# United States Patent [19]

**Pause et al.**

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[54] **APPARATUS FOR DISCHARGING THE CONTENTS OF A DISCONTINUOUSLY OPERATING CENTRIFUGE**


[75] Inventors: **Kurt Pause,** Grevenbroich; **Ernst Ullrich Dregger,** Neuss; **Gottfried Otten,** Grevenbroich, all of Germany

[73] Assignee: **Maschinenfabrik Buckau R. Wolf Aktiengesellschaft,** Grevenbroich, Germany



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[52] **U.S. Cl.** ..... **233/22,** 233/27, 233/46

[51] **Int. Cl.** ..... **B04b 11/08**

[58] **Field of Search** ..... 233/21, 22, 27, 28, 46, 233/47 R, 19 R



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*Primary Examiner*—George H. Krizmanich
*Attorney, Agent, or Firm*—Michael S. Striker



[57] **ABSTRACT**

In a discontinuously operating centrifuge having a drum provided in an upper axial end with an opening, an arrangement for discharging the contents of the drum comprising, in combination, a suction conduit mounted for insertion into and removal from the drum through an opening, and for pivotal displacement within the drum, the suction conduit having a nozzle portion provided with an inlet opening arranged to be located closely adjacent to an inner circumferential surface of the circumferential wall of the drum and to face opposite the direction of rotation of the drum, the plane of the inlet opening defining, when the conduit is so located, with a tangent to the circumferential wall of the drum a first acute angle, and with the drum radius a second acute angle which is greater than the first acute angle.


**7 Claims, 4 Drawing Figures**

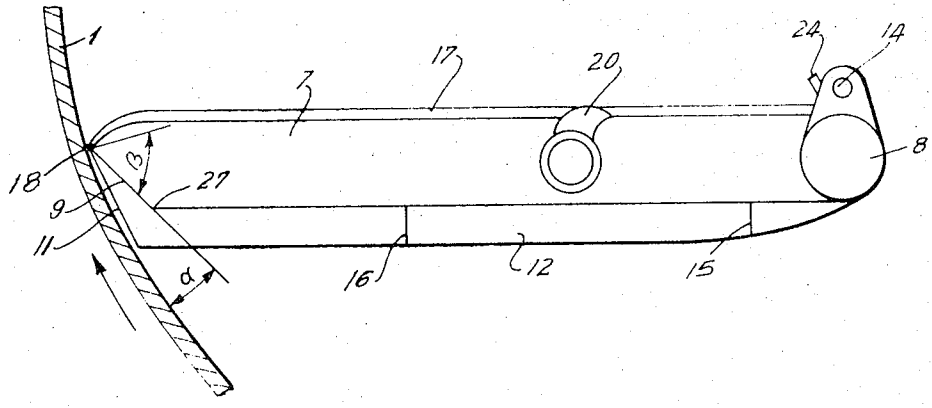
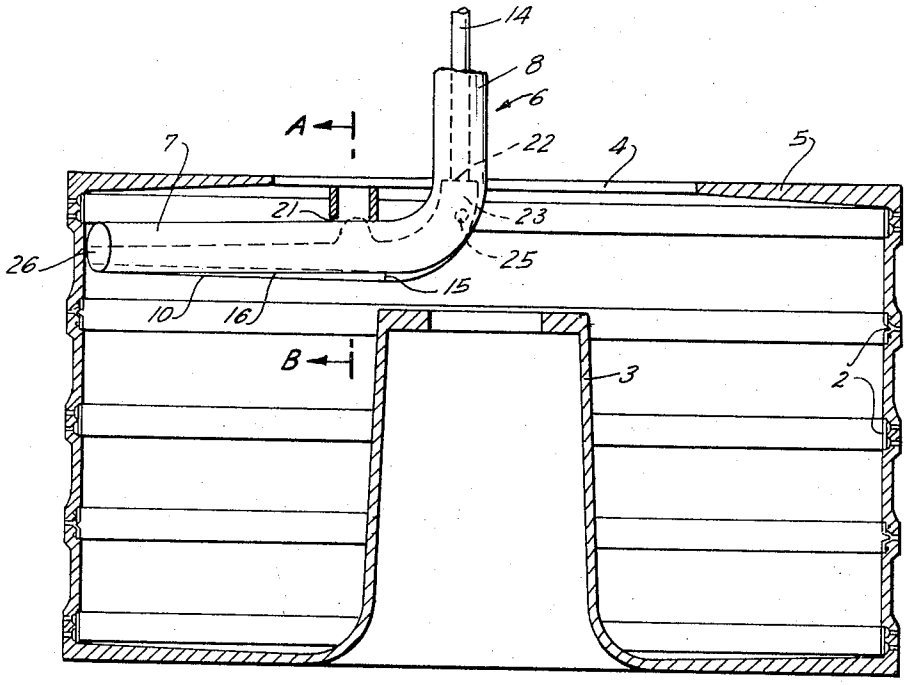


FIG. 1



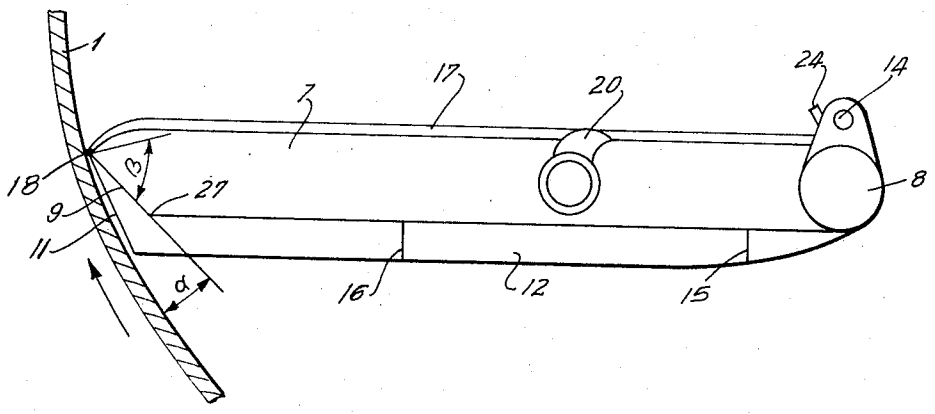



FIG. 2

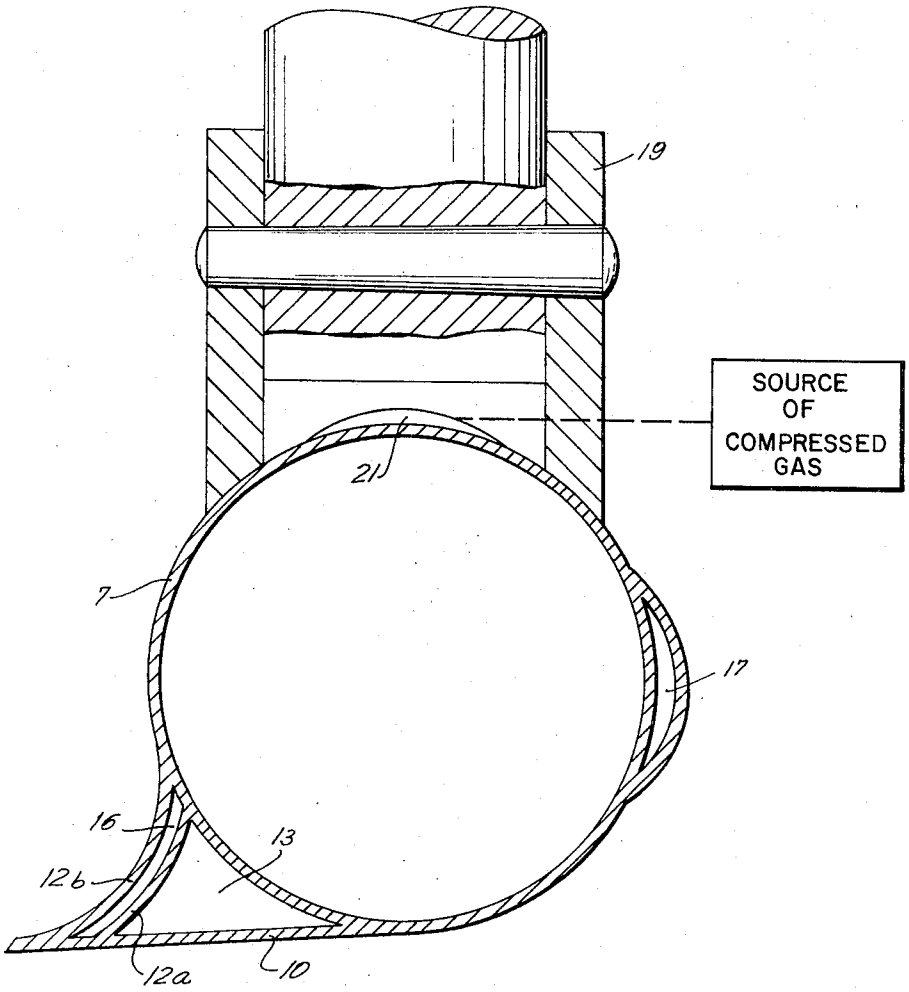



FIG. 3

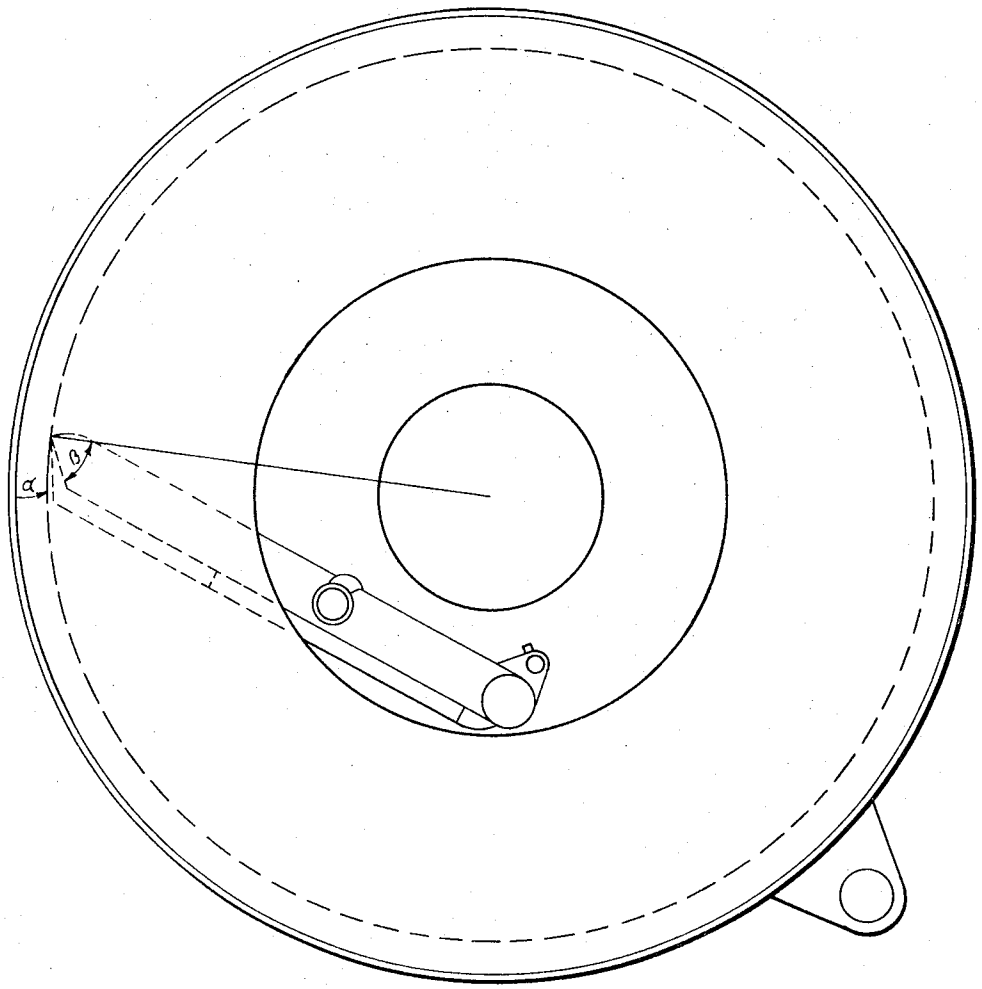



FIG. 4

# APPARATUS FOR DISCHARGING THE CONTENTS OF A DISCONTINUOUSLY OPERATING CENTRIFUGE

## BACKGROUND OF THE INVENTION

The present invention relates to an apparatus for discharging the contents of a discontinuously operating rotatable screen-type centrifuge, and in particular for discharging finely divided short-fiber material from the centrifuge.

The finely divided solid phase which is here intended is a fibrous mass in which the individual fiber has a diameter on the order of hundredth of a millimeter and a length on the order of tenths of a millimeter. If such fibers are poured in dry condition in a heap, the structure of the heap will be very loose so that the volumetric weight of the thus-poured material will be less than one-tenth of the specific weight of the same material in solid condition.

A particular type of such fibrous material is known as Nylflock, consisting of finely chopped nylon filaments. If such Nylflock is to be processed to produce a textile thread which can be woven, it is known to resort to a method in which the fibers are washed, dyed, surface-impregnated to influence electrostatic charging, and finally the formation of a thread. It is known to carry out the first three steps of the method in heated vessels provided with stirring arrangements. In the first step, 50 kg of flock are admised with 1,000 kg of wash solution, in the second step 50 kg of flock are admixed with 1,000 kg of dye solution and in the third step 50 kg of flock are admixed with 1,000 kg of impregnating solution. Then, the washing, dyeing and impregnating steps are respectively carried out.

Following each step, the flock must be separated from the solution with which it has been treated. In order to avoid the admixture of fibers having undergone different processing steps, the mixture of flock and solution is allowed to flow into bags which retain the flock but permit the solution to flow out. Such a bag is inserted into a stationary, heavily perforated centrifuge drum and an operator directs the mixture of flock and solution into the bag until such time as the bag is filled by the loose flock, the liquid having largely run off through the wall of the bag and thereupon through the perforations in the centrifuge drum. When the bag is filled it is closed and a new bag is inserted into the drum, which is then also filled. This continues until the entire charge of 50 kg of flock has been accommodated in such bags, and usually four bags are required for this purpose. Thereupon the operator starts up the cetnrifuge and centrifugally removes the last remaining liquid from the flock contained in the various bags in the drum. When the centrifuging process is completed the bags are manually removed from the centrifuge drum, taken to the next vessel and emptied into the same, for admixture with the next solution, for instance the dye solution or the impregnating solution. The empty bags are kept on hand for the next batch of flock.

This manual operation is evidently time-consuming as well as expensive in terms of the labor involved. In addition it is umpleasant for the operator because the flock and the solution are at temperatures in excess of 60°C. This makes it necessary for the operator to wear protective clothing, goggles and gloves, but despite this the operator can be annoyed or even endangered by various vapors. Automation of the operation to the maxiumum possible extent is therefore highly desirable.



## SUMMARY OF THE INVENTION

It is, therefore, a general object of the present invention to overcome the disadvantages of the prior art.

More particularly it is an object of the present invention to eliminate as much as possible any manual operations required, and to automate the processing to the maximum extent feasible.

Another object of the invention is to provide for the possibility of discharging the charge of flock from the centrifuge, without leaving any residue behind.

In keeping with these objects, and others which will become apparent hereafter, one feature of the invention resides, discontinuously operating centrifuge having a drum, in an arrangement for discharging the contents of the drum. The arrangement utilizes a suction nozzle which can be moved relative to the drum interior and whose inlet opening can be made to be positioned directly adjacent the inner side of the drum wall facing opposite the direction of rotation of the drum. In this position the plane of the inlet opening defines an acute angle with a tangent to the drum wall, and another but larger acute angle with the drum radius.

Despite the automation obtainable in accordance with the present invention it is desired to be able to avoid having to clean the centrifuge following each operation. In other words, the centrifuge is to be able to be used with charges of flock having undergone any of the three initial processing steps outlined earlier, that is washing, dyeing and impregnation, and it should not require cleaning between the introduction into it of flock having just undergone various different ones of these steps. Pneumatic and/or hydraulic conveying devices used should be self-cleaning, or leave behind no residual flock. The vessels with the stirring devices are to be capable of being maintained free of flock residue by pneumatic flushing. The walls, screens and other parts of the centrifuge should be free of flock when the centrifuge contents have been discharged, and stationary components must be so configurated that mixture cannot splash onto them and contaminate them.

The residual moisture of the flock which has been centrifuged should be identical in all types of flock, that is all types having undergone the various different processing steps, as related to the fiber surface. The filling quantity is to be supplied to the drum via a pump.

The admixture of flock and liquid phase takes place in a ratio of 1:20 and assures that if the fiber of the flock is evenly distributed in the liquid, the resulting mixture will rheologically act in the same manner as water. Investigations have shown that the coefficient of flow of such a mixture is no different from that of water.

Additional investigations have shown that if the mixture contains a uniform fiber thickness in the solution, the free movement of the individual fibers is lost if the ration of fibers to solution is changed from 1:20 to 1:15. This means that the distribution of the mixture in the centrifuge drum must be carried out in a condition intermediate these mixing ratios.

In the mixture the fibers are so distributed that their volumetric weight (assuming the liquid phase were taken away) would be 0.048 kg/dm$^3$. Given a density of the fiber which would correspond to a volumetric

weight of 0.1 kg/dm³, the fibers are already so interfelted that a shifting or distribution of the fibers relative to one another is no longer possible. In the centrifuge drum, however, after the residual liquid phase has been removed by centrifuging, and assuming a highest speed of rotation of the centrifuge, a volumetric weight is obtained for the fibers of 0.3 kg/dm³. This means that an interfelted ring of fibers is formed in the centrifuge drum, and is compressed in radially outward direction. Because the interfelting prevents the ring of fibers from accommodating itself to its increasing inner diameter, the ring will tear from its inner periphery towards its outer periphery and wedge-shaped gaps will form which converge in outward direction towards the surrounding wall of the drum and extend in longitudinal or axial direction of the drum. If the distribution was even over the circumference and the height of the drum while the fibers had freedom of relative movement, then the tearing of the ring of flock fibers will be evenly distributed over its circumference during further compacting, and will not disadvantageously influence the operations. However, if even distribution did not exist, then the ring will tear unevenly and form imbalances which necessitate shutting-down of the centrifuge.

Because of this it is necessary that the filling of the fiber-liquid mixture into the centrifuge drum take place while the drum rotates, and in order to obtain a controlled exit of the liquid the drum must rotate at increasing speed.

In order to assure that the drum will be properly emptied of contents, the drum is of cylindrical configuration and its walls are smooth and not provided with any kinds of steps or projections, gaps or undercuts. The drum advantageously rotates with a low speed, for instance between substantially 30 and 50 rpm.

In order to obtain a controlled ejection of liquid from the drum during rotation of the same, the combined cross sectional area of the perforations in the drum wall is relatively small. This means that relatively few perforations are provided for a relatively large drum, and these perforations need not be uniformly distributed over the entire drum wall. For this reason, the perforations are provided only in several annular zones in the drum wall.

It has been earlier mentioned that wedge-shaped gaps form in the ring of interfelted flock in the drum. When the drum, in which the formation of the gaps takes place at high-speed centrifuging operation—is subsequently operated at lower speed for removal of its contents, these gaps will close themselves because after elimination of the forces acting upon the ring of fibers, the latter behaves elastically and closes the gaps. The fibers at this time have a volumetric weight of approximately 0.15 kg/dm³. Of course, despite the fact that the gaps close, the separations which have resulted from the tearing of these gaps will remain. Because of the characteristics of the interfelted fibers, the ring cannot be peeled out of the drum with known mechanica means. For this reason the present invention resorts to an arrangement by means of which the fibers are removed via suction. It is necessary, however, that the arrangement be not susceptible to clogging by the fibers, and that it assures that all fibers are removed cleanly from the drum without leaving any residue, even if the fibers are very minute. Moreover, even the exterior of the arrangement for removing the fibers must be free of residue when the removal has been completed.

The problem is solved in the manner outlined earlier, by the particular configuration which has been set forth. The suction conduit of the arrangement can of course be raised and lowered into and out of the drum, and can be turned about the pivot located outside the drum. When the suction conduit with the intake nozzle moves into the drum and to working position, that is pivoted to a position in which its inlet is closely adjacent to the drum wall, the nozzle will pull off portion of the fiber ring and will free a strip of the inner wall of the drum in the region of the upper inlet end of the drum, without ever contacting flock. In other words, it will completely expose the inner surface of the drum wall without contacting the flock ring, and immediately adjacent the drum wall the further movement of the nozzle in direction towards the drum wall is then terminated by an appropriate mechanical abutment.

In operation, it is unavoidable that tufts of flock will fall from above onto portions of the nozzle and will tend to adhere to the latter. Although it is advantageous in accordance with the invention that the body of the nozzle be of circular cross section, so that the possibility for adherence is limited, the accumulation of even small quantities of flock is not permissible and must be avoided in accordance with the invention. For this purpose, a tube is provided adjacent the suction conduit, and compressed air is admitted from outside the drum into the tube. This compressed air is distributed via channels provided at the reverse side of the suction conduit and nozzle and a branch is provided which blows flock off the outer surfaces of the suction nozzle body.

A doctor blade is also provided on the suction nozzle, and as the latter approaches the inner surface of the drum wall, the doctor blade tends to loosen the flock layer. The compressed air used for blowing flock off the nozzle body is so directed that the loosened flock is blown by this compressed air towards the inlet of the nozzle, thereby facilitating its aspiration into the inlet and at the same time preventing accumulation of flock in the doctor blade itself.

Another problem area is that small flock fibers tend to adhere to certain surfaces, where they cannot be dislodged by the suction of the suction nozzle. This takes place on the drum wall itself as well as on the generally bell-shaped hub of the drum. According to the invention, these fibers are removed by providing at the reverse side of the suction conduit a channel of sickle-shaped cross section and a nozzle cooperating with it, so that compressed air can be directed against the drum wall and against the hub of the drum. This causes the fibers adhereing to these portions to be dried sufficiently so that the compressed air will blow them off. Due to the fact that the suction nozzle creates sufficient suction in the interior of the drum that air enters into the drum from the exterior, the thus dislodged individual fibers can be aspirated into and entirely removed by the suction nozzle, so that any danger that any of them might remain or might escape to the exterior is avoided.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following de-

scription of specific embdiments when read in connection with the accompanying drawing.

## BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a somewhat diagrammatic section of a centrifuge drum, showing the discharge arrangement according to the present invention in a side view and in operating position.

FIG. 2 is a fragmentary top-plan view of FIG. 1;

FIG. 3 is a section taken on line A–B of FIG. 1; and

FIG. 4 is a complete top-view of FIG. 1 for purposes of orientation.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the illustrated embodiment of FIGS. 1–4, it will be seen that reference numeral 1 identifies a centrifuge drum 1 having a plurality of annular zones 2 in which its circumferential will is provided with perforations. It further has a hub 3 of generally bow-shaped configuration by means of which it can be mounted for rotation about its central axis. This measure is too well known to require detailed discussion. The upper open end of the drum 1 is provided with a cover 5 having an opening 4 through which the discharging arrangement according to the present invention extends, this arrangement being identified with reference numeral 6.

As FIG. 1 shows particularly clearly, the arrangement 6 utilizes a suction conduit 7 of generally L-shaped configuration which is of course connected with a source of suction located exteriorally of the drum 1, for instance an exhaustor which is not illustrated. By means of conventional and therefore not illustrated expedients, the conduit 7 can be raised and lowered with reference to the axial direction of the drum 1, as well as being pivotable about a pivot axis which is coincident with or at least substantially parallel to the axis of rotation of the drum 1.

The front or end portion of the conduit 7 constitutes a suction nozzle having an inlet end 9 which extends at an angle as shown in FIG. 2. At that side of the conduit 7 which is forwardly directed insofar as the direction of rotation of the drum 1 is concerned, there is provided a doctor blade 10 (see especially FIGS. 3 and 4). That edge 11 of the doctor blade 10 which faces towards the inner surface of the drum 1 is inclined with reference to the longitudinal axis of that portion of the conduit 7 which is located within the drum 1. A curved wall portion 12 is provided between the doctor blade 10 and the suction conduit 7, forming a channel 13 which is connected with a pipe 14 that carries compressed air. In the region of the doctor blade 10 the channel 13 is provided with two nozzle-like slots 15 and 16 through which compressed air can escape in a direction towards the inner surface of the wall of the drum 1. These slots 15 and 16 are constituted by double walls 12*a* and 12*b*. A sickle-shaped channel 17 is provided at the reverse side of the conduit 7, and is also in communication with the pipe 14 carrying compressed air. The channel 17 extends from the vertical portion 8 of the conduit 7 up to the outlet end 9 where it forms a sickle-shaped gap 18 (see FIG. 2). A hollow member 19 is provided at the upper side of the conduit 7 to which it may be secured by welding, and the portion 19 is connected with the channels 13 and 17 via a passage 20, as shown in FIG. 2, in the direction towards the wall of the drum 1 the member 19 has a nozzle-shaped gap 21. Beneath the lower end 22 of the pipe 14, there is provided an air chamber 23 with which one or more circular nozzles 24, 25 are in communication.

In operation, the device 6 is so positioned that the outermost edge of its portion 9 is closely adjacent to the inner circumferential surface of the wall 1. When so positioned, the plane in which the inlet opening 26 is located defines with a tangent to the wall of the drum 1 an acute angle $\alpha$. Moreover, it also defines with the drum radius an acute angle $\beta$. The angle $\alpha$ must be smaller than the angle $\beta$ in order to assure that the distance of the edge 27 (see FIG. 2) from the wall of the drum 1 is smaller than the diameter of the inlet opening 26. This measures assures that a bunch or tuft of flock which passes through this space, cannot be so large that it could enter into and clog the inlet opening 26.

In the position shown in FIG. 1, the device 6 is shifted axially in the centrifuge drum (not in FIG. 4 that this is possible despite the hub) and in so doing removes all of the flock adhereing to the inner surface of the drum wall.

The compressed air which is ejected through the nozzle 15, 16, 21, 23 and 24, assures that no tufts of flock or even individual flock fibers can adhere to and remain on the device 6 itself or the hub 3. The nozzle 18, on the other hand, assures that all tufts of flock or individual flock fibers are blown off the inner surface of the wall of the drum 1 and can be readily aspirated by the conduit 7. After removal of the contents from the drum 1, the device 6 is withdrawn from the drum through the opening 4 and the drum is then ready for the next batch operation.

It will be understood that each of the elements described above, or two or more together, may also fine a useful application in other types of construction differing from the types described above.

While the invention has been illustrated and described as embodied in a device for discharging the contents of a discontinuously operating centrifuge, it is not intended to be limited to the details shown since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by appling current knowledge readily adapt it for various applications without omitting features that from the standpoint of prior art, fairly constitutes essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. In a discontinuously operating centrifuge, having a drum provided in an upper axial end with an opening, an arrangement for discharging the contents of the drum comprising, in combination, a suction conduit mounted for insertion into and removal from the drum through said opening, and for pivotal displacement within the drum between an operative position and an inoperative position, said suction conduit having a nozzle portion provided with an inlet opening arranged to be located closely adjacent to an inner circumferential surface of the circumferential wall of said drum and to

face opposite the direction of rotation of the drum, the plane of said inlet opening defining, when said conduit is so located, with a tangent to the circumferential wall of the drum a first acute angle, and with the drum radius a second acute angle which is greater than said first acute angle.

**2.** In a centrifuge as defined in claim **1**, wherein said a suction conduit has a portion provided with a doctor blade arranged to engage material adhering to said inner circumferential surface of said circumferential wall of the drum.

**3.** In a centrifuge as defined in claim **2**, wherein said doctor blade is provided with a channel extending longitudinally thereof and adapted to be connected with a source of compressed gas.

**4.** In a centrifuge as defined in claim **1**, wherein said suction conduit with a sickle-shaped passage extending longitudinally of said doctor blade to said inlet opening and forming at the same a sickle-shaped outlet gap, said passage being adapted to be connected with a source of compressed gas.

**5.** In a discontinuously operating cenrifuge having a drum provided in an upper axial end with an opening and a circumferential wall, an arrangement for discharging the contents of the drum, comprising, in combination, a suction conduit mounted for insertion into and removal from the drum through said opening, having a portion provided with a doctor blade arranged to engage material adhering to the inner circumferential surface of said circumferential wall of said drum, said doctor blade being provided with a channel extending longitudinally thereof and adapted to be connected with a source of compressed gas, said channel comprising two outlet slots one of which discharges compressed gas transversely of the elongation of the doctor blade; said suction conduit being mounted for pivotal displacement within said drum, and having a nozzle portion provided with an inlet opening arranged to be located closely adjacent to an inner circumferential surface of the circumferential wall of said drum and to face opposite the direction of rotation of the drum, the plane of said inlet opening defining, when said conduit is so located, with a tangent to the circumferential wall of the drum a first acute angle and with the drum radius a second acute angle which is greater than said first acute angle.

**6.** In a discontinuously operating centrifuge having the drum provided in an upper axial end with an opening and a circumferential wall, an arrangement for discharging the contents of the drum comprising, in combination, a suction conduit mounted for insertion into and removal from the drum through said opening, and for pivotal displacement within the drum, said suction conduit having a nozzle portion provided with an inlet opening arranged to be located closely adjacent to an inner circumferential surface of the circumferential wall of said drum and to face opposite the direction of rotation of the drum, said suction conduit being further provided inwardly spaced from said inlet opening with a chamber connected with a source of compressed air, and with outlet nozzle openings communicating with said chamber and arranged to direct compressed air in direction substantially towards the axis of rotation of said drum.

**7.** In a discontinuously operating centrifuge having a drum provided in an upper axial end with an opening, an arrangement for discharging the contents of the drum comprising, in combination, a suction conduit mounted for insertion into and removal from the drum through said opening, and for pivotal displacement within the drum, having a portion provided with a doctor blade arranged to engage material adhering to the inner circumferential surface of the circumferential wall of the drum; said conduit comprising a sickle-shaped channel extending longitudinally of said doctor blade, a hollow member mounted on said suction conduit and communicating with said sickle-shaped channel, said hollow member having a sickle-shaped discharge gap connected to a source of compressed gas, said discharge gap being so-oriented as to discharge compressed gas over an outer surface of said suction conduit.

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