April 12, 1949. J. HERTRICH 2,466,988

CENTRIFUGAL CONTROL SYSTEM

Filed Oct. 15, 1946 3 Sheets-Sheet 1

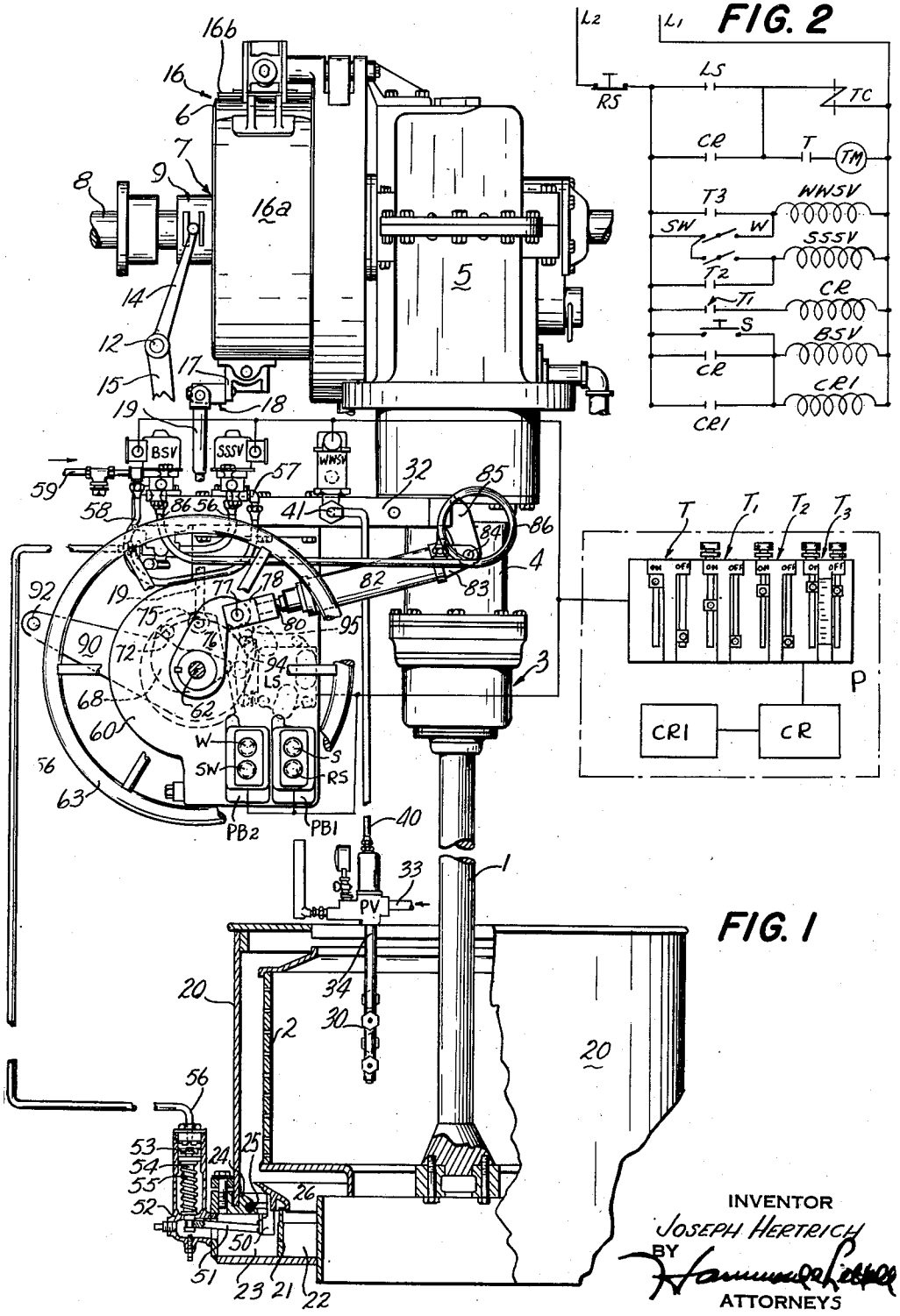


FIG. 2

FIG. 1

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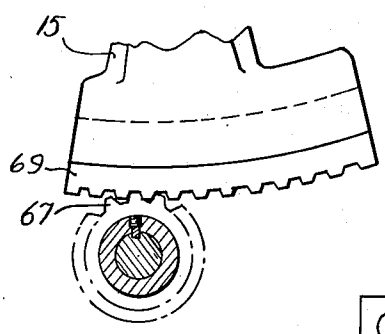


FIG. 4

FIG. 3

FIG. 8

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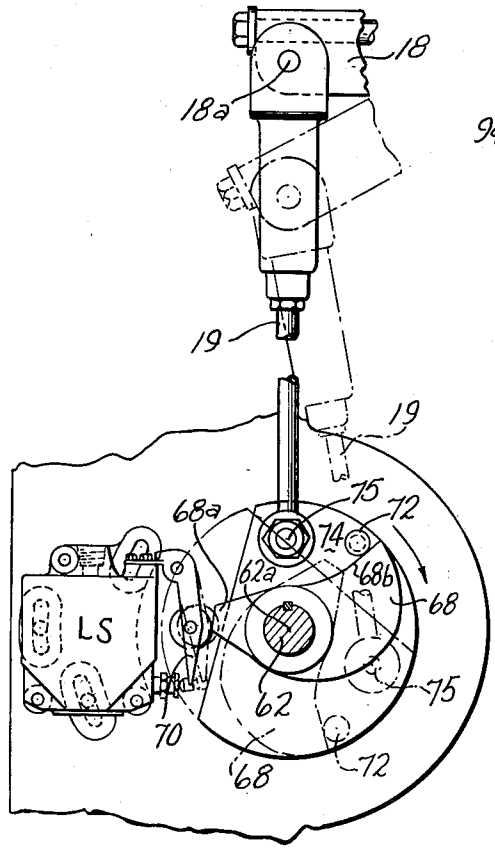


FIG. 6

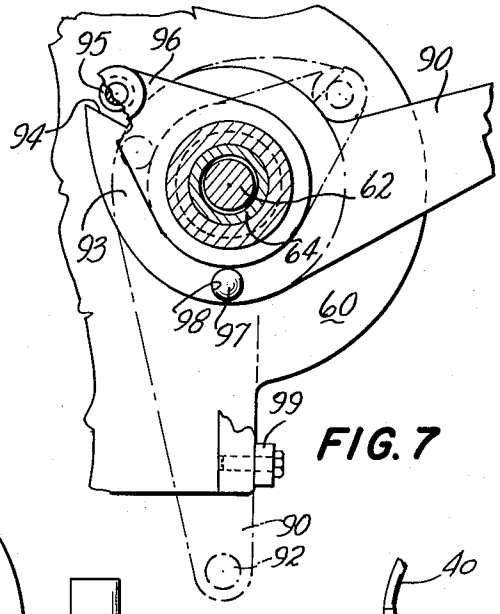


FIG. 7

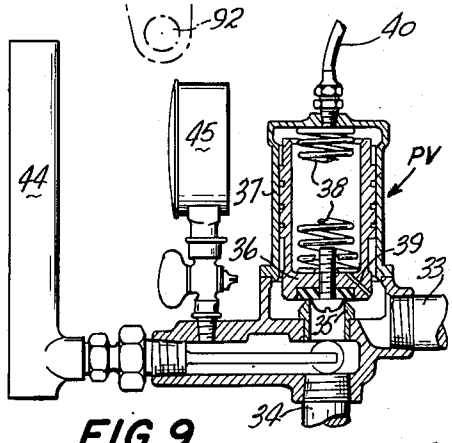


FIG. 9

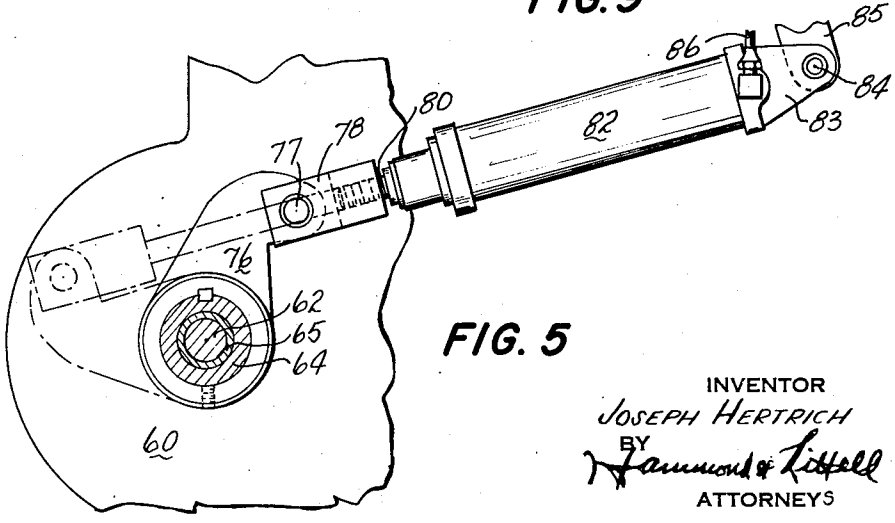


FIG. 5

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UNITED STATES PATENT OFFICE

2,466,988

CENTRIFUGAL CONTROL SYSTEM

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Application October 15, 1946, Serial No. 703,392

14 Claims. (Cl. 210—67)

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This invention relates to a system or apparatus for the control of centrifugal machines of the type used in sugar manufacture. It is adapted particularly for high speed suspended centrifugals, and as exemplified herein the invention is applied to a "gear driven" centrifugal to which a constantly rotating shaft transmits driving power through a shiftable clutch and a gear unit connected between the spindle of the centrifugal and the driven element of the clutch.

The control apparatus herein disclosed provides for manual control of the machine during the phases of its successive cycles when the centrifugal basket is unloaded at low speed, washed out if desired, and re-loaded at a somewhat higher speed; and it provides for automatic control of the machine during the running or centrifuging phase of each cycle, when the loaded basket is accelerated to a high speed, the liquid thus purged from the basket contents is collected in one trough, the contents of the spinning basket are washed with a washing fluid, the resulting wash liquid is collected separately in a second trough, the washing is discontinued, and after a suitable period of drying has ensued the driving system is disconnected and a brake is set to stop the machine.

The general object of this invention is to provide an improved mechanical organization giving operations as above outlined which utilizes new combinations of elements motivated manually, electrically and by fluid pressure to secure the desired conditions and movements of the control apparatus, so as to achieve a less expensive construction of the automatically controlled machine than has existed heretofore and a construction that is easier to operate, easier to adjust to suit operating and processing needs, and foolproof under the conditions encountered in sugar centrifugal work.

A preferred manner of constructing and using this invention is explained fully in the following detailed description and in the accompanying drawings in illustration thereof, while the parts, improvements or combinations distinguishing this invention will be set forth particularly in the appended claims.

In the drawings:

Fig. 1 is a front elevation, partly in section, showing an assembly of a high speed gear driven centrifugal machine embodying the improved control apparatus;

Fig. 2 is a wiring diagram illustrating a suitable control circuit for the machine;

Fig. 3 is a vertical section taken longitudinally

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of the control shaft, some of the framing and other parts appearing in elevation;

Fig. 4 is a partial view approximately along line 4—4 of Fig. 3, showing the pinion and gear segment of the clutch actuating mechanism;

Fig. 5 is a view approximately along line 5—5 of Fig. 3, showing the brake-setting air cylinder and its connection with the control sleeve;

Fig. 6 is a vertical view, partly in section, approximately along line 6—6 of Fig. 3, looking from the rear at the brake connections and the limit switch-control cam arrangement;

Fig. 7 is a vertical view, partly in section, approximately along line 7—7 of Fig. 3, looking from the rear at the hand lever system for emergency setting of the brake;

Fig. 8 is a horizontal section approximately along line 8—8 of Fig. 3, showing means for releasably holding said hand lever system in brake-set position; and

Fig. 9 is an enlarged view, partly in section, of a pressure-responsive sprayer valve in the washing system of the machine.

The drawings show the improvements herein claimed embodied in a suspended gyratory centrifugal machine having a basic organization like that shown in United States Letters Patent 2,317,528. A centrifugal spindle 1 carries a perforate centrifugal basket 2 at its lower end and at its upper end is suspended within a suitable gyratory head 3 supported in a suitable hanger structure 4 depending from framework (not shown). A housing 5 above the supporting framework encloses a suitable right angle bevel gear unit of which one element is connected with the spindle 1 and the other is connected with a rotary clutch and brake drum 6.

A centrifugal clutch 7, preferably as disclosed in the aforementioned patent, has arms and clutch shoes (not shown) secured to a constantly rotated line shaft 8 in position to work against the inside surface of the drum 6. A sliding collar 9 on the shaft 8 cooperates with the clutch arms so that movement of the collar to the right, as viewed in Fig. 1, will move these arms to disengage the centrifugal clutch, while movement of collar 9 to the left will free the arms and allow the clutch to become engaged by centrifugal force. The necessary movement of the clutch collar may be effected by a clutch shifting lever fulcrumed at 12 and having an upper arm 14 arranged to engage and move the collar 9 when its lower arm 15 is turned about the fulcrum.

The exterior surface of drum 6 constitutes the rotary element of a brake 16 having bands 16a

and 16b that become applied or set against the drum upon downward movement of a brake arm 17. Conversely, upward movement of arm 17 unsets or releases the brake bands from the drum 6. To effectuate these brake movements the arm 17 is connected through an articulated joint 18 with a vertically reciprocable rod 19.

The centrifugal basket 2 is surrounded by the usual stationary casing or curb 20, and this curb has at its bottom a "ring valve" syrup separator of the type disclosed in United States Reissue Letters Patent 22,772 of Eugene Roberts. To this end, a partition 21 in the curb bottom divides the bottom into inner and outer annular troughs 22 and 23, respectively, and on the curb side wall above the outer trough 23 is an annular ledge 24 carrying a resilient sealing element 25 for seating the outer periphery of an annular syrup deflector 26. The inner portion of this deflector ring extends inwardly to overlie the top portion and inner side of partition 21. When the deflector ring 26 is seated its outer edge engages and seals with element 25, so that the ring 26 forms with ledge 24 and partition 21 an uninterrupted syrup conducting platform extending from the inside wall of curb 20 into the inner trough 22. When, however, the deflector ring 26 is raised to the position in which it appears in Fig. 1, where it is spaced away from ledge 24 and its seat 25, this platform is interrupted to form an annular space over the outer trough through which syrup then flowing down the curb wall is entrapped into the outer trough 23, the inner portion of ring 26 remaining in an overlapping or substantially sealed relationship to partition 21.

A sprayer 30 of known construction extends into the basket 2 in position to direct a fine spray of washing fluid uniformly against the contents of the basket when the washing fluid is admitted at suitable intervals of the operating cycles.

The foregoing represents structures which are already known in the art and which therefore need not be explained in further detail. It remains to be explained how the wash water or other washing fluid delivered through the sprayer 30 may be turned on and off, how the syrup deflecting ring 26 may be moved to and away from its seated position, and how these conditions of actuation of the sprayer and the syrup separator as well as the on and off, or drive connecting and disconnecting, movements of the centrifugal clutch and the off and on (or unsetting and setting) movements of the centrifugal brake may all be coordinated according to my invention so as to achieve an improved control organization of the type described.

The sprayer as shown is adapted to be actuated through the combination of a pressure-responsive valve PV located on the top of curb 20 and a solenoid valve WWSV located on control framing 32. Valve PV, as shown in detail in Fig. 9, has an inlet 33 to which wash water is brought under pressure and an outlet 34 connected to the sprayer 30. Between the inlet and the outlet there is a valve seat 35 which normally is held closed by a valve plunger 36 that fits for vertical sliding movement in the valve casing 37 and normally is held against seat 35 by a compression spring 38. A bleeder hole 39 in the valve plunger 36 connects the inlet 33 with the interior of plunger 36 and casing 37, which in turn is connected with WWSV through a conduit 40 extending from the top of casing 37 to the entrance of WWSV at 41 (see Fig. 1). WWSV may be a solenoid valve of any suitable known construction, which normally holds the passage from entrance 41 closed under spring pressure but opens this passage to an outlet or vent 42 (Fig. 3) when an energizing circuit for WWSV is closed.

The bleeder 39 admits fluid pressure from the wash water line 33 to line 40, thus creating equal fluid pressure conditions on the opposite sides of plunger 36 in the normal, inactive condition of the washing system, so that the spring 38 holds valve PV closed and the wash water is "off." Upon the energization of WWSV, however, the pressure in line 40 is released, and since the bleeder causes only a small pressure drop in line 33 the pressure of water in line 33 overcomes the force of spring 38 and opens valve PV to deliver the wash water through line 34 and sprayer 30.

A thermometer 44 may be mounted in valve PV, as shown, to indicate the temperature of the wash water, and a pressure gage 45 also may be mounted in this valve to indicate the pressure of the wash water or other suitable washing fluid.

The syrup deflecting ring 26 may be shifted by providing it with a series of circumferentially spaced brackets 50 each having an arm 51 rigidly connected thereto and extending radially into a housing 52 mounted at the curb bottom. Only one of these several units is illustrated. Each housing 52 forms a cylinder for a piston 53 carried on the upper end of a piston rod 54 whose lower end is secured to arm 51. A compression spring 55 urges the piston 53, rod 54, arm 51 and ring 26 to the upward limit of their movement, where syrup received on curb wall 20 is entrapped into the outer trough 23. At the top of each housing chamber is an inlet line 56 through which fluid pressure may be admitted into the chamber so as to overcome the compression of spring 55 and force the respective piston 53 and the deflector ring assembly to the downward limit of their movement, where syrup received on curb wall 20 is deflected into the inner trough 22. This fluid pressure is admitted to or restrained from the inlet line 56 to the several units by action of a solenoid valve SSSV, which in Fig. 1 is shown mounted on the control framing 32.

SSSV may be a well-known form of electrically motivated three-way air valve, which receives air pressure at 57 from a branch 58 of a compressed air supply line 59. When denergized, SSSV transmits this pressure to line 56 so as to keep the syrup separator in its seated or down position, and when energized SSSV closes off the pressure inlet 57 and connects line 56 with a vent opening of SSSV, thus causing the springs 55 to move the syrup separator to its unseated or raised position. Hence, SSSV may be said to be "normally open," so that air pressure normally is transmitted through it to the pistons 53 and normally holds the syrup deflecting ring in its seated position where it deflects syrup flowing down the curb wall 20, after having been thrown from the contents of basket 2, into the inner trough 22.

The coordinated control of the desired phases of the machine operations is centered at a framing panel 60 depending from the framing 32 and carrying a suitably disposed control shaft 62 which has a hand wheel 63 secured to its forward end, as seen in Fig. 3. This control shaft 62 is surrounded by a control sleeve 64 which is rotatable independently of the control shaft upon bushing supports for the sleeve 64 in alined hubs 60a and 61a of the framing 60 and 61, there being further bushings 65 and 66 between the control shaft 62 and the control sleeve 64. The

control shaft extends beyond bushing 66 to a point at its rear end where a clutch shifting pinion 67 and a control cam 68 are keyed to the shaft.

The clutch pinion 67 stays in mesh with a sector gear 69 carried at the end of the lower clutch lever arm 15. When the hand wheel 63 and control shaft 62 are turned fully clockwise from their counterclockwise limit of movement the pinion 67 moves sector gear 69 and clutch lever arm 15 to substantially the position indicated in Fig. 4, at which position the clutch sleeve 9 has been moved to cause engagement of the centrifugal driving clutch. At this same position of the hand wheel and control shaft, which corresponds to the running condition of the machine, control cam 68 is positioned as it is shown in full lines in Fig. 6, its end 68*a* then depressing an arm 70 of a limit switch LS so as to close electrical contacts in the energizing circuit to the timing control system hereinafter described. Switch LS is suitably mounted on the rear side of the framing 61. Under circumstances hereinafter mentioned the same clockwise movement of the control shaft 62 and control cam 68 (counterclockwise as viewed from the rear in Fig. 6) will first produce a brake disengaging movement of the brake rod 19, through the action of face 68*b* of the cam upon a control pin 72.

It will be evident that counterclockwise movement of hand wheel 63 and control shaft 62 from the position above mentioned will move pinion 67 and cam 68 to disengage the driving clutch and to release the limit switch arm 70 so that LS will open its own electrical circuit. This counterclockwise movement of the hand wheel, etc., can take place whenever desired, so that the driving action upon the centrifugal can be established and interrupted at will to secure, through "jogging" of the clutch, any low speeds of rotation of the basket 2 that may be desired for unloading the basket or for re-loading it with a uniform wall of material to be processed. The concurrent closing and opening movements of the limit switch LS result in the timing control system performing its functions only when the driving clutch is kept engaged to go through a running or centrifuging period of the machine.

The control sleeve 64 has at its rear end a disk or arm 74 connecting it with the lower end of the brake rod 19 through a pin 75 pivotally held in the end of said rod. This same disk or arm 74 also carries the control pin 72. The center of the brake rod connection 75 is so disposed in relation to the center 18*a* of connection of the upper end of said rod and the center 62*a* of turning movement of disk 74 and pin 75 on shaft 62, that the center of pin 75 lies slightly to one side of a straight line between the centers 62*a* and 18*a* when the control sleeve and disk 74 are turned to the full line position of Fig. 6. This gives a toggle action which holds rod 19 at the upper limit of its movement, with the centrifugal brake in off or unset position, until a positive brake-setting action occurs.

This full line or brake-off position of the brake actuating mechanism is produced by the above-mentioned clockwise movement of the hand wheel 63 and control shaft 62, through the action of cam face 68b against the control pin 72 on disk 74. The broken line showings of brake rod 19, pin 75, control pin 72 and control cam 68 in Fig. 6, correspond to the brake-on or brake-set condition of the machine, at which control cam 68, shaft 62 and hand wheel 63 are disposed at substantially the counterclockwise limit of their movement and the driving clutch is disengaged or "off." Accordingly, the clockwise movement of the hand wheel from that limit will work first to move the brake off and thereafter will cause it to be held off by the said toggle action, since that movement causes cam face 68*b* to shift pin 72, disk 74, pin 75 and brake rod 19 to the full line position of Fig. 6.

Near its forward end the control sleeve 64 has keyed thereto a radial brake setting arm 76, and this arm has an articulated connection through a pin 77 and block 78 with one end of a rod 80 which at its other end carries a piston (not shown) inside an air cylinder 82 (see Figs. 1, 3 and 5). The base or upper end 83 of this air cylinder has a pivotal connection through pin 84 with a supporting arm 85 on the control framing 32. An air pressure line 86 leads into cylinder 82 from a solenoid valve BSV, also mounted on the framing 32. Valve BSV receives air pressure from a branch of line 59 and is so arranged that when it is energized it transmits pressure from 59 through line 86 into the air cylinder 82. The deenergization of BSV closes off the pressure from line 59 and connects line 86 with a vent outlet of BSV so that the piston inside cylinder 82 may then be moved freely.

Accordingly, the brake unsetting movement of hand wheel 63 and control shaft 62, whereby the brake rod 19, etc., are moved from the broken line position of Fig. 6 to the full line position of Fig. 6, must occur at a time when BSV is deenergized, for this same movement must move arm 76 and piston rod 80 to their full line position of Fig. 1 and Fig. 5, from their broken line position of Fig. 5, by reason of the turning motion imparted from the control shaft 62 to the brake-setting arm 76 through cam 68, pin 72, disk 74 and control sleeve 64.

The energization of BSV, on the other hand, transmits air pressure into the brake-setting cylinder 82, with the result that rod 80, arm 76, control sleeve 64, disk 74 and pin 75 are moved counterclockwise (clockwise as viewed from the rear in Fig. 6) to pull down the brake rod 19 and set the brake 16, and this same movement acts first through the action of pin 72 on the face 68*b* of control cam 68, to turn the end 68*a* of that cam away from the arm 70 of limit switch LS and to turn the shaft 62 and pinion 67 so that the driving clutch 7 is disengaged. The broken line positions of Figs. 5 and 6 thus correspond to a condition when the drive is disconnected, the brake is set and the control circuit through LS is open.

In the event of some failure in the air pressure system for setting the brake, or otherwise, occasion may arise for emergency brake setting, and to enable this a hand braking system is provided comprising a hand lever 90 cooperating with a radial arm 96 secured to the control sleeve 64. Lever 90 is free to turn on a bushing 91 surrounding the control sleeve (see Fig. 3). The lever has a handle 92 at its outer end. Its inner end 93, on the opposite side of the control sleeve, is formed with a lug 94 to abut against a pin 95 carried in the end of arm 96. The normal, inactive position of lever 90 is shown in Fig. 1, where it extends to the left and slightly upwardly from the control shaft assembly. This position appears in full lines, from the rear, in Fig. 7, and a spring-pressed retainer 97 mounted in the framing panel 60 (see Fig. 3) acts here in a hole or recess 98 of the lever to hold the lever releas-

ably at this inactive position allowing the brake actuating mechanism and arm **96** to move freely from their brake-off position shown in full lines to their brake-on position shown in broken lines. At any time, however, the centrifugal operator can pull downward on handle **92** so as to turn lever **90** and cause its abutment **94** to turn pin **95**, arm **96**, control sleeve **64** and the rest of the brake-setting mechanism from their brake-off to their brake-on position, which also disengages the driving clutch if it was engaged. The full line showing of the hand braking system in Fig. 3 is its normal, idle position, while its active position holding the brake set appears in broken ilnes. This latter position is releasably maintained by making the lever **90** somewhat flexible in a direction at right angles to its plane of movement and having its ride over and be retained by a catch **99**, mounted on the framing, as it reaches brake-set position, where it is shown in Fig. 8.

It remains to describe the manner of electrical control of the system. This involves, on the control framing, the limit switch LS, the solenoid valves BSV, SSSV and WWSV, and electrical push button devices PB1 and PB2, as well as an electrically connected timer and relay panel P mounted elsewhere. In the use of several like machines to process the same grade of material, panel P preferably is remotely disposed at a location accommodating the like panels of the several machines. Panel P carries adjustable timing relays or time delay switches, preferably several of them in a composite unit such as the known "Multiflex" type timer, although separate timers or time delay switches may be used for each of the several timing functions if desired. The panel also carries control relays CR and CR1 for holding certain control circuits.

Push button device PB1 comprises two buttons S and RS. S is a "stop" button having normally open contacts in a circuit to BSV, whereby, upon pushing button S, BSV will be energized to cause immediate disconnection of the driving clutch and setting of the brake of the machine, irrespective of the then existing condition of operation of the automatic timing control system. Button RS is a "reset" button having normally closed contacts in one of the two lines, L2 or L1 (Fig. 2), of the electrical control circuit, whereby upon pushing RS the control circuits are all opened and re-setting of the timer and relay elements, accompanied by deenergization of SSSV and BSV and the release of air pressure from the brake cylinder **82**, will take place.

Push button device PB2 has two buttons W and SW, both interlocked and connected in the circuit to WWSV, and also in the circuit to SSSV if desired, so that upon depressing button W contacts will be closed to start applying wash water through sprayer **30**, with concurrent unseating of the syrup deflector **26** if desired, and upon depressing button SW the same contacts will be opened to stop the washing and re-seat the syrup separator.

The "Multiflex" type timer is well known and need not be described in detail, except to point out that the form diagrammed comprises four timing contacts or circuits T, T1, T2 and T3 connected, respectively, with the timer's own motivating mechanism, control relay CR, SSSV and WWSV; and each of these contacts or circuits can be set, by the adjustment of an "on" detent and an "off" detent with respect to a timing scale, so that the timed action or circuit closing will occur at any desired interval in relation to starting the timer, according to the setting of the "on" detent, and will terminate at any desired interval in relation to starting the timer, according to the setting of the "off" detent. If the "on" detent is placed above the upper limit of the scale, its corresponding contact is closed when the timer is started, or energized, and if the "off" detent is placed below the lower limit of the scale it is inactive, so that its corresponding circuit, having been closed according to the setting of the "on" detent, stays closed until the timer is deenergized.

To illustrate the timer settings, it may be assumed that the machine described is to be used for processing a sugar massecuite which requires 60 seconds of purging, following by 20 seconds of washing, followed in turn by 20 seconds of drying before disconnecting the driving power and setting the brake to stop the machine; also, that the syrup separator should be shifted from its seated to its unseated position 5 seconds after starting the washing, in order to collect "wash syrup" separately from "green syrup," and that the syrup separator should be re-seated before the stopped machine is reloaded for another cycle.

In such a case, the "on" detent of element T is set at the top of the scale, so that the T contacts are closed to energize the timer motor TM when the timer is energized, and the "off" detent of T may be set near the bottom of the scale so as to deenergize the timer motor in the event of an abnormally long period of inattention to the machine after it has completed the automatic phase of an operating cycle. The "on" detent of element T1 is set at a 100 second interval from the top of the scale, the "off" detent being left inactive. The "on" detent of element T2 is set at a 65 second interval, the "off" detent being left inactive. The "on" detent of element T3 is set at a 60 second interval; and the "off" detent of this element is set at an 80 second interval. From the wiring diagram in Fig. 2 it will be evident that the control circuit is closed to energize the timer, etc., upon the closing of limit switch LS, which happens upon the movement of the hand wheel **63** to its clockwise limit where the driving clutch **7** is engaged to accelerate and run the machine.

The complete cycle of operation will now be described:

Assume that the hand wheel has just been turned to its clockwise limit as above mentioned, the loading of basket **2** having been just completed or having started upon so turning the hand wheel so as to take place during acceleration. The driving clutch **7** has thus been engaged, and the limit switch LS has been closed by cam **68**; so the machine proceeds to accelerate to its full running speed and the timer proceeds to operate due to the closing of contacts LS and T (Fig. 2).

After 60 seconds of purging the timer contacts T3 are closed with the effect of energizing WWSV, whereupon the pressure in line **40** is released and wash water flows under its own pressure through valve PV and sprayer **30** to wash the wall of purged material in basket **2**.

Five seconds after the start of washing, the timer contacts T2 are closed with the effect of energizing SSSV, which vents the pressure line **56** and causes the syrup deflecting ring **26** to be raised by springs **55** to its unseated position, whereupon the "wash syrup" received on curb

wall 20 flows down over ledge 24 into the outer trough 23, the "green syrup" previously purged from the sugar having been collected previously in the inner syrup trough 22.

Twenty seconds after the start of washing, or 80 seconds after the timer was energized, the timer contacts T3 are reopened to terminate the washing period and start a drying period. This drying period continues for 20 seconds while the sugar is spun at the full speed of the machine, and at the end of this period the timer contacts T1 are closed with the effect of energizing relay CR and causing it to close contacts CR through which BSV is energized. BSV then transmits air pressure from 59 through line 86 into the air cylinder 82, whereupon the air cylinder operates to thrust arm 76, control sleeve 64, disk 74 and the brake rod pin 75 counterclockwise, and the pin 72 on disk 74 at the same time thrusts cam 68, shaft 62, hand wheel 63 and pinion 67 counterclockwise (as viewed from the front), so that the driving clutch 7 is disengaged, the limit switch contacts LS are opened, and the brake 16 is set. The force of setting the brake is limited by a compression spring joint 19a in the brake rod 19.

The machine thereupon decelerates under the action of brake 16, and during this braking period the contacts T1 and CR stay closed so that the timer is held energized notwithstanding the opening of the limit switch LS, hence air pressure continues to be applied to the brake-setting cylinder 82.

When the machine has stopped, the operator returning to unload the treated sugar from basket 2 first pushes button RS and then turns the hand wheel 63 clockwise to disengage the brake and engage clutch 7 for a brief interval sufficient to bring the basket to the desired unloading speed, usually about 50 R. P. M. The pushing of button RS opens line L2 of the control circuit, with the effect of deenergizing the timer and relays so that the brake cylinder 82 is vented through BSV, SSSV is positioned to transmit air pressure that re-seats the syrup separator, and the timer and relay CR reset of their own accord to their initial or inactive positions.

The basket 2 having been unloaded in the usual manner, the operator may find it desirable to clean the basket outlets and screens by the application of wash water, and in such event he simply pushes button W to energize WWSV and SSSV, causing a washing spray to be delivered into the slowly revolving basket and causing the resulting washings to be collected in the outer syrup trough. To terminate this cleansing of the basket, the operator pushes button SW which deenergizes WWSV and SSSV. Then he may turn the hand wheel 63 clockwise once more to bring the basket to the desired loading speed. Having done this, he either moves the wheel counterclockwise momentarily to reset the timer and then turns it clockwise and loads the basket during the acceleration of the new running period, or else he moves the wheel counterclockwise or jogs it so as to load the basket at a more or less constant speed and turns the wheel clockwise to start the new running period and the timer concurrently at the finish of loading. The automatic phase of the new operating cycle then proceeds in the same manner and with the same timing of its component operations as occurred in the cycle described before.

If abnormal or emergency stopping of the machine is desired at any time during its operation, the operator may simply press button S. This

closes a circuit to BSV and also a circuit to relay CR1 which in turn closes CR1 contacts that hold the circuit to BSV even though the button S be released. The energization of BSV acts as described above to admit air pressure into cylinder 82 and cause immediate drive disconnection and brake setting.

If any failure occurs in the electrical power supply or in the supply of air pressure for the controls, the operator can bring about an emergency stopping of the machine by simply grasping handle 92 and pulling lever 90 downward so as to disconnect the driving clutch and set the brake. The assembly of the hand wheel, control shaft, control sleeve, air cylinder, solenoid valves and push button devices on the framing 32, 60, 61, etc., can be prefabricated and transported as a unit for simple installation in connection with existing gear driven centrifugal machines. The elements of control panel P also are quite simple to assemble and install. The construction and organization of the various control elements and the combination of electrical, fluid pressure and manual motivations employed for their working bring about easy operation of the controlled machine and render its operation foolproof under the conditions encountered in heavy centrifugal work.

It is to be understood that the detailed description and the accompanying drawings are illustrative and that the improvements herein disclosed may be embodied in various forms of construction within the scope of the appended claims. For example, another embodiment using some of the improvements herein disclosed is shown in my copending application, Serial No. 703,393, filed October 15, 1946.

I claim:

1. In centrifugal apparatus comprising a driving system having a drive control element movable to drive-on and drive-off positions, a brake having a brake control element movable to brake-on and brake-off positions, a rotatable control shaft connected with said drive element to move it, a relatively rotatable control member coaxial with said shaft and connected with said brake element to move it, and coacting abutment elements connected respectively with said member and said shaft and disposed together at the brake-off, drive-on and the brake-on, drive-off positions of the apparatus so that rotation of the shaft to drive-on position moves the member from brake-on to brake-off position and so that rotation of the member from brake-off to brake-on position moves the shaft from drive-on to drive-off position, said member having a radial extension, a brake connector articulated at one end to said brake element and at its other end to said extension, the rotation of said member describing an arc for the center of articulation of said other end from a point slightly to one side of a straight line between the axis of said member and the center of articulation of said one end to a point far to the other side of said straight line, to provide a releasable toggle locking action for the brake connections.

2. In centrifugal apparatus comprising a driving system having a drive control element movable to drive-on and drive-off positions, a brake having a brake control element movable to brake-on and brake-off positions, a rotatable control shaft connected with said drive element to move it, a relatively rotatable control member coaxial with said shaft and connected with said brake element to move it, and coacting abutment ele-

ments connected respectively with said member and said shaft and disposed together at the brake-off, drive-on and the brake-on, drive-off positions of the apparatus so that rotation of the shaft to drive-on position moves the member from brake-on to brake-off position and so that rotation of the member from brake-off to brake-on position moves the shaft from drive-on to drive-off position, said member having a radial extension, a brake connector articulated at one end to said brake element and at its other end to said extension, the rotation of said member describing an arc for the center of articulation of said other end from a point slightly to one side of a straight line between the axis of said member and the center of articulation of said one end to a point far to the other side of said straight line, the brake element being disposed at brake-off position when the first-mentioned center is at the first-mentioned point so that the brake is releasably held off through a toggle locking action.

3. In centrifugal control apparatus comprising a driving system having a drive control element movable to drive-on and drive-off positions, a brake having a brake control element movable to brake-on and brake-off positions, a rotatable control shaft connected with said drive element to move it, a rotatable control member connected with said brake element to move it, interconnecting means between said member and said shaft for moving said shaft and said drive element from drive-on to drive-off position as said member moves said brake element from brake-off to brake-on position, a limit switch adjacent said shaft, a cam on said shaft arranged to close said limit switch upon movement of said shaft to drive-on position and to cause opening movement of said limit switch upon movement of said shaft away from drive-on position, an electrical timing control system adapted to start operating when energized and to re-set itself when deenergized, brake setting means connected with said control member and connected with and actuated by said timing control system for moving said brake element from brake-off to brake-on position, and a control circuit through said limit switch for energizing said timing control system.

4. Apparatus as described in claim 3, said timing control system comprising a relay energized upon the actuation of said brake setting means and a circuit closed by said relay to hold said system energized notwithstanding the opening movement of said limit switch.

5. Apparatus as described in claim 3, said brake setting means comprising a radial arm on said member, a fluid pressure motivated cylinder anchored at one end and having a piston rod articulated to said arm, a fluid pressure line connected with said cylinder, a solenoid valve in said pressure line operable to admit fluid pressure to said cylinder and to vent said cylinder, and electrical connections from said timing control system to said solenoid valve for operating said valve.

6. In centrifugal control apparatus comprising a driving system having a drive control element movable to drive-on and drive-off positions, a brake having a brake control element movable to brake-on and brake-off positions, a rotatable control shaft, and gear and lever connections from said shaft to said drive element for moving the latter, a control sleeve surrounding and rotatable relative to said shaft, a toggle connection between said sleeve and said brake element to move said brake element upon rotation of said sleeve, coacting pin and abutment elements connected respectively with said sleeve and said shaft so that rotation of the shaft from drive-off to drive-on position moves the sleeve from brake-on to brake-off position and so that rotation of the sleeve from brake-off to brake-on position moves the shaft from drive-on to drive-off position, a radial arm on said sleeve, a fluid pressure motivated cylinder anchored at one end and having a piston rod articulated to said arm, a fluid pressure line connected to said cylinder, a solenoid valve in said pressure line operable to admit fluid pressure to said cylinder for moving said sleeve and said brake element to brake-on position and operable to vent said cylinder, a hand wheel on said shaft for rotating the same to and from drive-on position, a limit switch adjacent said shaft, a cam on said shaft arranged to close said limit switch when said shaft is at drive-on position, an electrical timing control system, a circuit through said limit switch to energize said timing control system upon closing movement of said limit switch, and a circuit from said timing control system to said solenoid valve to operate said valve.

7. Apparatus as described in claim 6 comprising also a hand lever movable on a fulcrum concentric with said sleeve and having a lever arm formed with an abutment, and a second radial arm on said sleeve carrying a pin in the path of said abutment so that upon movement of said hand lever, when said sleeve and pin are at brake-off position, said abutment moves said pin, said sleeve and said brake element to brake-on position.

8. Apparatus as described in claim 6 comprising also a hand lever movable on a fulcrum concentric with said sleeve and having a lever arm formed with an abutment, a second radial arm on said sleeve carrying a pin in the path of said abutment so that upon movement of said hand lever, when said sleeve and pin are at brake-off position, said abutment moves said pin, said sleeve and said brake element to brake-on position, a retainer coacting with said hand lever to hold the same releasably at an inactive position beyond the path of said pin, and a detent acting upon movement of said lever to brake-on position to hold said lever there.

9. In centrifugal control apparatus comprising a driving system having a drive control element movable to drive-on and drive-off positions, a brake having a brake control element movable to brake-on and brake-off positions, and a sprayer having a valve movable to wash-on and wash-off positions, a manually rotatable control shaft connected with said drive element to move it, a rotatable control member connected with said brake element to move it, interconnecting means between said member and said shaft for moving said shaft and said drive element from drive-on to drive-off position as said member is turned from brake-off to brake-on position, a limit switch adjacent said shaft, a cam on said shaft arranged to close said limit switch upon movement of said shaft to drive-on position, an electrical timing control system, a circuit through said limit switch for energizing said timing control system upon the closing of said limit switch, brake setting means including a fluid pressure motivated cylinder connected to move said control member to brake-on position, a fluid pressure line connected with said cylinder having a brake solenoid valve therein and a circuit closed by said timing control system to energize said brake solenoid valve, and sprayer operat-

ing means including a fluid pressure line connected with said sprayer valve, a wash solenoid valve in said line and a circuit closed by said timing control system to energize said wash solenoid valve.

10. Apparatus as described in claim 9 wherein said wash solenoid valve when energized vents the pressure line connected with said sprayer valve and said sprayer valve has a normally closed valve element formed with a pressure bleeder and responsive to the pressure of wash fluid supplied thereto to open upon the venting of said pressure line.

11. Apparatus as described in claim 9 comprising also a separate energizing circuit to said brake solenoid valve, a push button device mounted adjacent to said control shaft having normally open contacts in said separate circuit adapted to be closed manually at any time to energize said brake solenoid valve and move said control member and brake element to brake-on position, a separate energizing circuit to said wash solenoid valve, and another push button device mounted adjacent to said control shaft and having contacts in the last-mentioned circuit adapted to be closed or opened manually at any time to energize or deenergize said wash solenoid valve.

12. In centrifugal control apparatus comprising a driving system having a drive control element movable to drive-on and drive-off positions, a brake having a brake control element movable to brake-on and brake-off positions, a sprayer having a valve movable to wash-on and wash-off positions, and a curb syrup separator having a syrup deflector movable to seated and unseated positions, a manually rotatable control shaft connected with said drive element to move it, a rotatable control member connected with said brake element to move it, interconnecting means between said member and said shaft for moving said shaft and said drive from drive-on to drive-off position as said member is turned from brake-off to brake-on position and for moving said member and said brake element from brake-on to brake-off position as said shaft is turned from drive-off to drive-on position, a limit switch adjacent said shaft, a cam on said shaft arranged to close said limit switch upon movement of said shaft to drive-on position, an electrical timing control system, a circuit through said limit switch for energizing said timing control system upon the closing of said limit switch, brake setting means including a fluid pressure motivated cylinder connected to move said control member to brake-on position, a fluid pressure line connected with said cylinder having a brake solenoid valve therein and a circuit closed by said timing control system to energize said brake solenoid valve, sprayer operating means including a fluid pressure line connected with said sprayer valve, a wash solenoid valve in said line and a circuit closed by said timing control system to energize said wash solenoid valve and syrup separator operating means including air cylinders having pistons connected to said deflector to position it, a fluid pressure line connected to said cylinders, a separator solenoid valve in the last-mentioned pressure line, and a circuit closed by said timing control system to energize said separator solenoid valve.

13. Apparatus as described in claim 12 comprising also a separate energizing circuit to said brake solenoid valve, a push button device mounted adjacent to said control shaft having normally open contacts in said separate circuit adapted to be closed manually at any time to energize said brake solenoid valve and move said control member and brake element to brake-on position, a separate energizing circuit to said wash solenoid valve and said separator solenoid valve, and another push button device mounted adjacent to said control shaft and having contacts in the last-mentioned circuit adapted to be closed or opened manually at any time to energize or deenergize said wash solenoid valve and said separator solenoid valve simultaneously.

14. Centrifugal control apparatus comprising integrated control framing having framing panels and having assembled thereon manually, fluid pressure and electrically motivated control elements including a rotatable control shaft and a surrounding relatively rotatable control sleeve supported in said panels, a radial arm on the forward end of said sleeve, an air cylinder pivotally anchored at its base to said framing and having a piston rod articulated to said arm, a radial extension on said sleeve for connection with a brake moving element, a control cam on said shaft adjacent said extension, said cam having a radially disposed face, a pin projecting from said extension across the path of said face, a limit switch mounted on one of said panels and having a movable switch arm, said cam having an end portion to move said switch arm, a device on the rear of said shaft to cooperate with a drive control element, said shaft accommodating a hand wheel at its forward end, solenoid valves mounted on said frame, one of said valves having a fluid pressure line connected to said cylinder, and push button devices mounted on one of said panels adjacent said hand wheel for energizing and deenergizing said valves.

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