May 8, 1951 R. J. HUSER ET AL 2,551,838

SPEED CONTROL SYSTEM FOR CENTRIFUGALS

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Fig. 2

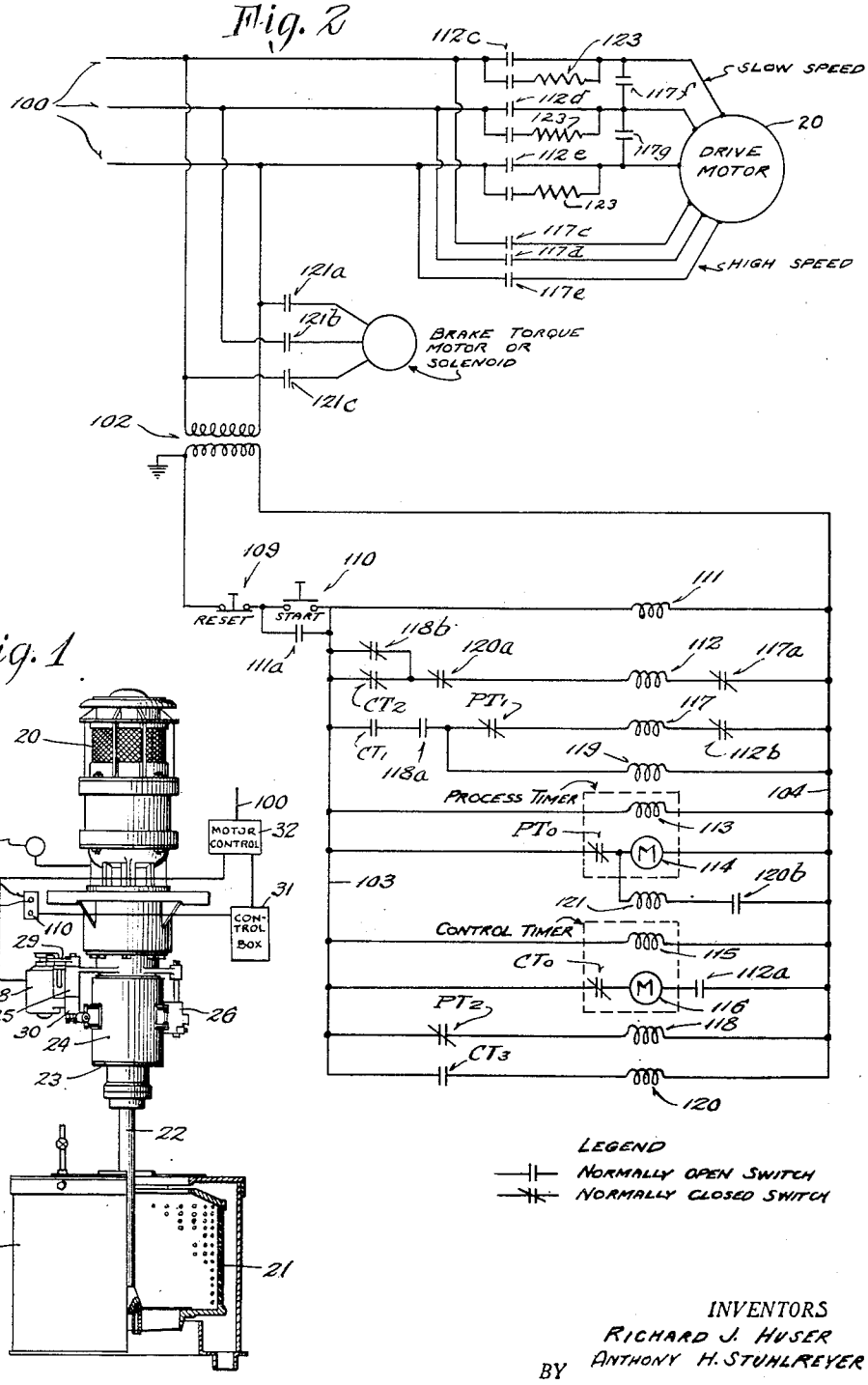


Fig. 1

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Fig. 3

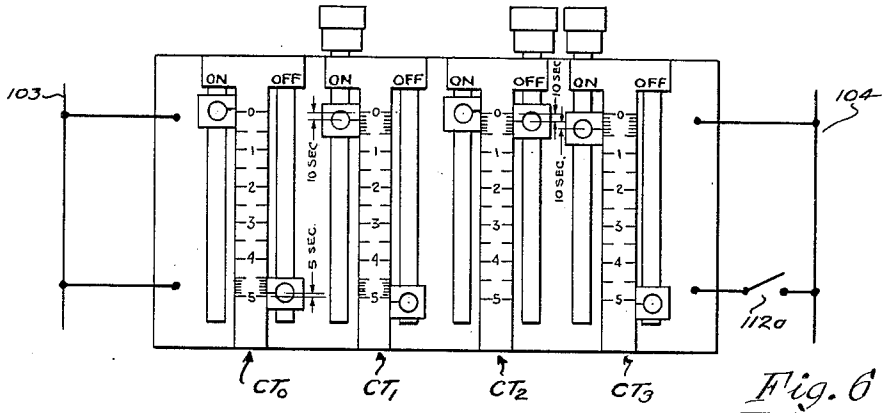


Fig. 4

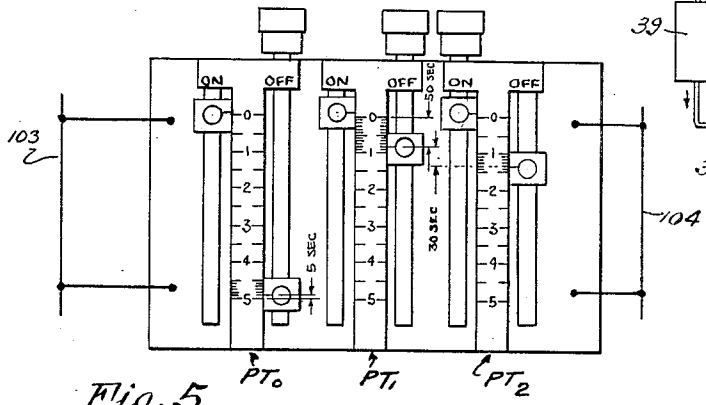


Fig. 5

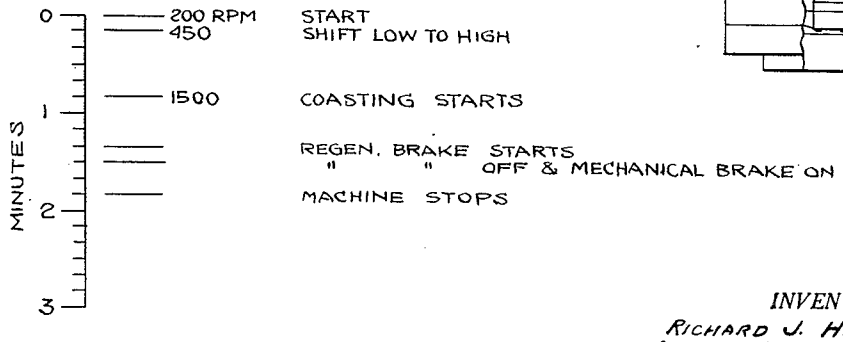
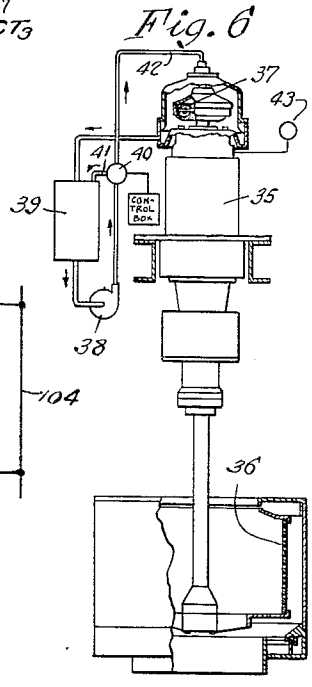


Fig. 6



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UNITED STATES PATENT OFFICE

2,551,838

SPEED CONTROL SYSTEM FOR CENTRIFUGALS

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Application June 21, 1947, Serial No. 756,307

4 Claims. (Cl. 210—72)

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This invention relates to a system or apparatus for the control of centrifugal apparatus, particularly of the type used in sugar refineries, and is especially concerned with the control of the speed of the centrifugals used therein.

In sugar centrifugals, the loaded basket must be accelerated to running speed in an extremely short period, the complete cycle being as short as two minutes and less. When the basket is connected directly to an electric motor, a very high load is placed on the motor due to the high acceleration required of the loaded basket. If a fluid coupling is interposed between the electric driving motor and the basket, a very high load also is placed on the motor during acceleration unless some special arrangement of the fluid coupling is employed. Some of said fluid coupling special arrangements do not transmit power through the coupling in the most efficient manner throughout the acceleration of the basket. Standard electric motors will not function properly under the aforementioned high load conditions because there is insufficient time for the motor to cool after the completion of each cycle and before the next cycle is started, the cycles of operation normally being frequently repeated. Consequently, it has been the general practice to use specially designed and constructed expensive electric motors for individually driven electrically operated sugar centrifugals.

When alternating current motors are used, the speed of the motor is governed by the construction of the motor, number of poles, and the frequency of the power supply. For example, standard alternating current 60-cycle motors have rated or synchronous speeds of 1800 and 1200 R. P. M. for 4 and 6 pole motors, respectively, with full load running speeds slightly thereunder. Frequently it has been found that sugar will be undertreated when subjected to a centrifuging speed of near 1200 R. P. M. only, whereas the sugar will be overtreated at a speed near 1800 R. P. M. When the sugar is overtreated, it may be packed so hard as to cause difficulty in the discharging operation.

One of the objects of the invention is to provide a control apparatus whereby standard electric motors can be employed without the necessity of using specially built motors to withstand the heavy load requirements of acceleration in sugar and similar type centrifugals.

Another of the object of the invention is to provide a system and apparatus wherein centrifugal speeds below the rated speed of an alternating current driving motor can be attained, as desired, to suit the processing requirements of particular materials.

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A further object is to save power, increase motor operating efficiency, and avoid overloading of the motor in the use of heavy motor-driven centrifugal machines.

One of the features of the invention in a direct connected drive is the use of a standard electric motor with a higher potential or normal running speed than the speed at which the centrifugal is to be operated. The torque characteristics of the drive and the load it must accelerate are relatively constant in the successive cycles of operation of heavy motor-driven centrifugal machines. Power is supplied to the motor at the beginning of the acceleration, and, at the end of a predetermined time period permitting the centrifugal to reach the desired speed below the normal running speed of the motor, power is cut off to the motor and the centrifugal is allowed to coast under its own momentum until the purging or separation of materials, washing, or other operations are completed. Thus, the centrifugal can be operated at almost any desired speed below the operating speed of the electric motor depending upon the time the accelerating power is supplied to the motor.

The accelerating power is applied to the motor only for a short time during the cycle, and therefore the motor will have an opportunity to cool between intervals of heavy power application. In addition to said opportunity to cool between power applications, the cooling rate of the motor will be higher due to rotation during the coasting period as compared with the cooling rate of a motor at standstill.

In accordance with one aspect of the invention, the time of application of power for acceleration in a direct-connected electric-driven centrifugal can be governed by a timer arrangement which operates at the end of a predetermined time to interrupt the supply of power to the electric drive motor or to interrupt the driving action thereof before the potential or running speed of the electric motor is reached by the centrifugal basket. The predetermined time is adjustably selectable so that the centrifugal can be operated to reach any desired operating speed.

When a hydraulic coupling or fluid drive is used to connect the electric motor with the centrifugal basket, the system of the present invention can be applied so as to interrupt the flow of oil to the coupling at a predetermined time after acceleration starts, and thus the operating speed of the centrifugal basket can be made less than the

potential or running speed of the driving motor or potential speed of the driving apparatus.

Another feature of the invention is the provision of a cycle control arrangement wherein, in consequence of the movement of a single control device such as a starting button, a control timer and a process timer are started and these can time, when low and high speed motor windings are employed, the shift from low to high speed windings to the drive motor, the time of acceleration until power to the motor or fluid to a coupling is cut off, the time of coasting, application of regenerative braking if used, application of the mechanical brake, and other desired operations.

These and other objects, features, and advantages of the invention will become apparent from the following description and drawings which are merely exemplary.

In the drawings:

Fig. 1 is a schematic view partially in section of one form of the invention.

Fig. 2 is a schematic wiring diagram of a circuit that may be employed in carrying out the invention.

Fig. 3 is a diagrammatic view of the face of a control timer suitable for use in the circuit of Fig. 2.

Fig. 4 is a diagrammatic view of the face of a process timer that may be used in the circuit of Fig. 2.

Fig. 5 is a chart showing one example of a time cycle of operation that may be employed for sugar centrifuging.

Fig. 6 is a diagrammatic view of the invention as applied to a fluid coupling driven centrifugal.

The invention will be depicted in conjunction with the operation of a sugar centrifugal, describing only the accelerating, coasting, and braking portions of a cycle, the washing and other portions of a normal sugar centrifuging operation being omitted.

In the direct driven centrifugal of Fig. 1, electric motor 20 drives suspended rotatable gyratory basket 21 through shaft 22, the motor being directly connected to said shaft and basket. Brake drum 23 has brake bands 24, the brake bands being movable to grip brake drum 23 by means of apparatus attached to bracket 25 as will be described hereafter, the bands being hinged at bracket 26 to the machine frame in a well known manner.

As explained in detail in the copending application Serial No. 756,308 filed June 21, 1947, the brake bands can be expanded or contracted relative to the brake drum by means of an operating device such as the torque motor 28 moving link 29, link 29 operating the brake applying mechanism shown diagrammatically at 30. A torque motor is a motor which rotates in a limited arc upon application of electric power thereto, the torque motor having an arm connected to the shaft thereof to which link 29 can be fastened.

A hydraulic cylinder, as described in said afore-mentioned application Serial No. 756,308, also may be used to operate the brake applying mechanism, as well as any other suitable apparatus. When a hydraulic cylinder is employed, the applications of pressure thereto may be controlled by a solenoid.

As an aid to the operator, a tachometer 34 of some suitable description may be employed, said tachometer being connected to give an indication of the speed of the centrifugal basket.

One form of wiring diagram and control circuit which may be used is shown in Fig. 2, said circuit omitting such features as the basket wash water control, the syrup separator control, etc. As is well known in the art, a solenoid can be used to operate a plunger or other mechanism connected mechanically to any number of switch operators. In the accompanying drawing, the mechanical connection is omitted in the interests of clarity, the switches operated by a solenoid being given the same numeral with appropriate or distinguishing subscripts or letters. The switches operable by the process and control timers will be identified by the reference characters PT and CT, respectively, with distinguishing subscripts.

Power is supplied from a three phase source of alternating current 100 to the main driving motor 20 having separate connections for the low and high speed windings. Power for the control circuit is taken from transformer 102 to bus bars 103 and 104 of the control apparatus. The control apparatus may be located in the control box indicated schematically at 31 in Fig. 1, suitable motor switches being located in the control box 32, and the starting and reset buttons being located at a convenient point 33 as desired. It is evident that the control apparatus and control buttons may be grouped and placed as convenient.

In order to start the basket centrifugal from rest, or to start the automatic control and acceleration of the centrifugal after the basket has been loaded and is revolving slowly, the start push button 110 is depressed which will energize starting relay solenoid 111 to close holding switch 111*a* around starting button 110, switch 111*a* being operatively connected with solenoid 111.

Closing of the circuit to bus bars 103 and 104 will cause energization of low speed solenoid 112 which will close circuits through connected contacts 112*c*, 112*d* and 112*e* to the low speed windings of drive motor 20. The process timer, which will be described hereafter, will have its clutch solenoid 113 energized and will have operating motor 114 thereof started, switch PT_0, connected with the process timer operating mechanism, being normally closed at the beginning of the cycle. The control timer will have its clutch solenoid 115 energized and its control motor 116 started, switch contact 112*a* connected with solenoid 112 having been closed upon energization of solenoid 112 and switch CT_0 being normally closed at the beginning of the cycle. The manner in which the timers operate the switches will be described hereafter.

In the drive motor 20 shown, a low and high speed winding are used and the low speed winding is energized first so that provision must be made to shift to the high speed winding at the desired time. If, for example, the motor has a rated high speed of 1800 R. P. M. and the full rotation of the low speed winding is 900 R. P. M., fast acceleration being desired, the timing of the relay circuits may be arranged so that there will be a shift from the low to the high speed winding of the driving motor when the driving motor reaches about 450 R. P. M., the exact speed of shift being a matter of choice, motor characteristics, and other variable factors. Loading of the basket may be carried out before this shift, usually at a speed of about 200 R. P. M., either while the basket is being accelerated on the low speed winding, or while the motor idles and is "jogged" to about such a speed, through successive movements of start button 110 and circuit opening reset button 109 before starting the

actual treating cycle. The reset button is normally closed and only opened momentarily to permit the circuit to reset. In the particular process and control timers, a clutch connects the switch operating motor with the switch operators. When a motor is stopped, the switch operator will remain at its stopped position as long as the clutch remains engaged. If the clutch is disengaged, the switches will be returned to zero by suitable means. The resistances 123 may be employed with any suitable control for energizing the low speed windings therethrough, so as to modify the torque at very low speeds, where a very low speed of the centrifugal is required, such as for discharging between successive running periods.

The aforementioned speed winding shift can be accomplished by the control timer switch CT_1 being closed by the control timer after a predetermined interval following the start of the cycle, the control timer having been started at the beginning of the cycle by being connected across control bus wires 103, 104. Immediately after, or at the time switch CT_1 closes, switch CT_2 is set to be opened by the control timer so as to deenergize the low speed solenoid 112, contact 118*b* connected to solenoid 118 having been opened at the beginning of the cycle because of energization of solenoid 118, switch PT_2 being closed. Opening of contact CT_2 will allow high speed solenoid 117 to become energized because CT_2 deenergizes low speed solenoid 112 so that switch contact 112*b* connected to solenoid 112 will close and complete the circuit to solenoid 117, normally open switch contact 118*a* having been closed when the start button was depressed. Energization of high speed solenoid 117 will close contacts 117*c*, 117*d*, 117*e*, 117*f* and 117*g* to connect the high speed windings of main driving motor 20 to the source of power, said solenoid being operatively connected to switches 117*c*, *d*, *e*, *f*, *g*. Low speed switch contacts 112*c*, 112*d* and 112*e* operatively connected to solenoid 112 were opened upon de-energization of low speed solenoid 112. Switch contact 112*a* also will open upon deenergization of solenoid 112 and stop the control timer motor 116, but the control timer will not reset itself inasmuch as the clutch solenoid 115 remains energized.

At the end of a predetermined time, which is that necessary to accelerate the driving motor and centrifugal to the desired operating speed, switch PT_1 of the process timer will be opened thereby and de-energize solenoid 117, thus opening the operatively connected high speed contacts 117*c*, 117*d*, 117*e*, 117*f* and 117*g*, cutting off power to the drive motor and causing the driving motor to coast.

Brake cooling water solenoid 119 was energized when switch CT_1 was closed by the control timer, switch 118*a* having been previously closed, so as to open a valve supplying cooling water to the brake drum in a manner similar to that disclosed in the patent to Roberts, No. Re. 22,686. Solenoid 119 will remain energized so as to continue the supply of cooling water to the brake drum during the coasting operation because said solenoid is shunted across switch PT_1, solenoid 117 and switch contact 112*b*.

At the end of the predetermined coasting period, switch PT_2 is opened by the process timer, which has continued to run, since the start of the cycle so as to de-energize solenoid 118, which in turn opens the connected contact 118*a* to interrupt the supply of current to brake cooling water solenoid 119 and thus shut the water supply valve for brake cooling. Normally closed contact 118*b*, which was opened by the energized solenoid 118 at the beginning of the cycle, also will close and thus connect the low speed solenoid 112 to the bus bars. Closing of contact 118*b* by de-energization of solenoid 118 will thus close the connected low speed winding switch contacts 112*c*, 112*d* and 112*e* to the source of power 100 so that the motor will be subjected to regenerative braking, switch contact 117*a* having closed upon de-energization of the high speed solenoid 117, it being noted that switch CT_2 was opened previously during the acceleration period.

At the end of a short predetermined period suitable for the regenerative braking, switch CT_3 will be closed by the control timer, the control timer having been started again upon the beginning of the regenerative braking inasmuch as the energization of the low speed solenoid 112 has caused switch contact 112*a* again to close. Closing of switch CT_3 will energize solenoid 120, which will open connected switch contact 120*a* in the low speed relay circuit and thus stop the regenerative braking. At the same time, switch contact 120*b* operated by solenoid 120 will be closed and thus energize the brake motor solenoid 121. Energization of solenoid 121 can be used to cause energization of switch contacts 121*a*, 121*b* and 121*c* to energize the brake setting torque motor 28 or to energize a solenoid controlling the admission of air to a fluid pressure operated brake cylinder as disclosed in copending application, Serial No. 756,308.

Thus, the machine is no longer subject to driving torque, and the friction brake bands 24 are applied to the brake drum 23 so as to bring the machine to rest.

After the centrifugal comes to rest, other operations, as desired, may be performed and the circuit reset for the next cycle by momentarily depressing the reset button 109 which will reset both of the timers by de-energizing the clutches and thus permit the timers to return to zero.

Various types of timers may be used and various arrangements thereof made. In the preferred form, a composite unit type, such as is known as the "Multiflex," and diagrammatically illustrated in Figs. 3 and 4, can be employed, it being understood that separate timers or time delay switches may be used for each of the timing functions. The "Multiflex" timer is well known and does not need to be described in detail except to point out that in the form shown in Fig. 3, four individually timed switches are available, and in Fig. 4, three are available. The timers have their own motivating mechanism and clutch for engaging the same with the switch operators. The operation of each of the contacts or circuits can be set by the adjustment of the "on" detent or "off" detent with respect to a timing scale shown on the face of the timer so that the timing action or circuit closing will occur at any desired interval according to the setting of the "on" detent and will terminate at any desired interval with relation to the time started. When the "on" detent is placed above the upper limit of the scale, its corresponding contact is closed when the timer is started or energized. If the "off" detent is below the lower limit of the scale, its corresponding circuit, after having been closed according to the setting of the "on" detent, will stay closed until the timer is de-energized or reset. One form of the "Multi-

flex" timer may be seen in U. S. Patent No. 2,175,864 issued October 10, 1939.

As an example of one type of suitable operating cycle, reference may be made to Fig. 5, wherein a scale of minutes is shown in relation to various operations for bringing a polyphase induction motor having a synchronous speed of 1800 R. P. M. up to 1500 R. P. M. It is understood, of course, that other speeds may be chosen and other intervals employed, the cycle shown being merely illustrative of one type of fast sugar centrifuging cycle.

Assuming that the start button has just been depressed following a loading of the basket leaving the basket turning at about 200 R. P. M., a period of 10 seconds is allowed before the motor windings are shifted from low to high speed. It is assumed that the motor will reach a speed of about 450 R. P. M. during the 10 seconds. At the end of about 40 seconds after the shift to the high speed winding (50 seconds after starting the cycle), the motor will have reached the desired speed of 1500 R. P. M., and at this time coasting switch PT_1 is set to open so as to interrupt the driving action by de-energizing the motor and allowing the centrifugal and motor to coast. It is to be understood that the time for reaching these various speeds will depend upon the size of motor, characteristics thereof, weight of charge in the centrifugal, and other variables, but that these variables are relatively constant for any given conditions of use of a given machine.

The motor may be allowed to coast for 30 seconds and the washing, if it is to be used, may take place during this period, such not being shown or described herein as it does not constitute a part of this invention. At the end of the coasting period of 30 seconds, the regenerative braking is started when switch PT_2 opens and can continue for 10 seconds, following which the regenerative braking is turned off by closing of switch CT_3, whereupon the mechanical brake is set.

In Fig. 3, the settings of the control timer to correspond with the above cycle of operations are shown schematically. The switch contact CT_0 is "on" from the beginning of the cycle and the "off" detent is arranged so that it will open approximately 5 seconds before the end of the range of the control timer. The purpose of this is to de-energize the control timer so that it cannot be left on indeterminately. The "on" detent of CT_1 is set for operation 10 seconds after the starting of the control timer and serves to shift the driving motor from low to high speed in conjunction with the opening of CT_2, the "off" detent of CT_2 being set to operate at the same time as, or immediately after, CT_1 closes. Upon shift to the high speed winding, the control timer will be stopped inasmuch as switch contact 112*a* is opened, but the timer will not reset.

The process timer of Fig. 4 also was started at the same time as the control timer and runs continuously. Switch PT_0 is normally closed before the timer is started and the "off" detent thereof is set approximately 5 seconds before the end of the 5 minute period for the purpose of turning off the timer in a manner similar to the control timer. Switch PT_1 is set to be "on" when the timer starts and to be opened at an appropriate time, say 50 seconds after starting the operation. This serves to cut off the power to the high speed winding and allow the coasting to start. It is evident that the coasting switch PT_1 may be set for operation by the process timer a predetermined time interval in accordance with the particular speed to be used. Switch PT_2 is set to be opened at a predetermined time after the coasting contact opens; in the particular cycle shown, this interval being set for 30 seconds. When switch PT_2 is opened, regenerative braking is started due to re-energization of the low speed solenoid. The control timer also is restarted inasmuch as switch 112*a* again is closed by the low speed solenoid. The regenerative braking will be continued for an interval governed by the setting of switch CT_3, CT_3 being arranged in the particular cycle shown 10 seconds later than the position of the "off" detent of CT_2. CT_3 is arranged to close at the time interval required for regenerative braking after operation of CT_2. When CT_3 is closed, the control timer will stop because the low speed winding is de-energized and switch contact 112*a* opened.

All of the usual necessary adjustments can be made on the process timer because PT_1 governs the length of time from the starting of the cycle until coasting starts and PT_2 governs the time of coasting. These two times can be adjusted as desired for the sugar involved.

In the event an electric drive is used with a hydraulic coupling, the timer switches governing acceleration and coasting can be employed to cut off the supply of oil to the fluid coupling at the end of the predetermined time necessary for the centrifugal to reach the desired speed. In Fig. 6, the motor 35 drives basket 36 through a fluid coupling 37, in a manner similar to that disclosed in the copending application of Joseph Hertrich, Serial No. 435,023, filed March 17, 1942, now U. S. Patent No. 2,441,356, or as disclosed in Fig. 1 of his copending application Serial No. 713,329, filed November 30, 1946. The pump 38 takes oil or fluid from tank 39 and delivers the same to the three-way valve 40. The three-way valve has pipe 41 returning to the storage tank 39 and pipe 42 leading to the coupling. The coupling continuously discharges oil. The control mechanism can be used to cut off the supply of oil to the fluid coupling at the desired time, thus interrupting torque transmission to the motor while allowing the driving motor to continue running under no load, by positioning the three-way valve to return the oil to the storage tank instead of supplying it into the coupling. This may be done by using a three-way solenoid valve at 40 with the solenoid connected in a control circuit like that of Fig. 2 in the relation occupied by relay solenoid 117 thereof. In such an embodiment, a single speed motor is used so that but one set of windings and motor controls are provided in the position of said circuit occupied by the low speed windings, and the speed shifting and related control timer elements thereof are eliminated.

The coasting control for a fluid coupling drive also can be used in conjunction with other types of controls for the fluid coupling. An example of another type of control is one for the regulation of the accelerating torque of the drive by control of the fluid supply to the coupling in response to the torque reaction on the motor frame and an opposing control force, as disclosed in said copending application Serial No. 435,023. In a fluid coupling drive, it is particularly desirable to have a tachometer such as

indicated at 43 to show the speed reached by the centrifugal basket, in order to assist in accurately predetermining the desired setting for timer contact PT_1.

It is to be understood that the illustrated embodiments of the combination and details thereof may be varied without departing from the spirit of the invention except as defined in the appended claims.

We claim:

1. In a suspended centrifugal machine adapted for operation to and from a high speed of rotation in each of frequently repeated cycles, the combination of a basket-carrying spindle, a rotary driving system connected therewith to drive the same, said system including activating means connected therewith shiftable to respective positions at which said drive is inactive and is active to apply its full accelerating torque to said spindle, braking means normally inactive but movable to retard rotation of said spindle, control means including starting means connected with said activating means movable to shift the activating means to said drive-active position upon actuation of the starting means, an adjustable timing system connected with said control means and said activating means started in action when said control means is moved so to shift said activating means, said timing system including a timer element connected with said activating means acting as a predetermined time after starting the timing system to shift said activating means to said drive-inactive position, so that said spindle then may coast under its own momentum at a desired high centrifuging speed, and another timer element connected with said braking means acting to move the same at a predetermined time after the action of the first-mentioned timer element, so that said spindle is stopped after a period of coasting sufficient to complete the centrifuging at high speed.

2. In a suspended centrifugal machine adapted for operation to and from a high speed of rotation in each of frequently repeated cycles, the combination of a basket-carrying spindle, a rotary driving system connected therewith having a full accelerating torque and speed which drive the spindle to more than a predetermined high centrifuging speed, said system including activating means connected therewith shiftable to respective positions at which said drive is inactive and is active to apply its full accelerating torque to said spindle, braking means normally inactive but movable to retard rotation of said spindle, control means including starting means connected with said activating means movable to shift the same to said drive-active position upon activation of the starting means, an adjustable timing system connected with said control means and moved thereby into action upon movement of said control means to activate the driving system, said timing system including a timer element connected with said activating means acting at a predetermined time after starting the timing system to shift said activating means to said drive-inactive position after a predetermined period of application of said full accelerating torque, during which said predetermined centrifuging speed is reached, so that said spindle then may coast under its own momentum, and another timer element connected with said braking means acting to move the same at a predetermined time after the action of the first-mentioned timer element, so that said spindle is stopped after a period of coasting sufficient to complete the centrifuging at high speed.

3. In a suspended centrifugal machine adapted for operation to and from a high speed of rotation in each of frequently repeated cycles, the combination of a basket-carrying spindle, a rotary electric driving motor directly connected with said spindle, said motor having a full accelerating torque and speed which drive the spindle to more than a predetermined high centrifuging speed, a power supply switch mechanism connected with said motor and shiftable to respective positions at which the motor is deenergized and is energized to apply its full accelerating torque to said spindle, braking means normally inactive but movable to retard rotation of said spindle, control means including a cycle starting element connected with said switch mechanism movable to shift the same to said motor-energizing position when said cycle starting element is activated, an adjustable timing system connected with said control means and moved into action upon movement of said control means so to shift said switch mechanism, said timing system including a timer element connected with said switch mechanism acting at a predetermined time after starting the timing system to shift said switch mechanism to said motor-deenergized position after a predetermined period of application of said full accelerating torque, during which predetermined high centrifuging speed is reached, so that said spindle then may coast under its own momentum, and another timer element connected with said braking means acting to move the same at a predetermined time after the action of the first-mentioned timer element, so that said spindle is stopped after a period of coasting sufficient to complete the centrifuging at high speed.

4. In a suspended centrifugal machine adapted for operation to and from a high speed of rotation in each of frequently repeated cycles, the combination of a basket-carrying spindle, a rotary driving system including an electric driving motor and a hydraulic coupling for transmitting torque from said motor to said spindle, a power supply switch mechanism connected with said motor to energize the same and adapted normally to be left in motor-energizing position, filling control means connected with said hydraulic coupling shiftable to respective positions at which the same is emptied and is filled to apply the full accelerating torque of said system to said spindle, braking means normally inactive but movable to retard rotation of said spindle, control means including a manually operable starting element connected with said filling control means movable to shift the same to said coupling-filled position upon activation of said starting element, an adjustable timing system connected with said manually operable control means and moved thereby into action upon movement thereof so to shift said filling control means, said timing system including a timer element connected with said filling control means acting at a predetermined time after starting the timing system to shift said filling control means to said coupling-emptied position, so that said spindle may coast under its own momentum, with said motor continuing energized and running, after a predetermined period of application of said full accelerating torque imparting a desired high centrifuging speed, and another timer element connected with said braking means acting

to move the same at a predetermined time after the action of the first-mentioned timer element, so that said spindle is stopped after a period of coasting sufficient to complete the centrifuging at high speed.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,866,499	Herr	July 5, 1932
2,148,320	Olcott	Feb. 21, 1939
2,152,562	Olcott	Mar. 28, 1939
2,175,864	Anderson	Oct. 10, 1939
2,280,916	Johnson	Apr. 28, 1942
2,338,053	Olcott	Dec. 28, 1943