Dec. 28, 1954 J. E. COOK 2,698,131

CENTRIFUGAL SEPARATOR

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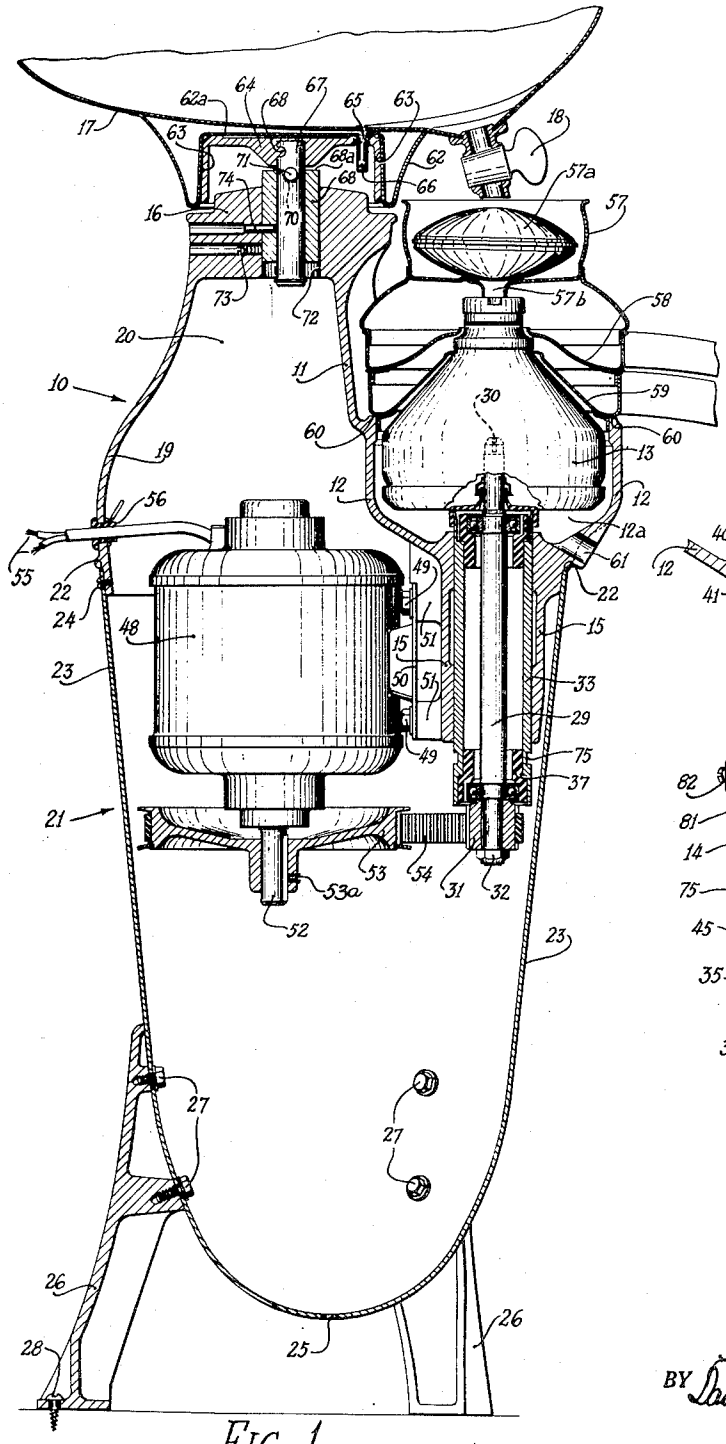


FIG. 1.

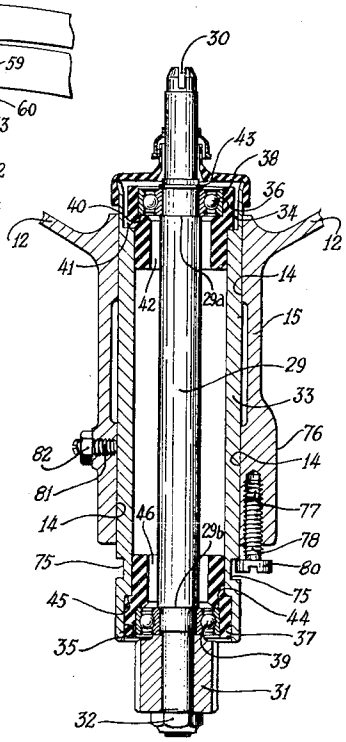


FIG. 2.

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CENTRIFUGAL SEPARATOR

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5 Claims. (Cl. 233—24)

This invention relates to centrifugal separators and has for its principal object the provision of a centrifuge of the vertical type which is sturdy but compact in construction, simplifies the assembly and disassembly steps, is readily adjustable to vary the height of the centrifugal bowl, and operates without any substantial vibration, as compared with prior centrifuges of this type.

A centrifuge made in accordance with the invention comprises a frame having a table portion for supporting a supply can, or the like, which feeds the centrifugal focal, the frame also having an adjacent annular wall forming a well for the bowl. A hollow projection on the frame extends downward from the well and contains a spindle which supports the bowl in the well. Preferably, the spindle is supported both axially and radially in upper and lower bearings held in resilient annular mounts which are positioned in the upper and lower end portions of a housing for the spindle, and this housing is slidable vertically in the hollow projection of the frame but is held in the desired vertical position by an adjustment member on the housing. In this way, both axial and radial vibrations of the bowl during operation are cushioned by the resilient mounts, and these mounts are adjustable vertically as a unit with the housing, the bearings and the spindle to vary the bowl height, by a simple manipulation of the adjustment member, which may be a bolt threaded in the frame projection and engaging part of the housing. I find it advantageous to provide the resilient mounts with enlarged portions engaged in enlarged recesses in the ends of the spindle housing, and to provide the mounts with enlarged spaces which receive the bearings, these spaces, however, having a smaller diameter than the interior of the intermediate portion of the housing, whereby the resilient mounts are stressed both in compression and in shear by axial thrusts on the bearings.

In the preferred construction, the frame is supported by a hollow stool in the general form of a truncated cone which is open at its enlarged upper end to receive the depending hollow projection of the frame and also a motor for driving the spindle in the projection. The motor is secured to this hollow projection and drives the spindle through a connection which includes a pulley or other rotatable member secured to the lower end of the spindle and holding the lower bearing in position in the housing. The table portion of the frame forms a space overlying the motor and opening downward into the hollow stool, thereby providing ample space for circulation of air around the motor.

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

Fig. 1 is a vertical sectional view of the new centrifugal separator, and

Fig. 2 is a vertical sectional view of the driving spindle, showing the bowl-height adjustment mechanism, this view being taken at an angle of about 90° to the view in Fig. 1.

In Fig. 1 of the drawings, a frame casting for the separator is indicated generally at **10**. The frame has at one side an arcuate vertical wall **11** merging at its lower portion with an annular wall **12** forming a well **12***a*. A separator bowl **13** is mounted for rotation on a vertical axis in the well **12***a*. At the bottom of the well **12***a*, and positioned axially of the bowl **13**, is a bore **14** (Fig. 2) extending through the frame casting, the latter having a hollow projection **15** depending from the well bottom and forming a downward extension of the bore **14**. At the opposite side of the frame casting **10** is an elevated table **16** for supporting a supply can **17**, which has a

valve cock **18** for controlling the supply of milk to the centrifugal bowl **13**. The table **16** is supported by and integral with the arcuate wall **11** and an arcuate wall **19** of the frame **10**. The wall **19** merges with the walls **11** and **12** and forms therewith a substantially closed space **20** below the table **16**.

Although the frame **10** has been described as being cast in one piece, the entire frame may be made from separate component parts secured together in any suitable manner.

The frame casting **10** is mounted on a supporting stool member indicated generally at **21**, the frame casting having near its bottom a continuous, peripheral, external shoulder **22** resting upon the upper edge of the supporting stool member **21**.

The stool **21** comprises a hollow member **23** in the general form of a truncated cone, the member being open at its upper or enlarged end and partly closed at its lower or reduced end. Thus, the member **21** has a parabolical shape. It is arranged in upright fashion, its upper edge closely surrounding the frame **10** below the shoulder **22**. The member **23** is secured to the frame **10** in any suitable manner, as by bolts **24**. In the bottom of the member **23** is a hole **25** for drainage, relief from condensation, etc. As shown, the stool member **23** is spun or otherwise fabricated from sheet metal. The stool member is supported at its lower portion by three or more foundation legs **26** secured to the stool by bolts **27**. The bottoms of these legs rest upon the floor where, if desired, they may be permanently anchored by bolts **28**.

The separator bowl **13** is mounted on the upper end of a vertical driving spindle **29**, the spindle **29** having a slot **30** which receives a mating part (not shown) of the bowl so that the bowl will rotate with the spindle. At the lower end of the spindle **29** is a driven pulley **31**, which is secured to the spindle by a nut **32**. The spindle is mounted for rotation in a cylindrical housing **33**, which extends through and is slidable vertically in the bore **14**. In its upper end and lower ends, the cylindrical housing **33** has enlarged spaces **34** and **35**, respectively, which receive flexible mounts **36** and **37** for spindle bearings **38** and **39**, respectively. The flexible mounts **36** and **37** are of annular form and are made of a resilient, rubber-like material. The mount **36** has an internal shoulder **40** supporting the upper bearing **38**, which is somewhat smaller in diameter than the main interior of housing **33** and fits closely in the upper part of mount **36**. The latter also has an external shoulder **41** located below the shoulder **40** and resting upon the housing shoulder formed by the enlarged space **34**. Below the shoulder **41**, the upper mount **36** fits closely in the housing **33**, but above this shoulder it has a clearance with the side wall of the enlarged space **34**. The mount **36** also has a clearance **42** with the spindle **29** extending through this mount and its bearing **38**. A split ring **43**, seated in a groove in the spindle, rests upon the inner race of bearing **38** and provides the vertical support for the spindle.

The lower bearing mount **37** is similar to the mount **36** but is inverted in the lower part of housing **33**. Thus, its shoulders **44** and **45** correspond to the shoulders **40** and **41**, respectively, of the upper mount. However, the enlarged portion of the lower mount fits closely in the enlarged space **35** of the housing. The lower mount forms a clearance **46** with the spindle **29**, which extends through this mount and its bearing **39**. The latter is held against its seat **44** by the pulley **31** engaging the inner race of the bearing. In this way, both the lower bearing and its flexible mount **37** are held in position in the housing **33** at all times during the operation of the centrifuge. The spindle has shoulders **29***a* and **29***b* engaging the inner races of bearings **38** and **39**, respectively, to prevent axial movement of the spindle in the bearings.

As is well known, the bowl of a centrifugal separator vibrates considerably during the centrifuging operation, even when the rotating parts are carefully balanced. Under dynamic conditions, the axial and radial vibrations of the centrifugal bowl are transmitted through the driving spindle to the supporting frame. The spindle mounting means of the present invention are highly effective to cushion and dampen these vibrations. The

radial vibrations are cushioned by the enlarged portions of the mounts **36** and **37** surrounding the bearings. By reason of the clearance space surrounding the enlarged portion of the upper mount **36**, the latter can be displaced bodily to a limited extent in the radial directions, this displacement, however, being yieldingly opposed by the resistance of the intermediate portion of the mount to the resulting shearing stresses. When the upper part of mount **36** has been displaced sufficiently to engage the side wall of the space **34**, further radial movement is yieldingly opposed by the resistance to compression of this part of the mount. Thus, the upper bearing mount accommodates greater radial movements of the spindle than the lower bearing mount, which is a desirable feature in view of the tendency of the upper end of the spindle to oscillate or gyrate about the lower end of the spindle as an axis. Axial displacements of the spindle are yieldingly opposed by the shear-resistance of the flexible mounts. For example, when the spindle **29** undergoes an upward vertical displacement, the lower mount **37** is placed in shear, the shearing forces being exerted by the outer race of bearing **39** and the shoulder of the housing member **33** formed by the recess **35**.

Driving power for the spindle **29** is provided by an electric motor **48** secured to one side of the depending hollow projection **15** of the frame casting **10**. The motor is located within the stool member **21** and underlies the frame space **20**, which opens into the stool member. The motor is secured to the adjacent side of the frame projection **15** in any suitable manner, as by means of bolts **49** extending through a bed plate **50** of the motor and threaded into bosses **51** welded or otherwise secured to the projection **15**. The motor is thus supported with the axis of its rotor **52** parallel to the axis of the spindle **29**. A driving pulley **53** is secured to the rotor **52** by a set screw **53***a*. The driving pulley **53** and the driven pulley **31** on the driving spindle **29** are connected by a belt **54**. The electric power supply for the motor **48** is delivered through leads **55** passing through a rubber eyelet **56** in the frame wall **19**.

The centrifugal bowl **13** may be of conventional type. Above it is the usual inlet cover **57** for receiving the liquid delivered through the overlying valve cock **18** of the supply can. The cover **57** contains the usual float **57***a* for controlling the flow of liquid through the bottom passage **57***b* into the bowl. Below the cover **57**, and surrounding the bowl, are receptacle covers **58** and **59** for receiving, respectively, the separated liquid components discharged from the bowl **13**. The covers **57**, **58** and **59** are nested together and rest upon a ledge **60** of the frame surrounding the bowl **13**. The bowl well **12***a* is vented at **61**.

The bottom of supply can **17** is provided with a recessed center ring **62** secured by welding or soldering. The recess in ring **62** is closed at the top, as shown at **62***a*, and has vertical side walls **63** tapered so as to give a larger diameter to the open bottom of the recess. A hollow plug **64** fits in the recess of the ring **62**. The sides of the plug have a taper complementary to that of the recess walls **63**, so that the plug has a sliding fit in the ring **62**. The reduced end of the plug engages the closed upper end **62***a* of the ring recess. At one side of the plug member **64** is a hole **65** which loosely receives a locating pin **66** secured to the ring wall **62***a*. The supply can **17** is removable from the plug **64** and may be replaced on it in one position only, since such replacement requires engagement of pin **66** in the hole **65**. Thus, the proper alignment of the stop cock **18** with the inlet receptacle **57** is assured. At the center of the plug **64**, a cylindrical bearing post **67** is fastened by means of a tongue **68**. The plug **64** is supported for rotation within a bushing **68** mounted in the table **17**. The post **67** extends through the bushing and is slidable vertically therein. The bushing **68** has diametrically opposed notches **70** in its periphery at the exposed upper end **68***a* thereof, the notches being adapted to receive the ends of a transverse pin **71** in the post **67**. With the pin **71** thus engaged in the notches **70**, rotation of plug **64** is resisted, but the supply can **17** and plug **64** can be rotated, in order to swing the stop cock **18** clear of the inlet cover **57** so as to permit removal or assembly of the covers **57**, **58** and **59**. By forcibly turning the supply can and the plug **64** slightly, the pin **71** in the post **67** is disengaged from notches **70** whereby the supply can is raised, due to the cam action between the pin **71** and notches **70**, and may be rotated in the bushing **68**. To adjust the spout of the stop cock **61** to its proper height, the bushing **68** is adjusted vertically within its aperture **72** in table **16**, so that the cock **18** just clears the top edge of the inlet cover **57**. A set screw **73** at one side of table **16** is then screwed tightly against the side of bushing **68**. A hole is then drilled through table **16** and bushing **68** so as to admit a locating pin **74**. With the pin **74** in position, the entire mounting for the supply can **17** is held permanently at the proper height adjustment.

At or near the lower end of the cylindrical housing **33**, a circular groove **75** is milled (Fig. 2). In an enlarged wall thickness **76** of the frame projection **15** is a tapped hole **77**. A bolt **78** having a flat head **80** is screwed in the tapped hole **77**, the outer portion of the head **80** engaging in the groove **75**. By this arrangement, the bolt **78** supports the housing **33**, and by rotating the bolt **78** the housing **33** and bowl **13** are raised or lowered relative to the covers **57**—**59** and the adjacent table **16**, as desired. When the bowl has been adjusted to the proper height in this way, a set screw **81** in the frame projection **15** is screwed against the side wall of housing **33**, the set screw **81** being in turn locked in position by a nut **82**. Access to the set screw **81**, the nut **82** and the bolt **78** is provided by a hole or holes (not shown) in the side walls of the hollow truncated member **23**.

It will be observed that the pulley **31** is of sufficient length to effect proper engagement with the belt **54** in the various vertical positions to which the bowl is adjusted by the bolt **78**.

By reason of the space **20** formed by the frame above the motor and below the table, and the space formed by the stool member **23** below the motor, ample circulation of air around the motor for cooling purposes is assured. The described arrangement of the stool and frame provides a sturdy and compact centrifuge construction and allows ready access to the motor by simply removing the frame from the stool. The spindle housing **33**, together with the spindle and its bearing assembly, may be removed as a unit from the upper end of the frame projection **15**, after removing the bolt **78** and removing the belt from pulley **31**.

I claim:

1. A centrifugal separator comprising a frame having a table portion and an adjacent annular wall forming a well, a depending hollow projection on the frame extending downward from the well, a housing having a vertical sliding fit in said projection and having a lower part extending below said projection, a spindle supported in the housing and rotatable relative thereto, the spindle extending upward into the well and having an extension projecting downward through the bottom of the housing, a centrifugal bowl rotatable in the well and mounted on the spindle, an adjustment member mounted on the depending hollow projection at one side of the housing and engaging said lower part thereof to support the housing, said member being adjustable vertically on the depending projection to vary the height of the bowl relative to said table portion, a motor secured to said hollow projection, and a driving connection between the motor and said bottom extension of the spindle.

2. A separator according to claim 1, comprising also a supply can mounted on said table portion and having an outlet positioned above the bowl for supplying a liquid to the bowl.

3. A separator according to claim 1, in which the frame forms a substantially closed space below said table portion and adjacent said annular wall, the motor being mounted in the lower part of said space.

4. A separator according to claim 1, comprising also upper and lower bearings in the housing engaging and surrounding the spindle, and resilient bearing mounts in the upper and lower end portions of the housing for supporting the respective bearings therein, the housing having enlarged internal recesses in its end portions, the resilient mounts having enlarged portions disposed in said recesses and also having reduced portions extending into the intermediate part of the housing.

5. A centrifugal separator comprising a frame having a table portion and an adjacent annular wall forming a well, a depending hollow projection on the frame extending downward from the well, a housing having a

vertical sliding fit in said projection, a spindle supported in the housing and rotatable relative thereto, the spindle extending upward into the well, a centrifugal bowl rotatable in the well and mounted on the spindle, a member supporting said housing and adjustable vertically on the frame to vary the height of the bowl relative to said table portion, a motor secured to said hollow projection, a driving connection between the motor and the spindle, and upper and lower bearings in said housing for supporting the spindle therein, said driving connection including a member secured to the lower end of the spindle and holding the lower bearing in position in the housing.

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