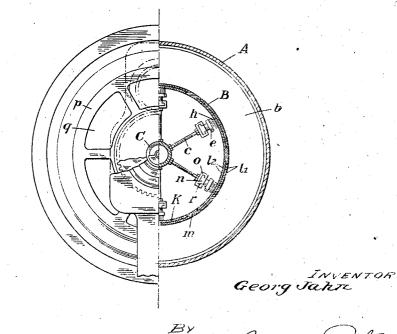


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Fig.3 G З 0F i B R 1M é ά Ba C 0F É

Fig.4



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DEVICE FOR THE SEPARATION OF SOLIDS OF VARIOUS PARTICLE SIZES CONTAINED IN A FLUID, ESPECIALLY IN THE MANU-FACTURE OF STARCH

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> (CL 233 - 2)7 Claims.

Centrifuges having closed housings are known in which the expulsion of the centrifuged solids is effected by means of a conveyor worm. Such a centrifuge consists of a wholly or partly conical 5 closed external drum driven by a hollow shaft, within which rotates, at a different rotary velocity an inner drum, which carries and moves a

- worm device. If the fluid which is to be centrifuged and which contains solids of varying size and varying specific gravities is introduced into the space between the outer and inner drums, at the narrower part of the outer drum, from the so-called inlet side, then as a result of the cen-
- trifugal force the solid, heavy components de-15 posit on the inner wall of the outer drum.

Whilst the lighter parts flow to the side located opposite the inlet, the heavier substances are scraped off the wall of the drum by the worm device and are conveyed to an outlet, for the

20 solid substances, located at the inlet side, during which they contact with a dry zone not touched by the fluid surface.

It has already been attempted to improve the operation of these centrifuges by constructing

25 the inner drum, which carries and moves the worm device, partly as a sieve drum and conducting the coarser solid substances, of the fluid introduced into the interior of the sieve drum, which do not pass through the latter, to the 30 outlet for the solid substances by a shorter path

by means of a separately driven worm. Since in this known improved centrifuge the finer solid substances thrown through the sieve drum are again combined at the outlet or a little

- 35 in front of this with the coarser solid substances which the sieve drum has not permitted to pass through this centrifuge, like the centrifuge with a completely closed housing mentioned initially, effects separation of the solid substances only ac-
- 40 cording to specific gravity, and not a separation according too the size of the particles. Separation in accordance with the size or nature, for example obstructiveness of the parts to be separated is however desired for many purposes.
- 45 For example, it is advantageous in the making of clay into paste or slurry, if the pieces of clay are separated from one another according to size and are moreover separated from the water. Such a double separation into at least three end
- $_{50}$ products could previously be carried out only by means of at least two separating apparatus or groups of apparatus arranged in series if treatment were to be carried out continuously and without loss of time. In particular the usual 55 process for the manufacture of starch requires,

on the one hand for the separation of the starch grains from the vegetable fluid of the initial raw material and from their coarser fibrous constituents on the other hand, at least two groups of separating apparatus, viz. in the case of modern processes, for example centrifugal separators on the one hand and washing-out apparatus on the other hand. In that case there is employed even at best one centrifuge fed with diluted shredding of the initial material and one fed with raw 10 starch milk, that is one centrifuge in front of and one following the washing-out apparatus, in the same process.

The object of the invention is to obviate the need for such a costly space and time wasting 15 accumulation and the arranging in series of separate separating apparatus in such separating processes. This is made possible in that these separating processes are carried out by centrifuging in one and the same centrifuge provided 20 with an additional inner sieve drum. In this case the separating action can be improved according to the invention by introducing into the inner or outer drum space, according to the object of the separation, an assisting agent, for 25 example a washing out or extracting fluid, steam or gas. A fluid is in this case preferably squirted into the interior of the inner sieve drum during the rotation of the drum, in order to employ for the separating processes the pressure increase 30 brought about by the centrifugal force.

The steps according to the invention can be employed with advantage for example in the preparation of clay, in the sugar industry and in the washing of coal. Particular advantages arise 35 however in the manufacture of starch, if according to the invention both the separation of the vegetable fluid from the shreddings of the initial raw material, especially potatoes, as well as the separation of the fibrous components from the 40 starch takes place in one and the same centrifuge. This is preferably done by introducing the shreddings of the raw initial material in dilute form into the inner rotating sieve drum where it is freed from the coarser fibrous constituents, 45 whereupon the starch with the finer fibrous constituents is separated from the vegetable fluid in the outer rotating drum. Preferably the starch is already washed in the inner drum by squirting therein a washing fluid, so that the inner drum 50 both takes over the role of the usual centrifuge fed with shreddings, or a corresponding device, and also replaces the usual following washing-out apparatus, whilst the outer drum operates in the usual connecting manner as a milk centrifuge and 55

removes the vegetable fluid, generally completely. A special milk centrifuge is therefore generally unnecessary. Any fibrous residues can however still be removed behind the centrifuge, for ex-

ample by means of a shaking sieve, whereupon for removing any residual vegetable fluid the starch milk can be introduced again into a centrifuge. For this purpose the outer drum space of a centrifuge having an additional inner sieve

- 10 drum is preferably employed, which inner drum serves for the further centrifuging of fibre water resulting from a previous centrifuge. If this still contains coarse shreddings, these are preferably further reduced in size prior to introduction into
- 15 the second centrifuge. Accordingly the mesh of the second centrifuge is preferably finer than that of the first. Consequently the process according to the invention may serve, first to separate in one centrifuge coarse pieces, for example
- 20 shreddings, from finer pieces and then these from a fluid, in order to subject the coarser pieces to a subsequent reduction in size and a further corresponding separating process. In both cases, fibre water or vegetable fluid originating from
- 25 the centrifuge itself or from a separating device running parallel thereto can be used for diluting the shreddings or for washing out purposes in order to economise in water.
- A centrifuge suitable for carrying out the proc-30 ess according to the invention includes, in a manner known per se, apart from the outer drum provided in the usual centrifuges, an additional inner sieve drum, which can be set in rotation with a suitable speed of rotation separately from
- 35 the outer drum. The outer drum can be constructed in the same manner as a known sieve drum, but is preferably a centrifuge of usual construction having a closed casing. For carrying out the said process the whole of the ma-
- 40 terial to be centrifuged is fed to the inner sieve drum. Contrary to the known centrifuge referred to, the centrifuge according to the invention is provided with separate outlet conduits for the solid substances which deposit on the inner
- 45 sieve drum and the usual drum respectively. Preferably feeding devices, which are preferably in the form of discharge worms or the like, and which are driven independently of the speed of rotation of the associated drum, are provided for
- 50 the two drum spaces and extend separately up to the associated outlet orifices, whilst in the said known centrifuge the discharge conveyor worm of the sieve drum conducts the discharge material to the discharge worm of the drum 55 having the closed casing.
- The outlet orifices of both drum spaces may according to the invention be preferably constituted by nozzles rotating with the drums, which nozzles are preferably arranged tangentially and
- 60 are in a manner known per se variable in the cross-section of their outlets in accordance with the measure of the material undergoing centrifuging. This variation in cross-section can be brought about by exchanging the mouth por-
- 65 tion of the nozzle or by adjusting devices for the cross-section of the outflow, and in such manner that as high a recovery as possible is obtained. An embodiment of the invention is illustrated
- 70 by way of example in the accompanying drawings, in which

Fig. 1 is a central sectional view taken along the axis of a centrifuge for carrying out the process according to the invention,

75 Fig. 2 shows on a larger scale an embodiment

of the device for supplying a washing-out or extracting fluid,

Fig. 3 is a central sectional view along the axis of a modified form of carrying out the invention, and

Fig. 4 is an elevational view of this centrifuge seen from the left in Fig. 3, partly in section through the sieve drum.

Figure 5 is a fragmentary vertical cross section illustrating a tangential nozzle arrangement. 10

The mixture of solids and fluid to be centrifuged enters the drum space formed within the inner additional sieve drum B between the latter and the central shaft C through the inlets D at one side of the centrifuge drum. This space 15 contains the discharge device for the coarser solid pieces, for example the fibres of the shreddings in the case of starch manufacture, which cannot pass through the drum B or the material stretched on it and which upon rotation of the 20 drum B are consequently deposited on the inside thereof under the action of centrifugal force. The discharge device consists of the conveyor members c, which are provided with inclined scraping heads e which slide along the inner wall 25 of the drum B. Upon rotation of the hollow shaft C at a rotary velocity different from that of the drum B, the coarser solid substances are in consequence thereof led by the conveyor members, preferably of a worm, to the outlet orifices 30 d, since the parts c of the conveyor members are rigidly secured in the hollow shaft C. The openings d feed into an annular space which is provided with outlet nozzles.

Instead of this device other conveying or scrap- 35 ing devices, in particular worm devices, can be mounted in the interior sleve drum space. The solid substances issuing from the outlet nozzles G are in general still mixed with a residue of the original fluid, which for example in the man- 40 ufacture of starch constitutes with these substances the so-called fibre water.

The nozzles F and G preferably are tangentially disposed as shown in detail in Figure 5, and each may include an adjustable lip L and 45 an adjustable wedge W by which movement of the lip can be effected to vary the cross-sectional area of the nozzle.

The main part of the fluid, which after separation of the coarser solid substances now con- 50 tains only the finer solids, passes through the openings or pores of the sieve drum or through the material stretched over it into the outer drum space which is formed by the outer closed housing A. This is set in rotation in the usual 55 manner, whereupon the heavier solids, for example the starch grains of the shredding in starch manufacture, are deposited towards the drum casing, whilst the fluid, which may still carry the lighter solids, for example finer fibres, passes 60 out of the centrifuge drum through the nozzles The solids deposited on the closed casing A F. are brought by a preferably automatic conveyor device, according to Fig. 1 by a conveyor worm b, to the outlet E, through which they leave the 65 centrifuge. The conveyor worm b is preferably connected to the sieve cylinder B, so that it can be driven therewith, but it may have a separate driving means, particularly if it is to be driven at a special velocity. The speed of rotation of 70 the worm b must in every case be different from that of the outer drum A.

According to the invention the hollow shaft C itself may be employed as the inlet for the washing-out fluid, in which case it should be pro-75 vided with squirting orifices. In the embodiment illustrated however the carriers for the conveyor members c are formed hollow, and serve as supply pipes from which an extracting fluid can issue through squirting orifices f. In this case also the hollow shaft, as will be seen at g at the inlet for the washing-out fluid, serves as a supply conduit for the orifices f.

For conveying the solid substances separated 10 out at the inner wall of the sieve drum to the outlet G, which might also be located on the inlet side of the centrifuge, brushes h or rubber strips or the like are provided as scrapers which rotate with the hollow shaft at a speed

- 15 different from that of the sieve drum. Since the conveyor members c always wear out in the course of time, their supports may be bent or resilient so that the centrifugal force presses the scraping heads against the wall of the sieve. For
- 20 the same purpose the heads alone may also be resiliently mounted on their supports. Together with the sieve drum B they constitute a rotating brushing and washing out apparatus.

In order not to interfere with the process of 25 deposition in the outer drum, when the fluid is thrown by the centrifugal force through the sieve drum, it is advisable to mount on the sieve cylinder, in a manner known per se, special guide or run-off plates H in front of the outlet orifices 30 for the fluid.

In each of the end walls of the centrifuge special in'ets may be provided for one of the drum spaces, for example for the introduction of vegetable fluid or fibre water in starch manufac-35 ture.

For driving the hollow shaft C, the sieve cylinder B and the shell A of the drum, there are provided three sets of gear wheels I, II, III. which are preferably so related that the sieve drum is

40 driven more slowly than the shell A but faster than the hollow shaft C, these three parts being driven from a common shaft i. Alternatively the parts A and C may rotate at the same speed but at a speed different from that of the part

45 B, and may have a corresponding drive. Differing from the embodiment according to

Fig. 1 the sieve drum B consists of two sieve cylinders B₁ and B₂ pushed one into the other and fitting tightly. The apertures 1₁ in the non-ex-50 changeable cylinder B₁ which is rotatably built

into the centrifuge have the greatest dimensions which could be required in any case of application of the centrifuge. The inner sieve cylinder B_2 consists of individual arcuate pieces K, which

- 55 are secured to the outer cylinder by means of swallow-tail shaped guide strips m. The pieces K are movable in the axial direction of the centrifuge in these strips, so that they can be pulled out of or pushed inwards through the openings q
- 60 of the end wall p of the outer drum A and the openings q_1 of the end wall p_1 of the inner drum B. The apertures l_2 of the inner cylinder B_2 register completely with the apertures l_1 of the cylinder B_1 in the embodiment illustrated, and 65 are of the same size as these. In this case the

sieve drum has the highest permeability.

If the permeability is to be reduced, different sieve inserts K having smaller apertures 1₂ can be inserted, which will only permit the passage 70 of corresponding'y smaller particles. These apertures 1₂, contrary to the arrangement shown in the drawings, register only partially with the apertures 1₁. The same effect could be obtained by slightly displacing the sieve inserts K 75 in an axial direction, until the apertures 1₂ are-

partly covered by solid wall parts of the inserts K.

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Those scraping heads e, which are in line in the axial direction are, contrary to the arrangement according to Fig. 1, mounted on a common 5 carrier-rail n. These carrier-rails have swallowtail shaped projections r, by means of which they can be pushed axially into correspondingly shaped recesses in guide members o. The guide members o are secured to the conveyor arms c 10 at a distance from the central axis which permits of the carrier-rails being pulled out or introduced through the openings q and q_1 . In this manner it is possible to exchange the scraping members in a series one after the other, without 15 the centrifuge requiring to be dismantled for this purpose. It is to be understood, of course, that the openings g will be closed by suitable remevable cover members as indicated at Y in Figure 3. The exchange is desirable in order to be 20 able to suit the type and nature of the brush heads h to the size of the apertures l_2 of the sieve inserts K actually employed and also on account of wear of the brush heads.

In order to facilitate the reintroduction of 25 material, a cup-like inlet member IM may be affixed to the end of the casing A, as shown in Figures 1 and 3, to direct the material through suitable casing end openings into the interior of the drum 3 from whence it flows through over- 30 flow openings OF into the surrounding casing A.

The driving mechanism I, II, III, is for the sake of clearness not illustrated in Fig. 2 but does not interfere with the exchange of the sicve inserts K or of the carrier rails n, since at 35 least one of the openings q on the side of the driving mechanism opposite the driving shaft i is uncovered.

The squirting of the washing-out agent into the sieve drum can be effected as in the case of 40. the embodiment shown in Fig. 1 through openings f in the conveyor arms c.

By means of the device described above there can be obtained, as will be apparent, firstly a separation and separate separation of the larger 45 from the smaller solid substances, and secondly a separation of different kinds of solid substances adhering to each other by virtue of the extraction or washing out.

I claim:

1. A device comprising a rotary screening drum having a coarse solids discharge outlet at one end thereof, a rotary coniform wall surrounding said drum in spaced relation and having a light fines discharge outlet at one end and a 55heavy fines discharge outlet at the other end thereof, means for introducing into said drum a volume of pulp or fluid from which substance of different particle sizes is to be separated, means for scraping coarse solids from the drum 60 and feeding them toward the coarse solids discharge outlet, said coniform wall serving to collect heavy fines and direct light fines toward the light fines discharge outlet, means for scraping 65 heavy fines from the wall and feeding them toward the heavy fines discharge outlet, a central shaft on which said coarse solids scraping means is supported, said heavy fines scraping means being carried by said drum, and means for rotating said shaft said drum and caid wall, said drum 70 being rotated at a speed differing from the speed of rotation of said wall and shaft for rendering said scraping means effective.

2. Apparatus for the separation of solid constituents of various particle size, which are con-75

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tained in a pulp or in a liquid, from each other and from the liquid or from the lighter material contained in the liquid, particularly in the manufacture of starch, comprising a rotary filter drum, a rotary conical imperforate drum encompassing said first drum and rotatable independently thereof, means for supplying all the pulp or liquid to the filter drum, means rotatable relative to the filter drum for withdrawing the coarse solid

- 10 constituents from the filter drum, means rotatable relative to the imperforate outer drum for withdrawing heavy solid constituents, which have passed through the filter drum, at the reduced end of the imperforate outer drum, and means 15 for removing the remaining liquid at the other end of the imperforate outer drum, the discharge means on the imperforate outer drum being independent of each other and of the discharge
- means of the filter drum. 20 3. Apparatus for the separation of solid constituents of various particle size, which are contained in a pulp or in a liquid, from each other and from the liquid or from the lighter material contained in the liquid, particularly in the manu-
- 25 facture of starch, comprising a rotary filter drum, a rotary conical imperforated drum encompassing said first drum and rotatable independently thereof, means for supplying all the pulp or liquid to the filter drum, means rotatable rela-30 tive to the filter drum for withdrawing the coarse solid constituents from the filter drum, means
- rotatable relative to the imperforate outer drum for withdrawing heavy solid constituents, which have passed through the filter drum, at the re-
- 35 duced end of the imperforate outer drum, means for removing the remaining liquid at the other end of the imperforate outer drum, the discharge means on the imperforate outer drum being independent of each other and of the discharge 40 means of the filter drum, and means for introducing a wash-out fluid into said filter drum.

4. Apparatus for the separation of solid constituents of various particle size, which are contained in a pulp or in a liquid, from each other

45 and from the liquid or from the lighter material contained in the liquid, particularly in the manufacture of starch, comprising a rotary filter drum. a rotary conical imperforate drum encompassing said first drum and rotatable independently 50 thereof, means for supplying all the pulp or liquid to the filter drum, means rotatable relative to the filter drum for withdrawing the coarse solid constituents from the filter drum, means rotatable relative to the imperforate outer drum for 55 withdrawing heavy solid constituents, which have

passed through the filter drum, at the reduced end of the imperforate outer drum, and means for removing the remaining liquid at the other end of the imperforate outer drum, the discharge means on the imperforate outer drum being independent of each other and of the discharge means of the filter drum, said means for withdrawing heavy solid constituents from the filter drum including a hollow shaft portion through which a wash-out fluid is introduced into said 10 filter drum.

5. Apparatus for the separation of solid constituents of various particle size, which are contained in a pulp or in a liquid, from each other and from the liquid or from the lighter material 15 contained in the liquid, particularly in the manufacture of starch, comprising a rotary filter drum, a rotary conical imperforate drum encompassing said first drum and rotatable independently thereof, means for supplying all the pulp or liquid 20to the filter drum, means rotatable relative to the filter drum for withdrawing the coarse solid constituents from the filter drum, means rotatable relative to the imperforate outer drum for withdrawing heavy solid constituents, which 25 have passed through the filter drum, at the reduced end of the imperforate outer drum, and means for removing the remaining liquid at the other end of the imperforate outer drum, the discharge means on the imperforate outer drum 30 being independent of each other and of the discharge means of the filter drum, said means for withdrawing heavy solid constituents from the filter drum including filter drum scraping brush elements disposed in angular relation to the axis 35 of the filter drum, and said means for withdrawing solid constituents from the imperforate outer drum including a spiral scraper vane carried by the filter drum.

6. An apparatus as defined in claim 2, in which 40 the filter drum includes superposed shell portions having registering apertures and which are relatively movable to vary the effective areas of registry of said apertures to alter the filtering effect of said filter drum. 45

7. An apparatus as defined in claim 2, in which the means for withdrawing heavy solid constituents from the filter drum includes drum scraping brush elements disposed in angular relation to the axis of the filter drum and aligned in groups, 50 and bars supporting groups of the brushes and being removable from the filter drums with the groups of brush elements thereon.

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