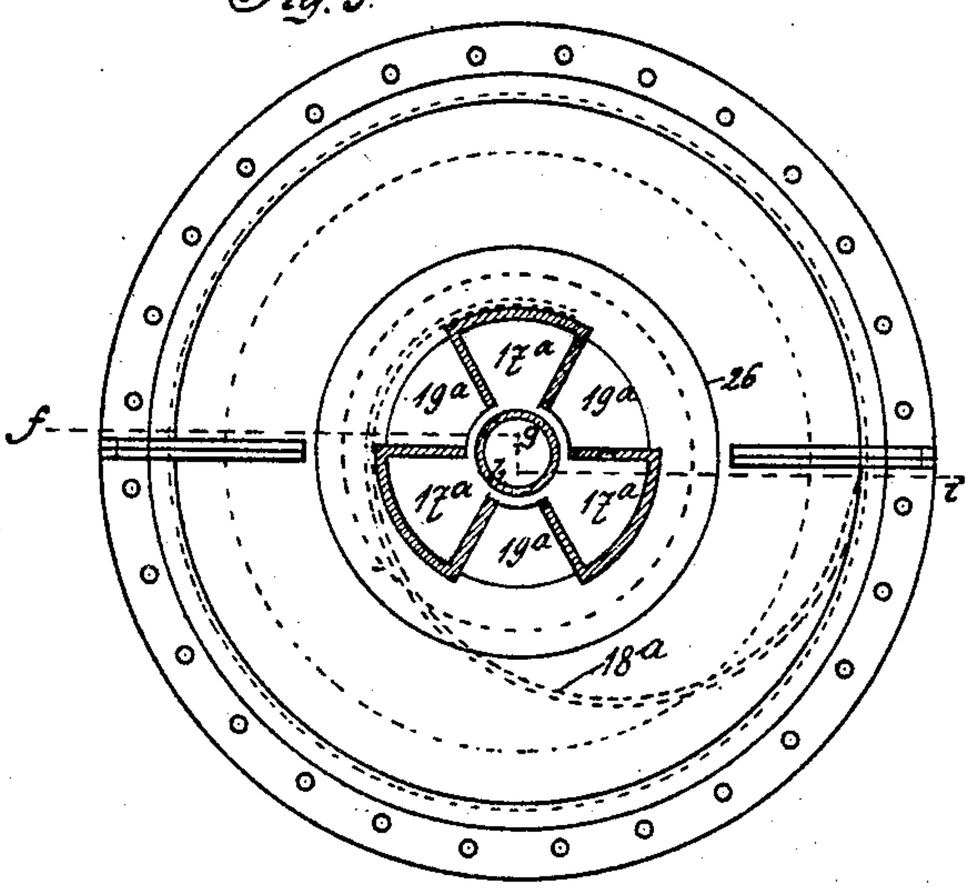


Fig. 2.

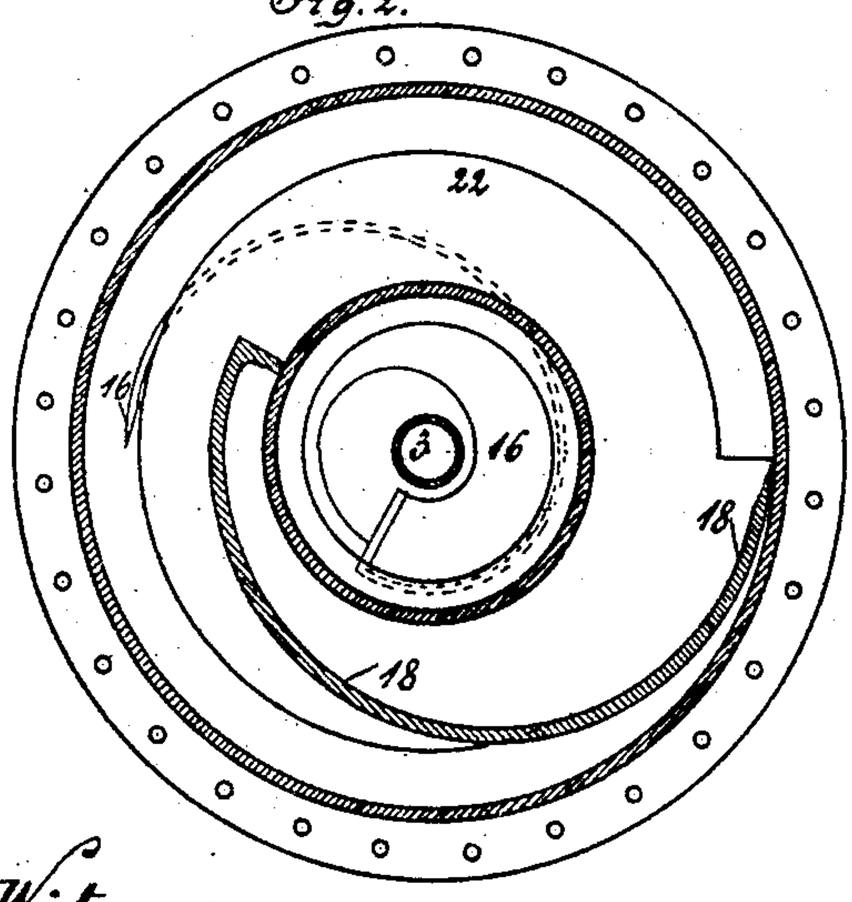
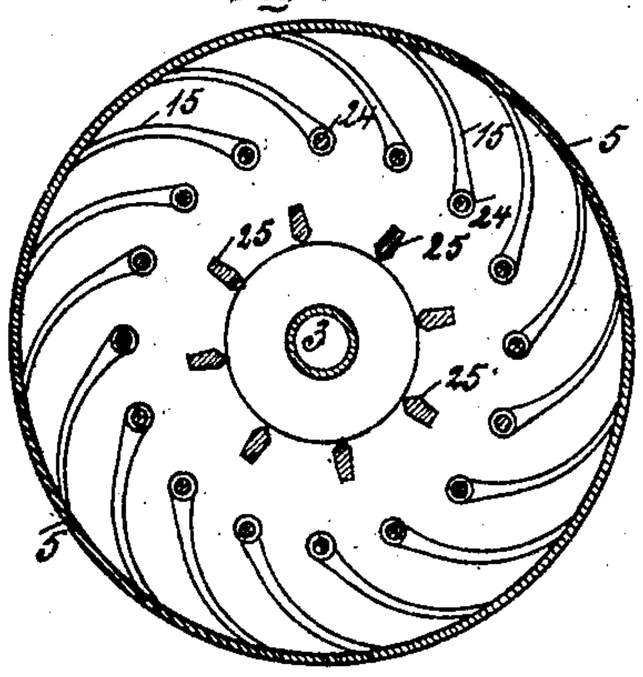


Fig. 3.



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CENTRIFUGAL SEPARATOR.

No. 832,191. Specification of Letters Patent. Patented Oct. 2, 1906.

Application filed July 7, 1905. Serial No. 268,705.

To all whom it may concern:

Be it known that I, WILHELM HOLZER, a subject of the German Emperor, and a resident of Nieder-Ramstadt, near Darmstadt, Germany, have invented certain new and useful Improvements in Centrifugal Separators, of which the following is a specification.

This invention relates to a device for separating mixtures of bodies in a continuous manner and with the aid of the centrifugal force.

This device may be used for mixtures of different composition, as well as for different kinds of separation. Thus solid bodies of different natures contained in a mixture may be separated one from the other. In the same manner solid or muddy parts may be separated from a mixture composed chiefly of liquid. Furthermore, liquids adhering to solid bodies may be separated from the latter.

In the annexed drawings, Figure 1 is a section of the device, some of the internal parts being shown in side elevation. Fig. 2 is a section on line *a b* of Fig. 1. Fig. 3 shows a section on line *k l* of the same figure. Fig. 4 shows a modification of the device shown in Fig. 1, this figure being a section on lines *f g h i* of Fig. 5. Fig. 5 shows a section on line *c b* of Fig. 4.

Similar reference-numerals designate like parts throughout all the figures.

3 is a pipe fixed outside the centrifugal apparatus in any suitable manner and projecting into the latter as a completely stationary pipe which is in no direct connection with the apparatus.

5 is a conical mantle mounted on the shaft 6, round which it can rotate. This mantle is held at the desired height in any preferred appropriate manner. This shaft 6 is rotatably supported in its lower part (not shown) and carries fixed upon it the screw 4, as well as the parts secured to the latter. The screw 4 leaves near its axis a hollow space or core through which the stationary pipe 3 projects in the centrifugal apparatus. Alongside the inner opening of the screw 4 stiffening webs or stays 25 are provided, which are rigidly secured to the screw 4 or cast in one piece with the latter. These stiffening-stays are arranged round the inner opening of the screw 4, as shown by Fig. 3. They are only shown on both sides in Figs. 1 and 4 for sake of clearness. Besides this the height of pitch of the screw 4 diminishes toward the top. Between the turns of the screw 4 are rakes 15, connected to the screw 4 by means of the bolts 24, round which they can rotate, while their free ends slide along the inner periphery of the centrifugal mantle. As best shown by Fig. 3, these rakes also exist in a certain number, only two rakes being shown in Fig. 1 on both sides of the worm in order to not complicate the drawings. The screw 4 carries at its upper end, either rigidly secured to it or cast integral with it, first a spirally-wound share 16, then above this a circular plate 22, and above the latter a second spirally-wound share 18. Plate 22 produces separate chambers for the shares 16 and 18. The top of the mantle 5 is closed by a cover which is provided with a funnel-shaped opening 17 and an annular opening 19 surrounding the latter. The funnel may as well be made of one piece with the screw 4 and project through the cover of the centrifugal separator. The part of the share 16 which is nearer to the center is directed obliquely upwardly and forms the continuation of the opening 17, and the said central part of this opening is a part of the said opening, while the share 18 continues in the same manner the opening 19. Both the shares, as well as the screw 4, to which they are rigidly connected, can rotate freely with regard to the mantle of the centrifugal separator and the upper parts of it. The exhaust-openings are arranged at different heights. In the lower part of the mantle 5 the latter is tightly connected to the shaft 6 by means of a stuffing-box 25. Besides this the separating apparatus above described is connected with a device (not shown in the drawings) which delivers in a continuous and uniform manner to the pipe 3 the mixture to be treated.

According to the nature of the material to be treated several modifications can be made in the device above described. Fig. 4 shows a narrower screw 4^a and only one share 18^a, another modification consisting in that the discharge-channels 17^a are rigidly connected to the screw 4^a or made integral with the latter. Furthermore, these discharge-channels 19^a are arranged on the same area of a circle and form a sort of cell upon the latter. In this instance the interval between the cellular channels 17^a and the cover or mantle of the

centrifugal separator is closed by the ring 26, which is connected to the cells 17ª in such a manner that it follows their rotary motion, while being adapted to be freely moved downwardly and upwardly. In the form shown by Fig. 4 the discharge-channels 17ª are cylindrical. However, they may also be conical when the nature of the material to be treated requires it. The same remarks may be made on behalf of the connecting-pieces of the shares. Furthermore, according to the nature of the material and the properties which the final product must have, the rakes 15 may be dispensed with; also the mantle 5, according to the nature of the material and the requirements, may be perforated or not. The mantle 5, as well as the shaft 6, is provided with a driving device which may have the most varying forms and which for this reason is not shown in the drawings.

The function of the device is as follows: Assuming that a mixture is to be treated which is composed of different kinds of solid bodies which are to be separated one from the other, the mixture introduced by the charging device (not shown) falls through the tube 3 uniformly on the bottom of the rotating centrifugal apparatus, where it is thrown against the wall of the latter by reason of the centrifugal force. As the pipe 3 does not rotate, there is no danger of the mixture adhering to the wall of the tube. The screw 4 rotates in the same direction as the mantle 5 of the centrifugal apparatus, but with a different speed. According to the sense of the worm 4 with reference to the direction of rotation of the whole, the motion of the screw 4 is more rapid or less rapid than the motion of the centrifugal apparatus. It results from this difference of speed between the centrifugal apparatus 5 and the screw 4 a raising motion of the mixed material which forms an annular couch along the periphery of the separator. During its ascensional motion of the mixed material it is continuously loosened and lifted off the periphery, so that the heavier particles can arrive near the periphery and push the lighter particles more toward the center. In this manner the bodies of the same kind will during their raising motion accumulate in annular couches, the lighter bodies lying nearer to the center, while the heavier ones are adjacent to the periphery. In order to facilitate the separation, a little quantity of water may be added to the mixture, and this water—*i. e.*, the part of it which has not penetrated into the couches of material—forms a further couch near the center. The water is prevented from escaping by the cover of the apparatus, and it can only escape through the opening situated nearest to the periphery, and its escape is exactly regulated upon the quantity of fresh water introduced. It is impossible that the water huddles in an inconvenient manner the material treated. When the latter has arrived at the top of the apparatus in separated annular couches, the couch which is nearest to the center is pushed toward the center by the share 16 and brought in the way of the discharge-opening 17, through which this couch escapes on the inclined plane of the share 16 and the discharge-channel toward the top and the outside. Here it is collected and carried away in any convenient manner. The heavier couch does not come in the way of the share 16 and is brought by the prolongation of the screw 4 farther toward the top in the way of the share 18, which brings it into the discharge-opening 19, whence it escapes on the inclined plane of the share upward and outward over the cover of the centrifugal separator in order to be collected and carried away in turn in any convenient manner. It is very important that the escape of the different materials takes place at different heights, so that different kinds of material can be separately collected and carried away at these different heights. The pitch of the worm 4 diminishes toward the top in order to prevent the thickness of the ring of material decreasing by reason of the increase of the diameter of the separator. A considerable decrease of the ring of material would have an unfavorable influence on the separating operation. In fact, the formation of couches would easily be more or less destroyed.

The guidance of the separated material before the discharging toward the center, and consequently the mounting of a cover, has been necessary, as it has already been stated, for keeping the water in the centrifugal apparatus. Another object of that arrangement is that the material which near the center escapes with a lesser speed is less exposed to destruction when striking the collecting apparatus. Consequently the whole apparatus requires less mechanical work, as the inertia of the bodies escaping with a little speed is lesser.

Besides the separation of two different materials a greater number of different kinds of materials may be discharged within certain practical limits. In this case a correspondingly-greater number of shares and discharge-openings are arranged.

The mantle of the centrifugal apparatus is enlarged at the top in order to facilitate the raising motion of the material. However, the enlargement of the mantle must only be sufficient to keep the upward motion of the material in dependence of the relative motion of the screw 4.

According to the nature of the material to be treated the process is somewhat modified. Thus when a mixture is treated which is essentially composed of liquid and from which solid or muddy parts are to be separated the above-described loosening of the mixture is

not necessary, so that the rake 15 may be dispensed with. Furthermore, one of the shares may be omitted, as the liquid escapes quite automatically in proportion as fresh liquid is introduced through the tube 3. It is, however, necessary to put the escape of the solid or muddy parts as near to the center as the escape of the liquid, as otherwise the latter would escape through the opening provided for the muddy parts and would again be mixed with the latter. In order to prevent this, the form of cells shown in Figs. 4 and 5 has been given to the escape-openings. If, on the contrary, a material substantially composed of solid bodies is to be separated from the adherent liquid, this may be carried out in two ways by the above-described construction. The mantle of the apparatus may receive the form of a sieve and a less-important number of rakes may be made to slide along the periphery in order to keep the holes of the sieve open and the mass loose. The liquid may thus escape freely. Another possibility is to leave the mantle without holes, but to render it smaller at the top. The liquid to be separated is first projected against the periphery of the centrifugal apparatus, while the solid material is raised by the screw. The liquid, partly by gravitation, partly by the influence of the centrifugal force, flows downwardly in the material loosened and kept permeable by the rakes along the wall inclined obliquely downward and outward. The liquid escapes at the lower end through special openings. It is particularly important that in this case the mantle of the separator is larger at the base than at the top, as the centrifugal force drives the liquid toward the larger end, while in the opposite case it would be driven to the spot where the solid bodies should have the greatest degree of dryness, which would be contrary to the object viewed. In the arrangement described the liquid encounters on its way toward the outside only material which is moister and moister. In both cases only one share would be necessary at the upper mouth and one escape-opening, if it is not desired to effect simultaneously with the separation of the liquid a special separation of the solid bodies between them.

Having now fully described my said invention, what I claim, and desire to secure by Letters Patent, is—

1. A centrifugal separator comprising a stationary feed-pipe, a rotatable conical drum provided with discharge-openings, a screw rotatable independently of the drum, and a plurality of fingers projecting outwardly from opposite sides of the blades of said screw to the drums.

2. A centrifugal separator comprising a stationary feed-pipe, a rotatable conical drum provided with centrally-disposed discharge-openings, a screw rotatable independently of the drum and provided with blades varying in pitch, and a plurality of fingers projecting outwardly from opposite sides of the blades of said screw to said drum.

3. A centrifugal separator comprising a stationary feed-pipe, a rotatable conical drum provided with centrally-disposed discharge-openings, a screw rotatable independently of the drum, and a plurality of radially-disposed fingers secured to and projecting from opposite sides of the blades of said screw, the outer ends of said fingers engaging the inner periphery of the drum.

4. A centrifugal separator comprising a stationary feed-pipe, a rotatable conical drum, a screw rotatable independently of the drum, a plurality of fingers projecting radially from the blades of said screw, and spiral shares 16 and 18 coöperating with the delivery end of said screw.

5. A centrifugal separator comprising a rotatable drum, feeding means delivering to the lower end of said drum and a discharge at the upper end thereof, an independently-rotatable screw, and a share coöperating with said screw and delivering to said discharge.

6. A centrifugal separator comprising a rotatable drum, feeding means delivering to the lower end of said drum and a discharge at the upper end thereof, an independently-rotatable screw, and a spiral share coöperating with said screw and delivering to said discharge.

7. A centrifugal separator comprising a rotatable drum, feeding means delivering to the lower end thereof, a central and a peripheral discharge at the top of said drum, an independently-rotatable screw, and spiral shares coöperating with said screw and delivering the lighter particles to said central discharge and the heavier particles to the peripheral discharge.

8. A centrifugal separator comprising a rotatable drum, feeding means delivering to the lower end thereof, a central and a peripheral discharge at the top of said drum, an independently-rotatable screw, and spiral shares coöperating with said screw and delivering the lighter particles to said central discharge and the heavier particles to the peripheral discharge, and a partition dividing said shares.

9. A centrifugal separator comprising a rotatable drum, feeding means delivering to the lower end thereof, a central and a peripheral discharge at the top of said drum, an independently-rotatable screw, and means cooperating with said screw for delivering the lighter and heavier particles respectively to said central and peripheral discharge.

10. A centrifugal separator comprising a rotatable drum, feeding means delivering to the lower end thereof, a discharge at the top, an independently-rotatable screw, a spiral share coöperating with said screw and de-

livering to said discharge, and a plurality of fingers carried by said screw and engaging said drum.

11. A centrifugal separator comprising a rotatable drum, feeding means delivering to the lower end thereof, a central and a peripheral discharge at the top of said drum, an independently-rotatable screw, spiral shares coöperating with said screw and delivering the lighter particles to said central discharge and the heavier particles to the peripheral discharge, and a plurality of fingers carried by said screw.

12. A centrifugal separator including a screw and a double discharge, and a spiral share delivering to each discharge, one share being located relatively near the axis of said screw and the other near the periphery thereof.

13. In a centrifugal separator the combination of a stationary feed-pipe, a rotary drum, a screw movable independently of the drum, means for controlling the thickness of the layers of the material to be separated, means for imparting to the material to be treated besides a rotary and transporting motion, a motion influencing the relative position of the particles of the material, and means for discharging the separated materials at different determined heights and at a determined distance from the center.

14. In a centrifugal separator the combination of a stationary feed-pipe, a rotary drum, a screw movable independently of the drum, means for discharging the separated materials at different determined heights and at a determined distance from the center and for keeping back bodies necessary for the separation.

15. In centrifugal separators the combination of a stationary feed-tube, a rotary drum, a screw movable independently of the drum, means for controlling the thickness of the layers of the material to be separated, means for imparting to the material to be treated, besides the rotary and transporting motion a motion influencing the relative position of the different particles, and means for discharging the separated materials at a determined distance from the center, as described.

16. In a centrifugal separator the combination of a device for feeding uniformly the material to be separated, a stationary feed-pipe, a conical rotary drum tapering in the direction wherein the solid material is carried, a screw movable independently of the drum, means for controlling the thickness of the layers of the material to be treated, means for imparting to the material to be treated, besides the rotary and transporting motion a motion influencing the relative position of the different particles, and discharging devices for liquid parts at the wider and for solid parts at the narrow part of the drum, as described.

In testimony whereof I have hereunto set my hand in presence of two witnesses.

WILHELM HOLZER.

Witnesses:

JEAN GRUND,

CARL GRUND.