SHOCK MOUNT FOR CENTRIFUGAL SEPARATORS

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This invention relates to centrifugal separators and has for its principal object the provision of an improved mount for the rotating bowl.

It is well known that centrifugal separators are subject to considerable vibration even when the rotating parts are carefully balanced. This vibration is objectionable not only in the large centrifugal machines but also in farm or smaller sized machines, which are usually of the direct-drive type designed for operation from a table-top or bench. The problem in either case is to damp these vibrations while maintaining a tight positive driving connection between the power source and the bowl proper. The invention solves this problem in a very simple and effective manner. Since it finds particular utility in centrifuges of the direct-drive type, that is, where the centrifugal bowl is rotated directly from an electric motor rather than through a gearing arrangement, the invention will be described in such an embodiment, although it will be understood that its use is not limited thereto.

A centrifugal separator made according to the invention comprises a rotary bowl having a separating chamber and adapted to be driven by a spindle. An axial member on the bowl forms a downwardly-opening axial recess at the bottom of the bowl, and fitted closely in this recess is a resilient, rubber-like plug. This plug likewise has a downwardly-opening axial recess or passage, which in this case is partly defined by a generally flat internal lateral wall of the plug. A driving dog on the spindle is fitted closely in this passage of the resilient plug and has a generally flat side wall engaging the flat internal wall of the plug. The resilient plug forms a positive driving connection between the spindle and the bowl and at the same time allows the bowl to tilt relative to the spindle due to any unbalanced condition of the parts while they are rotating. The resilient plug also allows radial and axial movements of the bowl relative to the spindle. The vibrations of the separator incident to its operation are effectively damped at the resilient plug, due to its ability to absorb the shocks applied from different directions.

A preferred form of the device, the axial member in the bowl for receiving the plug is a tubular shaft forming a central feed passage for the mixture to be separated. This tubular shaft has a lateral feed opening communicating with the separate chamber in the bowl. The resilient plug which receives the driving dog is located below the lateral feed opening in the tubular shaft so as to seal the feed passage at the bottom. Thus, the resilient plug serves not only as a yielding driving connection between the spindle and the bowl, to absorb vibrations and accommodate movements of the bowl relative to the spindle, but also to close and seal the bottom of the tubular shaft so as to complete the feed passage to the bowl chamber.

For a better understanding of the invention, reference may be had to the accompanying drawing, in which:

Fig. 1 is a vertical sectional view of a centrifuge embodying the invention;

Fig. 2 is an enlarged vertical sectional view showing the resilient plug member engaging the driving dog of the spindle, and taken on line 2--2 of Fig. 3;

Fig. 3 is a sectional view taken along the line 3--3 of Fig. 2; and

Fig. 4 is a vertical sectional view of the plug member and driving dog, taken on line 4--4 in Fig. 3.

Referring now to Fig. 1, numeral 1 designates the frame of a centrifugal separator having legs (not shown) and adapted to rest upon a table or bench. Mounted on the frame is a centrifugal or rotary bowl indicated generally at 2, the bowl having a lower or bottom portion 3 and an upper or shell portion 4. A tubular shaft 6 in the bowl 2 has a nut 5 screwed on its upper portion, the underside of the nut 5 having a recess for receiving the shell neck 7. The tubular shaft is affixed to the bowl bottom 3 by a nut 8. The tubular shaft 6 is in effect an axial member forming a central feed passage indicated generally at 10, through which milk or any mixture to be separated is fed to a distributor 9 by way of lateral feed openings 12 arranged around the periphery of the tubular shaft. The distributor 9 is fitted around the tubular shaft 6 and forms a plurality of passages 13 which serve to convey the milk to the separating chamber by way of distributing holes 14 in a stack of conical discs 15.

These discs have central openings through which the shaft 6 and the distributor 9 extend. The top disc 16 (having no distributing holes) of the disc stack has a neck portion 17 extending upward into the bowl neck 7. The separated cream (the lighter component of the milk) is discharged through passage 18 in the disc neck 17, and through port 19 in the bowl shell 4, to the cream cover or receptacle 20. The separated skim milk (the heavier component of the milk) is led between the outside of the top disc 16 and the inside of the bowl shell 4 to a variable size orifice 21, through which it passes to the skim milk cover or receptacle 22.

The tubular shaft 6 forms a downwardly-opening axial recess at the bottom of the bowl, which is closed by a resilient plug member 23. The plug 23 is fitted closely in the tubular shaft 6 below the lateral feed opening 12. It may be made of rubber or any similar elastic material and has a downwardly-opening axial passage or recess 25 for receiving the driving dog or tongue 26 on a driving spindle 27. This driving spindle is preferably the armature shaft of an electric motor 11. It will be understood, of course, that the driving dog 26 and the spindle 27 may be made of a single piece of stock. As shown, however, the dog 26 and spindle 27 are separate pieces, since it is cheaper to fasten a driving dog on the armature shaft of an electric motor than to remove the shaft and refashion the end thereof for receipt in recess 25. The driving dog 26 is affixed to the driving shaft 27 in any suitable manner, for example, by a drive pin extending diametrically through the spindle 27 or by a spline or key.

The exterior surface of plug member 23 is provided with a vertical rib 28 (Figs. 3 and 4) which is received in a vertical slot 24 in the interior wall of the shaft 6.

This rib and slot form one part of the driving connection between the bow 2 and the driving spindle 27.

For ease in assembly, the exterior sides of plug member 23 may be slightly tapered toward the top. A shoulder 29 at the bottom of the plug is engaged in a complementary recess in the bottom of shaft 6. It is preferred that there shall be a tight force fit between the exterior of plug member 23 so as to insure a positive driving connection between the plug 23 and the bowl 2.

The recess 25 of plug 23 is cylindrical except for at least one flat internal lateral wall 30. As illustrated (Fig. 3), the plug recess 25 has two opposed flat side walls 30. The driving dog or tongue 26 has a flat side
wall 26a for engagement with each lateral wall 30. The lateral walls 30 thus suffice to locate driving dog 26 relative to the bowl and to form the other part of the driving engagement between the bowl 2 and the driving spindle 27. Sufficient clearance 31 is provided between the under portion of shoulder 29 of the plug 23 and an external shoulder 26b of the driving dog so as to allow axial movements of the bowl relative to spindle 27. The top portion of the driving dog 26 and the top of recess 25 are in contact and limit the downward movement of the plug 23 on dog 26.

Below the bowl 2, the frame 1 has a generally horizontal partition 33 which closely surrounds a flexible mount 34 of rubber-like material. A vertical rib 33a on the frame partition 33 is fitted into a vertical groove 34a in the mount 34, whereby the latter is prevented from rotating relative to the frame. The electric motor 11 has an upper end bell 11a to which a collar 35 is secured. The collar 35 is surrounded by the flexible mount 34, the latter having an internal shoulder 34b resting upon the collar. The collar 35 is radially recessed, as shown at 35a, to receive an internal rib 34c of the flexible mount, thereby preventing rotation of the collar 35 and motor 11 relative to the mount 34. A reduced portion 35b of the collar extends upward and closely surrounds the lower portion of the driving dog 26.

In the operation of the centrifugal separator, the electric motor 11 drives the bowl 2 directly through the motor shaft or spindle 27 and the driving dog 26. But by reason of the inter-engaging flat surfaces 26a and 30 of the driving dog and resilient plug, respectively, slippage is prevented between these parts incident to the driving of the bowl. Similarly, the vertical rib 28 of the resilient plug and the tight fit of the plug into the lower end of the tubular shaft prevents slippage between the plug and the tubular shaft during the driving of the latter. On the other hand, the plug 23 allows the bowl to tilt in any direction relative to the spindle 27 during its rotation, although this tilt is yieldingly opposed by the plug. Likewise the resilient plug allows vertical movement of the bowl relative to the spindle and also radial movements. In addition, the driving plug 23 forms a tight seal in the bottom of the tubular shaft 6, to prevent leakage of the liquid being fed into the separating chamber. This sealing effect of the plug 23 is enhanced by the wedging or expanding action of the driving dog 26 within it. In other words, before the dog 26 is inserted in the plug 23 the cross-sectional area of the plug passage 25 is less than that of the dog at corresponding portions thereof, whereby the intrusion of the dog into the plug expands the latter against the inner wall of the shaft 6 so as to provide a tight liquid seal at the bottom of the feed passage 10. It will be observed that the plug 23 also serves to cushion the torsional shocks incident to the driving of the bowl, since it permits a limited rotational movement of the bowl relative to the spindle 27.

The flexible mount 34 yieldingly supports the electric motor 11 and the lower part of spindle 27 in the frame 1. The yielding support afforded by the mount 34 is principally in the radial direction although it yieldingly opposes twisting movement of the motor 11 relative to the frame 1. It will be observed that the mount 34 is capable of moving vertically in the frame part 33, along with the motor 11 and the bowl 2, to enable the height of the bowl to be adjusted.

I claim:

1. In a centrifugal separator having a rotary bowl provided with a separating chamber and also having a driving spindle for the bowl, the combination of a tubular shaft in the bowl rotatable therewith and forming a central axial feed passage having a lateral feed opening leading to the separating chamber, a resilient plug fitted closely in the feed passage below said lateral opening and sealing the feed passage at the bottom thereof, the plug having a downwardly opening axial passage, and a driving dog on the spindle fitted closely in said plug passage, said plug passage having a cross-sectional area which, prior to insertion of the dog in the plug passage, is less than the cross-sectional area of the driving dog, whereby the dog expands the plug against the surrounding tubular shaft to form a tight seal at the bottom of said feed passage.

2. A combination according to claim 1, in which the driving dog has an external shoulder spaced below the plug for limiting axial movement of the bowl relative to the spindle.

3. A combination according to claim 1, comprising also a vertical rib on the resilient plug, the rib being fitted in a complementary slot in the interior of the tubular shaft.

4. A combination according to claim 1, in which the resilient plug has an external shoulder at its bottom portion engaging the bottom of the tubular shaft.

5. A combination according to claim 1, in which the driving dog has opposed flat side walls engaging complementary walls of the plug passage.

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