Aug. 9, 1932. G. TER MEER 1,871,284

CENTRIFUGAL SEPARATOR FOR THE TREATMENT OF FLUIDS OR SLUDGES

Filed July 15, 1930 5 Sheets-Sheet 1

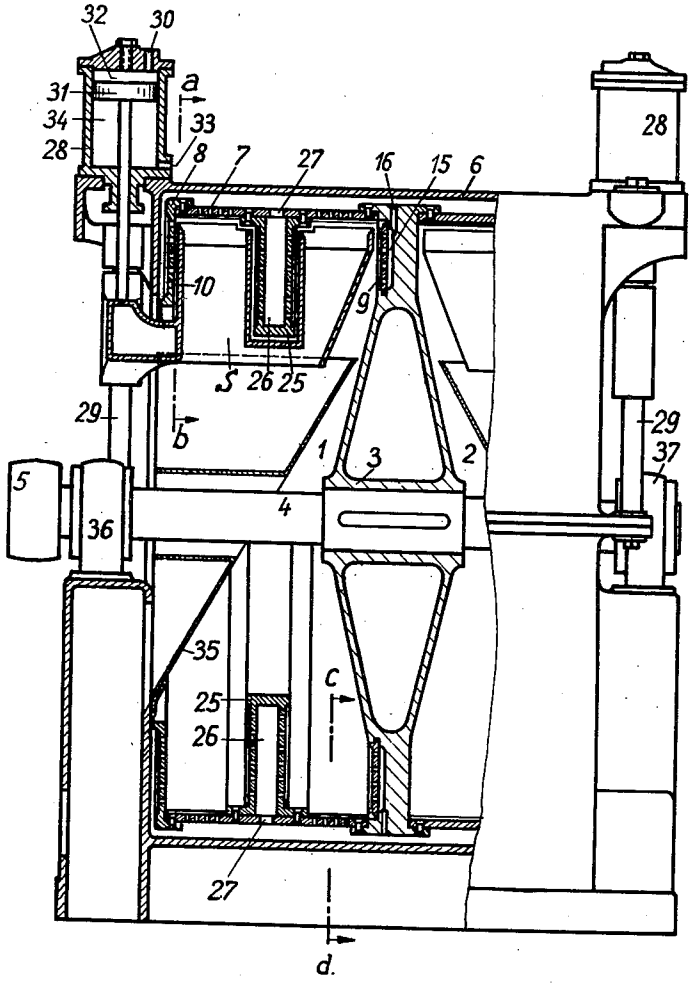


Fig. 1.

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Filed July 15, 1930 5 Sheets-Sheet 2

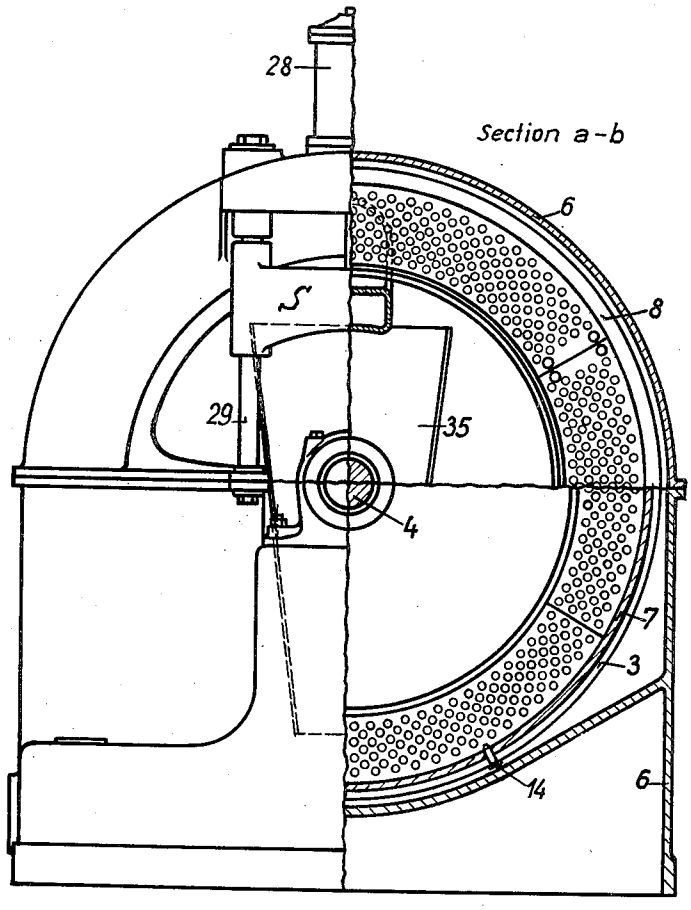


Fig. 2.

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CENTRIFUGAL SEPARATOR FOR THE TREATMENT OF FLUIDS OR SLUDGES

Filed July 15, 1930 5 Sheets-Sheet 3

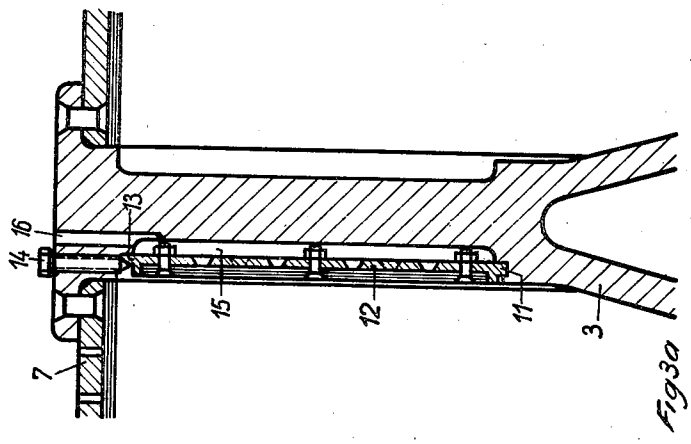


Fig 3a

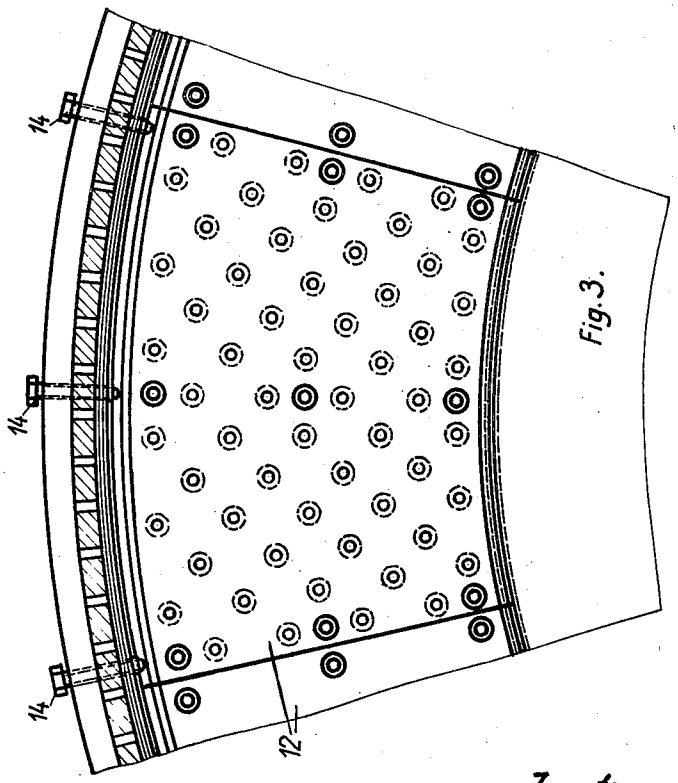


Fig. 3.

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Aug. 9, 1932. G. TER MEER 1,871,284

CENTRIFUGAL SEPARATOR FOR THE TREATMENT OF FLUIDS OR SLUDGES

Filed July 15, 1930 5 Sheets-Sheet 4

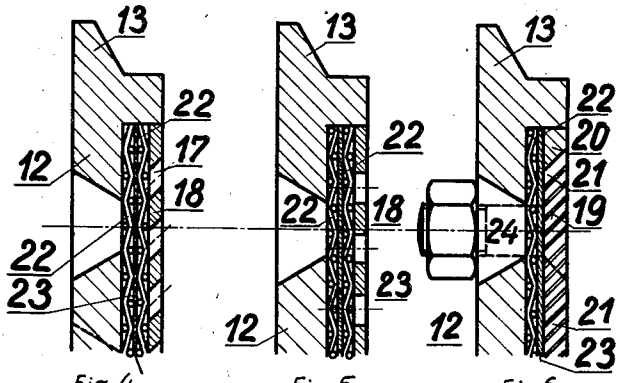


Fig. 4 Fig. 5 Fig. 6

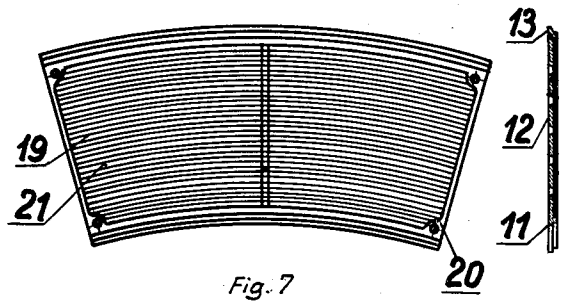


Fig. 7

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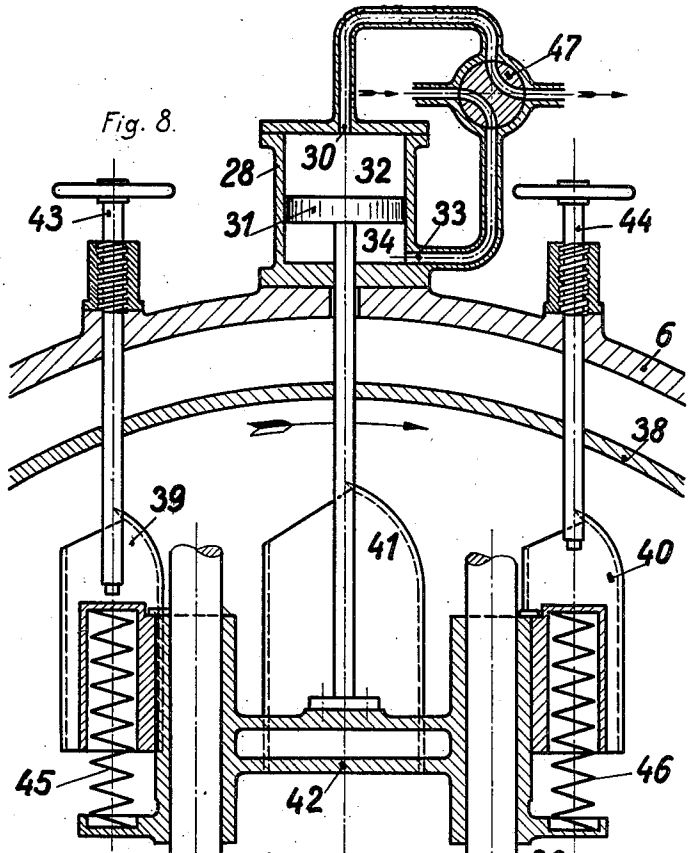
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Aug. 9, 1932. G. TER MEER 1,871,284

CENTRIFUGAL SEPARATOR FOR THE TREATMENT OF FLUIDS OR SLUDGES

Filed July 15, 1930 5 Sheets-Sheet 5

Fig. 8.



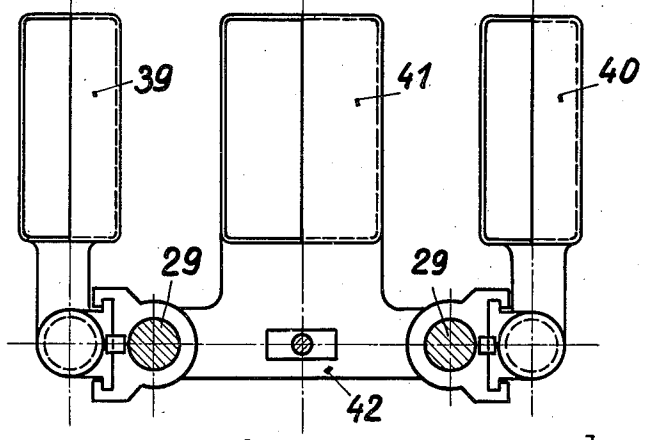


Fig. 9.

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Patented Aug. 9, 1932

1,871,284

UNITED STATES PATENT OFFICE

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CENTRIFUGAL SEPARATOR FOR THE TREATMENT OF FLUIDS OR SLUDGES

Application filed July 15, 1930, Serial No. 468,020, and in Germany September 12, 1928.

This invention relates to centrifugal machines for separating solids from fluid or sludgy materials owing to their respectively different specific gravity. The purpose of the invention is to improve the said centrifugal machines in design in order to increase the output and thereby the efficiency of such machines.

The common type of centrifugal machines, which serve for purifying of liquids or for the separation of the different components of certain materials, is divided into two classes, according whether the basket is perforated or imperforated.

Centrifugal machines with baskets having a perforate wall, as experience has proved, can be employed for the treatment of liquors in an economical manner only if the solids extracted from the liquor form a film or layer on the wall of the basket, which has large pores and thereby provides an easy passage for the liquid to be thrown out. There are however numerous kinds of sludge, the separation of which from the liquors by means of perforate separators with walls serving as filtering surfaces is either impossible or at least very difficult and unsatisfactory. In such cases the centrifugal force presses the fine-grained sludge with such pressure onto the filter or sieves of the basket, that the latter are quickly choked and the escaping liquor prevented from passing through the layer or film of solids radially in direction of the centrifugal force. Owing to the deposit on in layers a steadily thickening compressed film of solids is soon formed even with coarse-grained materials, as experience has proved such film soon becomes impermeable and thus foiling all attempts to attain an efficient service.

One of the objects of the present invention is to increase the efficiency of such centrifugal separators considerably through an increase of the filtering surfaces, namely by making those surfaces, which are vertical or nearly vertical to the axis of the basket also into filters besides the cylindrical part of the basket. In order to provide means for the hydro-extraction of those parts of the material under treatment, which are furthest from the walls of the basket, and in order to accelerate the hydro-extraction, the invention provides, that double-walled filters should be added in the interior of the basket, such additional filters to be arranged vertically to the axis of the basket. The liquor escaping through the additional filtering surfaces of the double-walled filters is thrown out of the machine radially through the centrifugal force and passes away through holes or slots in the wall of the basket.

A further object of the present invention is the sub-division of the upper and lower filtering surfaces of the basket into segments, so that the fitting of the said filtering surfaces or the eventual exchange of the same in case of need on account of damage or wear is facilitated and accelerated, whereby the running expenses are considerably lessened, because it will no longer be necessary to renew the total lateral or upper and lower filtering surfaces of the basket in case of repairs or replacements as used to be the practice formerly.

A further object of the invention is the avoidance of choking of the filter openings for the axial passage of the liquor in such manner, that the openings are arranged obliquely, so that any solid particles, which should accidentally get into the openings, will be thrown out again in the direction of the centrifugal force. This oblique arrangement of the filter openings in the lateral walls of the basket offers no longer an opportunity for the thrown-out solids to accumulate and thus gradually close the openings.

If further in a plant large volumes of fluids or sludges are to be treated, wherefor formerly two independent sets of separators were used, this invention provides for the mount-

ing of such two baskets on one common shaft at either side of one common hub, so that a minimum of floor space will be required. This part of the invention can be applied to perforate or imperforate baskets in like manner.

Finally this invention provides, that on imperforate baskets of centrifugal separators, in which for instance the town sewage is purified, and where it is important that the separated fluids should be as clear as possible, a perfect result is attained by the provision of separate peeling devices for the different strata, as formed under the influence of the centrifugal force, namely for instance, clear liquor, sludge (composed of lightly cohering particles of material) and solids, such peeling devices to extend preferably over the whole length of the basket. The various independent peeling devices come into action automatically and in succession and are adjustable regarding their depth of cutting according to the varying thicknesses of the different strata owing to the changeable nature of the material under treatment.

By means of all these improvements the value and efficiency of centrifugal separators is greatly increased.

In order that the invention may be more clearly understood these and other features of my invention will be hereafter fully described and pointed out, and are illustrated in the accompanying drawings in which, viz:

Figure 1 is a central vertical section taken longitudinally, showing a centrifugal separator constructed in accordance with my invention,

Figure 2 is a section on the lines *a*—*b*, *c*—*d* of Figure 1,

Figure 3 shows a front elevation of a segment of the filter embodying the present invention and serving as the lateral filtering walls of the basket,

Figure 3*a* shows a side elevation of the construction shown in Figure 3,

Figure 4 shows in an enlarged scale the top part of a filter segment with oblique holes or openings in the covering plate,

Figure 5 shows also a top part of a filter segment with vertical holes or openings in the covering plate,

Figure 6 shows a filter segment built up from laminations, producing openings running in an oblique direction to the axis of the basket,

Figure 7 shows a laminated filter segment in front and side elevation in a smaller scale,

Figure 8 shows the arrangement of three peeling knives within the basket of the machine with adjusting device to the prevailing thickness of the stratum of material to be removed and the actuation of the said knives by a common pressure cylinder,

Figure 9 shows a plan view of the automatic peeling knife arrangement according to Figure 8.

In these drawings 1 represents a perforate basket and 2 an imperforate basket (without filtering surfaces), which are both mounted in this case on a common hub 3 on the shaft 4. The centrifugal baskets 1, 2, are made to revolve by means of the belt pulley 5. The outer, stationary casing 6 surrounds both baskets 1 and 2. The perforate basket 1 is designed in such manner, that besides the usual perforation in the peripheral wall 7 of the basket, passages 10 are provided in similar end walls 8 and 9 of the basket, so that part of the liquor of the material under treatment in the machine is permitted to leave the basket 1 in an axial direction. The lateral filtering walls 8 and 9 are preferably formed in segments in order to provide quick and easy means of exchanging them. If it is found, that the lateral filtering walls 8 and 9 are damaged at any spot, only the damaged segment need be removed and repaired or exchanged for a new one if beyond repair.

The fastening of the said filtering walls 9, can for instance be carried out, as the same is subdivided into segments 12, by recessing the hub member 3 as shown in Figure 1. The radially inner edge 11 of the filtering segment 12 fits into a corresponding groove of the hub member 3, whilst the radially outer edge portion 13 of the filtering segment 12 is held by a screw 14 (Fig. 3) or other suitable means, which can be operated from outside the basket 1. The liquor, which leaves the basket through the filtering walls 9 in an axial direction, flows into the recess 15 and is thrown by the centrifugal force through the hole 16 in the hub member 3. This example of an arrangement of the filtering segments of the lateral filtering walls 9 offers the advantage, that the hub member 3 is not weakened by axially arranged passages. The filtering segments arranged on the opposite filtering wall 8 can be placed for instance into annular recesses of the perforate basket wall and fixed to it by means of screws, rivets or other suitable devices. The filtering segments may be arranged on the inside or outside of the lateral basket wall.

In order to avoid the clogging or choking of the openings in the lateral filtering walls 8 and 9 during working, apart from the gradually accumulating layer of centrifuged material, these openings are arranged in an oblique direction to the path of the centrifugal force, as shown distinctly on Figures 4 and 6. Figure 4 shows such oblique perforations 17 on the covering perforated plate 18. A similar effect can be obtained on the filtering surfaces according to Figures 6 and 7 by building the filtering segments from laminations. These narrow, obliquely arranged laminations 19 can be built into a segment by different ways. For instance the various

laminations 19 may be set into a segment-shaped frame 20, made of channel-shaped material, and held therein by distance pieces in proper order as desired (distance pieces are not shown). It is also possible to fasten the laminations 19 in the segment-shaped frame 20 by riveting, screwing or welding same to the radial sides of the frame at the desired intervals 21.

If the obliquely arranged passages 17 or 21 are adopted in accordance with the invention, any solid particles, thrown accidentally into these said passages will always be radially towards the envelope of the basket under the influence of the centrifugal force.

Generally the separate filtering segments for the filtering surface 9 consist of segment-shaped, perforated baseplate 12, to which are fastened by means of counter-sunk screws 24 or other suitable means one or several sheets of wire netting 22 and a perforated covering plate 18 or 20 with one or more layers of filtering cloth 23 interposed. The perforated covering plate 18 or 20 can however be made strong enough, that the baseplate 12 can be dispensed with.

The enlarged filtering surface of a perforated type as obtained on the basis of the above description offers amongst others the advantage, that during the charging period a large part of the liquor, to be separated, will escape axially, which means the saving of time during the charging of the basket 1 with material to be treated. If further, after a certain period of centrifuging the radial passages of the basket envelope 7 becomes more or less obstructed, the liquor is still able to follow the line of least resistance, namely by the lateral filtering surfaces 8 and 9 for their escape, which advantage is of special importance with less permeable material under treatment. This arrangement in accordance with the invention, offers the further advantage, that the separated liquor is not forced to penetrate into and through the various strata of centrifuged material as was the case hitherto, thereby rewetting the already dried material, which would go on as long as the charging period is in progress and the innermost layer of material has been separated from the liquor. An arrangement in accordance with this invention will also shorten the time required for centrifuging and warrant a satisfactory degree of dyeness at the same time.

In order to separate the liquor from those portions of the material under treatment, which are farthest removed from the filtering surfaces 7, 8 and 9 of the basket 1, some additional filtering surfaces can be provided, 25, which are arranged vertically to the basket shaft 4, therefore radially, and can be fixed to the basket envelope 7 by means of set screws etc. These additional double-walled filtering devices 25 can be fitted to the basket 1 at all those spots, where the liquor to be separated meets with great resistance during its escape from the basket. Through the provision of this new device, the material under treatment will be evenly dried in all parts of the basket, a result which has hitherto been limited through the size of the basket. The liquid passing through the passages of the additional filtering surfaces 25 flows into the annular cavity 26 of the latter and hence under the influence of the centrifugal force to the outside through the radial holes 27 in the basket envelope 7. In order not to decrease unduly the holding capacity of the basket 1 through the fitting of these additional filtering members 25, these will be made as narrow as possible in the axial direction of the shaft. In order to allow for the fitting of these additional filtering members 25, the scraping devices S for the removal of the dried material etc. are given a corresponding shape as shown on Figure 1. The peeling knife S is moved up and down on the columns 29 by means of the control cylinder 28, which is actuated under pressure of oil, compressed air etc. The pressure fluid enters the cylinder space 32 in front of the control piston 31 through the port 30, whilst 33 is the port for the pressure fluid into the space 34 below the control piston 31. The peeled-off dried material is taken away from the basket by means of the discharge trough 35.

If a plant has to deal with large quantities of material, better economy can be obtained by the arrangement of two centrifugal baskets 1 and 2 on a common hub member 3, whereby the maximum output is obtained on a minimum floor space, amounting in reality to the output of two separately erected machines. The common hub member 3 is best arranged between the two bearings, so that the stress of the bearings 36 and 37 is evenly distributed. Such twin arrangement of baskets on a minimum floor space permits the operating of the two baskets independent from each other but alternately, so that the various phases of a working period, such as charging, discharging etc. will be timed in such way that the overload on the driving motors and the congesting of the charging and discharging conduct is avoided as much as possible and an even and balanced running ensured. It is also possible, that two different kinds of material may be treated in the two baskets. Such twin plant corresponds, as explained, with the employment of two separate plants, but with the difference, that operation, required floor space, required power and first cost are considerably more advantageous in a twin set. If the twin set is used for similar working periods according to the invention, another advantage is secured by having them operated by a common control gear.

It is immaterial according to this invention whether a perforated or imperforated type of machine is used. The advantages gained by the twin arrangement are the same.

Figures 8 and 9 show a device for the automatic discharge of imperforated type machines 28, such as are used for the treatment of town sewage or similar sludgy substance. The difficulties met with hitherto on such machines, were, that the separated, purified liquid has to be removed in its clearest stage without taking away at the same time any portion of the separated solids, because such action would lead at once to a clouding of the former. Such difficulty is removed by this invention, through the employment of a separate peeling device for each of the various strata of the treated material, such device being specially adapted to the nature of the portion of the material to be taken out by the said peeling device for the basket 38. In the example used, wherein the basket 38 is for instance employed in the treatment of town sewage, the peeling scoop 39 in the shape of a tube serves for the removal of the purified stratum of liquor, the peeling device 40 for the following stratum of sludge and the peeling knife 41 for the solids clinging to the inside of the basket envelope. All three peeling devices are moved in a straight line by the common peeling knife carrier 42 along the columns 29 in an up and down direction, whereas this movement is caused by the common control cylinder 28, arranged on the common stationary casing 6, this cylinder being under pressure of oil or other suitable medium, which is alternately led into the cylinder above or below the piston 31. The peeling devices 39, 40 are adjustable to suit the nature and composition of the material under treatment, so that their action, namely the peeling operation, is interrupted according to the adjustment. In order to attain the automatic action adjustment spindles 43 and 44 are provided, which will prevent the peeling devices from following their path after coming in contact with the said spindles 43 and 44. As the peeling knife carrier 42 travels further however, the peeling device 39 and 40 are under spring pressure from the springs 45 and 46, so that the springs can be compressed as soon as the peeling devices 39 and 40 come in contact with their respective stops at the adjusting spindles 43 and 44, the compression of the springs being able to take up the whole of the remaining path of the peeling knife carrier 42, whilst the peeling devices 39 and 40 rest against the stops and only the peeling knife 41 proceeds on its path and does its work.

The action of this new and automatic peeling device is as follows:

When the sludge in the basket 38 has been centrifuged, the peeling device comes into action, whose members 39 and 40 have been adjusted to their respective correct length of cut by means of the control spindles 43 and 44 according to the thickness of layer to be removed by each of the same. The change-over valve 47 is adjusted in such manner, that the pressure fluid employed enters the space 34 underneath the piston 31 through the port 33 of the cylinder. The piston 31 is thereby lifted upwards and carries with it the peeling knife carrier 42 and the three peeling devices 39, 40 and 41 along the columns 29 acting as guides. Owing to this "feed" movement the peeling device 39 comes first into action for clearing away the purified liquor, because the cutting edge of the peeling device 39 is in advance of the other edges of 40 and 41, whilst these latter edges are also brought forward, but will not come into action owing to their retarded position. The spindle 43 is adjusted in such manner, that after the removal of the purified liquor the peeling device 39 comes into contact with the former and remains stationary, whilst the peeling device 40 comes into action. During this period the spring 45 of the peeling device 39 will be correspondingly compressed during the further progress of the peeling knife carrier 42. The peeling device 40 remains in action until it comes into contact with spindle 44, which has also been adjusted in accordance and correspondingly with the thickness of the respective layer to be removed by the said peeling device 40. After the second peeling device 40 has completed its work, the peeling knife 41, whose action is retarded in relation to the peeling devices 39 and 40, becomes active, whilst the latter are resting against their respective stops 43, and 44, and the springs 45 and 46 are further compressed during the continued progress of the peeling knife carrier 42.

After the removal of the final layer, which rests on the inside of the basket envelope 38, the change-over valve 47 is turned, so that the admission of pressure fluid to the space 34 underneath the piston 31 is interrupted, whilst pressure fluid enters the cylinder through the port 30 into the space 32 above the piston 31. The piston 31 is thereby forced downward and carries with it the peeling knife carrier 42 and the peeling devices 39, 40 and 41 into the original position (out of action).

Favourable conditions can further be obtained during the peeling operations of the various layers by the use of peeling devices, extending over the whole length of the basket. A broad peeling knife or scoop is a special advantage for the removal of the liquid layer, because the formation of eddies and lateral swirls, known to exist hitherto, can thereby be avoided.

The above described new automatic peeling device warrants a perfect and neat removal of the purified liquor in its clearest

condition. A further advantage is gained by the possibility of selecting the most suitable shape for the various different peeling devices in accordance with the particular nature of the stratum to be removed by the same.

The above described invention can be applied in a suitable manner to centrifugal extractors with vertical shafts also.

Having thus fully described the construction of a machine embodying my invention, so that others skilled in the art can utilize the same, I am aware that many modifications can be made therein without departing from the scope of my invention. Therefore, what I claim as new and desire to secure by Letters Patent is:

1. A centrifugal separator including a horizontally disposed shaft, and a basket mounted for rotation with said shaft, said basket having a cylindrical wall, and an end wall extending radially inwardly from said cylindrical wall, said end wall having perforations inclined radially outwardly towards the interior of the basket, whereby any solid material disposed in said perforations will be urged towards the interior of said basket under the action of centrifugal force.

2. A centrifugal separator including a shaft, and a basket connected for rotation with said shaft, said basket including a cylindrical wall, and an end wall connected to said cylindrical wall and extending radially inwardly therefrom, said end wall including a plurality of segmentally shaped frame members, and a plurality of slats mounted on each of said frame members, in spaced relationship with each other, and inclined radially outwardly towards the interior of the basket to provide inclined passageways, whereby any solid material disposed in said passageways would be urged towards the interior of the basket under the influence of centrifugal force.

3. A centrifugal separator including a shaft, a basket mounted for rotation with said shaft, a pair of filtering plates extending radially inwardly from said basket intermediate the ends thereof, and a cylindrical wall connected to the inner periphery of said filtering plates, the portion of the basket between the outer peripheries of said plates being provided with openings to permit the passage of liquid therethrough.

4. A centrifugal separator including a horizontally disposed shaft, a hub member connected to said shaft, a web member connected to said hub member and extending radially outwardly from said hub member, and a basket connected to said web member for rotation therewith, said basket including a cylindrical wall having one end thereof disposed adjacent the outer periphery of said web, and end wall members extending radially inwardly from the ends of said cylindrical wall, said end walls including perforated base plates segmentally shaped, a sheet of wire netting and a sheet of filtering cloth connected to each of said base plate sections, and shaped corresponding to the segmental shape of their associated base plates, said sheets of filtering cloth and wire netting being connected to their associated base plate sections, whereby each of said segmental base plates and their associated wire netting and filtering cloth sheets may be fitted or taken out of the basket as a unit, said web member being provided with an annular groove for receiving the inner periphery of the end wall adjacent thereto, said last mentioned end wall being spaced from said web to provide a radially extending passageway leading to the outside of the basket.

5. A centrifugal separator including a horizontally disposed shaft, a pair of spaced bearings for said shaft, a hub member connected to said shaft between said bearings, said hub member having connected thereto an imperforate web extending radially outwardly therefrom, and a pair of baskets arranged on opposite sides of said web between said bearings and supported entirely by said web, whereby the flow of liquid from one basket to the other is prevented, one of said baskets including a cylindrical wall, and a perforated end wall extending radially inwardly from the end of said cylindrical wall adjoining said web, said end wall being spaced from the web to provide a radially extending passageway from the interior of said basket to the outside thereof.

6. A centrifugal separator including a rotatable basket, means for removing the separated liquid from the interior of said basket, a plurality of peeling knives mounted in the interior of said basket, and means for stopping the peeling movement of said peeling knives successively, whereby each of said knives will remove a different stratum of solids collected in the interior of said basket.

7. A centrifugal separator including a rotatable basket, means for removing the separated liquid from the interior of said basket, a peeling knife carrier, means for moving said carrier towards the periphery of said basket, a plurality of peeling knives mounted on said carrier, and means for successively stopping said peeling knives at a predetermined distance from the peripheral wall of said basket, whereby a predetermined stratum of solid collected in the interior surface of said basket may be removed by each of said peeling knives.

8. A centrifugal separator including a rotatable basket, means for removing the separated liquid from the interior of said basket, a peeling knife carrier, a rod for guiding said carrier therealong, fluid pressure means for moving said carrier along said rod, a peeling knife spring-mounted on said carrier, and a

spindle disposed in the path of travel of said peeling knife, whereby said knife will be stopped by said spindle after said knife reaches a predetermined position with respect to the periphery of said basket.

9. A centrifugal separator including a rotatable basket, means for removing the separated liquid from the interior of said basket, a scoop mounted for movement in the interior of said basket and having the form of a conduit, and a peeling knife at one end of said scoop, said scoop being adapted to receive the solids peeled off from the basket by said knife, means for moving said knife in a direction parallel to the radius of the basket towards the periphery of said basket, and means for stopping the further movement of said knife after it has reached a predetermined position with respect to said basket.

10. A centrifugal separator including a rotatable basket, a knife carrier, fluid actuated means for moving said knife carrier towards the periphery of said basket, a knife spring-mounted to said carrier, a spindle disposed in the path of travel of said knife, and means for setting said spindle in any selective position, whereby the end of said spindle will come in contact with said knife and stop its further travel towards the periphery of said basket after said knife has reached a predetermined position with respect to said basket.

11. A centrifugal separator including a horizontally disposed shaft, a pair of spaced bearings for said shaft, a hub member connected to said shaft and disposed centrally between said bearings, an imperforate web connected to said hub and extending radially outwardly therefrom, and a pair of peripheral walls rigidly secured to said web and extending in opposite directions therefrom, and supported entirely by said web, and forming with said web a part of separate baskets.

12. A centrifugal separator including a horizontally disposed shaft, a pair of spaced bearings for said shaft, a hub member connected to said shaft between said bearings, an imperforate web connected to said hub and extending radially outwardly therefrom, a pair of peripheral walls rigidly secured to and supported entirely by said web, said web being imperforate, whereby the flow of liquid from one basket to the other is prevented, a peeling knife mounted in each of said baskets, and means for independently moving each of said knives into peeling relationship with its associated peripheral wall.

13. A centrifugal separator including a rotatable basket mounted on a horizontal axis, a tubular conduit open at the upper end and extending into said basket, and having a peeling edge at its open end extending substantially parallel to the axis of the basket, a vertical guide parallel to a radius of said basket, and means for moving said conduit vertically along said guide to vary the position of said edge in respect to the periphery of said basket.

14. A centrifugal separator including a rotatable basket, a tubular conduit terminating in a scoop mounted in the interior of said basket, and having a peeling edge at this end extending substantially parallel to the axis of said basket, and means for moving said conduit endwise and substantially radially of said basket.

In testimony whereof I affix my signature.

DR. GUSTAV TER MEER.