Nov. 4, 1930. A. NYROP 1,780,655

SLUDGE SEPARATOR

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Fig. 1.

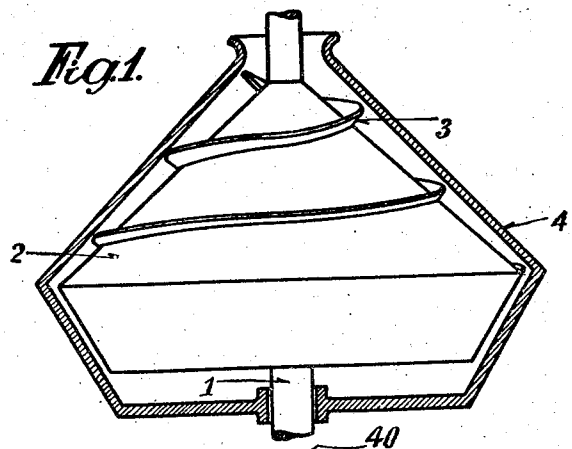
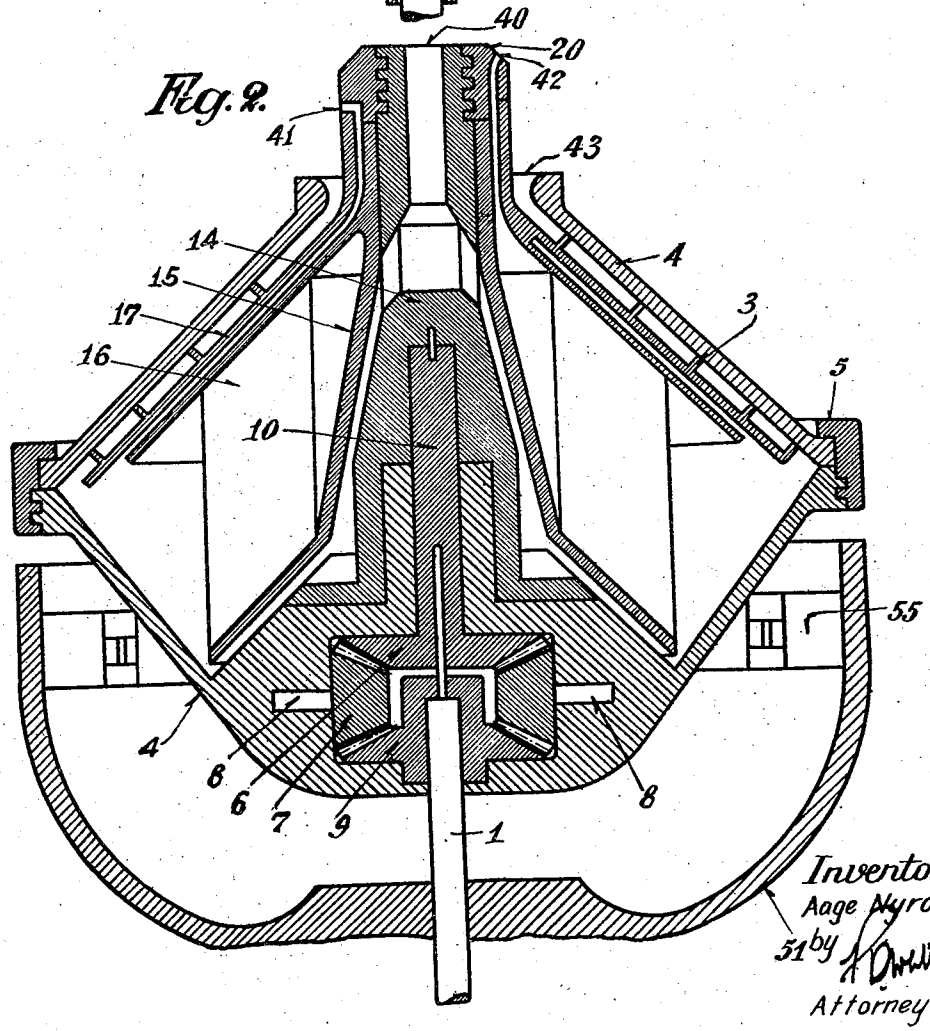


Fig. 2.



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Fig. 3.

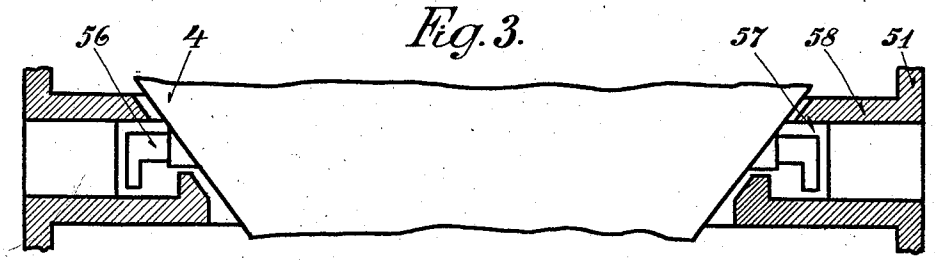


Fig. 7.

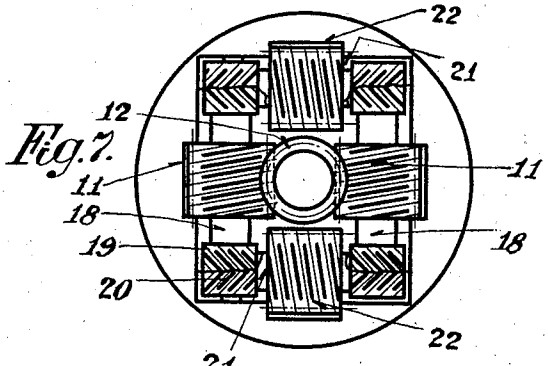
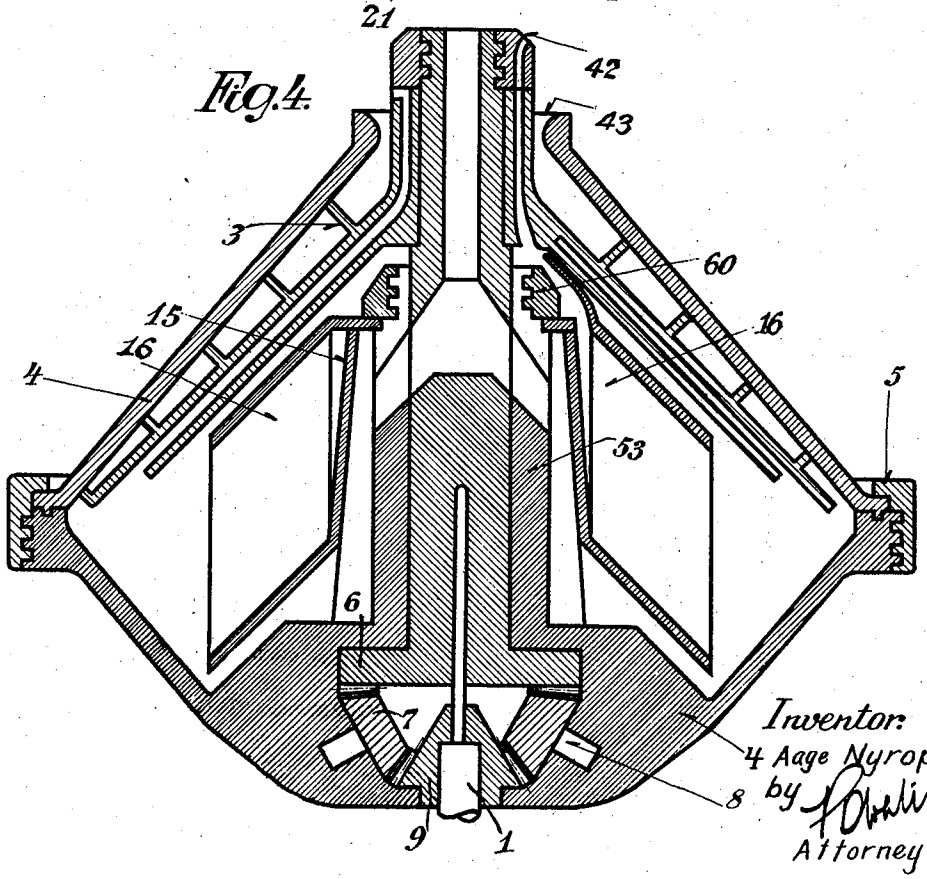


Fig. 4.



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Fig 5.

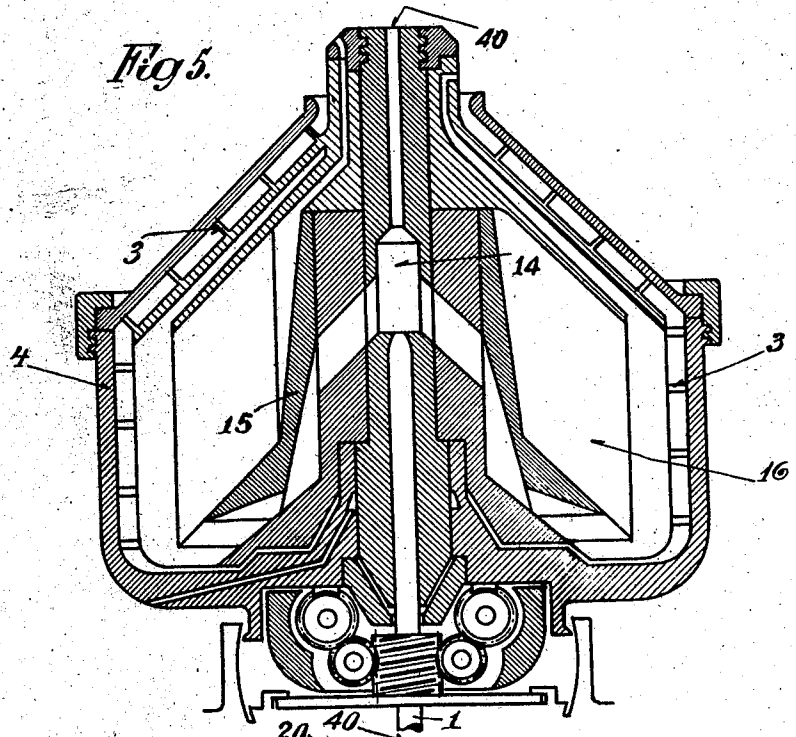
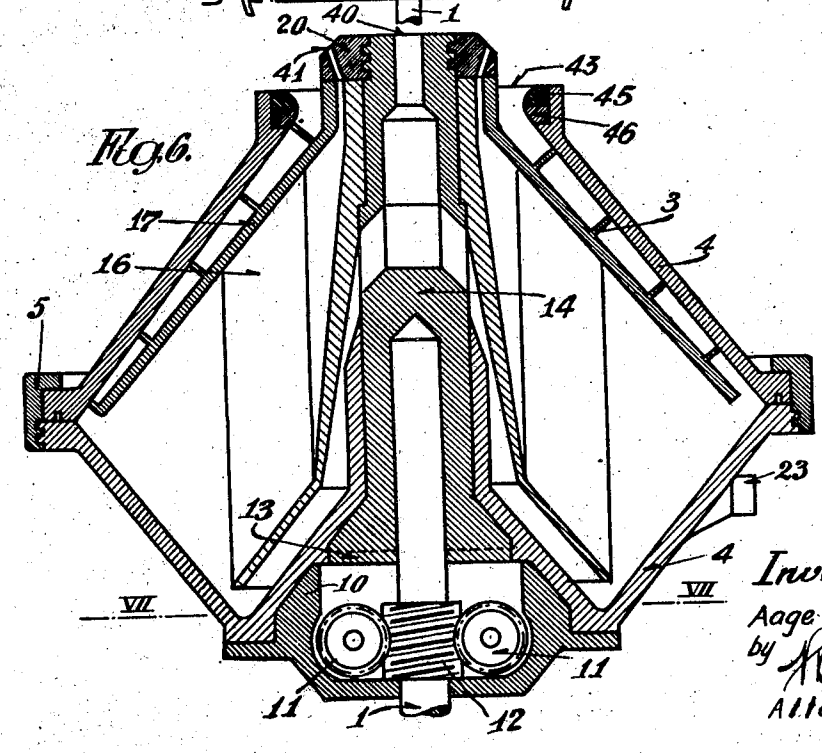


Fig 6.



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Fig. 8.

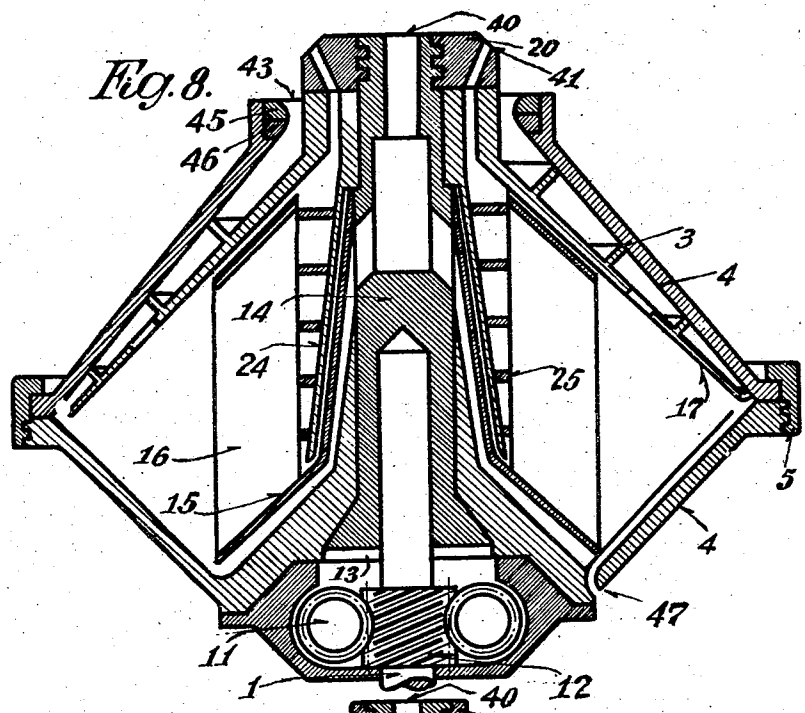
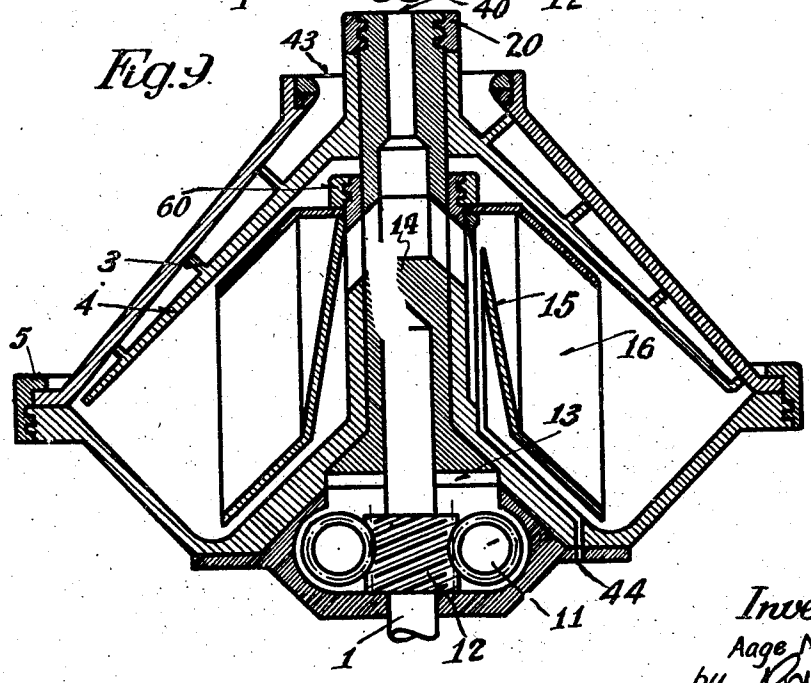


Fig. 9.



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Fig. 10.

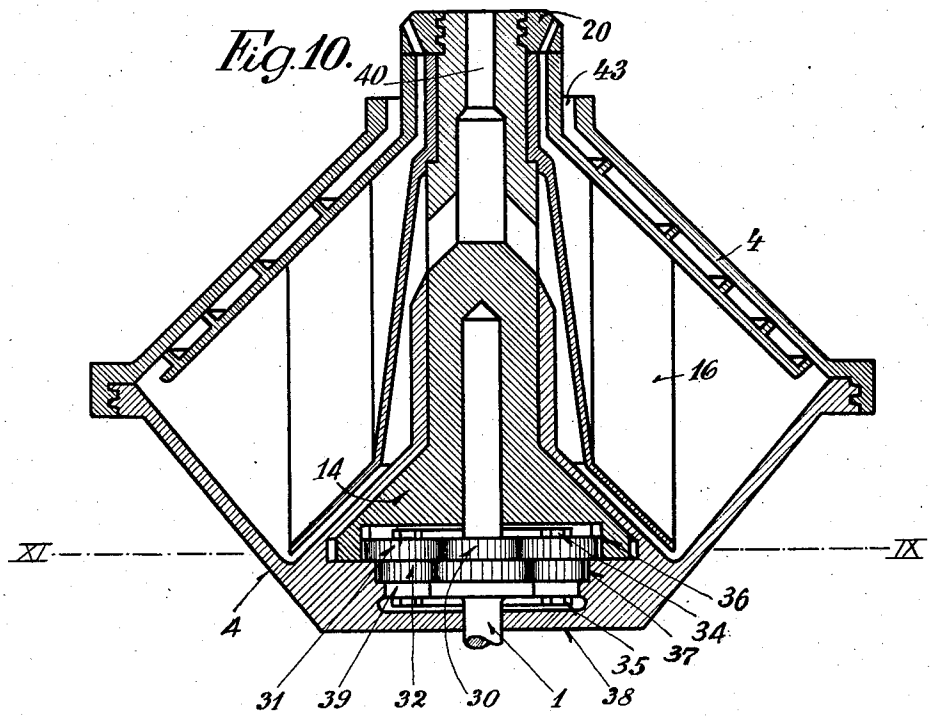
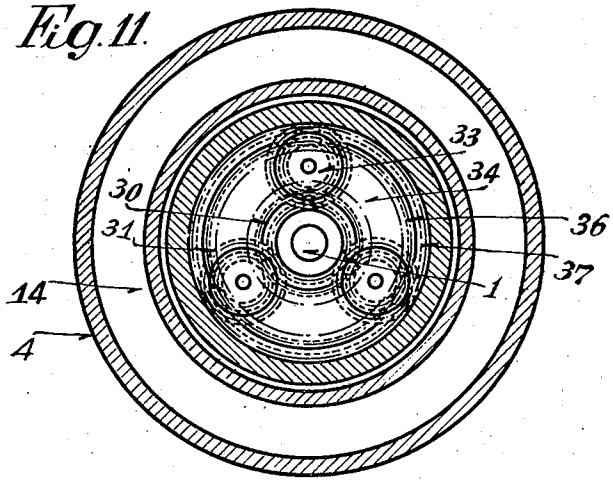


Fig. 11.



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UNITED STATES PATENT OFFICE

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SLUDGE SEPARATOR

Application filed October 31, 1929, Serial No. 403,793, and in Denmark November 2, 1928.

The present invention relates to a separator for the separation of liquids and sediments, and special arrangements with regard to the said invention and the manner in which the same is to be performed.

The separator is especially distinguished thereby, that sediments of any specific gravity in relation to that of the liquid in which it has been deposited may be separated out and removed by means of one or more worms placed in the separator-bowl, these worms being rotated by powers released by—or in—the separator-bowl proper, either by the inertia of a liquid admitted to the separator-bowl or by a retardation or braking effect on parts of the bowl. It is a further characteristic that the bowl has only one axle, which may be through a double, and that the moving parts of the bowl may be intercontrolled by suitable transmission arrangements placed in the rotary separator bowl-proper.

It is a well-known fact that separators have been constructed, from which the sediment is removed by means of a built-in worm, driven by two independent, concentric axles, but it is a special characteristic of the present invention that only one axle is used, rotatable in relation to the main parts of the bowl.

The invention is shown on the attached drawing, on which

Fig. 1 shows the main principle of the invention in a vertical section,

Fig. 2 shows a diagrammatic vertical section of such a separator,

Fig. 3 shows a detail in vertical section of a modified form of retarding means,

Fig. 4 shows a section similar to that shown in Fig. 1 through a modified type of separator-bowl,

Fig. 5 shows a vertical section through another modification with a cylindrical separator-bowl,

Fig. 6 shows a corresponding section through a fourth construction,

Fig. 7 shows a horizontal section through the line VII—VII on Fig. 6,

Figs. 8, 9 and 10 illustrate vertical sections through several different constructions of separators with application of the principle shown in Fig. 1, and

Fig. 11 shows a horizontal section through the line X—X on the separator-bowl shown in Fig. 10.

On Fig. 1, 1 indicates an axle which rotates in a known manner, and which carries the inner part of the separator-bowl 2. This inner part is furnished with a worm 3 enclosed in a mantle 4, which may rotate freely in relation to the inner part.

The action of the separator is as follows:

When the inner part 2, of the separator-bowl is rotated by means of the axle 1 and liquid is admitted, the mantle 4 will also be put into a rotating motion on account of the inertia. This rotation will, however, be slower than that of the inner part 2, on account of the resistance of the air on the outside of the mantle, as long as this resistance is greater than the effect of the liquid on the inside. A momentum of torsion will thus be created between the bowl and the axle, until the external resistance, i. e. the brake effect of the air, and the internal resistance i. e. the resistance between the worm 3 and the mantle 4 become equalized. Till this state of equalization has been attained, the mantle 4 will—as mentioned above—rotate at a slower speed than the inner part 2 whereby sediment deposited in the space between the inner part and the mantle will be impelled out of the bowl through the upper opening in the mantle by means of the worm 3.

If the resistance between the inner part and the mantle, or rather, the resistance between the worm 3 and the mantle 4, be increased the difference in speed will decrease until the external and internal resistances reach the degree of equalization, at which the parts are brought to rotate at the same rate of speed.

This construction represents the invention in its simplest form, but it has the drawback that the action of the separator-bowl becomes uneven, the equilibrium being subject to sudden changes and the invention, therefore, further aims at the production of an equal ratio of speed between the inner part and the mantle by the introduction of a transmission-system controlling the mantle 4, the inner

part 2 and the axle 1, whereby a predetermined ratio of rotation between these parts is secured. Fig. 2 shows such a intercontrol of the mantle and the inner part in its simplest form.

On this figure a central part 14 has been fixed to an insertion 15 by means of a nut 20. This central part contains an inlet 40 with passages for the admission of the sediment-filled liquid into the separator-bowl. The inserted piece 15 may also, in a known manner, carry discs 16 or a filter, and its upper end is inserted in and fixed to a cover plate 17 furnished with helical threads 3. The central part 14, the insertion 15 and the cover plate 17 form together with the discs 16 the inner rotor of the separator, enclosed in an outer mantle 4, which e. g. may consist of two parts assembled by means of a connecting screw-ring. The device intercontrolling part 14 and the mantle 4 may be arranged in the following manner.

The vertical axle 1 carrying the separator-bowl is furnished with a bevel-wheel 9 which meshes with bevel-wheels 7 revolving on shafts 8 bearing in the mantle 4. These bevel wheels 7 also mesh with a bevel-wheel 6 which carries the axle 10 on which the inner part 14 is placed. If, now a retardation sets in with regard to either or both of the parts thus intercontrolled, a difference in the speeds of the cover plate 17 and the mantle 4 will result. When a liquid is admitted to the interior of the bowl through the passage 40, a separation will occur, as the lighter part of the liquid will mount up between the disc 16 and be thrown out through an outlet 42, whence it is led to a vessel or tank, in a known manner. The heavier part of the liquid will be forced out through the passage 41, whereas the sediment will be deposited on the inner side of the bowl, whence it will be moved, or thrown up through the space between the cover plate 17 and the mantle 4, by means of the worm arrangement shown at 3 which on account of the transmission will rotate at a speed different from that of the mantle 4. As the diameter is reduced upwards towards the opening 43 the distance between the threads must be increased or the area of the cams forming the worm must be made larger, in order to prevent a decrease in the area of flow. The difference in speed between the worm 3 and the mantle 4 may be produced by braking or retarding the rotation of the mantle, but as far as many kinds of sediment are concerned, a fully sufficient braking momentum will be created by the resistance of the air on the outer surface of the bowl and the inertia of the liquid inside; the external retardation may, however, be increased by furnishing the outer surface of the bowl with fins, a description of which will be given in the statement regarding Fig. 6.

Otherwise, retardation of the mantle 4 may take place by means of a mechanical or electromagnetic brake as indicated at 55 (Fig. 2), this brake being affixed to the stationary standard or part 51 cooperating with suitable parts on the bowl. A variation of this brake arrangement is shown on Fig. 3, the brake contemplated in this instance being an air-brake or a hydraulic brake or a combination of both. The brake consists of some fins 56 on the mantle 4 projecting into a space 57 in a stationary box 58 on the standard 51. By regulating the flow of air or liquid through space 57 a greater or smaller retardation of the mantle will result. Fig. 4 shows an alteration of the gear ratio from that shown on Fig. 2 as on Fig. 4 the bevel wheels 9 and 6—which on Fig. 2 are of the same size—are of different sizes, so that the power is transmitted from wheel 9 to the larger wheel 6 through the oblique wheels 7 and 8, whereby the relative speeds of the inner part of the bowl and the enclosing mantle 4 are varied in relation to the difference in speed between the said bowl and axle 1.

A further change appears from Fig. 4 namely that the insertion 15 is fixed to the central shaft 53 of the outer mantle 4 by means of a nut 60. Fig. 4 further contains the alteration from Fig. 2 that the helical windings which on Fig. 2 are shown with a changing pitch are shown on Fig. 4 with an increasing area of the cams, both arrangements being intended to secure that the outlet area for the sediment is not decreased.

The alteration shown on Fig. 5 is a purely constructive one, the separator-bowl in this instance being cylindrical.

Figs. 6 and 7 show a mode of construction in which the mantle 4 by means of the retarding powers is made to revolve at a speed with little difference from that of the inner part of the bowl as compared with the difference of speed of the whole system in relation to the axle 1. When for instance the bowl 4 with insertion and inner parts, loses speed in relation to the axle 1 partly on account of the resistance of the air on the outer side of the bowl and partly on account of the inertia of the liquid admitted, the following action will take place.

On the axle 1 is fixed a worm 12 meshing with worm-wheels 11 on the shaft 18 which by means of gears 19 and 20 transmits the movement to shaft 21, furnished with a worm-wheel 22 which again meshes with a tooth-rim 13 on the bottom of the insertion 14. When the above-mentioned variation in speed occurs, the inner part consisting of the parts 14, 15, 16, 17 and 3 described in the above, will rotate in relation to the mantle 4. The difference in the speeds of part 17 and the mantle 4 will thus effect, that the worm transport or screw the sediment deposited in the bowl out of the bowl.

Fig. 6 further indicates fins or wings 23

tending to increase the resistance of the air against the rotation of the bowl.

The above described arrangement involves, besides a differential effect also a strong gearing effect, whereby a considerable screw-power is effected by the great difference between the speed of the axle and the collective revolving parts and the little difference in speed between the mantle 4 and screw 3.

With reference to Fig. 8 it may be stated, that the ratio between the expulsion of sediment and the outflow of liquid may be varied in various manners, according to the composition of the different liquids. The separator is thus able to operate with liquids of different specific gravities. While in the case of the figures previously described, it has been taken for granted that the sludge was heavier than the liquid, the construction shown in Fig. 8 contemplates that the liquid dealt with consists of fluid heavier than the sediment, and a helical conveyor or scraper 25 cooperating with an inner screen 24 has therefore been fixed to the parts of the insertion 16 by which means the sediment which is lighter than the liquid dealt with, and which consequently would form a layer on the screen 24 will be scraped off. This figure also shows an outlet 47 used for the liquid which is heavier than the deposited sediment which e. g. may be of a semiheavy gravity as compared with the crude-fluid.

It may be added that the distance of outlet pipes 41, 42, 44 and 47 from the central axle may be regulated in any known manner by suitable arrangements, but besides as far as outlet 43 is concerned, this distance may be regulated by discs 45 and 46, Fig. 6.

Fig. 9 shows the alteration that the outlet for liquids 44 is placed opposite to that for the sludge, whereby the sludge-outlet may be placed closer to the center of the bowl than the outlet for the liquid.

Finally Figs. 10 and 11 show a modification of the invention in which the transmission is arranged somewhat differently. A bevel-wheel 30 is fixed to the axle 1. Around axle 1 is placed an annular body 34, 35 connected by shafts 33 on which bevel-wheels 31 move. These bevel-wheels mesh with the above-mentioned central bevel-wheel 30.

It will be understood that in the annular body 34 and 35 any suitable number of shafts 33 fitted with bevel-wheels 31 may be placed. To each of these bevel-wheels 31 another wheel 32 of a different size is fixed besides some steering- or roller slides 39, so that the bevel-wheels are externally controlled by ball-races at the tooth-rims 36 and 37 provided for that purpose.

This construction will readily appear from Fig. 11 which shows a section through line XI—XI on Fig. 10, somewhat enlarged. The bevel wheels 31 mesh with the crown-wheel 36 on the inner part 14 and bevel-wheel 32 meshes with crown-wheel 37 on the mantle 4, which on account of the size of bevel-wheels 32 is different in size from crown-wheel 36. The result of this gearing is, that the entire bowl, on account of the retardation on its outer surface or inner parts will lose several revolutions in relation to the axle 1, whereas the inner part of the bowl with the worm 3 will only revolve once in relation to the outer mantle 4.

The above modifications may be constructed in any way which may be desired, and the invention is in no way limited to the modification shown, but any other modification of the same comes within the principle of the invention, and in the cases where vertical or horizontal parts are mentioned it must be understood in such a way that the parts may be placed in any angle in relation to the vertical or horizontal sections.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:

1. A rotary separator comprising, a rotating shaft, a rotatable outer casing on said shaft, a central part rotatably mounted within said casing, a cover plate rigidly connected to said central part, helical threads on said cover plate slidably abutting said outer casing, gear train means in the base of said outer casing between said shaft and said central part and retardation means retarding said outer casing to cause relative motion of said cover plate with respect thereto.

2. A rotary separator comprising, a rotating shaft, a rotatable outer casing on said shaft, a central part rotatably mounted within said casing, a cover plate rigidly connected to said central part, radial vanes between said cover plate and central part, helical threads on said cover plate slidably abutting said outer casing, gear train means in the base of said outer casing between said shaft and said central part and retardation means retarding said outer casing to cause relative motion of said cover plate with respect thereto.

3. A rotary separator according to claim 1 wherein said retardation means comprises a magnetic brake.

4. A rotary separator according to claim 1 wherein retardation means comprises fins on said outer casing fluidly impeded.

5. A rotary separator comprising, a rotating shaft, a rotatable double truncated conical outer casing provided with an upper central opening on said shaft, a central part rotatably mounted in said casing, a conical cover plate connected to said central part and in spaced relation to said casing and said opening, helical threads on said cover plate slidably abutting said casing, axial feeding means, an annular discharge means in said cover plate, gear train means in said

outer casing between said shaft and said central part and retardation means impeding rotation of said outer casing.

6. A rotary separator comprising, a rotating shaft, a rotatable double truncated conical outer casing provided with an upper central opening on said shaft, a central part rotatably mounted in said casing, a conical cover plate connected to said central part and in spaced relation to said casing and said opening, helical threads on said cover plate slidably abutting said casing, axial feeding means, an annular discharge means in said cover plate, discharge means for crude particles at the bottom of said casing, gear train means in said outer casing between said shaft and said central part and retardation means impeding rotation of said outer casing.

7. A rotary separator comprising, a rotating shaft, a rotatable double truncated conical outer casing provided with an upper central opening on said shaft, a central part rotatably mounted in said casing, a conical cover plate connected to said central part and in spaced relation to said casing and said opening, helical threads on said cover plate slidably abutting said casing, axial feeding means, directing means in said cover plate for the fluid, an annular discharge means in said cover plate, gear train means in said outer casing between said shaft and said central part and retardation means impeding rotation of said outer casing.

8. A rotary separator comprising, a rotating shaft, a rotatable double truncated conical outer casing provided with an upper central opening on said shaft, a central part rotatably mounted in said casing, a conical cover plate connected to said central part and in spaced relation to said casing and said opening, helical threads on said cover plate slidably abutting said casing, axial feeding means, an annular discharge means in said cover plate, a gear on said rotating shaft, a gear on said central part, a plurality of gears mounted in said casing interengaging said first and second mentioned gears and retardation means impeding rotation of said outer casing.

In testimony whereof I affix my signature.

AAGE NYROP.