United States Patent

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[33] **Italy**
[31] **6996A/68, 7004A/68, 7025A/68**

[54] **CENTRIFUGE FOR SEPARATION OF MIXTURES OF SOLIDS AND LIQUIDS OF DIFFERENT WEIGHT**
17 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **233/2,** 233/7, 233/27, 233/35, 233/47
[51] **Int. Cl.** **B04b 3/00,** B04b 1/00, B04b 11/00
[50] **Field of Search** 233/7, 8, 10, 2, 23, 24, 46, 45, 47, 27; 64/28; 184/6

[56] **References Cited**

UNITED STATES PATENTS

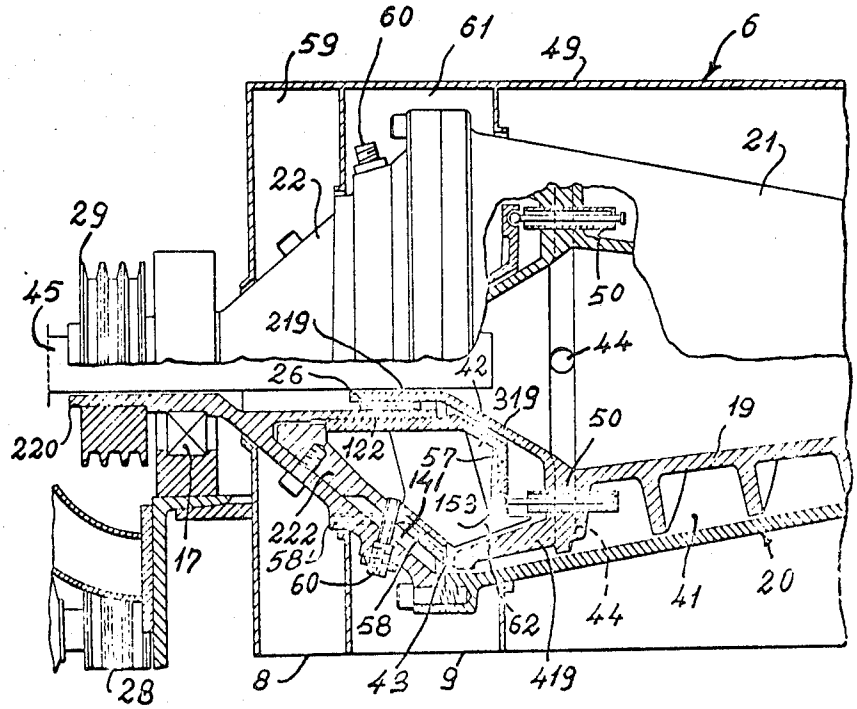
2,528,974	11/1950	Ritsch	233/7
2,733,856	2/1956	Kjellgren	233/7
2,734,681	2/1956	Schmiedel	233/7
3,348,767	10/1967	Ferney	233/7
2,129,992	9/1938	DeMattia	233/7
2,743,865	5/1956	Graae	233/7

FOREIGN PATENTS

259,222	11/1926	England	184/6

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Assistant Examiner—George H. Krizmanich
Attorney—Flynn & Frishauf

ABSTRACT: A centrifuge for separating mixtures consisting of solids and at least one liquid comprises a rotatable drum formed by two opposed hollow cones in one of which a hollow worm is coaxial and rotatable relative to the drum. The worm forms with the conical portions of the drum a precentrifuging chamber which communicates with a postcentrifuging chamber and mixture fed into the worm passes into the precentrifuging chamber so that solids sludge is fed out through an outlet remote from the postcentrifuging chamber. Liquids separated from the sludge pass into the postcentrifuging chamber and are centrifugally separated to pass, according to weight, out of the chamber through ducts arranged at different distances from the axis of rotation and through outlets appropriate thereto.



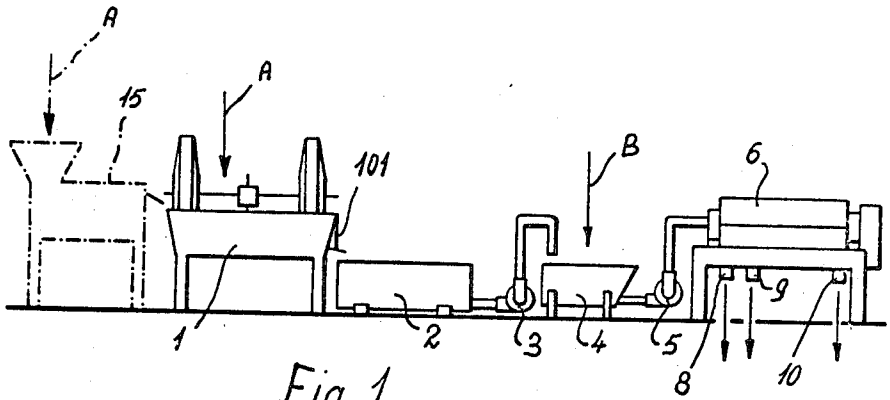


Fig. 1

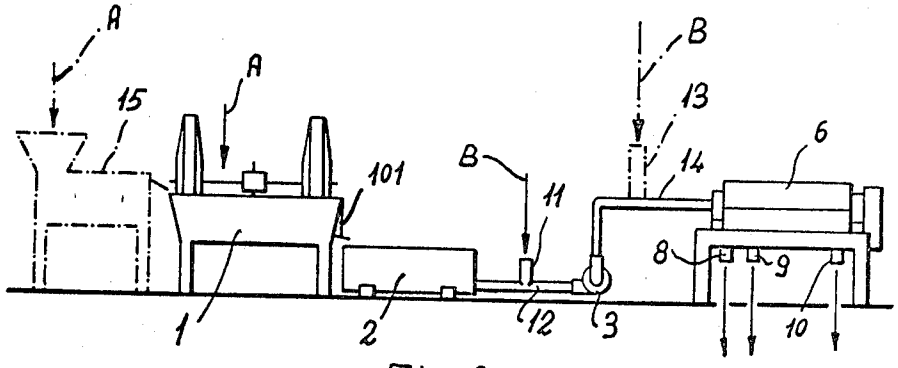


Fig. 2

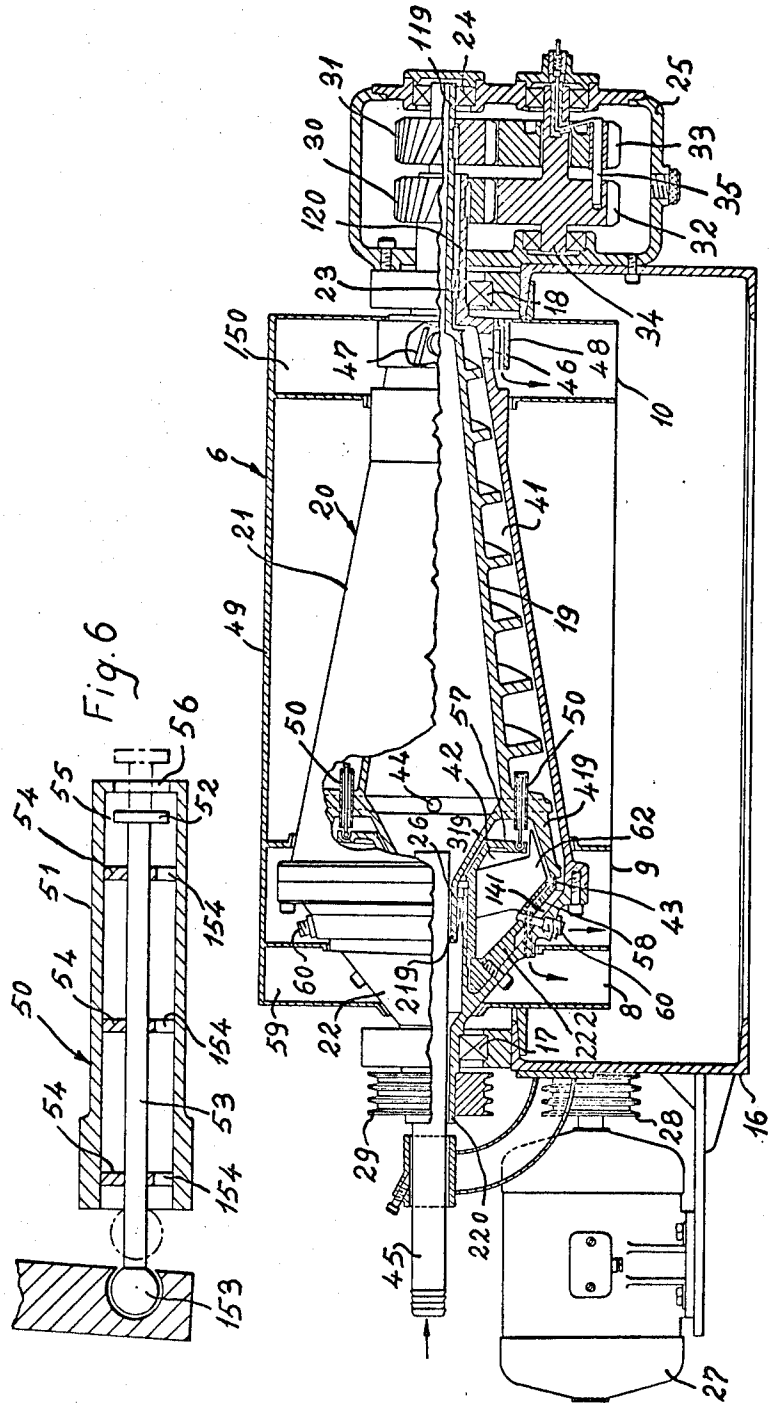

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Fig. 6

Fig. 3

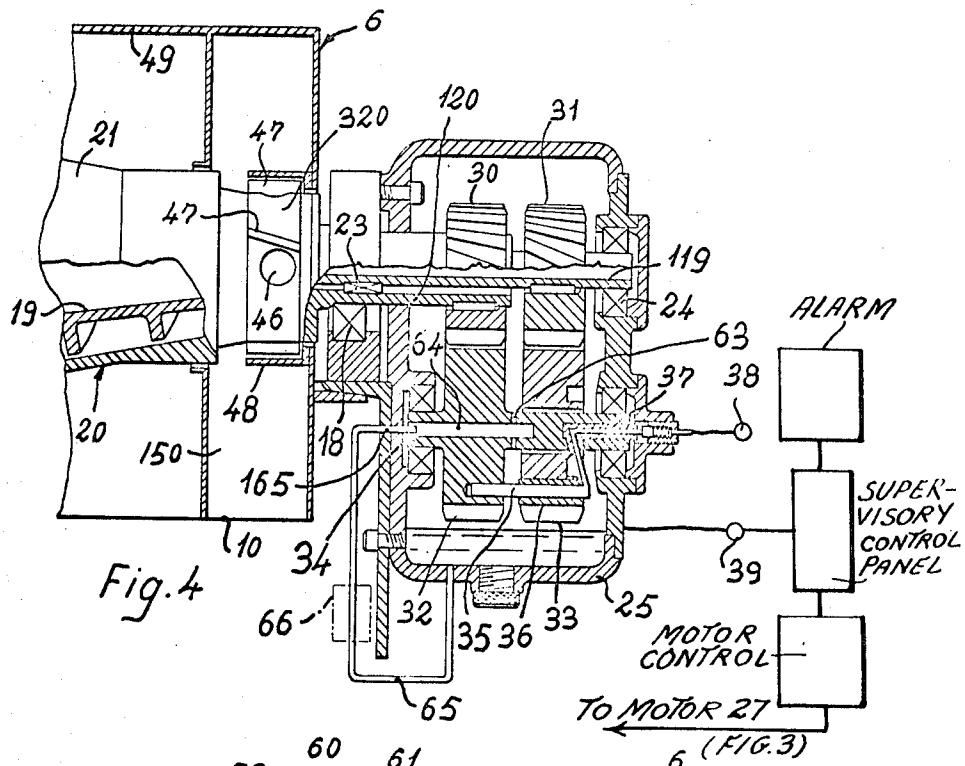

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MOTOR
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TO MOTOR 27
(FIG. 3)

Fig. 4

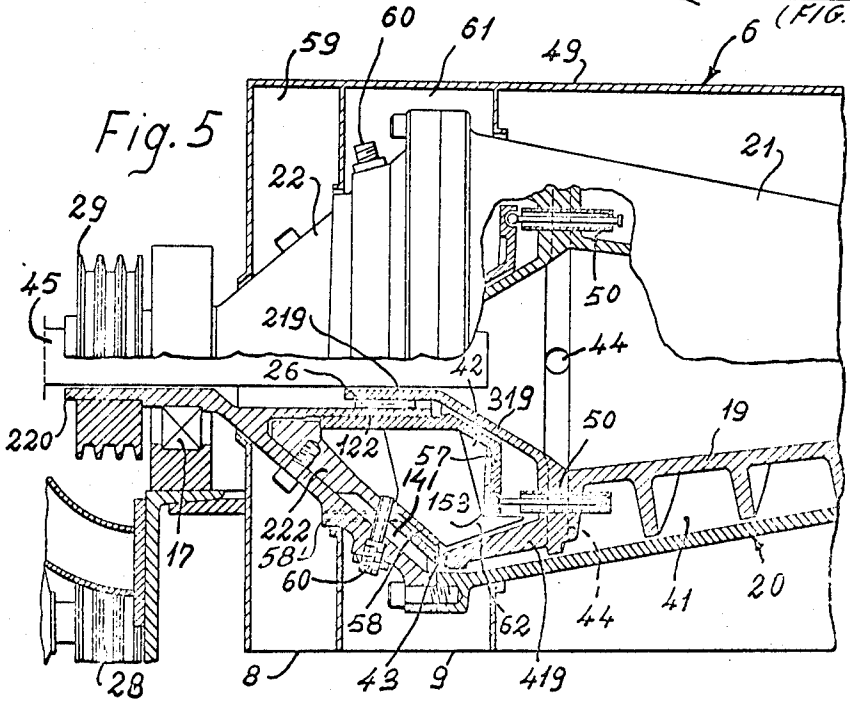

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Fig. 5

CENTRIFUGE FOR SEPARATION OF MIXTURES OF SOLIDS AND LIQUIDS OF DIFFERENT WEIGHT

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to a centrifuge for separating mixtures consisting of solids and at least one liquid, for example, mixtures arising in the production of olive oil.

The object of the invention is to create a centrifuge having an improved mode of operation and more extensive separation of the liquid or mixture of liquids from the solids, and to increase the degree of purity of the clarified liquid, particularly of the liquids of different weight which are to be separated from each other, with a relatively small degree of structural complexity.

SUMMARY

According to the invention there is provided a centrifuge for separating mixtures consisting of solids and at least one liquid, comprising a rotatable drum housing a hollow solids-conveying worm coaxial with and rotatable relative to the drum and forming with the drum communicating precentrifuging and postcentrifuging chambers, said worm communicating with the precentrifuging chamber and having associated therewith inlet means by which a mixture to be separated is delivered to the interior of the worm, a first outlet communicating with the precentrifuging chamber at the end thereof remote from the postcentrifuging chamber, second and third outlets each communicating with the postcentrifuging chamber, and outflow ducts communicating with the postcentrifuging chamber at different distances from the axis of rotation of the drum and one each with said second and third outlets.

The solid-liquid mixture to be separated may be fed intermittently or continuously into the precentrifuging chamber of the centrifuge, in which a separation of the solid from the liquid ingredients is performed initially. The sludge formed by the solids is advanced by the solids-conveying worm towards the solids outlet of the precentrifuging chamber and discharged therethrough, whereas the liquids or the mixture of liquids passes into the postcentrifuging chamber of the centrifuge, in which the clarification of the liquid or the separation of the liquids of different weight is performed. These liquids flow out separately through the outflow ducts of the postcentrifuging chamber.

Other features of the invention are described with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 respectively illustrate two different embodiments of a plant comprising a centrifuge for producing olive oil,

FIG. 3 is a side view, partly in section, of a centrifuge employed in the plants illustrated in FIGS. 1 and 2,

FIG. 4 is a view, to an enlarged scale, of the right-hand end of the centrifuge shown in FIG. 3,

FIG. 5 is a view, to an enlarged scale, of the left-hand end of the centrifuge shown in FIG. 3, and

FIG. 6 illustrates a liquid passage situated between a precentrifuging chamber and a postcentrifuging chamber embodied in the centrifuge of FIG. 3, and which comprises a built-in filtering device and an automatic filter cleaning device.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 for the plant shown therein the production of olive oil consists of a known olive mill 1, formed as a crushing roller mechanism, in which olives fed thereto as indicated by the arrow A are crushed and broken up. The mixture emerging from the outlet 101 of the olive mill 1, and which consists of solid olive parts, water and oil, runs into a

mixing and homogenizing device 2, which is formed as a basin having situated therein a stirring mechanism of optional kind not illustrated, in the device 2, the mixture delivered thereto from the olive mill 1 is thoroughly mixed and homogenized. From the mixing and homogenizing device 2, the mixture is conveyed by a pump 3 into a settling tank 4, in which heavier foreign bodies such as pieces of stone and iron which may be present, are deposited. In the settling tank 4, water is added to the homogenized mixture, as indicated by the arrow B. The degree of concentration of the mixture is thereby adjusted to one suitable for the subsequent centrifuging operation and is subsequently fed into a centrifuge 6 by means of another pump 5. The centrifuge 6 is so constructed that the three ingredients of the mixture (oil, water and solid olive residues) are separated therein in a single operation, and issue from corresponding separate outlets 8, 9, 10. In the example being described the solid in sludge form, consisting of the olive residues, issues through the outlet 10 from one end of the centrifuge, whereas the water issues through the outlet 8 and the oil through the outlet 9 at the other end of the centrifuge.

The tank of the mixing and homogenizing device 2 can be formed in such manner that it acts as a continuous flow compensating tank and despite the charging of the olive mill 1 with batches, allows of a continuous and uniform feed to the centrifuge of the mixture of oil, water and solids to be separated. On the other hand, the feed of the mixture to the centrifuge may, if desired, be intermittent in accordance with the charging of the olive mill 1 by batches.

The alternative form of plant illustrated in FIG. 2 differs from the plant according to FIG. 1, inasmuch as the settling tank 4 is omitted and the homogenized mixture is fed direct to the centrifuge 6 from the tank of the mixing and homogenizing device 2 by means of the pump 3. The addition of water for dilution of the mixture to be separated may then be made through a connector pipe 11 into the pipe 12 on the suction side of the pump 3, as indicated by the arrow B. It is also possible for the diluting water to be pumped through a connector pipe 13 into the delivery pipe 14 of the pump 3, as shown by dash-dotted line B in FIG. 2.

In both versions of the plant illustrated, the olives can be fed not only direct to the olive mill 1, but also into an olive-washing machine 15 preceding the same and illustrated by dash-dotted lines. The olives washed and freed of coarser foreign bodies in the machine 15 are then fed to the olive mill 1.

FIGS. 3 to 6 illustrate a centrifuge 6 which is employed to separate the three ingredients (oil, water, solid olive residues) of the mixture. The centrifuge 6 has a support frame 16, on which a drum 20 having a horizontal longitudinal axis is rotatably arranged by means of ball or roller bearings 17, 18. The drum 20 is formed to be doubly conical, that is it comprises two coaxial conical portions 21 and 22 of different length, the apices of which outwardly point in opposite directions the wider ends of the cones being firmly interconnected.

A correspondingly conical conveying screw or worm 19 formed as a hollow element is coaxially arranged in the longer drum portion 21. The apex of the conveying screw 19 merges into a hollow shaft 119 which protrudes out of the drum 20 through the corresponding extremity of the drum 20. The hollow shaft 119 is rotatably supported by a roller bearing 24 in a gearcase 25 which is fastened on the centrifuge frame 16, and in a roller bearing 23 mounted inside the hollow shaft 120 of the drum. The inner, conically formed end 319 of the conveying screw 19 merges into a hollow shaft 219 which is rotatably arranged by means of a ball or roller bearing 26 within an internal tubular extension 122 of the shorter portion 22 of the drum. The end of the centrifuge drum 20 corresponding to the drum portion 22 merges into a hollow shaft 220 which is rotatably supported by the ball or roller bearing 17 in the centrifuge frame 16.

The drum 20 and the conveying screw 19 are driven in the same direction of rotation, but at different speeds of revolution. An electric motor 27 drives the drum 20 by means of a

belt pulley 28, driving a belt pulley 29 secured on the hollow drum shaft 220 at the outer end of the drum portion 22. The driving belt connecting pulleys 28 and 29 is omitted for clarity. The drive to the conveying screw 19 is derived from the drum 20 at the opposite end of the centrifuge. To this end, a gear system is arranged in the stationary case 25 at this end of the centrifuge, and comprises a gearwheel 30 fastened on the hollow shaft 120 of the drum 20, and a gearwheel 31 fastened on the shaft 119 of the screw 19. The gearwheel 30 of the drum shaft 120 meshes with a gear 32 secured to a countershaft 34 rotatably arranged in the gearcase 25. A second gear 33 is freely mounted on the countershaft 34 and meshes with the gearwheel 31 of the conveying screw shaft 119. The second gear 33 is coupled to the first gear 32 by an axially directed coupling pin 35 which is shearable under overload. The transmission ratio between the gearwheels 30, 31, through the gears 32, 33 is so chosen as a function of the slope of the turns of the conveying screw, as to engender a relative rotary displacement between the drum 20 and the conveying screw 19, in which the conveying direction of the screw 19 operates towards the narrower extremity of the drum portion 21, that is to the right as viewed in FIGS. 3 to 5. This transmission ratio can be established by different diameters of the gearwheels 30, 31 and of the gears 32, 33 and/or by different spiral angles of the pairs of gearwheels 30, 32, 31, 33 formed as helical gears.

The shearable coupling pin 35 is insulated electrically relative to the second gear 33, for example, by a plastics bushing 36, FIG. 4, or the like, and by means of an electrically insulated conductor 37 connected to one connection terminal 38 of an electrical control circuit. The coupling pin 35 is connected in electrically conductive manner to the other connection terminal 39 of the control circuit through the first gear 32, the countershaft 34 and the gearcase 25. The electrical control circuit is thus closed through the coupling pin 35. In case of an overload that is when the torque derived from the centrifuge drum 20 for the entrainment of the conveying screw 19 exceeds a predetermined maximum value, the coupling pin 35 is sheared through. This not only interrupts the transmission of force between the gears 32, 33 and consequently between the drum 20 and the conveying screw 19, but also the electrical connection between the connection terminals 38, 39 of the control circuit. The interruption of this circuit can cause the driving motor 27 to be switched off and/or trigger a warning signal.

For lubrication of the gear system enclosed in the case 25, the countershaft 34 has one or more radial and approximately nozzlelike drillings 63 between the countershaft gears 32, 33, which are in communication with a central axial bore 64 of the shaft 34, as shown in FIG. 4. The axial bore 64 of the countershaft 34 terminates at the end of the shaft 34. Into the terminal aperture of the axial bore 64 there is engaged an open endpiece 165, coaxial with the bore 64, of a stationary oil feed pipe 65. The oil feed pipe 65 is connected to the lower oil-filled part of the gearcase 25, that is to say either direct, or through an oil pump 66 shown dash-dotted in FIG. 4.

In the first case, that is with direct connection of the oil feed pipe 65 to the lower part of the gearcase 25, the stationary endpiece 165 of the pipe 65 is connected in oiltight and airtight manner to the axial bore 64 of the rotating countershaft 34. Owing to the rotary motion of the countershaft 34 and the centrifugal effect engendered thereby, the lubricating oil is flung out in all directions through the radial drillings 63 of the shaft 34, whereas fresh oil is drawn at the same time from the lower part of the gearcase 25 through the oil feed pipe 65, 165 and the axial bore 64 of the countershaft 34.

In the second case, that is if the oil feed pipe 65 is connected to the lower oil-filled part of the gearcase 25 through the oil pump 66, the stationary endpiece 165 of the pipe 65 can engage freely, that is with omnilateral radial play, into the axial bore 64 of the countershaft 34. The lubricating oil is drawn by the pump 66 from the lower part of the gearcase 25 and impelled into the axial bore 64 of the countershaft 34, from which it is flung out in all directions through the radial drillings 63 of the shaft 34 by the centrifugal force generated by the rotation of the shaft.

In both cases, the lubricating oil flung out of the radial drillings 63 of the countershaft 34 is finely atomized and not only performs an excellent lubrication, but also a particularly effective cooling action on the transmission gears 30 to 33. The lubricating oil flung out then collects in the lower part of the gearcase 25, from which it is drawn again by means of the oil pump 66 or of the suction generated by its ejection.

On its wider internal extremity 319, the conveying screw 19 has an external, angled-over conical flange 419, the free extremity of which is aligned with the coordinated free marginal portion of a correspondingly conical lining insert 222 situated within and secured to the drum portion 22. Between the conveying screw flange 419 and the lining insert 222 of the drum portion 22, is situated a seal ring 43, which is rotatably arranged in at least one of the relatively rotating parts 419, 222.

By this arrangement, the centrifuge drum 20 is subdivided into two separate chambers 41, 42, FIGS. 3 and 5, which are closed off hermetically and follow one another in the longitudinal direction of the centrifuge. The chamber 41 which is referred to hereinafter and in the appended claims as a precentrifuging chamber is situated in the longer conical drum portion 21 and is defined by the wall of the drum portion 22, the exterior of the conveying screw 19, and the conveying screw flange 419. At its wider, or inner, end, the precentrifuging chamber 41 is in communication with the internal space of the hollow body of the conveying screw 19 through radial inlet bores 44 provided in the conveying screw flange 419. At the left-hand end of the centrifuge, a stationary inlet pipe 45 is inserted into the hollow body of the conveying screw 19 through the coaxial hollow shafts 220 and 219 of the drum 20 and conveying screw 19. The wider internal end of the precentrifuging chamber 41 is also in communication with a third chamber, namely the conical separating chamber 141 which is formed as a "blind" chamber and is situated between the conical wall of the drum portion 22 and the conical insert lining 222 fastened therein. The separating chamber 141 is thus defined at the outside and inside by conical walls 22, 222 which are firmly interconnected and revolve conjointly.

The opposite, narrower, end of the precentrifuging chamber 41 is provided with an outlet for solids, which outlet consists of several radial outlet drillings 46 formed in a cylindrical terminal portion 320 (FIG. 4) of the drum and which are distributed around its periphery, as illustrated in FIG. 4. The outer side of the drum portion 20 carries obliquely extending blades 47 arranged between the outlet drillings 46, and is surrounded by a cylindrical, annularly continuous intercepting screen or baffle 48 open at one axial end. The intercepting baffle 48 is stationary, for example it is fastened to a stationary housing 49 enclosing the entire centrifuge. In the region of the drum portion 20 provided with the outlet drillings 46 and the blades 47, the centrifuge housing 49 has a chamber 150, FIGS. 4, having the outflow opening 10 for the solids.

The centrifuge chamber 42, referred to hereinafter and in the appended claims as a postcentrifuging chamber, is situated in the region of the shorter conical drum portion 22 and is defined by the wall of the lining insert 222, the adjacent flange 419 of the conveying screw 19, the inner tubular extension 122 of the drum portion 22, and the inner conical extremity 319 of the conveying screw 19. The postcentrifuging chamber 42 is in communication at one side with the precentrifuging chamber 41 through axially directed liquid passages 50, FIGS. 5 and 6, which are formed in the conveying screw flange 419 and which are arranged as sieves or filters and are each provided with a cleaning device.

As illustrated in FIG. 6, each liquid passage 50 consists of a pipe element 51 which passes through the flange 419 of the conveying screw 19 approximately parallel to the axis of the centrifuge and is secured to the said flange 419. In the pipe element 51 is a coaxial rod 53 which is arranged in longitudinally displaceable manner in stationary guiding partitions 54

provided with through flow openings 154 which are eccentric to the axis of the pipe element 51. On the end of the rod 53, facing towards the precentrifuging chamber 41, is fastened a disc-pistonlike throttling head 52, the external diameter of which is less than that of the internal diameter of the pipe element 51. Consequently, a very narrow annular through flow passage 55 is formed between the throttling head 52 and the surrounding wall of the pipe element 51. The end of the pipe element 51 facing towards the precentrifuging chamber 41 has an inlet opening 56 which is of slightly lesser diameter than the bore of the pipe element, but which is such that the throttling head 52 can pass through the said inlet opening 56 with the minimum possible radial play.

The other end of the rod 53, which extends out of the pipe element 51, bears a preferably spherical head 153 which engages in a correspondingly profiled groove of a control plate 57, FIG. 5, which is inclined relative to the axis of the centrifuge, is fastened on the inner cylindrical extension 122 of the drum portion 22, and is situated in the postcentrifuging chamber 42. Owing to the relative rotary displacement between the control plate 57 rotating with the drum 20 and the ring of liquid passages 50 rotating with the conveying screw 19, the control plate 57 acts as a wobble- or swash-plate and reciprocatingly displaces the rods 53 in the pipe elements 51, the throttling heads 52 being alternately extended and retracted through the inlet opening 56 of the corresponding pipe elements 51, that is oscillating between an inner terminal position shown in solid lines in FIG. 6 and an outer terminal position shown dash-dotted in FIG. 6.

The postcentrifuging chamber 42 comprises two sets of outflow ducts opening inside the chamber 42 at different distances from the axis of the centrifuge. The one set of outflow ducts consists of outflow passages 58 which are provided at regular intervals around the periphery of the centrifuge in the drum portion 22 and in the inner lining insert 222, and whereof the inner extremities open into the widest end of the postcentrifuging chamber 42, close to the seal ring 43 between the lining insert 222 and the conveying screw flange 419, into the chamber 42. The outer ends of the outflow ducts 58 open into a chamber 59 of the stationary centrifuge housing 49 which is provided with the bottom outflow opening 8. The other set of outflow ducts of the postcentrifuging chamber 42 consists of outlet connectors 60 which pass at regular intervals around the periphery of the centrifuge through the wall of the drum portion 22 and the lining insert 222. The outlet connectors 60 extend into the postcentrifuging chamber 42 so that their inner ends open into the postcentrifuging chamber 42 in a region thereof which is situated considerably closer to the axis of the centrifuge than the outflow passages 58. The outer ends of the outflow connectors 60 however open into a chamber 61 in the stationary centrifuge housing 49, the chamber 61 being provided with the bottom outflow opening 9.

The mixture to be separated, consisting of solids and of two liquids of different weight, in particular of solid olive residues, water and oil, is fed through the inlet pipe 45 into the hollow body of the conveying screw 19 and passes through the radial inlet drillings 44 into the precentrifuging chamber 41. In the precentrifuging chamber 41 the two liquids are separated from the solids. The sludge of solids is conveyed by the conveying screw 19 towards the apex of the precentrifuging chamber 41, in which it is flung out through the radial outflow drilling 46 of the drum portion 320. The radially ejected sludge of solids is intercepted by the annular interception baffle 48 and issues therefrom in an axial direction. The sludge of solids is conveyed towards the open end side of the annular interception baffle 48 by the inclined external blades 47 of the drum 20. The drum blades 47 revolving at a small distance from the inner surface of the annular interception baffle 47 at the same time also act as scrapers, that is they scrape off sludge of solids adhering to the interception baffle 48 and prevent the forming of large stationary accumulations which would obstruct the outflow of solids. The sludge of solids, that is olive residues, dropping out of the annular interception baffle 48 emerges through the bottom outflow opening 10 of the housing chamber 150.

The mixture of liquids separated from the coarser solid parts and consisting of two liquids of different weight (oil and water), travels towards the wider internal end of the precentrifuging chamber 41 where it enters the separating chamber 141. The mixture of liquids is exposed to a centrifugal action in the chamber 141, which latter is not disturbed by the relative rotary displacement between the centrifuge drum 20 and the solid-conveying screw 19, since the defining walls 22, 222 of the separating chamber 141 are firmly interconnected. Consequently, the finer solid particles contained in the liquid mixture are also separated in this chamber 141. These collect on the conical wall of the drum portion 22 and slide back on this wall into the precentrifuging chamber 41, where they are engaged by the solid-conveying screw 19 and conveyed towards the outlet 46 for solids for delivery together with the rest of the sludge of solids.

The mixture of liquids cannot issue from the narrower blind extremity of the separating chamber 141 and flows back into the precentrifuging chamber 41, from which it passes into the postcentrifuging chamber 42 through the axially parallel liquid passages 50. The solid particles entrained by the mixture of liquids cannot pass through the narrow throughflow gap 55 formed around the throttling heads 52, and collect in the throughflow pipes 51 in the space preceding the corresponding throttling heads 52, from which they are ejected through the inlet opening 56 of the throughflow pipes 51 by the reciprocating motion of the throttling heads 52, and are returned into the precentrifuging chamber 41.

The mixture of liquids (oil and water) freed of the solids, i.e. of the olive residues, is separated into its components in the postcentrifuging chamber 42. The heavier liquid, that is the water, collects in the portion of the chamber 42 remote from the axis of the centrifuge and flows out into the chamber 59 of the centrifuge housing 49 through the outflow passages 58 terminating at 58' (FIG. 5). The lighter liquid, i.e. the oil, collects in the portion of the postcentrifuging chamber 42 which is closer to the axis of the centrifuge and flows out into the chamber 61 of the housing 49 through the outlet connectors 60. The two liquids issue separately respectively through the bottom outflow openings 8 and 9 of the housing chamber 59 and 61.

By screwing in or screwing out of the outlet connectors 60, the inner inlet openings can be adjusted to the required position thereof relative to the interface between the outer layer of heavier liquid (water) and the inner layer of lighter liquid (oil). Blades 62 are provided in the postcentrifuging chamber 42 and are firmly connected to the drum portion 22 through the internal lining insert 222 and the blades 62 overlap the bent over flange 419 of the conveying screw 19. The blades 62 are so formed, for example by being helically bent, that they impel the residual solids separated in the postcentrifuging chamber 42 under exploitation of the relative rotary displacement between the drum portion 22 and the conveying screw 19, towards the inlet opening of the outlet passages 58 for the heavier liquid (water). The blades 62 thus, in effect, constitute a second solid-conveying worm or screw, which is surrounded by the conical hollow end portion 419 of the first screw 19 and cooperate with the latter in such manner that the residual solids separated in the postcentrifuging chamber 42 are conveyed towards the outlets 58, that is in the opposite direction to the solid sludge feed caused by the screw 19 in the precentrifuging chamber 41.

The shaft 119 of the solids-conveying screw 19 is preferably formed as a hollow shaft at the end of the centrifuge remote from the inlet pipe 45. An optional additional liquid, e.g. a treatment or washing liquid, may be fed into the internal space of the centrifuge even during centrifugal operation by means of the hollow shaft 119, through the internal space of the screw 19 and the radial inlet drillings 44.

The invention is not limited to the example described and illustrated, several solutions differing in respect of structure being possible within the scope of the general inventive principle. In particular, the centrifuge according to the invention may also be employed for separation of optional other mixtures, which consist of a solid ingredient and of two liquids of different weight. The centrifuge according to the invention may also be employed for separation of a mixture of solids and a single liquid. In this case, a clarification of the liquid separated from the solids is performed in the postcentrifuging chamber **42**, that is the liquid is separated from the residual solid particles entrained from the precentrifuging chamber **41**. The clarified liquid flows out through the outlet connectors **60** and the bottom outflow opening **9** of the housing chamber **61**, whereas the solid particles separated during clarification emerge through the outflow passages **58** and the bottom outflow opening **8**.

In the structural sense, the sieving and filtering devices for the traversing liquid and the corresponding cleaning devices may be constructed to be of any suitable form and may be driven by any suitable means, these devices being arranged between the precentrifuging chamber **41** and the postcentrifuging chamber **42**. It may be envisaged, moreover, to construct the stationary cylindrical interception baffle **48** around the solid outlet drillings **46** of the drum **20**, so as to be open at both axial ends. The blades **47** arranged on the drum **20** between the solid outflow drillings **46** can be approximately V-shaped so as to convey the ejected solids from approximately the middle of the interception baffle **48** towards the two open extremities of the same.

I claim:

1. A centrifuge for separating mixtures consisting of solids and at least two different heavy liquids, comprising

a rotatable drum (**20**), said rotatable drum being provided with a first precentrifuging chamber (**41**), a hollow solids-conveying worm (**19**) coaxial with and rotatable relative to the said first drum chamber (**41**), said worm (**19**) communicating with one end of said first chamber,

inlet means (**45**) connected to the interior of the drum (**20**) by which a mixture to be separated is delivered to the interior of the drum,

said drum (**20**) being further provided with a second, postcentrifuging chamber (**42**), port means (**50**) at the end of said first chamber (**41**) adjacent to the said mixture delivery inlet means (**45**) and communicating with the said postcentrifuging chamber (**42**), the said postcentrifuging chamber (**42**) being provided with at least two outflow ducts (**58, 60**), each communicating with the postcentrifuging chamber at different distances from the axis of rotation of the drum, blade means (**62**) in the said postcentrifuging chamber connected to said drum for delivering any solid materials against the outflow openings for the heavy liquids, and a third, frustoconical separating chamber (**141**) disposed around the postcentrifuging chamber (**42**), a pair of walls (**22, 222**) rotating together with said drum (**20**) defining said separation chamber (**141**), said separation chamber (**141**) communicating at its wider end with the said first precentrifuging chamber (**41**).

2. A centrifuge according to claim **1**, wherein the port means (**50**) includes cleaning devices (**53, 55**) therefor, and movable relative thereto, said cleaning devices comprising actuating means (**57, 153**) coupled to and operable by the relative rotary displacement between said drum and said worm.

3. A centrifuge according to claim **1**, wherein communication between the precentrifuging chamber and the postcentrifuging chamber is effected by pipes approximately parallel to the axis of the drum and which traverse and are secured to a flange carried by said worm and which separates the precentrifuging chamber from the postcentrifuging chamber.

4. A centrifuge according to claim **3**, wherein each said pipe supports a throttling head axially reciprocable relative to the inlet to the pipe and which on the forward stroke thereof forms with the pipe inlet an annular through-flow gap directed towards the precentrifuging chamber.

5. A centrifuge according to claim **4**, wherein the throttling head is carried by an axially reciprocable rod reciprocation of which is effected by a wobble- or swash-plate rotatable with the drum and which is inclined relative to the axis of the drum.

6. A centrifuge according to claim **1** wherein the drum consists of first (**21**) and second (**22**) hollow cones the bases of which are secured one to the other, wherein the solids-conveying worm is conical, is housed in the first drum-forming cone with the base chamber thereof directed towards the base of the first drum-forming cone, and the sides thereof form with the interior of the first drum-forming cone said precentrifuging chamber, and wherein one of said walls (**222**) defining the postcentrifuging chamber (**42**) is a lining insert (**222**) rotatable with the interior of said second hollow cone (**22**) and said postcentrifuging chamber is further defined by a base portion (**419**) of the conical solids-conveying worm.

7. A centrifuge according to claim **1**, wherein communication between said first outlet and the interior of the precentrifuging chamber is effected through at least one radial outflow opening formed in the drum, wherein the first outlet is formed in a stationary housing arranged around the drum, and wherein around the portion of the drum provided with said radial opening there is disposed a stationary interception baffle which is annularly continuous but open at one axial end, which closely encircles a ring of blades provided externally on said drum portion and which are arranged to convey sludge intercepted by the interception baffle towards said first outlet and also to scraping the inner surface of the baffle.

8. A centrifuge according to claim **1**, wherein the drum and the solids-conveying worm are coupled by a transmission gear including a safety device against overloads.

9. A centrifuge according to claim **8**, wherein the safety device comprises a shearable coupling element including an insulated electrical conductor interposed in a circuit arranged to trigger a warning signal and switching off the drive of the drum, upon shearing of the coupling element.

10. A centrifuge according to claim **8**, wherein the transmission gear comprises gears rotatable respectively one with the drum and one with the worm, a first drive gear rotatable with a countershaft and meshing with the drum gear, a second drive gear freely rotatable on the countershaft, and a coupling element coupling said first and second drive gears and which is shearable upon exceeding a predetermined torque.

11. A centrifuge according to claim **10**, wherein the gear rotatable with the drum is secured to an extension the drum formed as a hollow shaft the gear rotatable with the worm is secured to an end of the worm which extends out of the drum through said hollow shaft.

12. A centrifuge according to claim **10**, wherein the countershaft has at least one radial bore connected through an axial bore of the countershaft and through a stationary oil pipe with a supply of lubricating oil.

13. A centrifuge according to claim **12**, wherein the axial bore of the countershaft is connected through an oil pump to a lubricating oil container.

14. A centrifuge according to claim **13**, wherein the container comprises the lower portion of a casing for the gears.

15. A centrifuge according to claim **12**, wherein the axial bore of the countershaft is connected in oiltight and airtight manner to a terminal portion coaxial thereto of an oil pipe connected to a lubricating oil container.

16. A centrifuge according to claim **15**, wherein the container comprises the lower portion of a casing for the gears.

17. Centrifuge according to claim **1** wherein said solids-conveying worm has a hollow terminal part encircling the blade means (**62**), said blade means being shaped to convey residual solids separated in the postcentrifuging chamber in the opposite direction to the advance of the sludge of solids caused by the worm in the precentrifuging chamber.