

May 19, 1931.

F. DUPUIS

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CENTRIFUGAL SEPARATOR

Filed March 6, 1930

2 Sheets-Sheet 1

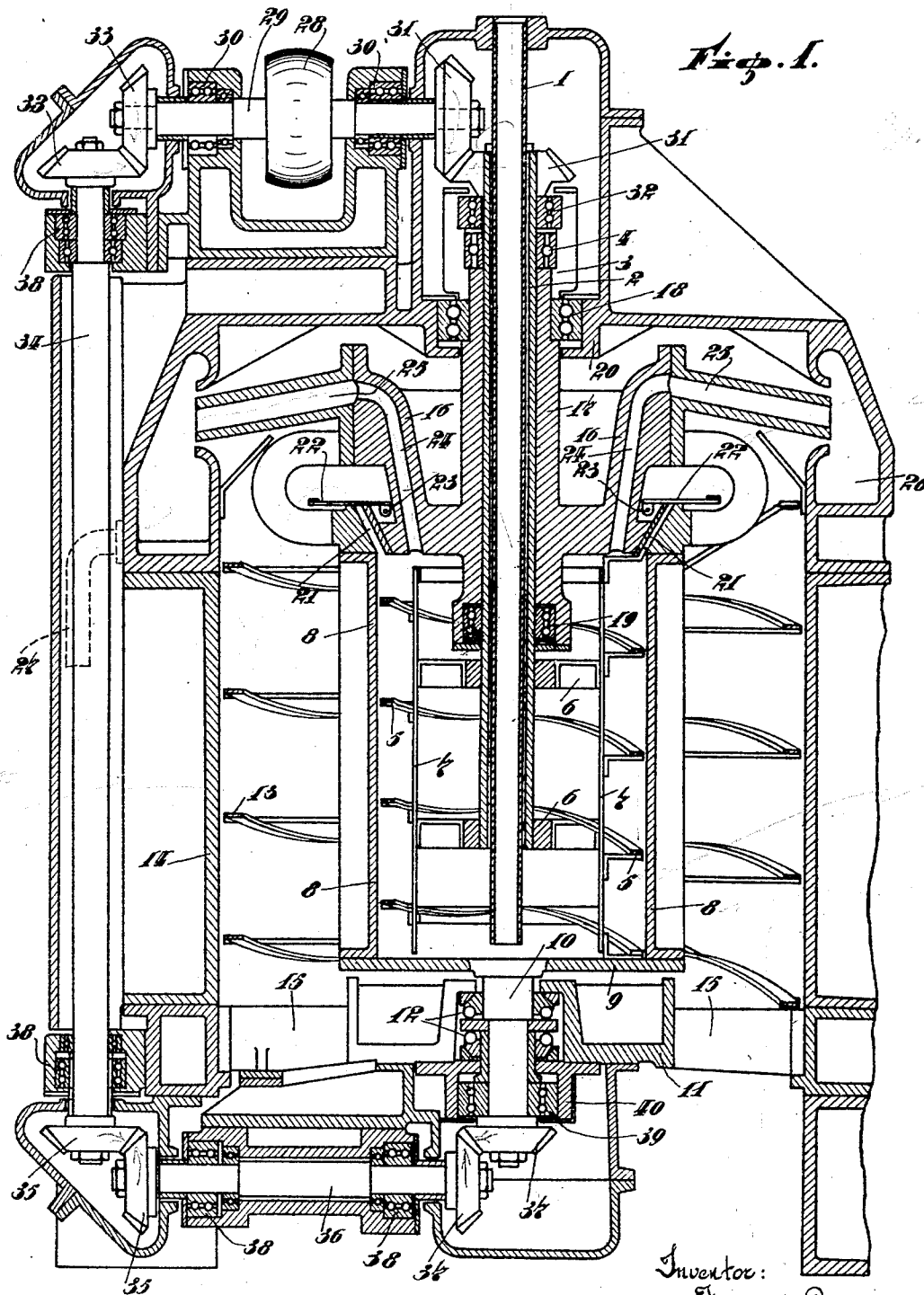


Fig. 1.

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Fig. 2.

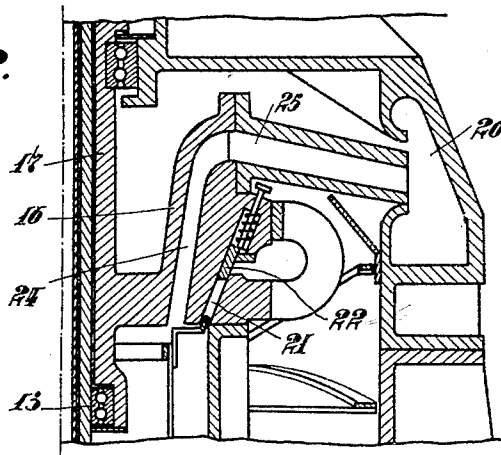
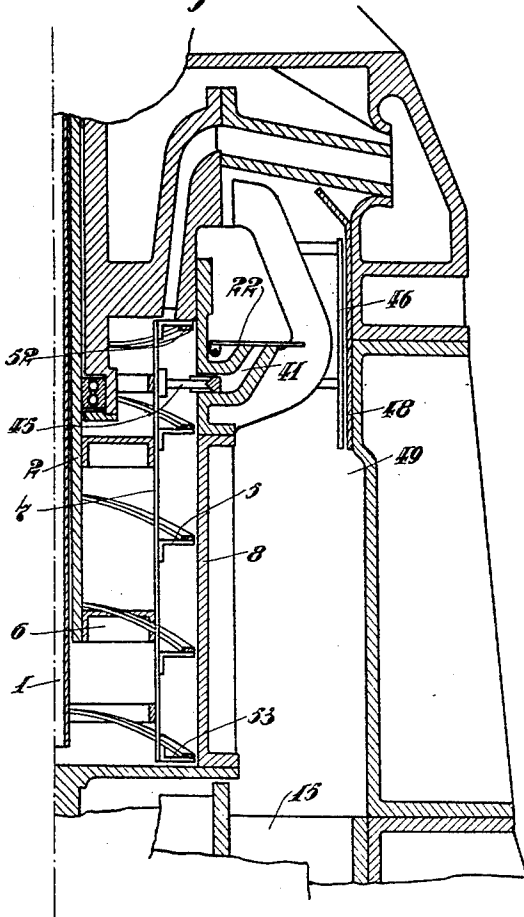


Fig. 3.



*Upper part of cone 22 is
reverted to allow solids back
from liquid part.*

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UNITED STATES PATENT OFFICE

FERNAND DUPUIS, OF CHARLEROI, BELGIUM

CENTRIFUGAL SEPARATOR

Application filed March 6, 1930, Serial No. 433,740, and in Belgium March 9, 1929.

The present invention relates to centrifugal separators used for separating solids and liquids and more particularly the solid matter held in suspension in a liquid.

5 The object of the invention is to obtain in apparatus of this kind a continuous discharge of the clarified liquid and of the solid matter through the top of the apparatus, and to avoid all escape of liquid through the discharge port for the solid matter when there is no solid matter in suspension in the liquid.

10 For this purpose, apparatus according to the invention comprises a rotary vessel closed at the bottom, into which the liquid charged with solid matter is centrally introduced at the bottom by means of a tubular element, this vessel being provided at its upper part with a lid or cover, in which separate discharge conduits for the clarified liquid and for the separated solid matter are formed, the conduits for the solid matter being normally closed and openable under the influence of the thrust of the solid matter forced upwards by a worm which is caused to rotate within the vessel.

15 According to the invention, the discharge of the separated solid matter may be made through a lateral chamber disposed at a very short distance from the upper end of the vessel. In order to reduce the contents of water of the separated solid matter forced by centrifugal force into said lateral chamber, this matter is compressed by a rod penetrating into said chamber and actuated to rotate.

20 The matter separated by centrifugal force which might have gone beyond the discharge chamber is brought back towards the latter by directing the upper part of the worm arranged within the vessel in the opposite direction with regards to the lower part of said worm.

25 The matter separated by centrifugal force, discharged through a door or other closing means, is brought into a discharge apparatus

and is scraped from the walls of the latter by means of vanes or paddles adapted to scrape a portion of the frame of increased thickness, the length of said vanes being limited to the length of said portion of increased thickness for the purpose; the separated matter then falls freely into a tank, which may deliver it through suitable discharge orifices.

30 In order that the invention may be clearly understood, it will be described hereafter with reference to the figures of the accompanying drawings, which are given merely by way of example.

Fig. 1 is a sectional elevation view of the apparatus through the central shaft thereof;

Fig. 2 is a sectional detail view, on a larger scale, of another closing device for the discharge ports for the solid matter;

Fig. 3 is a vertical sectional view of a part of the apparatus according to a different form of construction.

Referring to the drawings, 1 designates a stationary vertical tube fitted in a sleeve 2 supported, through the medium of a ball bearing 4, on a supporting element 3 forming part of the fixed portion of the apparatus on the lower portion of this tube 1.

This sleeve 2 is provided with radial arms or rods 6 supporting uprights 7 to which a worm 5 is attached.

35 The lower end of the tube 1 issues into the bottom of a vessel or tank 8, concentric with the tube and the inner wall of which completely surrounds the worm 5. This vessel 8 is provided with a closed bottom 9, which is supported on a shaft 10, which is in turn carried by the lower frame 11 of the apparatus, through the medium of ball bearings 12. Outside the vessel 8, a worm 13 is secured, which revolves within a stationary casing 14 forming part of the frame 11 and which is provided at the bottom with discharge apertures 15.

40 The upper part of the vessel 8 is provided with a lid or cover 16. The latter forms an

outer guide sleeve 17, concentric with the sleeve 2 and which is maintained in this concentric position by means of ball bearings 18 and 19. The ball bearing 18 is supported on a seat 20 forming part of the stationary housing of the apparatus, whereas the ball bearing 19 maintains the two rotary sleeves 2 and 17 in concentric position.

In the cover 16 are formed ports 21, issuing into the periphery of the vessel 8 and which serve the purpose of discharging the solid matter, these ports being normally closed by means of lids 22 adapted to pivot about spindles 23, or by means of slides or doors 22 (Fig. 2) acted upon by the pressure of an adjustable screw or by any other appropriate means, so as to compress more or less the separated solid matter, and therefore, to reduce more or less its contents in liquid. Other ports 24, located nearer to the tube 1, issue into conduits 25, which open into a collecting channel 26, with sloping bottom, located outside and completely surrounding the stationary casing 14. This collecting channel with sloping bottom has at its lowermost part an outlet port 27.

The various movable parts of the apparatus are rotated by means of a belt, which is passed round a pulley 28 keyed on a shaft 29 supported on ball bearings 30. At one end of this shaft 29, two bevel gears 31 impart to the sleeve 2 and consequently to the worm 5, a rotary movement. A ball bearing 32 positioned beneath the bevel gear keyed on the sleeve 2 prevents any lateral movement from taking place under the influence of the bevel gear mounted on the shaft 29.

At the other end of the shaft 29, a pair of bevel gears 33 imparts, through the medium of a vertical shaft 34, a pair of bevel gears 35, a horizontal shaft 36 and a pair of bevel gears 37, a rotary movement to the vessel or tank 8. The transmission shafts 34 and 36 are supported on ball bearings 38 and in order to prevent the shaft 10 of the rotary tank 8 from moving laterally under the influence of the bevel gear 37, a ball bearing 39 is supported on a vertical base 40 secured to the lower frame of the apparatus.

The working of the centrifugal separator is as follows:

The mixture is supplied through the vertical tube 1 by any appropriate known means. At the lower end of the tube 1, the mixture falls on the bottom of the rotary vessel 8, which is caused to revolve by the means hereabove described. Under the action of the centrifugal force, the solid particles held in suspension in the liquid, which are of higher specific gravity than the latter, are projected against the wall of the tank 8.

The worm 5, which is actuated to revolve at a slightly different speed from the vessel 8, slowly lifts the solid particles projected

against the wall of the vessel by centrifugal force.

On arriving near the lid 16 of the rotary vessel 8, the solid particles are forced by the worm 5 into the discharge ports 21, which are normally closed by the lids 22. Under the action of this pressure, the lids or covers 22 open and give way to the solid matter, which is then projected against the inner wall of the stationary casing 14. In a similar way, the pressure which the separated solid matter has to overcome, may be obtained, for instance, by a spring of regulable tension (Fig. 2), or by the weight of an inclined slide or door, so as to obtain a product having a more or less great content of liquid by reason of a more or less great compression. The worm 13 secured to the rotary vessel 8 leads the separated solid matter towards the bottom of the casing 14, where it may be discharged through apertures 15.

The liquid separated from the mixture flows, under the action of the static pressure due to the difference in level between the inlet aperture for the mixture and the outlet orifice for the clarified liquid, which is discharged through the ports 24 and the conduits 25, into the circular channel 26, from where it is delivered through the port 27 for further use.

The centrifugal separator constructed according to the invention has the advantage of entering into action only when solid matter is contained in the apparatus. Indeed, the covers 22, normally applied on their seats under the influence of the centrifugal force, can only open under the action of a pressure exerted on them and this pressure can only be exerted thereon when solid matter is present in the ports 21. When there is only liquid matter inside the rotary vessel 8, the worm 5 rotates in this liquid which escapes through the passages 24 and 25 without exerting any pressure on the covers 22. The advantage resulting herefrom resides mainly in the absolutely perfect separation of the solid matter from the liquid in which it is held in suspension. The solid matter which is discharged through the ports 21 is not diluted and it is only slightly wet due to its stay in the liquid.

In the embodiment illustrated in Fig. 3 can be seen, at a slight distance from the upper end of the vessel 8, a lateral chamber 41, into which the separated high gravity matter is forced under the action of the centrifugal force. In order to bring back to said lateral chamber 41 any matter separated by centrifugal force which might have gone beyond said chamber, the upper part 52 of the worm 5 is directed in opposite direction to the lower part 53 of said worm 5.

Into the lateral chamber 41 penetrates an arm or rod 45, connected in a convenient way to the upright 7, this rod serving the purpose to compress the solid matter contained in the

chamber 41 and thereby to reduce its contents in water.

The lateral chamber 41 is normally closed by covers 22 or by slides or doors, in the same way as has been described hereabove, the opening of this closing means being only possible under the action of the pressure exerted thereon by the solid matter enclosed in the chamber 41.

The solid matter having passed the closures 22 penetrates into a compartment 49 and in this compartment it is detached from the walls thereof by vanes or paddles 46, which are rigidly connected with the rotary vessel 8, the length of these vanes or paddles 46 being limited to that of the portion 48 of increased thickness of the frame of the apparatus.

When the separated solid matter has gone beyond the lower end of said portion 48, it falls freely into the lower part of the compartment 49, from where it is discharged through the apertures 15.

The centrifugal separator according to the invention has thus the advantage of ensuring a better separation, a better drying of the separated matter and of allowing the discharge of this matter without having to use intricate mechanical means.

I claim:

1. A centrifugal separator for separating solids from liquids, comprising a rotary vessel closed at the bottom, a tubular feed element centrally located in said vessel and extending to near the bottom thereof, a rotary worm in said vessel, a cover for the top of said vessel, ports in said cover for the clarified liquid outwardly inclined, conduits in the top part of the covered vessel and arranged outside said ports for the separated solid matter and valves normally closing said conduits, said valves being arranged and guided so as to be deprived from centrifugal action and openable under the influence of the thrust of the said solid matter forced upwards by said worm into said conduits.

2. A centrifugal separator for separating solids from liquids, comprising a rotary vessel closed at the bottom, a tubular feed element centrally located in said vessel and extending to near the bottom thereof, a rotary worm in said vessel, a cover for the top of said vessel, ports in said cover for the clarified liquid outwardly inclined, conduits in the top part of the covered vessel and arranged outside said ports for the separated solid matter, slides positively guided on either side for normally closing said conduits and adjustable spring means acting on said slides so as to compress more or less the solid matter forced upwards by said worm into said conduits against the slide and thereby reduce more or less the state of humidity of said solid matter.

3. A centrifugal separator for separating

solids from liquids, comprising a rotary vessel closed at the bottom, a driving shaft connected to said bottom for rotating the vessel, a tubular feed element centrally located in said vessel and extending to near the bottom thereof, a rotary worm in said vessel, a cover for the top of said vessel, ports in said cover for the clarified liquid, outwardly inclined conduits in the top part of the covered vessel and arranged outside said ports for the separated solid matter, valves normally closing said conduits arranged and guided to avoid centrifugal action, an outer stationary tank within which said vessel rotates and a worm outwardly rigidly connected to said vessel so as to rotate within said tank and to bring the solid matter discharged through said conduits to the bottom of said tank.

4. A centrifugal separator for separating solids from liquids, comprising a rotary vessel closed at the bottom, a tubular feed element centrally located in said vessel and extending to near the bottom thereof, a rotary worm in said vessel, a cover for the top of said vessel, ports in said cover for the clarified liquid, discharge passages for the separated solid matter laterally formed in the wall of the vessel at a slight distance from the top, and having a horizontal outlet, flap valves normally closing said horizontal outlets and openable under the influence of the pressure of said solid matter and means rotating with the worm to compress said solid matter in said passages.

5. A centrifugal separator for separating solids from liquids, comprising a rotary vessel closed at the bottom, a tubular feed element centrally located in said vessel and extending to near the bottom thereof, a rotary worm in said vessel, the upper part of which is directed in opposite direction to the lower part, a cover for the top of said vessel, ports in said cover for the clarified liquid, discharge passages for the separated solid matter laterally formed in the wall of the vessel at a slight distance from the top, and having a horizontal outlet, flap valves normally closing said outlets and openable under the influence of the pressure of said solid matter and means rotating with the worm to compress said solid matter in said passages.

6. A centrifugal separator for separating solids from liquids, comprising a rotary vessel closed at the bottom, a tubular feed element centrally located in said vessel and extending to near the bottom thereof, a rotary worm in said vessel, the upper part of which is directed in opposite direction to the lower part, a cover for the top of said vessel, ports in said cover for the clarified liquid, an annular discharge passage for the separated solid matter laterally formed in the wall of the vessel at a slight distance from the top,

and having a horizontal outlet, flap valves normally closing said outlet and openable under the influence of the pressure of said solid matter, radial rods rotating with the worm to compress said solid matter in said passage and engaging said annular discharge passage, an outer stationary tank into which said passage issues, having an upper portion of smaller width, and means rotating with the vessel for scraping the wall of said narrower portion and causing the solid matter to drop on the bottom of the tank.

In testimony whereof I signed hereunto my name.

FERNAND DUPUIS.