PNEUMATIC CONTROL SYSTEM FOR A LAUNDRY MACHINE

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The present invention relates broadly to acceleration control systems, and is more particularly concerned with a novel apparatus wherein a horizontal or substantially horizontal axis type drum is limited to a safe optimum rotational speed in response to deflections of the drum due to rotation of unbalanced loads therein.

The principles of the present invention can readily be incorporated into existing systems and methods wherein it is desired to counterbalance unsymmetrically disposed centrifugal forces generated because of unbalance in a rotating body, however, because these principles find a particularly useful application to a laundry machine and method, the invention is described and illustrated in connection with a specific laundry machine associated with domestic utilization such as a typical home laundry appliance.

In contemporary domestic laundry appliances, including automatic washing machines wherein clothes are washed and centrifuged, or in so-called combination washer-dryers wherein clothes are washed, rinsed, spun dry and tumbled dry with the application of heat energy, that part of the total washing and drying time preceding the tumble dry or line dry portion of the total laundering cycle time is designated as the wash portion of the total cycle, and consumes substantially the same amount of actual time for most available machines. Accordingly, to decrease the overall wash and dry time of a particular load, the most practical substantial time savings can be made by shortening the dry portion of the total cycle.

The conventional approach to an attempted improvement of machine drying involves the consideration of increasing the drum speed to dry the load of wash and to minimize the effects of the unbalanced centrifugal forces. Within such drum arrangements, it is inevitably necessary that the size of the enclosing cabinet must be greatly increased or the size of the load receiving cylinder greatly reduced to allow for the violent gyratory motions of such system during the operation of the machine.

In other forms of prior art machines, eccentric motions of the rotating body are sensed and located by relatively complex mechanisms which control the addition or subtraction of weights from the rotating components of the machine, thereby to counteract the unsymmetrically disposed centrifugal forces generated by the unbalanced conditions within the cylinder or drum.

In accordance with the principles of the present invention, a drum is journaled for rotation on a substantially horizontal axis within a casing rigidly connected to a base frame. A transmission interconnects the drum with a drive motor, and the transmission has a low speed ratio for tumbling fabrics at a lower washing speed and a high speed ratio for rotating the drum at higher extracting speeds for extracting fluids from the fabrics in the drum. As a further feature of this invention, there is provided clutch means for changing the speed ratios of the transmission, as well as sensing means responsive to movements of the drum due to rotation of unbalanced loads therein at the high speed ratio, for limiting the speed ratio of the transmission to a value between the low and high speed ratios to thereby effect the rotation of the drum at a safe optimum speed above the lower washing speed.

Illustratively, the clutch control for the pneumatic type and the sensing means may include bleed off valve means actuated by vibrations of the drum to reduce
the pneumatic pressure on the clutch means whereby the clutch intermittently slips to prevent increased drum acceleration but at the same time maintaining an essentially constant drum rotative speed. In this manner, the drum speed is maintained during the off balance function at a speed that produced sufficient centrifugal force on the off balance load in the drum to produce the necessary deflection to initiate water balancing. As the off balanced load is counterbalanced, the deflection decreases with the result that the pneumatic clutch receives uninterrupted full pressure, and acceleration again continues.

It is accordingly an important aim of the present invention to provide acceleration control apparatus for a rotating receptacle.

Another object of this invention lies in the provision of an acceleration control system for use with counterbalance control means and which does not impede the proper functioning thereof.

Still another object of the instant invention is to provide a system embodying transmission means, clutch means and sensing means, and wherein the structure is so constituted that the sensing means detects deflections of a rotating plate which are greater than the deflections which initiate performance of load balancing functions, the sensing means being in control of the clutch means to limit the transmission speed ratio so that the receptacle rotates at a safe optimum speed and which is further sufficiently high so that there is no interference with performance of the load balancing function.

Other objects and advantages of the invention will become more apparent during the course of the following description, particularly when taken in connection with the accompanying drawings.

In the drawings, wherein like numerals designate like parts throughout the same:

FIGURE 1 is a front elevational view of a laundry machine incorporating the principles of the present invention, but with the outer cabinet removed and with parts broken away and with other parts removed for clarity;

FIGURE 2 is a side elevational view of the machine of FIGURE 1, with portions of the cabinet structure removed for clarity of illustration;

FIGURE 3 is an enlarged fragmentary view constituting a layout of the hydraulic control mechanism which may be employed to initiate the load counterbalancing function and transmission speed ratio limiting function;

FIGURE 4 is a cross-sectional view taken substantially along the line IV—IV of FIGURE 3, but with parts removed in order to show additional details of the construction of the fluid water balance sensing mechanism of FIGURE 3;

FIGURE 5 is a more or less diagrammatic view, with portions thereof taken in section, showing the acceleration control system of this invention;

FIGURE 6 is a sectional view taken through a two-speed transmission employed in the instant invention; and

FIGURE 7 is a diagrammatic representation of certain hydraulic circuitry incorporated in the illustrated machine.

Reference will first be made in the following description to certain structural details of the illustrated form of combination washer-dryer, and to an illustrative type of water balance system used therewith. However, it will be readily appreciated that the acceleration control system of this invention is not restricted in its use to the particular structural organization shown in FIGURES 1 and 2, nor do its advantages flow only from use with the particular liquid balance system also appearing in FIGURES 3 and 4. As will be observed as the description proceeds that parts not necessary to a description of the instant acceleration control system have been removed in the interests of clarity.

As appears in FIGURES 1 and 2, a domestic laundry appliance in the form of a combination washer-dryer is designated generally by the numeral 18, and comprises an outer cabinet 11 providing an aesthetically appealing enclosure for the machine 10. In the manner conventional in the art, access to a treatment zone formed within the speed level member 13 through a suitable opening in the outer cabinet front wall, this front opening being closed by an access door (not shown) during the laundering operation.

Within the outer cabinet 11 is a rigid base structure shown generally at 13, and which comprises a channel member 13a and which is fastened thereto a front wall 18a of a generally importance base casing 18b.

The casing 18 is connected to and supported on the base frame 13 by a front support plate member 19 which is integrated with a front wall 18b of the casing 18 by welding or similar techniques. The plate member 19 is further securely fastened to the plate member 14 of the base frame 13, as by bolt means or the like 20.

The rear wall 18a of the casing 18 has a centrally apertured embossed portion 21 cooperate with a support spider 22 connected in firm assembly with the rear wall 18a to rigidly mount a bearing assembly generally designated at 23 in which is journaled shaft means (not shown) connected for rotation with perforate drum or cylinder 24 rotatable within the casing 18.

It is to be noted that the connections provided by the parts 14 and 19 between the base frame 13 and casing 18 are rigid connections, however, there is sufficient yieldability in the support structure so that some very small movement of the casing 18 relative to the base frame 13 may occur. The connections afforded by the connection of the plate members 14 and 19 to the channel member 13a and the connection of the part 17 to the casing 18 are sufficiently rigid to confine the casing 18 for oscillatory movements about an axis positioned parallel to and located below the horizontal rotational axis of the drum 24 prescribed by the connecting shaft means. In the machine exemplified in the drawings, such allowable arcuate movement is approximately 0.010 inch from its normal centered position as measured from an approximate 16 inch lever arm.

The machine 10 is equipped with an electric drive motor 25 which is mounted on the casing 18 and is provided with a power take-off shaft drivingly connected with a transmission 26 which is also mounted on the casing 18. The transmission, here described in more specific detail, has a take-off shaft 26a (FIGURE 2) mounting pulleys 27 and 28, the pulley 27 having trunnions thereabout a pulley belt 29 driving a pulley wheel 30 to rotate the drum 24. The pulley 28, on the other hand, is wrapped by a pulley belt 31 connecting with blower means (not shown) to circulate heated air through the drum 24.

Machine 10 is further equipped with a conventional mixing valve arrangement (not shown) as well as a sump 140 formed in the lower portion of casing 18 for receiving fluids for the washing, rinsing and extraction operations. Sump 140 communicates with pump 141 which is in turn is connected to a first two-way valve 142 which leads either to drain for pump out operations or to a second two-way valve 143 which is provided with one conduit 144 for recirculating washing fluid through drum 24 during the washing operation by way of a recirculation nozzle (not shown) and a second conduit 232 leading to nozzle 68 for recirculating balancing fluid through nozzle opening 68a during the extraction operation which balancing fluid is supplied to the fluid receiving pockets 39 by way of the respective collector segments 45a—e communicating with these pockets. A conventional type sequential controller or timer 33 regulates the operation of valves 142 and 143 throughout a programmed sequence.
It will be understood that the sequential control means shown generally at 33 is preselectable by the operator and is associated with the usual electrical circuitry with all of the operating components of the machine, including the electric drive motor 25, the variable valve means employed, and particularly solenoid valve means to be later described in detail which is in control of the pneumatic clutch means forming a part of the transmission 26. The sequential control means 33 by the various electrical connections conventionally employed actuates the machine through a program consisting of washing, rinsing, extracting and drying. In a typical operation, the operator will load a batch of clothes to be laundered through the access door into the drum 24, and upon initiation of a preselected program, the casing 18 will be charged with a supply of water. Following the washing operation, the laundry liquid will be drained through the sump and discharged to drain, and the materials within the drum 24 are then subjected to an extraction operation, followed by rinsing and a subsequent extraction operation, which portions of the washing cycle may be repeated as often as may be desired in accordance with the preset program. After the final extraction operation, the machine either continues through a drying period involving operation of the drying system and including the addition of heat of vaporization to the steam of ventilating air circulated through the treatment zone, or the batch of materials being laundered may be removed from the machine by the operator for line drying.

As earlier indicated, the acceleration control system of this invention may be employed in connection with various types of water balance systems, however, one particularly advantageous balance system is shown in the application drawings in order to clearly illustrate the numerous novel operational advantages obtained by the instant acceleration control system. In this connection, it is to be observed from FIGURE 1 that the drum 24 has formed along its back wall 24a a plurality of radially extending and angularly spaced strengthening ribs 34. At the center of the back wall 24a, the drum 24 is connected as at 35 to shaft means 36 journaling in the bearing assembly 12. The outer peripheral wall of the drum 24 is formed by a formative wrapper 37 and is particularly characterized by a plurality of openings 38 through which liquid may escape from the interior of the drum 24 into the casing 18. The drum periphery is further provided at a plurality of circumferentially spaced locations therealong with recess means provided to accommodate mounting therein of a liquid balancing receptacle indicated generally in FIGURE 2 at 39. Each receptacle 39 comprises a generally trough-shaped tray member having radially spaced walls 40 and 41, axially spaced end walls 42 and 43 and a pair of spaced side walls 44. Each receptacle 39 is provided with an inlet segment 45a, 45b and 45c which may be seen to be of generally U-shaped configuration and each provided with an opening 46 through which all of the fluid within the inlet segment is discharged radially outwardly into a particular receptacle as required for countercalibrating purposes. In the exemplary disclosure illustrated, there are three receptacles 39, and accordingly, each segment 45c--c may, if desired, extend through 120° of arc on the front wall of the drum 24. The inlet segments, generally designated by numeral 45, are attached in assembly by welding or the like to the drum front wall in register with the liquid supply means provided to introduce balancing fluid thereinto.

In order to control the introduction of balancing fluid into the receptacles 39 by way of the inlet segments 45a--c, there is desirably utilized as a controlling variable a momentary operational as a relatively small linear movement between the casing 18 and a relatively stationary reference means. As appears in FIGURES 1 and 3, a balance and nozzle housing 47 is provided with an aperture 48 forming an upper wall 49 constituting a surface portion movable in unison with the casing 18. Fastening means 50 may be employed to secure the balance and nozzle housing 47 to the front wall 18b of the casing 18.

In order to provide a relatively stationary reference with respect to the housing 47, there is utilized a subframe 51 (FIGURE 1) including an oblique leg 52 fastened in firm assembly with the base frame 13 at 53, as well as a vertical leg 54 secured to the base frame at 55. The reference means may be seen from FIGURE 3 to further include a slide member 56 fastened to the A-shaped subframe 51 as at 57, the slide member 56 having an arm 58 to which is connected a slide block 59 having a hardened surface confronting the wall 49 of the balance and nozzle housing 47, and closely spaced and in parallel relation thereto.

For the purpose of sensing oscillatory movements of the casing 18 which are produced as a function of any unbalance manifested within the rotating drum 24, there is desirably utilized a sensing member in the form of a rollable pin 60 confined between the surfaces 49 and 59. Although not shown in specific detail, the surface 49 is particularly characterized by a niche or grooved slot which has width slightly larger than the outer diameter of the rollable pin 60 to provide the necessary clearance. If desired, the mentioned slot may receive therein a hardened insert 49b provided to present a surface for engagement against the peripheral surface of the pin 60. As it is believed now quite apparent, the curved surface of the pin 60 is on a fixed radius with respect to the centerline axis of the pin and, therefore, the relative linear movement produced between the surfaces 49 and 59 is converted by the sensing member or pin 60 into a linear angular movements about the pivot axis of the pin by the rolling action of said pin between the relatively moving surfaces 59 and 49.

In order to assure that the pin 60 is tightly confined between the surfaces 49 and 59, a plurality of spring means 61 are confined by bolt means 62 and a nut 63 extending between a bottoming plate 65 and embossments 64 on the slide member 59.

The angular movements of the pin 60 are amplified through a moment arm provided by an interrupter or flag member 66 connected in firm assembly with one end of the pin 60. The connection may be accomplished by welding the pin to the interrupter member, and it may be observed that this member extends generally parallel to the front wall 18b of the casing 18 and is closely spaced to a splash housing 67 mounted on the inside surface of the front wall 18b between the casing 18 and drum or cylinder 24. The splash housing 67 has formed therein a slotted opening 67a and mounted in register with the opening is a nozzle member 68 connecting with the conduit 32, and particularly characterized by a narrow elongated nozzle outlet 68a in discharging register with the slotted opening 67a in the splash housing 97.

Both the nozzle discharge outlet 68a and the slotted opening 67a are located directly adjacent to the arcuate path of movement of the interrupter member 66. Accordingly, the movements of the casing produced as a function of any acentric disposed load in the rotating drum 24 are sensed in a linear motion of the surfaces 49 and 59, wherein the rolling pin 60, which is forcefully and resiliently squeezed between a portion of the front of the casing 18 and the vertical stationary extension 51 of the base frame 13, will convert such movements into angular displacement. The rolling pin 60 provides a pivotal axis for the water deflector member or interrupter flag 66, which is normally positioned in the path of a fluid stream discharged through the nozzle outlet 68a during extraction operations. The deflection means provided by the interrupter member 66, which is located within the casing 18 on the rear side of the casing front wall 18b and spaced from both the casing front wall and the splash housing 47, will serve to deflect the fluid stream emanating from the nozzle outlet 68a downwardly in the splash housing 57 for return to the casing 18.
opening 67a in the splash housing 67, as well as the nozzle opening 68a, are aligned with the three inlet segments 45a-c carried on the front of the drum 24.

In operation, the movements of the casing 18, due to the rotation of unbalanced loads within the drum, cause a radial movement of the interrupter member 66 away from the fluid stream emanating from the nozzle opening 68a so that the fluid may be injected directly into an appropriate inlet segment 45 for passage to the correct fluid-receiving pocket or compartment provided by a corresponding receptacle 59 on the drum 24 for automatically counteracting the unbalanced load causing the arcuate movement of the casing.

As was earlier stated, the described water balance system is illustrative of a typical arrangement which can be employed in conjunction with the acceleration control system of this invention. During the course of the following description, which is directed particularly to a new and improved system for controlling drum acceleration in response to deflection of the cylinder or drum structure relative to stationary base structure, it will be readily apparent that other types of water balance systems can be effectively utilized.

Briefly stated, in the acceleration control system of this invention a pressurized fluid-operated system comprising a double acting bleed off or relief valve is mounted on the stationary A-frame structure 51 to sense vibrations caused by rotation of an unbalanced load in the drum 24. The valve connects with an outlet port of a solenoid operated air valve means and is constructed to provide a pressure bleed off line between an air compressor and the air cylinder in control of slip clutch means in the transmission 26. Compressed air from a suitable source is communicated to an inlet port in the solenoid valve and the solenoid is energized to accelerate drum 24 from tumble to spin speed by pressurizing a chamber within the solenoid valve means leading to the pneumatic clutch. When an off-load balance is accelerated and produces a deflection, the bleed off valve on the stationary A-frame is intermittently opened to reduce the pressure on the solenoid valve chamber, which through the outlet port leading to the clutch air cylinder, slips the clutch to prevent increased drum acceleration until the off-load balance is counterbalanced. However, as will be pointed out in detail hereinafter, the drum rotational speed is necessarily reduced, but is maintained at essentially the speed which caused the casing deflections so that there is no interference with accomplishment of the proper water balancing function.

The acceleration control system of this invention is more or less diagrammatically illustrated in FIGURE 5, and it may be seen therefrom that the drive motor 25 connects with the transmission means 26 having an output shaft 26a mounting the pulleys 27 and 28 constituting the output of FIGURE 5. The structural details of the transmission means 25 will be later described, and for the present purposes it may be noted from FIGURE 5 that conduit means 70 is in communication with the transmission means (specifically a clutch actuated air cylinder therein which will also be later described) and an outlet port 71 of solenoid air valve means generally designated by the numeral 72. A compressor 73 of any suitable construction has connected to the outlet port thereof conduit means 70 leading to an inlet port 75 of the solenoid valve means 72. The solenoid valve means is further provided with a second outlet port 76 which communicates through conduit means 77 with a double acting bleed off or relief valve means designated generally by the numeral 78.

The solenoid valve means 72 is provided with a body portion 79 having at one end thereof a plurality of threaded openings 80a, 80b and 80c receiving coupling members 81a, 81b and 81c, respectively, which are internally bored to provide the outlet port 76, inlet port 75 and outlet port 71.

The body portion 79 of the solenoid valve means 72 is shaped interiorly to provide a chamber 82 communicating with the ports 76, 75 and 71 through reduced diameter passages 76a, 75a and 71a. The chamber 82 communicates with a chamber 83 through a central aperture 84a in a rigid diaphragm member 84, which is further provided with vent passages 84b leading through vent passages 79a in the body portion 79 to atmosphere.

The central aperture 84a in the rigid diaphragm member 84 receives a generally T-shaped flat surface valve member 85 positioned for contact with the solenoid armature 87 when solenoid 88 is de-energized. It may be noted from FIGURE 5 that the solenoid armature 87 has a central axial passage 87a and bottoming at one end thereof is spring means 89 which also bottoms against a fixed plug member 90 having a passage 90a therein. The plug member 99 may be secured in any suitable manner to a solenoid housing 91, and if desired, seal means 92 may be located between the solenoid armature 87 and plug member 90.

The energization of the solenoid 88 of the solenoid valve means 72 controls the shifting of the double acting bleed off or relief valve means 72 and thereby establishes the speed transmission 26 from tumble to spin speeds. When the solenoid is de-energized, the spring loaded solenoid armature 87 assumes its uppermost position which forces the valve member 85 against surface 82a, which in turn permits cavity or chamber 83 to be vented to atmosphere through the vents or passages 84a, 84b and 79a in the rigid diaphragm 84 and body portion 79, respectively. The action prevents the air pressure from the compressor 73 from reaching the pneumatic clutch in the transmission 26. In addition, this action blocks the inlet passage 75a to the chamber 83, and the compressor 73 can thereby build up pressure until contacted by relief means in the compressor bleeds the excess pressure.

When it is desired to shift the transmission from tumble to spin speed, the solenoid 88 is energized, as through suitable electrical circuitry connected to the presettable timer means 33. Energization of the solenoid 88 withdraws the solenoid armature 87 against the pressure of spring means 89 to essentially the position of FIGURE 5. The air pressure from the inlet port 75, coupled with gravitational forces, moves the valve member 85 to a seating position upon surface 82a of the rigid diaphragm member 84. This blocks communication between the valve and the solenoid armature 87 and prevents both of the valve outlets 71 and 76. The outlet port 71 leads to the pneumatic clutch in the transmission 26, causing this clutch to operate. The outlet 76 connects to the bleed off valve 78, and as an off-load balance is accelerated and produces a deflection, the bleed off valve is intermittently opened to cause a reduction of the air pressure in the chamber 82. The reduced air pressure acting upon the pneumatic clutch causes clutch slipping and a termination of increased drum acceleration, until the off-load balance is counterbalanced.

As appears in FIGURES 3 and 5, the double acting relief valve means is constructed to provide a body portion 95 having outlet portions 96 and 97 threadably receiving collar portions 98 in each of which travels valve core stems 99 and 99a. The valve body portion 95 is mounted on support means 100 (FIGURE 3) carried by a plate portion 101 welded or otherwise firmly secured to the brace members 52 and 54 of the A-frame 51. The angular position of the support means 100 relative to the plate member 101 may be adjusted by screw means 102 and 103. The body portion 95 of the air valve means 78 may be adjusted linearly with respect to support means 100 by means of screws 102a and 103a.

The plate member 101 mounts a pivot pin 104 receiving the adjustable support means 100, as well as a yoke member 105 having arm portions 105a and 105b relatively closely spaced from the valve core stems 99 and 99a. As appears in FIGURE 3, the nozzle housing 47 rigidly mounts a lever member 106 having a claw portion 106a engageable with the yoke member 105 and an end portion 106b connected by a spring 107 to said yoke member. As
is believed now apparent, when the support means 100 is properly adjusted in a static condition, the yoke arm portions 105a and 105b are spaced at substantially equal distances from the valve core stems 99 and 99a. When the tank and cylinder assembly starts to oscillate about its center of oscillation due to the acceleration of an off-balance load, the yoke member 105 will also oscillate about the pivot pin 106b. This is a result of the support means properly adjusted as stated and assuming deflection of the tank and cylinder assembly, the yoke arm portions 105a and 105b will depress the valve core stems 99 and 99a as the casing 18 oscillates with respect to the A-frame 51 to bleed off air pressure from the pneumatic clutch in transmission 28, terminating increased acceleration, although maintaining the drum speed relatively constant for effective water balancing.

The double acting valve assembly 78 is highly advantageous as contrasted with a single acting valve since it assures that air will be bled off if the machine 10 is moved, or if the support means 100 is not properly adjusted. In either of these circumstances, the distance between one of the yoke arm portions 105a and 105b and the adjacent valve stem 99 and 99a would be less than the desirable setting. If the machine 10 was then started up in the spin cycle with a severe off-balance load present in the drum or cylinder 24, the acceleration since valve assembly 78 would bleed the air pressure from the pneumatic clutch on a smaller than normal movement in at least one direction of the tank and cylinder assembly. Accordingly, there would be prevented any possibility of the machine tipping or "walking" under these severe conditions. Of course, in order for the pneumatic clutch to again be properly actuated, the support means 100 and body portion 95 would necessarily have to be properly adjusted with respect to yoke member 105 to the static condition noted.

The positioning of the valve core stems 99 and 99a with respect to the yoke member arm portions 105a and 105b is adjustably controlled in relation to the position of the deflector or interrupter member 66 and its associated parts so that a slightly greater deflection of the tank and cylinder assembly is required to bleed off the necessary operating air pressure than is required to initiate the valve opening. This ensures that proper adjustment of parts and assures that the water balancing function will be first initiated and the acceleration control then set into action to maintain the transmission speed ratio at the speed which initially caused the off-balance condition and initiated the counterbalancing action without unnecessarily diminishing the cylinder speed.

Referring now to FIGURE 6, the transmission means 26 is provided with a housing 110 comprising a main body portion 111 to which is secured by fastening means 112 a cap portion 113. The main body portion 111 is formed with an apertured central embossment 114 receiving the conduit through variable diameter shaft means 115 connected at one end to the motor means 25. The apertured embossment 114 may receive bearing means 116 and seal means 117.

Axially inwardly of the bearing means 116 there is co-rotatably mounted upon the shaft means 115 gear means 118 in meshing relation with gear means 119 co-rotatably mounted as by pin means 119a upon shaft means 120 supported at opposite ends in bearing means 121 and 122 received in recesses in the body portion 111 and cap portion 113, respectively.

The shaft means 120 supports for corotation gear means 123, keyed as at 123a to shaft 120, meshing with gear means 124 which rotates freely at a constant speed upon sleeve means 125 connected to the pulley 27 and surrounding the reduced diameter portion of the shaft means 115.

Gear means 124 includes an eccentric portion 124a that has mounted on it an encircling follower strap member 125a that drives the piston (not shown) of the compressor 73 at a constant speed whenever motor 25 is energized.

Gear 124 is also provided with a pocket which receives a disc insert member 126 which is anchored to gear 124 by means of the cross member 128. Mounted on sleeve means 127 and positioned within a cylindrical recess provided in member 126 is a sprocket like clutch member 127 and a plurality of clutch roller members 128 which cooperate with members 126 and 127 to form a one-way drive connection between these latter members. Since the one-way roller clutch formed by members 126, 127 and 128 is of conventional construction, it will suffice to state that this connection is made during the low or tumble speed operations when member 126 cams rollers 128 tightly against the sprocket like clutch member 127 to rotate sleeve member 125 and the driven pulley 27. During the spin operations, member 127 is driven at the speed of shaft 115 and thus overcomes disc member 126 thereby moving roller members to a disengaged position.

Clutch member 127 is provided with a notched laterally extending flange 127a which positively engages a cup or disc-shaped member 129. Located within the recess defined by member 129 is a clutch disc 130 which is provided with friction surfaces 130a and which is corotatable with a mounting collar 131 which in turn is corotatable with and axially movable relative to shaft 115. Corotatable with an axially movable on collar 131 is a second clutch disc member 132 provided with friction surface 132a. Corotatable with and axially movable on the cup shaped member 129 and positioned between the clutch discs 130 and 132 is a drive member 132a.

The means for shifting the collar member 131 to vary the rotative speed of the pulley 27, as by terminating continued acceleration when an off balance load is detected, may comprise a yoke member 135 connected to the collar member 131 and bearing against a fulcrum providing surface 136, while being connected at its opposite end to an elongated end portion 137a on piston arm 137. The piston end portion may travel in an embossment 138 while the piston arm is guided by an apertured embossment 139a formed on cylinder 139 connected to the cover member 113. As apertured end portion 137a is connected to a head portion 140, and the cover portion 113 is apertured (not shown) to receive the conduit means 70 for supplying air pressure to the cylinder chamber 141.

The operation of the acceleration control system of this invention may be described as follows. As the machine proceeds from tumble to spin speed, the solenoid 88 in the solenoid valve means 72 is energized by the electrical circuitry in the machine. Energization of the solenoid 88 withdraws the solenoid armature 87 in opposition to the pressure of the spring 89 and to essentially the position of FIGURE 5. The air pressure from the compressor 73 entering the inlet port 75, in combination with gravitational forces, moves the valve member 86 against the surface 84c to block the passage 84c between the chambers 82 and 83. The valve outlet ports 71 and 76 are then pressurized, and as was noted, these ports lead through the conduit means 70 and 77 to the air cylinder chamber 141 in the transmission 26 and the double acting relief valve 78, respectively.

Pressurization of the air cylinder chamber 141 in the transmission housing 110 pivots the top of yoke arm 135 to the left about fulcrum 126, in FIGURE 6, which causes disc member 127 to move to the right. Drive member disc 129a and clutch portion 139 to the right until disc shaped member 129 is driven through collar member 131 at the speed of shaft 115. This causes clutch member 127 to override disc member 126 and thus drum 24 is driven at spin speed.
the defections resulting in the drum and casing structure oscillate the yoke member 105 about the pivot pin 104 to intermittently actuate the valve core stems 99 and 99a of the bleed off valve 78 which thereby reduces the pressure in the chamber 82. A reduction of the pressure in this chamber lessens the pressure applied against the division 160 of the air cylinder 139 and the yoke member 135 pivots in opposite directions about the fulcrum 136 to intermittently shift the collar member 131 along the shaft 115. This action causes less pressure on disc 129 and on the inside vertical surface of dish member 129 resulting in a slipping action of the pneumatic clutch. However, since there is intermittent slippage in the pneumatic clutch herein provided, there is no marked speed reduction in the pulley 27 necessarily, but merely a termination of an increased acceleration rate. In other words, the pulley 27 which drives the cylinder 24 rotates at essentially the speed which caused the off-balance condition, so that the counterbalancing action can continue. Of course, when counterbalancing is accomplished, the acceleration control system reverts to the condition originally described and the solenoid 88 is then de-energized. The action of the spring 89 then forces the valve member 86 against the surface 82a, which permits the chamber 82 to be vented through the passage 84a and through the vent openings 84b and 79a. In this manner the increased air pressure from the compressor 73 does not reach the pneumatic clutch, and since the inlet passage 75a is blocked, a buildup of pressure occurs in the compressor 73 until the conventional relief valve therein opens.

As was earlier noted, the sensing components for the water balance system and for the acceleration control system are preferably coordinated so that a relatively greater deflection is required to actuate the acceleration control system than is needed to initiate the water balancing function. Of course, an electrical sensing means could be used in substitution for the structure described hereinabove, and these and other modifications can be practiced without departing from the novel concepts of this invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. Laundry apparatus comprising,
a drive motor,
a support,
a rotary basket for receiving fabrics to be washed and centrifugally dried,
means mounting said basket on said support for movement in response to vibrations produced by rotation of unbalanced loads in said basket at centrifuging speed,
a transmission interconnecting said drive motor and said basket and having a low speed ratio for tumbling fabrics at a lower washing speed and a high speed ratio for rotating said basket at higher centrifuging speeds for extracting fluids from said fabrics,
clutch means for changing the speed ratio of said transmission,
actuating means for said clutch means,
pressure source means including conduit means directing pressurized fluid to said actuating means, and
valve means mounted in said conduit means, actuator means connected to said basket mounting means and operable upon movement of said basket mounting means due to rotation of unbalanced loads at said high speed ratio to actuate said valve means for reducing the flow of said pressurized fluid to said actuating means to shift said clutch means and limit the speed ratio of said transmission to a value between said low and said high speed ratios to thereby effect the rotation of said basket at a safe optimum speed above said lower washing speed.

2. Laundry apparatus comprising,
drive means,
support means,
a rotary basket for receiving fabrics to be washed and centrifugally dried,
means mounting said basket on said support means to accommodate vibratory movements of said basket as produced by the rotation of uncentered loads in said basket,
transmission means interconnecting said drive means and said basket to provide a plurality of speed ratios for rotating said basket,
means providing a source of fluid pressure, fluid clutch means controlling the selection of said speed ratios,
conduit means interconnecting said source of fluid pressure with said fluid clutch means,
valve means in said conduit means,
valve actuator means connected to said basket mounting means and actuated by vibratory movements of said basket to actuate said valve means for regulating the supply of pressure to the clutch means and thereby limiting the rotation of said basket to those speeds which produce only minimal basket vibrations of a predetermined amplitude,
means for controlling said centrifuging loads on said basket, and
control means operatively connected between the basket mounting means and said support means and operatively engageable with said valve actuator means and said means for counterbalancing so that greater amplitudes of basket movement are required for actuation of said valve means than for said counterbalancing means.

3. Laundry apparatus comprising,
drive means,
support means,
a rotary basket for receiving fabrics to be washed and centrifugally dried,
means mounting said basket on said support means to accommodate vibratory movements of said basket as produced by the rotation of uncentered loads in said basket,
transmission means interconnecting said drive means and said basket to provide a plurality of speed ratios for rotating said basket,
a fluid compressor driven by said transmission means, fluid clutch means in said transmission means controlling the selection of said speed ratios,
conduit means interconnecting said compressor and said fluid clutch means, and
valve means in said conduit means having valve actuating means operatively engageable with said basket mounting means and actuated by vibratory movements of said basket relative to said support means for regulating the supply of fluid pressure to the clutch means and thereby limiting the rotation of said basket to those optimum speeds which produce only minimal basket vibrations of a predetermined amplitude.

4. In a washing machine,
a drive motor,
a support,
a rotary basket for receiving fabrics to be washed and centrifugally dried,
means mounting said basket on said support for movement in response to vibrations produced by rotation of unbalanced loads in said basket at centrifuging speeds,
a transmission interconnecting said drive motor and said basket and having a low speed ratio for tumbling fabrics at a lower washing speed and a high speed ratio for rotating said basket at higher centrifuging speeds for extracting fluids from said fabrics,
13 clutch means for changing the speed ratios of said transmission,
and a pressurized fluid operated system in control of
said clutch means and said transmission and comprising
valve means,
valve actuating means engageable with said basket
mounting means for sensing movement of said basket
mounting means relative to said support
due to rotation of unbalanced loads at said high
speed ratio,
a fluid cylinder and piston connected to said
clutch means,
and conduit means connecting said valve means
and said fluid cylinder to a source of pressurized
fluid,
said valve means being effective when an un-
balanced load is rotated in said basket at high speed ratio, and said basket
mounting means is thereby in movement relative to
said support, to engage said basket mount-
ing means,
thereby reducing the fluid pressure in said conduit means and through said clutch means actuating said transmission to limit the speed ratio to a value between said low
and said high speed ratios, thereby effecting rotation of
said basket at a safe optimum speed above said lower
washing speed.

5. Laundry apparatus as defined in claim 1,
a fluid supply line connected to said clutch means, said
valve means comprising a pair of bleed-off valves
connected in said fluid supply line,
said actuator means comprising a yoke member respons-
itive to vibratory movements of said basket and having
a pair of arms respectively positioned adjacent
to said basket for actuating the said basket
during vibrations of said basket to bleed said fluid
supply line to limit the effective speed ratio of said
transmission and control the rotational speed of said
basket to a safe optimum speed between a first lower
speed and a higher centrifuging speed.

6. Laundry apparatus as defined in claim 5, said fluid
supply line comprising pneumatic means, said valve
means comprising pneumatic valves connected in parallel
with one another in said fluid supply line.

7. Laundry apparatus as defined in claim 1 and further
characterized by
a casing,
said basket being positioned for rotation in said casing
about a horizontal axis,
a stationary support structure yieldingly mounting said
casing for angular movement about an axis spaced
from and parallel to said horizontal axis,
both of said axes being disposed in a common verti-
cal plane intersecting said casing and said sup-
port structure,
a fluid line connecting said clutch means with a source of
pressurized fluid,
said valve means comprising first and second fluid
pressure bleed-off valves positioned in said fluid
line and mounted on said casing to bleed off
said first fluid bleed-off valve when said casing
deflects to one side of said vertical plane and
to bleed-off said second bleed-off valve when said casing
deflects to the opposite side of said vertical plane in response to the rotation of
unbalanced loads in said basket to limit the
speed of said drive means to an optimum level.

8. Laundry apparatus as defined in claim 1 and fur-
ther characterized by the provision of
a casing,
a rigid support for said casing having sufficient yield-
ability to afford limited movement of said casing
in a confined arcuate path about an axis positioned
parallel to the rotational axis of said basket,
said actuating means being responsive to move-
ments of said casing in said confined arcuate
path.

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