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2,752,044

DRIVING MEANS FOR CENTRIFUGAL MACHINES

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2 Sheets-Sheet 1

Fig. 1

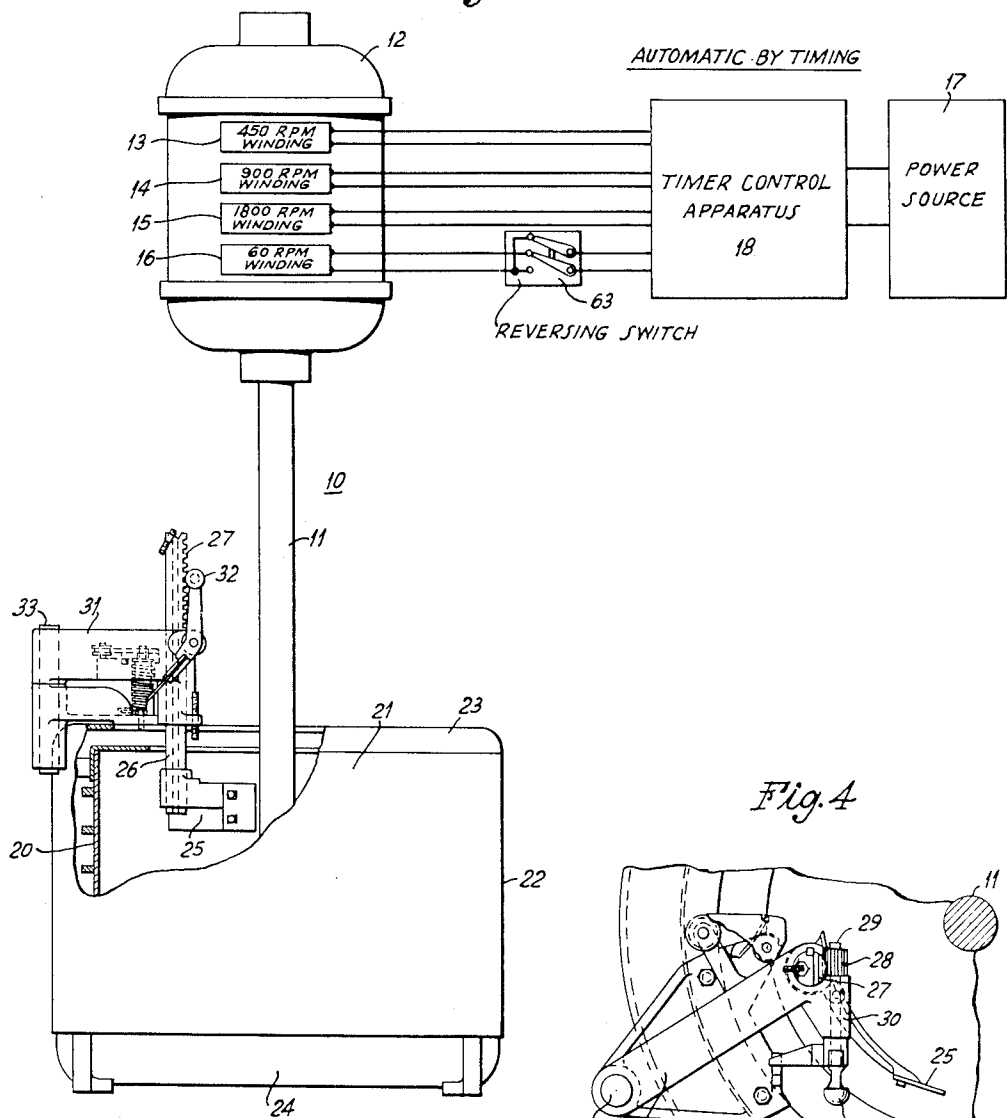
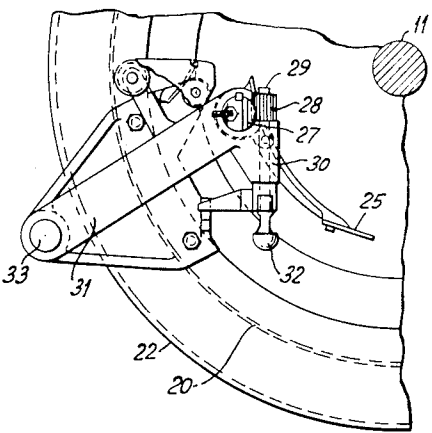


Fig. 4



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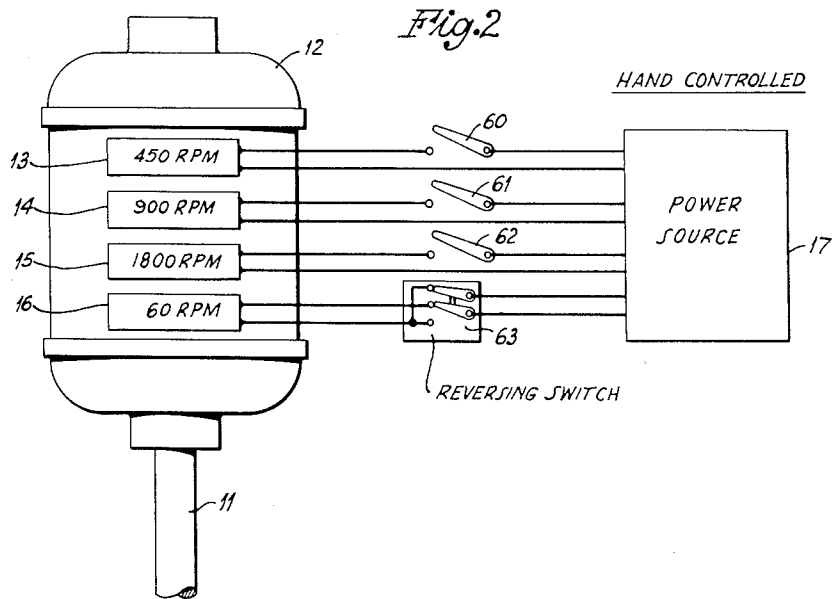
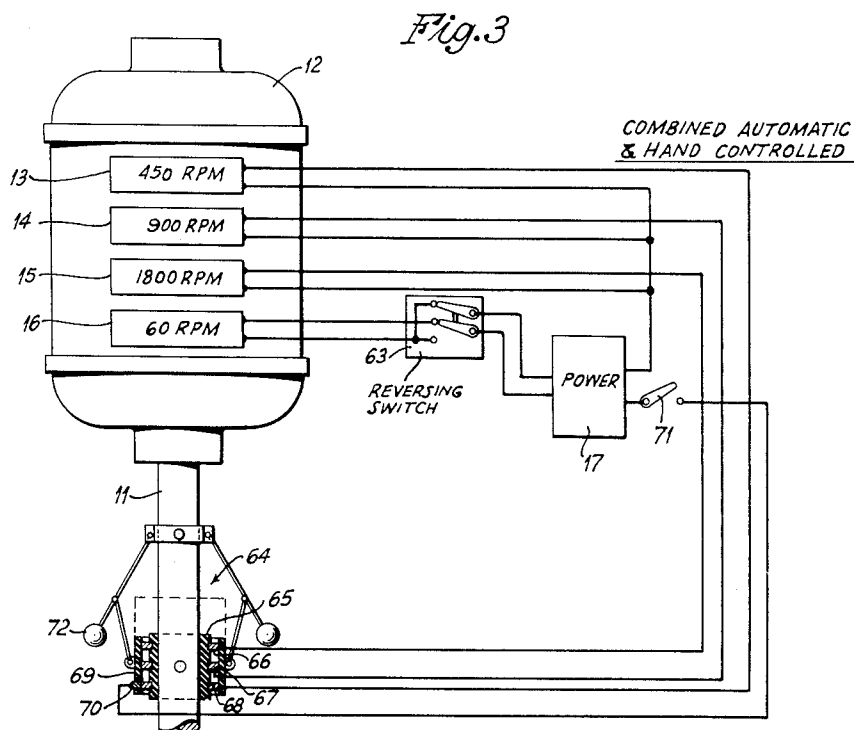
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DRIVING MEANS FOR CENTRIFUGAL MACHINES

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1 Claim. (Cl. 210—70)

This invention relates to mechanical driving means and more specifically to driving arrangements for centrifugal machines.

It is an object of this invention to simplify the driving and controlling equipment for centrifugal machines and particularly those used in the refining of sugar and the like.

In the operation of centrifugal machines in the sugar refining art, it has been customary to quickly accelerate the centrifugal to its normal or operating speed, allow it to run at this speed a period of time sufficient to purge, wash and dry the sugar-bearing material in the centrifugal basket, and then quickly decelerate the machine to rest. It is then unloaded at low speed, making use of a mechanical unloader. One well-known type of unloader is disclosed in Mackintosh Patent 1,205,128, issued November 14, 1916, and it includes a plow which can be swung into the centrifugal basket so that it plows out the sugar. This plow can be raised or lowered as necessary to plow out the sugar and to remove it from contact therewith after the sugar has been discharged. In the Mackintosh unloader and many others of the same general type, the plow points toward the right and the centrifugal basket is rotated by power in a clockwise direction so that the plow has the proper action to dig the sugar out.

One problem connected with the operation of this type of unloader is that considerable skill is required of the operator because if he tries to plow out the sugar when the machine is rotating too rapidly, then a part of the apparatus might break, with a resultant possibility of injuring the operator.

An improved driving means for centrifugals is disclosed in Mackintosh Reissue Patent 15,115, issued May 31, 1921. This patent shows an arrangement wherein the driving motor for the centrifugal can be run at one-half speed, thus reducing the torque in the friction clutch which is customarily used to the amount required for proper unloading. This reduces the demand for skill on the part of the operator but still is no safeguard against damage due to introducing the plow when the machine is running at high speed. However, this two-speed drive was found to have other advantages, that is, the low speed winding of the motor can be used in decelerating the machine from high speed to about one-half speed. At the time this reissue patent was issued, the high speed of a centrifugal machine was only 1200 R. P. M., but in recent years, due chiefly to increased mechanical strength in materials available for the purpose, the high speed of such a machine has been increased to 1800 R. P. M. At this speed, the kinetic energy of the rotating machine is $2\frac{1}{4}$ times as much as at 1200 R. P. M. and the removal of this kinetic energy naturally puts $2\frac{1}{4}$ times as much heat and wear into the brake. Thus it became highly advantageous to use this type of drive for slowing the machine down to one-half speed, greatly reducing the wear on the brake. For these reasons, a two-speed centrifugal machine, that is, a machine with a motor which can run either 1800 R. P. M. or 900 R. P. M. and in which

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the low speed of the motor is used both for plowing, as in the Mackintosh reissue patent, and for decelerating the basket has become very widely used.

As an additional safety feature, some sugar manufacturers prefer that, when the centrifugal is unloaded at low speed, the basket turn in a direction opposite to its direction of rotation at high speed. In such an instance, the manufacturer equips the machine with a left-handed unloader, that is, an unloader in which the plow extends upward and to the left instead of downward and to the right as shown in Fig. 1 of Mackintosh Patent 1,205,128. With such a left-handed arrangement, the machine runs clockwise at high speed and if the operator, by mistake, should introduce the unloader plow into the sugar while the machine is running at this high speed, it would not tend to dig into the sugar and that might reduce the amount of the breakage. When operating such a machine, the sugar would be dried with the machine running in a clockwise direction and then half speed of the motor would be applied, bringing the machine down to about half speed. At this point a friction brake would be applied, bringing the machine to rest. Then the brake would be released and a second slow speed motor would be clutched to the driving shaft and this slow speed motor energized so that through a suitable set of gears it would rotate the machine in a counter-clockwise direction at a speed of 50 or 60 R. P. M. Then it would be necessary to de-energize the slow speed motor, de-clutch it from the drive shaft, apply the brake to stop the machine and then the machine would be at rest and ready to receive a charge of wet massecuite for its next cycle of operation. The operation of applying the friction brake to stop the machine, energizing the clutch connecting the low speed motor and energizing the low speed motor itself would usually be done automatically and because the operation was in part mechanical and in part electrical, the whole mechanism was complicated and apt to get out of order and was fairly costly to maintain. All of this made the feature of "reverse plowing" of a somewhat doubtful advantage. Aside from the complication of the equipment as described above, that is, the addition of another motor and gearing to provide the plowing motor with the low speed and the clutch mechanism, there was the additional disadvantage that the machine required a left handed unloader. Workers have been trained for right hand operation and the operation of the left-handed unloader would be awkward for the average worker.

In accordance with the present invention, there has been provided a new motor and control means therefor which has the advantages of "reverse plowing" without the accompanying disadvantages enumerated above. Moreover, the use of friction brakes and control means therefor is avoided. The centrifugal is direct driven from the motor (thus eliminating the clutch of earlier centrifugals) in the counter-clockwise direction and is discharged while rotating in a clockwise direction. This makes it possible to use a right-handed unloader and avoid the need of training the average operator the functioning of an unloader suitable only for left-handed people. Preferably, though not necessarily, the motor is provided with one or more intermediate speeds to be used in accelerating and decelerating. In decelerating from the high or normal operating speed (1800 R. P. M. for example), the motor passes through these intermediate speeds and then is connected to run (still counter-clockwise) at a low speed (60 R. P. M. for example). This low speed winding connection is then reversed so that the machine operates at 60 R. P. M. in the reverse, or clockwise, direction. The effect of this reversal of connection is to first apply a braking action which slows the machine down to zero speed. This action is known as "reverse current" braking. This is not a new idea in itself but in all known

former instances where it has been used, the motor control means included an arrangement for disconnecting the motor from the line when deceleration is complete and zero speed has been reached. In the present invention, the motor not only stops the machine but also accelerates it in the opposite direction as a speed which is proper for unloading with a right handed plow.

The invention will be more readily understood by referring to the following description taken in connection with the accompanying drawings forming a part thereof, in which:

Fig. 1 is an elevation view, with portions broken away, of a multi-speed centrifugal machine in accordance with the invention, the machine being controlled by timer mechanism;

Fig. 2 is a partial elevation view of the machine of Fig. 1 with the exception that the driving means is hand controlled;

Fig. 3 is a partial elevation view of the machine of Fig. 1 with the exception that the driving means is partially hand-controlled and partially automatically speed controlled; and

Fig. 4 is a top plan view of the unloader of the machine of Fig. 1.

Referring more specifically to the drawings, Fig. 1 shows, by way of example for purposes of illustration, a sugar centrifugal machine 10 embodying a novel multi-speed drive in accordance with the invention. The centrifugal comprises a rotatable vertical shaft or spindle 11 from which a perforated basket 20 is suspended and which is adapted to be driven by a motor 12 positioned above it. The motor has a plurality of windings for driving the spindle at various selected speeds. By way of example, four windings 13, 14, 15 and 16 have been indicated by rectangles for simplicity in the drawing but it is to be understood that these windings are wound and positioned in the motor frame in accordance with well-known electrical equipment manufacturing technique. Speeds of 450 R. P. M., 900 R. P. M., 1800 R. P. M. and 60 R. P. M. have been indicated on the drawing but this is merely by way of example as a fewer or lesser number of speeds may be utilized or the speeds chosen can be different from any of those indicated. The motor windings selectively receive power from a source 17 through a suitable timer control apparatus 18, the operation of which will be described more fully below.

The centrifugal perforated basket 20 suspended from the spindle 11 has a stationary outer casing or curb 21. This curb has a cylindrical side wall 22, a top 23 and a bottom 24 which is provided, in a manner well-known, with suitable annular troughs to carry away the various liquids, ejected from the basket 20 during the centrifuging process. As is well-known, massecuite or magma is placed in the basket and, after acceleration to be described more fully hereinafter and rotation at high speed for several minutes, green syrup is caused to be thrown through the apertures in the basket, striking the curb wall and flowing down its sides to the annular troughs below. Washing fluid can then be introduced and the wash syrup (possibly mixed with a little green syrup) is also caused to strike the curb wall and is collected below. This centrifuging process leaves a wall of sugar grains on the inside of the basket 20. In order to remove this sugar and permit it to pass through a central opening in the bottom 24 of the basket (which opening is covered during the centrifuging process), a mechanical unloader including a plow 25 is provided. This plow is fastened and keyed to the lower portion of a vertical rod or shaft 26 which has teeth 27 cut therein. These teeth mesh with those of a gear 28 (see Fig. 4) mounted on a shaft 29. This shaft is mounted on an arm 30 of the frame 31 and can be turned by a crank handle 32. The frame 31 pivots about shaft 33, making it possible to move the plow 25 into the sugar wall. For a more complete description of a plow of the type briefly described herein,

reference is made to the above-identified Mackintosh patents.

The operation of the arrangement of Fig. 1 will now be described. First, the basket 20 is loaded with massecuite and the 60 R. P. M. winding 16 (which, for example, may have 120 poles) is energized from the timer 18 in such a direction that the basket 20 rotates counter-clockwise. After a suitable interval, the timer switches the power to the 450 R. P. M. winding 15 (which, for example, may have 16 poles) and the machine accelerates in the counter-clockwise direction. When it has nearly reached 450 R. P. M., the motor is connected to the 900 R. P. M. winding 14 (which, for example, may have 8 poles) and when the machine reaches a speed of nearly 900 R. P. M., the timer 18 connects the power to the 1800 R. P. M. winding 13 (which, for example, may have 4 poles).

The timer 18 may be, for example, any of several suitable types sold commercially which operate by means of an electric motor-driven disc or other member to close proper contacts in sequence at predetermined intervals after the timer is started or it can be a mechanical one of the well-known "Steps" type commonly used as an automatic timing device in sugar refining.

When the centrifugal machine reaches top speed, it continues at that speed until the sugar has been properly purged, washed and dried and then the automatic timer 18 operates to initiate, in sequence, the various steps of deceleration.

In deceleration, the motor is first connected to operate on its 900 R. P. M. winding 14 bringing the machine nearly down to half speed. Then the timer 18 connects the power to the 450 R. P. M. winding 15, thus effecting a further speed reduction. Next the 60 R. P. M. winding 16 is connected to the power source by the timer 18 bringing the machine down to about 60 R. P. M. At this point, the 60 R. P. M. winding 16 has its polarities reversed, that is, it is reconnected so as to tend to drive the basket in a clockwise direction which is, of course, opposite to the direction at which it is rotating during the drying cycle. The effect of this reversal is to first apply a braking action which slows the machine 10 down to zero. This action is known as reverse current braking or "plugging" the motor. This is the only braking utilized in the present invention. The motor not only stops the machine but also reaccelerates it to 60 R. P. M. in the reverse (clockwise) direction. This direction is suitable for unloading with a standard type of unloader such as that shown in Figs. 1 and 4.

After plowing has been completed and the machine is running 60 R. P. M. in a clockwise direction, then the drying cycle can be started without the use of a brake by merely reconnecting the 60 R. P. M. winding 16 for counter-clockwise rotation. The machine then first comes to zero speed and then reaccelerates counterclockwise for the purging, washing and drying of the sugar.

Figs. 2 and 3 show modifications of the arrangement of Fig. 1. In the arrangement of Fig. 2, all switching is done by hand switches 60, 61, 62 and 63, the latter being a reversing switch so that the power to the winding 16 can be reversed between the decelerating and unloading stages of the cycle. In the arrangement of Fig. 3, the switching is hand controlled, as in Fig. 2, for the winding 16 but speed controlled for acceleration and deceleration. This speed control is obtained by means of the flyball governor arrangement 64. This comprises an insulating cylinder 65 surrounding and adapted to turn with the shaft 11 and containing three metallic ring contacts 66, 67 and 68. Surrounding the cylinder 65 is another insulating cylinder 69 having a metallic ring contact 70. The rings 66, 67 and 68 are connected respectively to one terminal of the 1800 R. P. M., 900 R. P. M. and 450 R. P. M. windings while the ring 70 is connected through a switch 71 and the source of power 70 to the other terminal of each of these three windings. When

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the switch 71 is closed, the 450 R. P. M. winding 13 is connected to the power source 17. After a speed of about 450 R. P. M. is reached, the sleeve 69 is lifted sufficiently by the action of the flyballs 72 to make the member 70 contact the ring 67 and connect the 900 R. P. M. winding 14 to the source of power 17. Similarly, at an appropriate time in the cycle, the 1800 R. P. M. winding is connected to the source of power through ring contacts 70 and 65. At the end of the centrifuging period, the switch 71 is opened for a long enough period to allow the machine to decelerate slightly at which time the switch 71 is closed to contact members 70 and 66. The machine will continue its deceleration till it reaches 900 R. P. M. Then the switch 71 is opened again to cause the machine to decelerate again till the members 70 and 65 contact one another. On closing the switch 71 again, the machine will "power decelerate" to 450 R. P. M. Then the switch 71 is opened and the reversing switch 63 closed in the position to cause counterclockwise operation of the 60 R. P. M. winding 16. Then at the proper time (for unloading), the switch 63 is reversed and the centrifugal machine 10 rotates in the clockwise direction for unloading.

It will be apparent that the present invention eliminates much of the complication now inherent in the present form of reverse plowing. It will be appreciated that in the normal operation of the invention, a friction brake is not used, thus eliminating one item of wear and also the complication of solenoid valves, air cylinders, etc. previously required when applying and releasing the brake. Also eliminated is the secondary or plowing motor with its control reduction gears and clutch for connecting and disconnecting it from the driving shaft. The machine has no more than one motor, and the whole group of controls which in prior art arrangements had to operate when the machine reached zero speed have in the present invention been entirely eliminated.

It is obvious that various changes can be made in the

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embodiments described above without departing from the spirit or letter of the invention, as indicated in the claim.

What is claimed is:

5 The method of operating a sugar centrifugal machine of the type having a basket, which is adapted to be cyclically rotated through accelerating, running, decelerating and unloading stages by a power source and by an electric motor having a high speed winding and a low speed winding and connections for reversing the direction of rotation produced by said low speed winding, and a plow for unloading said basket, which comprises the steps of accelerating the basket for operation in the counter-clockwise direction by successively energizing the low speed winding and the high speed winding, continuing to energize the high speed winding for operation of the basket in the same direction during the normal running period of said machine, energizing the low speed winding for operation of the basket in the same direction during the decelerating period, and unloading the basket by energizing the low speed winding by the reversing connections in such a manner that the basket passes through zero speed and builds up in the clockwise direction, during which rotation in the clockwise direction the plow is positioned to scrape the sugar from the basket, without disconnecting the motor from the power source.

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