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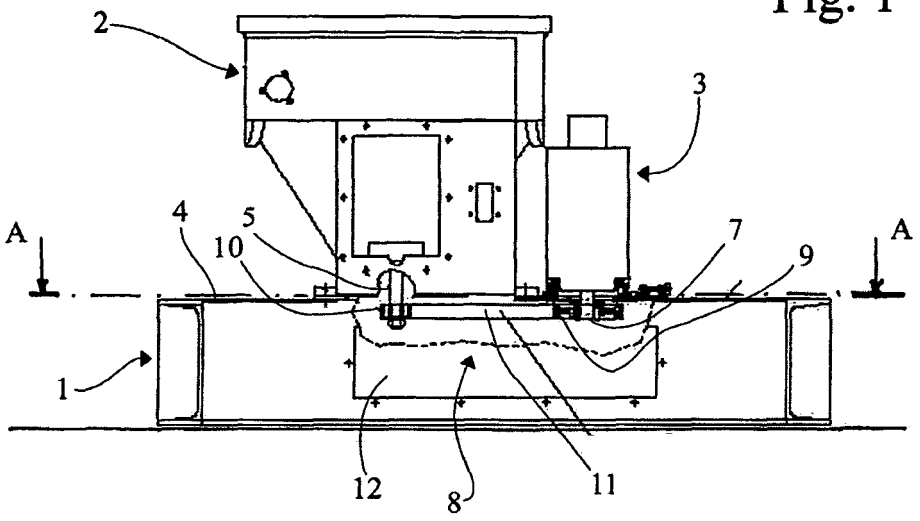
(54) **A machine for the centrifugal separation designed in particular for the oil-producing industry**

(57) A machine for the centrifugal separation, designed in particular for the oil-producing industry, comprising on a machine bed (1) a vertical-axis centrifugal separator (2), which is provided with a vertical transmission shaft (5). The motion is imparted to the vertical transmission shaft (5) by an output (or drive) shaft (7) of an electric motor (3), and by a transmission unit (8) with flexible member.

Fig. 1



EP 2 000 214 A2

Description

Technical Field

[0001] The invention relates to a machine for the centrifugal separation, designed in particular for the oil-producing industry. Nonetheless, it could also apply to other technical fields.

Background Art

[0002] A machine of the kind forming the subject of the present invention includes a vertical-axis centrifugal separator and allows separation of liquids of different densities and features, by means of high peripheral velocity centrifugation. By providing this machine downstream of a continuous-processing-cycle plant for the extraction of olive oil at ambient temperature, it permits to separate oil from "vegetation water" (water contained in the olive) and from any suspended solid residues.

[0003] Presently, the motion to the vertical shaft of a centrifugal separator is imparted by an electric motor through a gear drive. This kind of transmission has some drawbacks.

[0004] Since in the known centrifugal separator the motion is transmitted between skew axes, a local, considerable sliding/dragging among the teeth of the gears occurs, whereby the same are subject to high surface wear. Furthermore, the contact area between the engaging teeth is extremely limited. This entails a limit for the load-bearing capacity of a tooth, and consequently, for the transmissible power. The mechanical efficiency of the transmission is for this reason extremely low. Besides, the mutual engagement of the teeth gives rise to a high noise, over 80 decibels, thereby forcing the operators to wear individual, hearing protection devices.

[0005] Lastly, it should be emphasised that the transmission between skew axes, besides a (spiral) bevel ring gear and a pinion, also requires the assembling of a number of mechanical components; thus, the realisation cost of this transmission is considerably high.

[0006] Because of said numerous components, the current transmission unit also renders its assembling more difficult and increases the time required for carrying out this job.

[0007] The object of the present invention is to eliminate these disadvantages.

[0008] In particular, an object of the present invention consists in the realisation of a both effective and efficient transmission unit arranged between the electric motor and the vertical shaft of the centrifugal separator.

[0009] An additional object of the present invention is the reduction of the cost of the transmission unit for each centrifugal separator, as compared with the presently employed transmission unit, by reducing the number of its components, thereby leading at the same time to less difficult and less time-consuming assembling operations.

[0010] A further object of the invention is to design a low-noise transmission unit which does not require the use of individual (separate) means for the protection from noise.

Disclosure of the Invention

[0011] To achieve the above and further objects, the invention provides a machine for the centrifugal separation, which is designed in particular for the oil-producing industry, comprising a vertical-axis centrifugal separator which is provided with a vertical transmission shaft, the latter receiving the motion from an output shaft (drive shaft) of an electric motor, wherein the connection between said vertical transmission shaft and said output or drive shaft is realised by a transmission unit with a flexible member.

[0012] Advantageously, this transmission is a synchronous transmission unit and the flexible member is a timing belt (positive drive belt) having cogs which engage with the drive pulley and the driven pulley, and which are provided with a profile/contour corresponding to that of the belt.

Brief Description of Drawings

[0013] The above and further objects and advantages of the invention will more clearly result from the following detailed description of one of its embodiments considered in combination with the annexed drawings, wherein:

FIGURE 1 is a schematic, partially cutaway front view, of a machine for the centrifugal separation in accordance with the present invention, and

FIGURE 2 is a cross-section obtained in a plane corresponding to line A-A in Figure 1.

Description of Preferred Embodiments

[0014] The machine for performing centrifugal separation according to an embodiment of the invention comprises a machine bed 1, a centrifugal separator with vertical axis (vertical-axis centrifugal separator) generally indicated by 2, and an electric motor 3 which cooperates with the centrifugal separator 2.

[0015] As shown in figures 1 and 2 corresponding basically to a front view and a sectional view taken in a horizontal plane of the machine, the machine bed 1 acts as support of the machine components. The machine bed 1 is appropriately anchored to the ground at its lower part, while at its upper part 4 it carries the centrifugal separator 2 and the electric motor 3.

[0016] The centrifugal separator 2 is of the vertical-axis kind; for instance, the present invention may apply to the model Ramef 2750/G, already manufactured by the applicant itself, which therefore does not require further explanation. The centrifugal separator 2 is equipped with a vertical transmission shaft 5 as shown in the cut-

away portion of the front view of Figure 1. It can be seen that the centrifugal separator is fixed to the upper part 4 of the machine bed in such a manner that the vertical transmission shaft 5 downwardly projects into the machine bed at its lower end.

[0017] The electric motor 3 could be an asynchronous three-phase motor, with a cage-type rotor, two pole pairs, and a rating (power) of 7.5 kW. The motor flange - not shown in detail - of motor 3 is appropriately fixed to the upper part 4 of the machine bed 1 with the interposition of a mount plate 6 which is visible in Figure 2. Plate 6 has an aperture traversed by the drive shaft (output shaft) 7 of the electric motor 3, the lower end of this drive shaft projecting downwardly, starting from the upper side 4 of the machine bed, in a way similar to the vertical transmission shaft 5.

[0018] Motor 3 is vertically positioned on one side of the centrifugal separator 2 so that, according to the present invention, the respective shafts - i.e. the drive shaft 7 and the vertical transmission shaft 5 - can receive (support) the mechanical members embodying the motion transmission unit, the latter including said flexible member and being generally referenced 8 in the figure.

[0019] This transmission unit 8 with flexible member comprises a drive pulley 9, rigidly attached to the lower end of the drive shaft, a driven pulley 10, rigidly attached to the lower end of the vertical, transmission shaft 5, and a belt 11, connecting the drive pulley 9 and the driven pulley 10 with each other.

[0020] By virtue of this strict design scheme the transmission unit 8 with flexible member is received inside the machine bed 1 and may be reached through an aperture, which is normally closed by a removable panel 12, the latter being provided frontally in the machine bed 1.

[0021] The correct strain of the transmission belt is obtained by directly acting on the plate 6 used to fix the motor, this plate being suitably shaped for this purpose. Due to functional requirements, linked to the nature of the separation process carried out by the machine, the transmission 8 with flexible member is of a synchronous kind. Therefore, the belt has cogs. The cogs (teeth) of the timing belt 11 (not shown in detail) engage with the drive pulley 9 and the driven pulley 10, these having a toothed contour corresponding to that of the timing belt 11. Advantageously, the timing belt 11 has a toothed profile in the form of a double helix (not shown, since already well-known). This particular profile of the cogs allows a progressive and continuous engagement of the timing belt 11 with the drive pulley 9 and the driven pulley 10, thereby insuring, in this way, a considerable reduction of vibrations and noise. The efficiency of the transmission is particularly high.

[0022] The electric motor 3 is controlled by an inverter that insures a gradual and progressive delivery of the torque during the most critical phase, corresponding to the machine starting phase.

[0023] The vertical transmission shaft 5, to which the driven pulley 10 is attached, drives in rotation a drum (not shown) of the centrifugal separator 2, at a speed of about 6450 rpm, to allow the separation of liquids contained in the drum, i.e. of oil and water, by virtue of the centrifugal action.

[0024] The vertical transmission shaft 5 of the centrifugal separator 2 is supported on its lower side by means of two angular-contact ball bearings, mounted in an "O" configuration, and which are received within a spherically shaped support, so that the vertical transmission shaft 5 is free to oscillate. This movement is in any case limited by springs (not shown) of adequate stiffness, which constitute an upper elastic support for the vertical transmission shaft 5 of the separator.

[0025] The action of the belt 11 on the vertical transmission shaft 5 causes a tilting moment whose magnitude depends on the transmitted torque. Surely, the most critical phase is the starting phase, when the machine is started, during which phase all masses need to be accelerated to their steady-state velocity, by overcoming the mechanical forces of friction. Defining, by means of the inverter, a "soft" acceleration ramp for the motor, it is anyway possible to limit/control the tilting action within acceptable values.

[0026] No axial thrust is transmitted to the shaft by the flexible-member transmission unit 8, due to the double helical profile of the teeth of the timing belt 11.

[0027] The weight of the shaft and of the drum is enough to avoid a lifting of the shaft during normal machine operation.

[0028] The transmission unit 8 with flexible member according to the present invention does not eliminate the possibility of height-adjusting the vertical transmission shaft 5 and the drum which is integral with it, which adjustment is necessary during the assembling of the machine.

[0029] The machine for the centrifugal separation according to the present invention, which is provided with a flexible-member transmission unit, has several advantages. Some are briefly stated in the following part of the description.

[0030] In the machine of the present invention the noise is greatly reduced, compared with a centrifugal separator of the prior art, due to the specific double helical profile, or "circular-arc" profile, of the teeth of the timing belt, which allows a progressive and continuous engagement with the pulleys, thereby reducing vibrations and consequently the noise of the transmission unit. Moreover, the mesh is very accurate and no slipping phenomena occur; these phenomena could originate tooth wear and thus reduce the life of the transmission. Moreover, the uniform transmission of the loads by the meshing teeth allows to transmit high powers with efficiencies above 95%. This is a great advantage in terms of energy savings.

[0031] Compared with centrifugal separators based on a gear drive, production costs are reduced by virtue of the lower costs of the employed components and the shorter time required for mounting the transmission unit

to the machine. Actually, it should be emphasised that assembling and maintenance of the flexible-member transmission unit are decisively simpler than the same operations performed on a machine based on the gear drive transmission unit. This simplicity is due to the fact that both pulleys can be mounted on their respective shafts in a way fully independent from each other.

[0032] When assembling the belt and providing the necessary initial strain to the belt, the mutual distance between the axes of the transmission is adjusted by adjusting the mount plate of the electric motor on the machine bed, as already mentioned above.

[0033] To perform maintenance works, all transmission unit components are easily accessible after the removal of said panel, covering the opening on the front part of the machine bed.

[0034] A further advantage of the present invention is that on the machine bed there may be provided/fixed several centrifugal separators driven by a single electric motor by means of flexible-member transmission units analogous to the one already described.

Claims

1. A machine for the centrifugal separation, designed in particular for the oil-producing industry, comprising a vertical-axis centrifugal separator (2) which is provided with a vertical transmission shaft (5), the latter receiving the motion from an output shaft (7) of an electric motor (3), **characterised in that** the connection between said vertical transmission shaft (5) and said output or drive shaft (7) is formed by a transmission unit (8) with a flexible member.

2. A machine according to claim 1, **characterised in that** said transmission unit (8) with flexible member includes a drive pulley (9) rigidly attached to the output shaft (7), a driven pulley (10) rigidly attached to the vertical transmission shaft (5), and a belt (11) connecting the drive pulley (9) and the driven pulley (10) to each other.

3. A machine according to claim 2, **characterised in that** said transmission unit (8) is a synchronous transmission unit and the belt (11) is a timing belt, having teeth meshing with the drive pulley (9) and the driven pulley (10) which are provided with a profile or contour corresponding to that of the belt (11).

4. A machine according to claim 3, **characterised in that** said timing belt has teeth with a double helical profile.

5. A machine according to claim 1, **characterised by** the presence of a machine bed (1), supporting several centrifugal separators (2) which are connected to a single electric motor (3).

6. A machine according to claim 5, **characterised in that** said machine bed (1) houses the transmission unit (8) with the flexible member.

Fig. 1

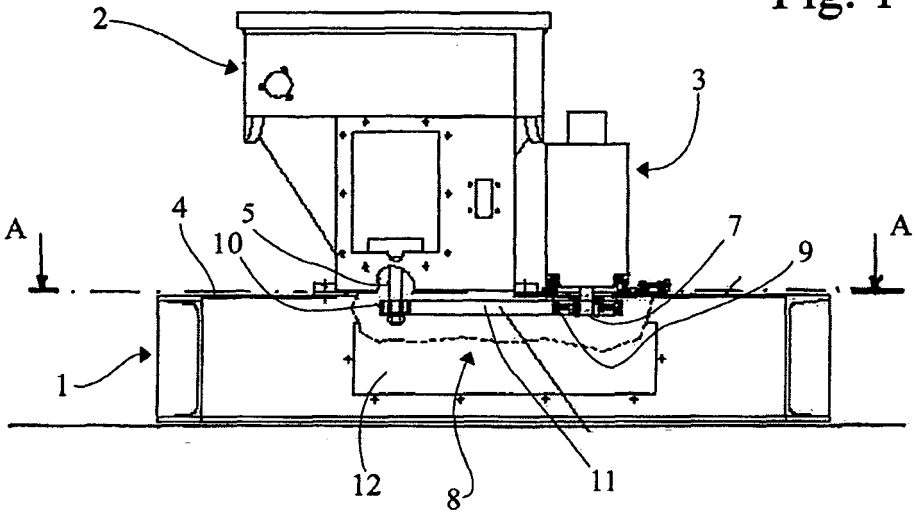


Fig. 2